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Stakeholders Become Partners in Estuary Management

Estuary Program Balances Sustainability, Community Needs

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Estuaries are marine transition zones offering rich habitats for renewal, interaction, conflict, and transformation. Simply stated, estuaries are the semi-enclosed lower tidal reaches of a river where fresh water from land drainage dilutes salt water from the sea. Estuarine habitats are varied, comprising salt marshes and tidal flats, wetlands, oyster beds, open bay bottoms, submerged seagrass meadows, and barrier island grasslands. These critical coastal habitats serve as nurseries for fish, nesting areas for migratory birds, and homes for terrestrial wildlife. Estuarine vegetation and marsh grasses filter sediment and pollutants from water, help control erosion, and provide a buffer against storm waves and floods.

The commercial shrimping industry has a tremendous impact on the economy of Texas. Studies in both Galveston Bay and Corpus Christi Bay will address public health issues and protection of the shrimp industry.

Estuaries also represent a substantial economic resource. In the United States, 87 percent of commercial fish (more than $19 billion annually) is harvested in estuaries. Fully 31 percent of this country's Gross National Product is produced in coastal counties. Thanks to the sheltering effects of barrier islands, estuaries offer an inviting environment for recreational fishing, boating, sailboarding, swimming, snorkeling, and bird-watching. Birding/ecotourism is the fastest-growing segment of the nation's tourism industry. Estuarine recreational activities generate more than $5 billion annually. Owing to their semi-enclosed nature, estuaries provide ports and shipping channels with natural wavebreaks.

Precursors of the National Estuary Program

In 1987, Congress established the National Estuary Program (NEP) as part of the Clean Water Act. As of June 1995, 28 estuaries, including two in Texas, had been named Estuaries of National Significance. Administered by the Environmental Protection Agency, the mission of the NEP is to protect and restore the health of estuaries while supporting economic and recreational activities.

The National Estuary Program traces its roots to the Great Lakes and Chesapeake Bay programs of the 1970s and 1980s, respectively. In response to alarming eutrophication from excessive nutrient loading, point and nonpoint source pollution, and resulting fish kills, these programs initiated a phased approach to combating a set of identified problems. These two programs, along with the 1965 Water Resources and Planning Act, the 1972 Federal Water Pollution Control Act, and the 1977 Clean Water Act served to shape the process used in the National Estuary Program for developing Comprehensive Conservation Management Plans (CCMP) for identified estuaries.

Each NEP follows an established approach leading to the publication of a consensus-based CCMP. The process of developing the CCMP, which is as important as the Plan itself, employs collaborative problem-solving approaches to balance conflicting uses. Under the auspices of the Clean Water Act, the EPA administrator may convene a Management Conference to set up partnerships between government agencies which oversee estuarine resources and the people who depend upon estuaries for their livelihood and quality of life. This process has four steps: (1) building a management and decision-making framework, (2) scientifically characterizing existing resources and identifying priority problems, (3) developing both conventional and innovative solutions to identified problems, and (4) implementing the management recommendations, with support from public and private sectors.

By involving stakeholders in the process of hammering out a consensus for estuary management, NEPs cut across jurisdictional and political boundaries, allowing an integrated ecosystem-wide approach. The resulting CCMP is a roadmap for balancing estuarine resources with the needs of user groups to maintain or restore the health of the estuary.

Texas' Estuaries of National Significance

Two Texas estuaries were named Estuaries of National Significance and accepted into the National Estuary Program: Galveston Bay in July 1988 and Corpus Christi Bay in October 1992. Galveston Bay's five-year-long Management Conference completed its CCMP, *The Galveston Bay Plan* in December 1995. Carol M. Browner, EPA Administrator, approved the plan in March. In fact, *The Galveston Bay Plan* was the seventh national estuary CCMP submitted, but the first such document to run the gauntlet of 17 federal EPA reviews with no revisions. Corpus Christi Bay National Estuary Program plans to submit a completed CCMP to the EPA in September 1998. Both NEPs

in Texas are jointly funded and administered by the Texas National Resource Conservation Commission (TNRCC).

Before the National Estuary Program, 19 federal, state, and local agencies monitored Texas' estuaries, but in patchwork fashion. This scattershot approach resulted in unexpected side-effects, as actions taken on any ecosystem do not occur in isolation. By taking an ecosystem, rather than resource approach, NEPs consider interrelated processes.

For example, fresh water inflow into both Galveston Bay and Corpus Christi Bay has become a contentious subject, a balancing act between water consumers within the watershed and regulated fresh water releases. House Bill 2, enacted in 1985, requires beneficial fresh water inflows to achieve "a salinity, nutrient, and sediment loading regime adequate to maintain an ecologically sound environment in the receiving bay and estuary system necessary for the maintenanceof economically important and ecologically characteristic sport or commercial fish and shellfish species." Volume, quality and timing of fresh water inflows affect circulation and water quality within the estuary. Since 1992, fresh water inflow planning has been a case-by-case consensus-based approach between the TWDB, TPWD, and TNRCC.

But the water demands presented by burgeoning populations in the watersheds of both estuaries (by the turn of the century, four million in the Houston-Galveston area and over a half-million in the Coastal Bend region) face off against mandated fresh water releases from surface water impoundments upstream. The Galveston Bay Plan now supports a phased approach to fresh water inflow management, including monitoring of fresh water inflows, assessing the impact of impoundments and levees, and increasing public awareness of the impact of water conservation on the bay environment. A Pass-Through Plan recently approved for the Nueces Bay estuary provides for natural streamflows, up to a monthly target, to be "passed through" to the estuary. Streamflow in excess of the target is captured and stored in reservoirs for water supply purposes. If monthly streamflow is less than the target, only the natural streamflow is passed through. There is no requirement to use water already in storage to meet the monthly target. Water levels in Lake Corpus Christi appear low because there have been no significant streamflows in the Nueces River watershed in two years.

Estuaries have been the subject of studies by Texas regulatory agencies. The Texas Water Development Board (TWDB) initiated a cooperative Bays and Estuaries Program in 1967 to collect physical, chemical, and biological data necessary for state water planning. In 1975, Senate Bill 137 was passed requiring comprehensive studies of effects of fresh water inflows on bays and estuaries to be performed by five state agencies. This early partnership completed its study in 1979. Following passage of House Bill 2 in 1985, the TWDB and Texas Parks and Wildlife Division (TPWD) jointly conducted a continuous data collection and analysis program to study estuarine conditions.

Priority Problems Facing Each Estuary are Characterized

The Scientific/Technical Advisory Committee (STAC), an arm of the Management Conference, culls out a list of priority estuarine issues, then oversees studies to characterize history status, and trends of living and nonliving resources; water quality and sedimentation; human impact; physical form and function; habitat and public health issues. These studies, constituting the second phase of CCMP development, are accomplished by state and federal partners, as well as by academics and consultants.

For the Galveston Bay NEP, 23 studies were undertaken ranging from point source and nonpoint source pollution to dredge/fill impacts to socioeconomics of bay utilization to analysis of oyster reef habitat. The University of Texas, Texas A&M University, University of Houston at Clear Lake, Rice University, the U.S. Fish and Wildlife Department, and several private consultants were contracted to conduct research. The culmination of research directed by the STAC was *The State of the Bay: A Characterization of the Galveston Bay Ecosystem*.

At the Corpus Christi Bay NEP, seven characterization projects are in progress, focusing on fresh water inflows, wetlands loss, living resources, water and sediment quality, estuarine circulation, point and nonpoint source pollution, and public health issues. The latter issue was added in Fall 1994 in response to concerns elicited in a series of public workshops. Richard Volk, Corpus Christi Bay NEP director, said the public indicated its concern with seafood consumption and contact recreation. Although an actual problem has not been demonstrated, the public perception is that unknown problems may exist. Study of this problem will assess potential public health risks. If health risks are identified, they become a priority focus for management action.

According to Volk, "One of the most important contributions of the academic community was to discuss in open forum the approach to characterize the bay system, its ecosystem, form, and processes. The end result is that a consensus is built around the health of the estuary."

Characterization projects were developed to better define the problems. The boundaries for scientific studies to be undertaken was that (1) they provide information to managers, (2) work would be undertaken in the context of a disturbed system, (3) research results would be geographically generalized, (4) data would be reduced and analyzed, and (5) ongoing work would be structured to enable monitoring of management objectives.

The partnership approach is apparent in the reliance on existing data and talent to carry out the directives of the program. Voluminous data collected by regulatory and monitoring agencies were located, compiled, reduced, and analyzed by teams of scientists from the academic, governmental, and private sectors.

Efforts Yield Unexpected Findings

"The more well-accepted the hypotheses that are rejected (or more usually, modified), the greater the leaps of knowledge," wrote Frank Shipley, former Galveston Bay NEP director (Shipley, *The Second State of the Bay Symposium*). Interestingly, fresh water inflow studies by William Longley and Ruben Solis of the TWDB, and also documented in *Freshwater Inflows to Texas Bays and Estuaries*, published by TWDB and TPWD, reveal urbanized areas showed *increased* inflows. An analysis of fresh water inflow trends for the period 1968 to 1987 did not identify statistically significant trends indicating a reduction in the volume of fresh water. In fact, the characterization studies yielded several conclusions differing from conventional wisdom. Surprisingly, comparisons of monthly mean flows before and after dam construction on the Trinity River indicate only slight shifts in timing and volume, possibly because of the expansion of impervious surfaces and increased wastewater flows.

For instance, a commonly held belief was that an increase in bay salinity resulted from human diversion of river inflows and intrusions of Gulf of Mexico sea water landward through dredged channels. The water and sediment quality study by Ward and Armstrong of the University of Texas revealed a three-decade decline in bay salinity. William L. Longley and Ruben Solis of TWDB found *increasing* streamflow trends, possibly attributable to increases in impervious cover, conservation practices, and increases in groundwater return flows. According to Longley and Solis, the assumption that total fresh water inflows to Galveston Bay are decreasing cannot be supported.

Scientific Characterization of Estuaries

Characterization of both estuaries could be described as a scientific inventory and analysis of historical ecosystem records. For example, to characterize living resources for the CCBNEP, researchers Wes Tunnell and Quenton Dokken of the Texas A&M-Corpus Christi Center for Coastal Studies examined mountains of literature. Data was culled from peer-reviewed journals, theses, and dissertations. Also examimed was the so-called "gray literature," technical reports from regulatory agencies, such as the biological data collected for the past 20 years by TPWD.

Reliance on existing data presented its own challenge. One criterion for determining trends of living resources is that the same kind of data be collected five years in a row in the same manner. For living resources in Corpus Christi Bay, for example, only for birds and fish was this five-year criterion met, owing in part to Audubon Society Christmas bird counts and TPWD coastal fisheries data, respectively. For some other living resources, only current status was known with any certainty; for others, only spotty data records exist.

Galveston Bay Characterization

The Galveston Bay estuary system is adjacent to the fourth largest urban area in the United States, encompassing a five-county area with 3.3 million residents, nearly 50 percent of the nation's petrochemical production, and 30 percent of its petroleum industry. The bay is also a transportation artery: the Port of Houston is the third largest in the United States and the six largest in the world. The Houston Ship Channel runs through Galveston Bay.

The Galveston Bay Estuary is adjacent to Texas' most highly populated urban area, and about 60 percent of all wastewater discharged in Texas flows to Galveston Bay.

Galveston Bay is an economic powerhouse: commercial fishing pumps $200 million annually into the region. Its shrimp industry is valued at $46 million, and the bay accounts for 30 percent of oysters harvested in the United States. Recreational fishing contributes more than $600 million annually and generates $20 million in tax revenues. More than $25 billion of cargo is shipped into and out of the Port of Houston annually, making it the busiest in the United States.

The Galveston Bay Estuary system comprises 600 square miles of surface area divided into four sub-bays: Trinity, West, East, and Galveston bays. The most pressing problems faced by the estuary are habitat destruction and nonpoint source pollution. Despite a national "no net loss" policy, 33,000 acres of marshland have been lost to subsidence (from groundwater pumping) and development in the past four decades. "Nonpoint source pollution, a side effect of the urban lifestyle, goes hand-in-hand with the way we live. Oil and gas, hard surface runoff, trash down storm drains and dumped in drainage ditches, trash thoughtlessly tossed out is fouling our waterways," according to M.A. Bengtson, former acting director of GBNEP.

Galveston Bay receives the outflow of the San Jacinto River and much of the drainage from the City of Houston via Buffalo Bayou and the Houston Ship Channel. Trinity Bay receives the outflow from the Trinity River, with a watershed extending to the Dallas-Fort Worth area. The Trinity River Basin contributes 54 percent of the inflow to Galveston Bay, the San Jacinto Basin, 28 percent The Trinity and San Jacinto Rivers drain a watershed of 33,000 square miles, just under 12 percent of Texas' surface area,

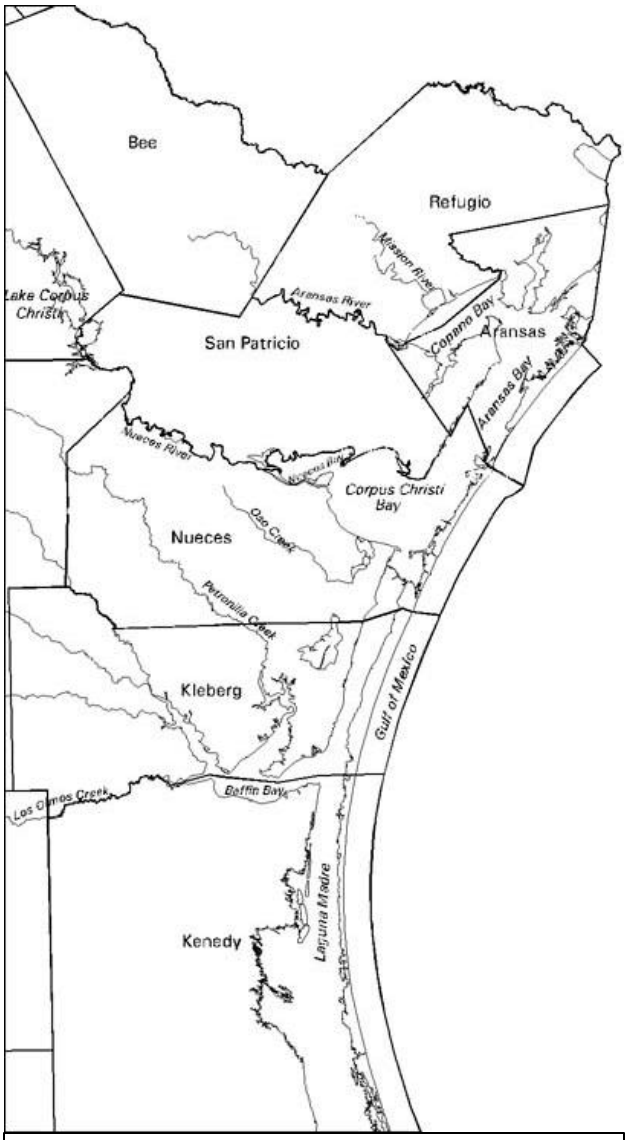
but the Galveston Bay system receives approximately 60 percent of the state's wastewater discharge.

George Ward and Neal Armstrong of the University of Texas Center for Research in Water Resources conducted five characterization efforts for Galveston Bay NEP and are in the process of conducting two more for Corpus Christi Bay. For their study of sediment quality in Galveston Bay, the researchers correlated 26 separate data collection programs--TNRCC, Texas Department of Health, TPWD, and the U.S. Geological Survey--and compiled these in a machine-readable data base.

From their efforts for Galveston Bay, researchers Ward and Armstrong determined that nonpoint source pollution has become the estuary's greatest water quality challenge. The influx of pollutants from both river flow and nonpoint sources has declined since the 1960s due, in large part, to the Water Quality Act of 1965 and the Clean Water Act of 1977, which required point sources to treat wastewater prior to discharge. Later, the National Pollution Discharge Elimination System (NPDES) regulated nonpoint source discharges, such as stormwater runoff. "In contrast, all indications are that nonpoint sources of pollutants have steadily increased to the present day," according to *The State of the Bay: A Characterization of the Galveston Bay Ecosystem*. The success story resulting from legislation and regulations is evident in the Houston Ship Channel. In the mid-1960s, the Houston Ship Channel had become biologically sterile because oxygen concentrations were too low to support life. Massive fish kills occurred downstream in the bay where the Channel intersects open water. Since the initiation of point source controls, construction of wastewater processing facilities by industry (made possible by grants from the EPA and TWDB) and massive cleanup efforts have resulted in a cleaner Galveston Bay. Today, fish kills in the upper bay due to the influx of pollutants from the landlocked portion of the channel have stopped, and bay species have recolonized the upper channel itself. Cleanup efforts and regulations have been so successful that *The Galveston Bay Plan* does not establish a renewed emphasis of water quality permits and standards.

Corpus Christi Bay Characterization

Over 35 data bases are being compiled into reports to render a historic profile of the bay. In some cases, however, adequate data do not exist. For the Corpus Christi Bay study, which encompasses the fourth largest agricultural area of any U.S. estuary, composition of cropland runoff was unknown with any certainty. In progress now is an Action Plan Demonstration Project to monitor and collect baseline data on agricultural runoff from 2700 cropland acres in the western portion of San Patricio County in the watershed of the Nueces River.



The Corpus Christi Bay National Estuary Program encompasses a 550 square-mile area along 75 miles of the south-central Texas coastline in a heavily agricultural area.

Corpus Christi Bay is gateway to the seventh largest port in the United States, and home of the country's third largest refinery and petrochemical complex. The shipping industry generates over $1 billion of revenue for related businesses, and commercial fishing and recreational activities contribute almost $800 million to the local economy. Three estuaries Aransas-Copano, Corpus Christi, and Baffin Bay-Upper Laguna Madre--are included in the program study area. Laguna Madre is one of three hypersaline lagoon systems in the world, and Aransas-Copano estuary borders whooping crane habitat and includes oyster reefs. Padre Island, which bounds the eastern edge of the study area, is the world's longest barrier island.

Partnerships Work in Demonstrations

Researchers from the Texas Agricultural Experiment Station at Corpus Christi, led by Bob Eddleman, and personnel from the U.S. Geological Survey are working with cotton and grain sorghum farmers to collect data on herbicide, pesticide and nutrient concentrations in runoff from 2700 acres of cropland near Elroy, Texas. Collection stations are located at the edge of fields to capture runoff near its source, one-half mile from the edge of fields in drainage canal structures, and just upstream of the confluence of the drainage canal and the Nueces River. Runoff will be tested for organo-chlorine and organo-phosphorus pesticides, oil, and grease, nutrients and sediments. Concentrations of chemicals in runoff depends upon pre-existing conditions, such as stored soil moisture, as well as rainfall. Interestingly, since the monitoring equipment was installed in June, not one runoff event has been recorded, and researchers speculate that current best management practices might reduce wet weather runoff. Many farmers in the watershed practice deep subsoil tillage, which allows water to percolate down, rather than run off. In concert with the Elroy runoff study, a large privately funded study on the expansive King Ranch is developing baseline data on agricultural cropland runoff into Baffin Bay.

The demonstration project is a possible win-win partnership for both farmers and the estuary. It will provide factual information as to the nature and amount of agricultural chemicals in runoff. Farmers will then evaluate the amount and timing of fertilizer and pesticide application. Scientists gain information on how this nutrient source might relate to the persistence of the brown tide. As for the estuary, speculation is that nutrient loading is responsible for the persistent brown tide.

One demonstration project in Galveston was a study to prevent loss of wetlands, one of the priority problems of Galveston Bay CCMP. The Texas A&M University Marine Advisory Service and the U.S. Department of Agriculture Soil Conservation Service initiated a project in 1989 to study the effectiveness of transplanting smooth cordgrass (*Spartina alterniflora*) as a means to reduce shoreline erosion. Storms washed away the initial grass planting; however, subsequent plantings have proved successful and continue throughout the bay area. Coastal salt marshes serve as a nursery for over 90 percent of coastal marine organisms in the Gulf of Mexico. Tidal marshes trap sediments, reducing turbidity in runoff water, and filter pollutants. Marshes also stabilize shorelines by absorbing and dissipating wave energy.

The Future of Texas Estuary Programs

Now that the Galveston Bay Plan has been accepted by the EPA, the alliance progresses to the next phase of estuarine stewardship: implementation of solutions. *The Galveston Bay Plan* identified 82 management initiatives to address 17 areas of concern. The Galveston Bay Council, composed of agencies, user groups, and private citizens, will work in an advisory capacity with TNRCC, Galveston Bay Program staff, and the Texas General Land Office to implement solutions. Issues to be addressed include habitat destruction, nonpoint source pollution, human uses of the bay, water and sediment quality, shoreline development, and decline of marine organisms.

The most serious problem facing Galveston Bay is habitat destruction. To stem the alarming loss of wetlands, what is now called the Galveston Bay Estuary Program has several approaches. First the spoil from dredging operations will be used to rebuild Redfish Island, now under water due to subsidence, into a usable fishing island with boat dock and a wildscape habitat. Also, public ownership of highest priority wetlands will be investigated, augmented by economic and tax incentive programs to protect wetlands. Marsh grasses, such as the smooth cordgrass planted in the demonstration project, will serve as nonstructural erosion control measures. Water conservation and conversion from groundwater to surface water are hedges against subsidence.

Another potentially rewarding government-industry, the subject of a study by Dr. Sammy Ray, Texas A&M University-Galveston, is the use of fly ash pellets to build oyster reefs at Galveston Bay. Fly ash, an industrial waste product, is processed into pellets, mixed with shells from dredging operations, and formed into oyster reefs. Oyster spats attach to the artificial material and continue to build a self-sustaining reef. For added benefit, the reef is built high enough to act as a wave break to dissipate wave action and slow shoreline erosion.

Also, an interagency Beneficial User's Group recommends that dredged material be used for creation of intertidal marshes, construction of boater access channels and building of an island in lower Galveston Bay for bird nesting.

In the transition period between Plan approval in March 1995 and the end of the 1995 fiscal year, the Galveston Bay Estuary Program worked in partnership with numerous agencies on a demonstration project in the Dickinson Bayou area, a sub-watershed of Galveston Bay.

This demonstration included a water conservation/home plumbing retrofit project for 500 elementary students, a watershed education program for 600 middle school science students, and distribution of wetlands information to 150 teachers in the Dickinson Independent School District. Also included in the demonstration was wetlands restoration and erosion control plantings in a Dickinson park. A Dickinson Bayou cleanup in conjunction with the TNRCC Clean Rivers Program and the Houston-Galveston Area Council as part of the annual River, Lakes, Bays `N Bayou Trash Bash.

With implementation beginning last November, more ambitious projects are being launched by team members in the areas of water/sediment quality, watershed management, and public participation and education.

Plans include the construction of an artificial oyster reef and shoreline plantings in Dickinson Bay, a small business assistance program for pollution prevention in cooperation with League City, and a Galveston County septic system survey and education program. With the Houston-Galveston Area Council, a baywide program for collection and storage of water monitoring data will be developed in cooperation with the 19 federal, state, and local agencies which now monitor the bay system. Monitoring standards and quality assurance/quality control criteria have been set, and all participating

agencies will be able to access data. The goal is to eliminate duplication of effort, identify areas of neglect, and maximize use of resources.

A Harris County urban bayou/Houston Ship Channel cleanup effort, projected to extend over a five-year period, has been undertaken with the cooperation of federal, state, and local environmental agencies; environmental organizations; Ship Channel industries; private citizens; and the Port of Houston Authority. A massive five-month education program in 24 Harris County public school districts is being coordinated through the Harris County Department of Education, with the potential to reach 450,000 to 500,000 students. Information is targeted to both students and the general public through use of mass media. Funding for this project is provided by TNRCC and the Port Authority.

The synthesis of conclusions from existing data is now complete, but gaps in knowledge remain. The Galveston Bay Council Advisory group is charged with identfiying areas needing new attention.

The Galveston Bay Estuary Program is estimated to cost $2 million annually, with 75 percent comingfrom state funds administered by the TNRCC and 25 percent from EPA funds.

At Corpus Christi Bay, work was begun early this year on the preliminary CCMP. As with the GBNEP, public participation is emphasized throughout the duration of the program. Thirteen task forces composed of stakeholders--resource managers, scientists, representatives of industry, commercial fishing, agriculture, ranching, recreational sports, environmental organizations, and local governments, as well as the general population--will continue active participation in CCMP committees. Through the outreach and public education program of the Corpus Christi Bay NEP, residents of the twelve-county area surrounding Corpus Christi Bay are kept abreast of the progress of the program, as well as the link between human activities and the health of the estuary. Through this process, public input is also collected for the plan. All reports produced during the course of the project will adhere to standardized format and be made accessible to the public.

The goal of the National Estuary program is to restore and sustain the health of estuaries while supporting economic and recreational activities. Cooperation between stakeholder groups ensures balance betweem competing goals is achieved.

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