

III.

Balanced Human Uses

This section of *The Galveston Bay Plan* deals with maintaining a balance between public access to bay resources and the environmental requirements of a healthy ecosystem. Action plans were developed to address four categories of human uses of the bay.

Public Health Protection Requirements for monitoring seafood and shellfish taken from the bay are considered in order to maintain adequate public health standards and reduce potential health risk resulting from consumption of seafood contaminated with toxic substances. Measures are recommended for decreasing the risks associated with using the bay for contact recreation (see page 92).

Freshwater Inflow and Bay Circulation Adequate seasonal inflow of high quality freshwater is critical to the living resources of the bay, therefore this action plan recommends that freshwater inflow be managed on a comprehensive watershed basis. A phased approach is supported beginning with increased understanding of the issues and building towards improved management of the volume, timing, and quality of freshwater inflows to the estuary (see page 93).

Spills/Dumping This action recognizes and supports the continuing spill contingency planning response efforts already in place. Additional public education and storm water screening efforts are recommended to eliminate shoreline and water-borne debris by reducing the amount of trash reaching the bay (see page 109).

Shoreline Management Comprehensive planning for shoreline development in the area immediately adjacent to the bay is recommended to address impacts from new and existing structures. In addition, access to publicly owned shoreline resources should be provided in a manner that minimizes degradation of the bay (see page 127).

Public Health Protection

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
PH-1	Medium	Develop a seafood consumption safety program	90
PH-2	Low	Enhance the TDH Shellfish Sanitation Program	91
PH 3	Low	Develop a contact recreation advisory program.....	92

THE ISSUES

Galveston Bay is the state's largest estuarine source of seafood, and is one of the major oyster producing areas in the country. Commercial and recreational fishing represents a nearly one billion dollar per year industry. Molluscan shellfish (oysters, clams, and mussels) and other seafood (crabs, shrimp, and finfish) harvested from Galveston Bay are consumed by millions of individuals. Maintenance of adequate public health standards within estuarine seafood is important for the protection of the general public, and is also critical for the long-term stability of the fishing industry. *The Galveston Bay Plan* recommends the following initiatives for public health protection:

- **Risk Management:** Galveston Bay receives the largest total amount of industrial and municipal effluent of all Texas estuaries, and also receives significant amounts of contaminants from non-point sources via storm water runoff. Loading estimates for a large number of metals and organic chemicals are incomplete, and insufficient data are available regarding the distribution of potentially toxic compounds within estuarine waters and sediment. Fish and shellfish from Galveston Bay are not routinely sampled for toxic contaminants, nor are consumer risks routinely assessed by any government entity and communicated to the public. To address this situation, the Public Health Protection Task Force of the Galveston Bay National Estuary Program (GBNEP) recommends additional research to establish risk-based standards for toxic contaminants within seafood. Based on established standards, the implementation of a seafood

sampling, analysis, and risk communication program is recommended to safeguard the quality of seafood produced from the Galveston Bay Estuary.

- **Shellfish Sanitation Program:** The Texas Department of Health (TDH) has controlled the harvest of shellfish from Galveston Bay for approximately 40 years, and the quality of produced molluscan shellfish has been maintained at a level which has posed a minimal risk of illness. However, limited funding is available for this shellfish program, and accordingly, shellfish closures are larger than would be necessary with greater frequency of field sampling. To address this problem, an expansion of the shellfish sampling program, including more frequent sampling, is recommended.
- **Contact Recreation Advisory Program:** All open bay areas of Galveston Bay presently conform to current Texas water quality standards for contact recreation. However, fecal coliform concentrations exceeding the state standard for contact recreation have been observed from three tidal tributaries on the more developed western side of the bay: Buffalo Bayou Tidal, Clear Creek Tidal, and Dickinson Bayou Tidal; and additional problems have been reported at Highland Bayou, the Diversion Canal, Moses Lake, Moses Bayou, Offats Bayou, Galveston Ship Channel, the Texas City Dike, and Chocolate Bayou. To ensure that contact recreation only occurs in areas that are in conformance with state water quality standards, this action supports the development of a contact recreation advisory program focusing on potential problem areas on the west side of the bay.

ENVIRONMENTAL STATUS

Status and Trends

The major public health issues associated with the Galveston Bay Estuary are 1) the consumption of molluscan shellfish, primarily oysters; 2) the consumption of other seafood (crabs, shrimp, and finfish); and 3) contact recreation.

Water Quality Standards

A measurement of the number of microorganisms in natural waters is used to determine if those waters are safe for different uses, such as contact recreation (swimming, wading, etc.), non-contact recreation (boating), and shellfish harvesting. For example, if there are too many bacteria in the waters of the bay, then there is a chance that a swimmer will become ill from contact with the water. As would be expected, water relatively free of bacteria is needed to harvest filter feeders such as shellfish than for swimming, while more bacteria can be tolerated for non-contact as compared to contact recreation.

Because it is difficult to measure all of the different microorganisms in water, fecal coliform bacteria are currently used as an indicator parameter. In the Galveston Bay system, the State of Texas uses fecal coliform counts to determine if waters are safe for three different uses:

- 1) A water is acceptable for **harvesting shellfish** if the fecal coliform count is less than 14 fecal coliform colonies per 100 milliliters of water and not more than 10 percent of the samples exceed 43 fecal coliform colonies per 100 milliliters of water.
- 2) A water is safe for **contact recreation** if the fecal coliform count is less than 200 fecal coliform colonies per 100 milliliters of water as a geometric mean based on five samples collected over a 30-day period; and the fecal coliform count is less than 400 in greater than 90 percent of all samples, based on at least five samples taken during any 30-day period. If 10 or fewer samples are analyzed, only one sample can exceed 400 colonies per 100 milliliters.
- 3) A water is safe for **non-contact recreation** if the fecal coliform count is less than 2000 fecal coliform colonies per 100 milliliters of water.

Although the fecal coliform test has been used successfully (as measured by an overall good quality of shellfish from Galveston Bay sold for human consumption) for many years, it is by no means an ideal indicator organism. One major limitation of the test is that it is subject to many false positive results (that is, it may indicate that a health risk exists when one does not exist). On the other hand, the test does not directly measure several of the naturally occurring pathogens, such as *Vibrio vulnificus*, which may be harmful if contacted or consumed. Through the National Indicator Study, research is currently underway on the national level to investigate potential replacements for the fecal coliform test which may reduce the incidence of false positives while providing a higher level of protection against other pathogens. Development and adaptation of an improved testing procedure, however, is not anticipated within the next several years.

Seafood Monitoring

The Galveston Bay Estuary supports a major commercial and recreational fishery, which sustains such species as white shrimp, flounder, sea trout, blue crab, oysters, black drum, red drum, and menhaden. However, despite the fact that the bay receives waste waters from one of the largest industrial centers in the country, the TDH has no funding for routine fish tissue sampling and analysis. Instead, the current TDH seafood advisory program must rely upon fish tissue studies that may be conducted by other organizations, agencies, or researchers.

To date, two seafood consumption advisories have been issued within the Galveston Bay Estuary. The first consumption advisory, which was issued in 1990 and is still in effect, recommends only limited consumption of catfish and blue crab taken from the Houston Ship Channel and a contiguous portion of the upper Galveston Bay, due to the detection of dioxin within samples of these two species in this portion of the estuary. The second advisory is based on three toxic compounds discovered in fish from Clear Creek, one of the principal tributaries on the bay's western shoreline. The contaminated fish were found in the vicinity of the former Brio Refining Company, a U. S. Environmental Protection Agency (EPA) Superfund site where a cleanup of toxic industrial compounds is in the early stages.

Available information to characterize the risk from eating seafood from Galveston Bay is extremely limited. Because of the lack of historical information, GBNEP recently sponsored a

study which investigated the risk attributable to toxic contaminants in five species of fish and shellfish harvested from four separate locations within Galveston Bay. The contaminants included in the study were heavy metals, polynuclear aromatic hydrocarbons (PAHs), selected chlorinated pesticides, and polychlorinated biphenyls (PCBs). These contaminants were measured in the tissues of oysters, blue crab, spotted seatrout, black drum, and southern flounder from Morgans Point (at the mouth of the Houston Ship Channel), Eagle Point (near San Leon, on the west side of the bay), Carancahua Reef (in West Bay), and Hanna Reef (in East Bay). The results of the study indicated Morgans Point to be the most contaminated sampling site, with contamination of seafood tissue generally decreasing downbay. The study measured the estimated risk level associated with consumption of average amounts of seafood in some parts of the bay to be above the benchmark risk level used by the EPA in previous studies to identify possible problems. Additional research will be required, however, to obtain a more comprehensive understanding of potential risks associated with seafood consumption.

Shellfish Harvesting

The Galveston Bay Estuary is the largest producer of oysters in Texas, typically accounting for 50-80 percent of total state production. TDH administers a molluscan shellfish classification and monitoring program which determines those areas of the bay open to oyster harvesting. This program utilizes the fecal coliform test as an indicator of the possible presence of disease-causing bacteria.

Based upon the results of comprehensive sanitary surveys, the TDH has categorized the majority of estuary waters into four classifications for oyster harvest: 1) Approved, 2) Conditionally Approved, 3) Restricted, and 4) Prohibited. *Approved areas* are acceptable for direct market harvesting under all but very unusual situations. *Conditionally approved areas* are subject to occasional changes which make them unacceptable for harvesting, such as elevated fecal coliform concentrations in water triggered by a significant rainfall. Following a temporary closing of a conditionally approved area, the area must be re-sampled to confirm acceptable harvesting conditions prior to being reopened. *Restricted areas* are unacceptable for harvesting without cleansing of the shellfish before entry into the market. The fourth category, *prohibited area*, is used in several areas immediately surrounding sewage treatment outfalls entering directly into growing areas. Harvesting is not allowed from prohibited areas for any reason. Harvest classification areas as 1991 are shown on Figure PH-1, with restricted and prohibited areas combined under the category *Polluted Area*.

Due to the inherent conservatism of the fecal coliform test as an indicator of bacterial contamination (it *overestimates* the actual health risk), and because of a shortage of funding which restricts the frequency of shellfish area sampling, the current program results in limited shellfish harvesting in larger portions of the bay and for longer periods of time than would be warranted based on public health considerations alone. However, the program has succeeded in ensuring the production of shellfish which, on the whole, present a minimal risk of illness to consumers. In those instances when illness has been linked to shellfish consumption, improper handling of shellfish following harvest, rather than the produced shellfish itself, has most frequently been identified as the source of the problem.

Contact Recreation

The current Texas water quality criterion for contact recreation is 200 fecal coliform colonies per 100 milliliters of water. All open bay areas of the estuarine system are generally in conformance with this standard. Fecal coliform concentrations within western bay tributaries declined dramatically during the 1970s and 1980s, reflecting the influence of improved wastewater treatment. However, fecal coliform levels above the standard have recently been reported from three tidal tributaries on the west side of the bay: Buffalo Bayou Tidal, Clear Creek Tidal, and Dickinson Bayou Tidal. Additional problems have been reported at Highland Bayou, the Diversion Canal, Moses Lake, Moses Bayou, Offats Bayou, Galveston Ship Channel, the Texas City Dike, Chocolate Bayou and several urbanized freshwater tributaries.

Potential risks from pathogens associated with contact recreation in the open parts of the bay system are considered to be relatively low, with increased risks in tributaries, waters receiving large quantities of urban drainage, and areas with poor circulation. Variation in recreational water quality due to rainfall and changes in circulation patterns make real-time information concerning water quality virtually impossible to attain. Currently, no routine sampling program exists within the estuary to monitor fecal coliform or toxicant concentrations in contact recreation areas.

Probable Causes

Studies of toxicants within the Galveston Bay Estuary show concentrations to be generally higher in the upper bay, near the source of the largest municipal and industrial discharges, as compared to the middle and lower bay. Sources of toxicants within the bay system include wastewater discharge from industrial facilities, municipal treatment plant outfalls, storm water runoff, oil and gas production wastes, and airborne combustion by-products from vehicular and industrial sources. Some toxicants, such as PCBs and heavy metals, can remain in estuarine sediments for many years, acting as long-term potential sources of contamination. Point source discharges are known to have declined over the last several decades. At present, a complete picture of contaminant sources and distribution is beyond the scope of the available data.

Recent studies of the bay have identified a static to decreasing trend for fecal coliform loadings to the bay over the last 20 to 30 years, and a decreasing trend for fecal coliform concentration within the Houston Ship Channel over the last 10 to 20 years. The primary source of fecal coliform bacteria to the estuary is non-point source runoff. Urban areas contribute much higher fecal coliform concentrations as compared to less developed areas, due both to higher concentrations in storm water runoff and the added contribution from sewer leaks and overflows. Point sources represent an insignificant source of fecal coliform bacteria to Galveston Bay, because disinfection, which is typically applied to point source discharges, is very effective in controlling fecal coliform concentrations. Shoreline septic systems contribute only a small volume of water to the bay. While the water quality impact of these shoreline septic systems is not currently known, they may possibly have an impact in specific areas of restricted circulation, such as Dickinson Bayou and other side-bays and tributaries.

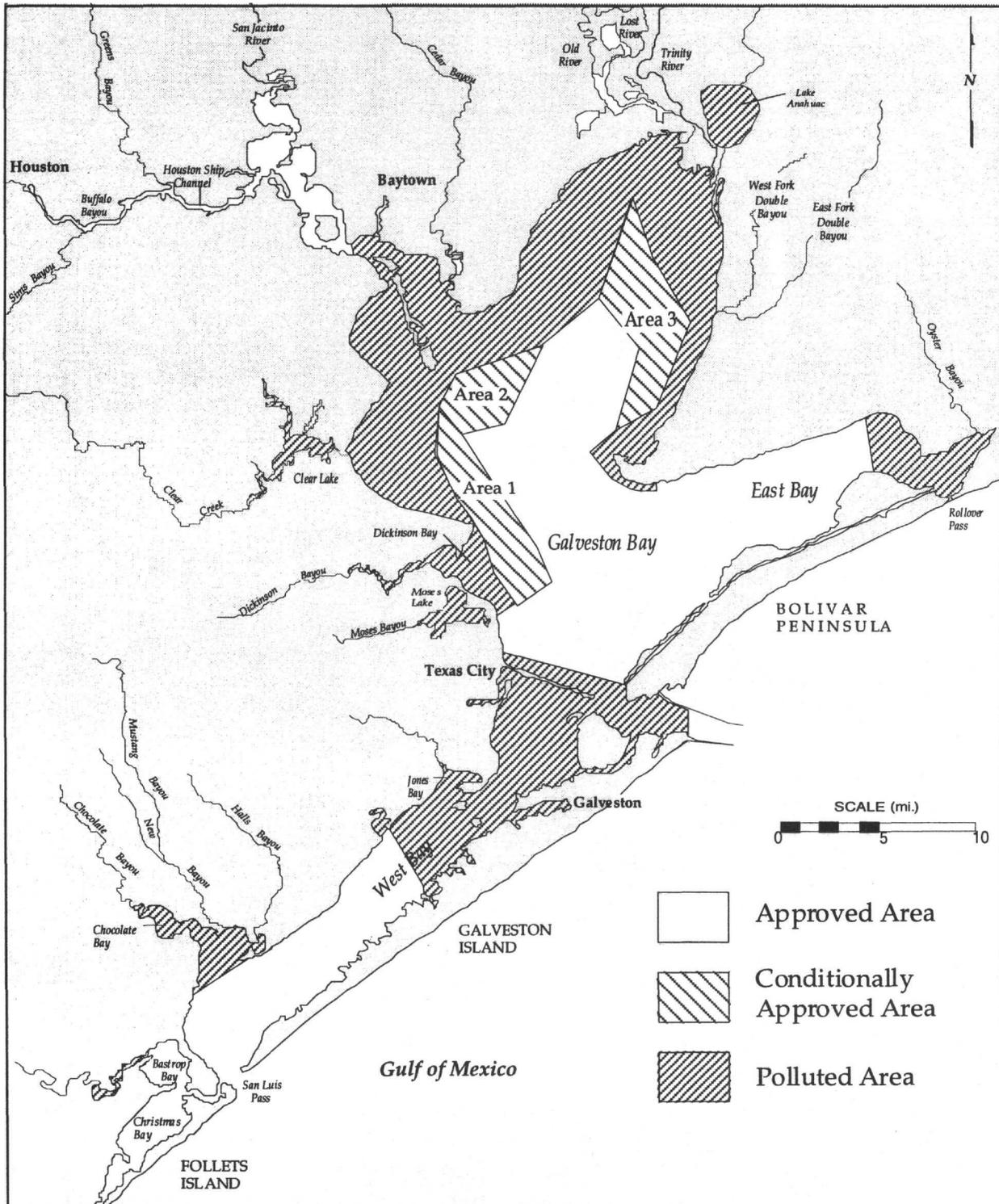


FIGURE PH-1: Shellfish Harvesting Areas, 1991

MANAGEMENT STATUS

Seafood Monitoring

Currently, there is no program for routine monitoring of toxic contaminant concentrations in fish and shellfish harvested from Galveston Bay. Monitoring of toxic contaminants in fish tissue is expensive due to the sophisticated laboratory analyses that must be performed. Under current funding limitations, establishment of a seafood monitoring program that includes routine periodic sampling and analysis of fish tissue is not possible.

When potential problems are identified by fish tissue studies conducted by other organizations or agencies, the TDH may issue seafood consumption advisories or area closures under the authority of the Texas Aquatic Life Law. Prior to issuing a consumption advisory or area closure, the TDH performs a risk assessment based upon the data provided in the fish tissue study.

If a risk assessment indicates an imminent health hazard, the affected area is declared *Prohibited* for the taking of affected species. Fishing or harvesting of affected species from the *Prohibited* area is a violation of the law. An imminent hazard would exist if one meal or a few meals resulted in immediate or acute health problems. If a hazard exists, but frequent long term consumption is required to cause the health effects, a *Consumption Advisory* would be issued. If the risk assessment indicates that observed concentrations do not present a health hazard, TDH advises the originating agency and the public is notified. Two seafood consumption advisories have been issued to date for the Galveston Bay area.

Shellfish Harvesting

The National Shellfish Sanitation Program (NSSP) is a cooperative effort between the federal Food and Drug Administration (FDA), state governments, and the shellfish industry to classify shellfish growing areas and to certify interstate shellfish shippers as described by the NSSP Manual of Operations. States voluntarily adopt these guidelines that include provisions for the following activities:

- Conducting sanitary surveys of growing areas
- Delineating prohibited growing areas (for example, the TPWD classifies all oyster waters as open to oystering, closed to oystering, or conditionally closed to oystering under certain circumstances).
- Inspecting shellfish plants
- Issuing certificates to shellfish dealers in compliance with state sanitary laws

The FDA evaluates each state's compliance with the NSSP guidelines. The FDA's activities include inspection of shellfish processing plants, growing areas, and test laboratories. The FDA publishes a monthly list of shellfish dealers certified by the states to pack and ship shellfish.

The TDH Division of Shellfish Sanitation Control oversees the human health aspects of consuming and processing crabs and shellfish. The state has adopted the NSSP guidelines as regulations. TDH's responsibilities include:

- Classifying shellfish growing waters
 - Sampling shellfish for contaminants which affect human health
- Regulating the harvesting, processing and shipping of shellfish
 - Inspecting and licensing of processing plants

In addition, the TDH periodically collects water samples, analyzes the samples for fecal coliform concentration, and adjusts the harvest status of oyster fishing areas based on the sampling results.

The Texas Parks and Wildlife Department (TPWD) has responsibility for the enforcement of laws concerning harvesting and depletion of seafood, including oysters and other shellfish. TPWD game wardens regulate the harvesting activities of commercial oyster boats.

Shellfish classifications in Texas are relatively conservative because of the limited sampling effort that can be achieved under current funding constraints. Of the 331,000 acres available for shellfish production in Galveston Bay, 60 percent were closed in 1990 under the procedures established by the TDH shellfish sanitation program. With increased sampling, it is believed that unnecessary closures could be significantly reduced, opening more of the bay to commercial oyster harvest. Policing of closed or restricted areas is also severely limited by funding. Approximately 20 game wardens from the TPWD are employed in the Galveston Bay area but only a small portion of their time can be allocated to oversee the 200-400 active commercial oyster boats.

Contact Recreation

No contact recreation advisory program is currently in place within the Galveston Bay Estuary. Although fecal coliform concentrations in excess of the state contact recreation standard have been documented in western bay tributaries where contact recreation is known to take place, no routine sampling or public notification is performed in these areas due to a lack of available funding. Effective implementation of such a program would be complicated by the constantly changing conditions in near-shore areas, which make accurate characterization of bacterial conditions virtually unachievable on a real-time basis.

Pollution Reduction

A fundamental component of a long-term strategy for the reduction of potential health risks associated with seafood consumption is a reduction of contaminant loadings to the estuary. This aspect of public health protection is addressed in the action plans primarily concerned with water quality (Water and Sediment Quality, Non-Point Sources of Pollution, and Point Sources of Pollution). The actions included under this Public Health Protection Action Plan focus upon the characterization and management of current and future public health risks posed by human-caused impacts to the estuary. Information regarding potential public health

problems identified during the course of these actions will be provided to the agencies and entities concerned with pollution reduction, to facilitate identification and reduction of the contaminant sources.

PUBLIC HEALTH PROTECTION ACTION PLAN

To maintain and enhance the Galveston Bay environment to ensure that seafood produced is safe for human consumption and water quality is safe for contact recreation.

OVERVIEW

Priority Problem

Seafood from some areas in Galveston Bay may pose a public health risk to subsistence or recreational catch seafood consumers as a result of the potential presence of toxic substances. Fish and shellfish from Galveston Bay are not routinely sampled for toxic contaminants, nor are consumer risks routinely assessed by any government entity and communicated to the public. The current risk level represented by seafood consumption is difficult to quantify, due to a shortage of high-quality sampling data.

Goal

Reduce potential health risk resulting from consumption of seafood contaminated with toxic substances.

Objective

By the year 2000, reduce the risk of consumption of Galveston Bay seafood containing tissue concentrations of toxic substances above risk level standards established by the TDH.

Action PH-1 Develop a seafood consumption safety program.

Priority Problem

About half of the bay is permanently or provisionally closed to the taking of shellfish because of high fecal coliform bacterial levels that may indicate risk to shellfish consumers. Of the 331,000 acres available for shellfish production in Galveston Bay, 60 percent were closed in 1990 under the procedures established by the TDH shellfish sanitation program. With increased sampling, it is believed that unnecessary closures could be significantly reduced, opening more of the bay to commercial oyster harvest.

Goal

Reduce oyster reef harvest closures.

Objective

Increase oyster reef areas open to harvest by 25 percent on a spatial and temporal basis by August 31, 1995, as compared to a 1988 baseline (the last major reclassification of Galveston Bay oyster reef areas was conducted in 1988).

Action PH-2: Enhance the TDH Shellfish Sanitation Program.

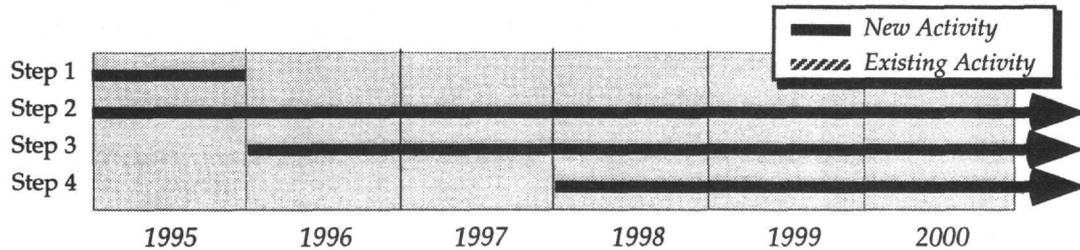
ACTION PH-1: Develop a Seafood Consumption Safety Program

What Develop a seafood consumption safety program to characterize and monitor any potential health risks to consumers of Galveston Bay seafood and inform the public of identified risks.

How

- Step 1 TDH will establish applicable standards, a risk assessment methodology, and a risk management process. Standards will be established for selected metals and organic compounds, including PCBs, PAHs, heavy metals, pesticides, and dioxins. These standards will apply to seafood, including molluscan shellfish, harvested from the Galveston Bay Estuary.
- Step 2 TDH will pursue federal funding sources as well as funding through the Texas Legislature.
- Step 3 TDH will, provided adequate funding is made available, begin a seafood monitoring program, utilizing the standards, risk assessment methodology, and risk management procedures developed in Step 1. The monitoring program will consist of periodic sampling and analysis of seafood from various locations within the estuary. The monitoring program will also include a public education program, involving the regular distribution of information regarding the seafood safety program, public forums, public meetings, news releases, the distribution of advisory pamphlets, and the installation and maintenance of signs. The seafood monitoring program will be coordinated with the Regional Monitoring Plan for the Galveston Bay Estuary (see Regional Monitoring Plan).
- Step 4 If the monitoring program identifies elevated concentrations of toxic substances, TDH will coordinate with the TNRCC, local governments, and other management agencies to incorporate measures to identify and eliminate the contaminant sources. The TNRCC will have primary responsibility for enforcing effective control of the source(s) of contamination. (Several actions under Water and Sediment Quality, Point Source Pollution, and Non-point Source Pollution address reducing contaminant sources to the estuary).

When



Where Galveston Bay Program Area.

Who Lead entity: TDH. Other participants: TNRCC, EPA, and local governments will be involved with reducing contamination that might be identified by the monitoring program. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 11,250
• TDH	\$ 2,400,000
TOTAL	\$ 2,411,250

Potential Sources of Funding: NOAA and Texas Legislature.

Regulatory Issues None.

Related Actions: NPS-4, NPS-6, NPS-11, NPS-13, NPS-16, and PPE-3.

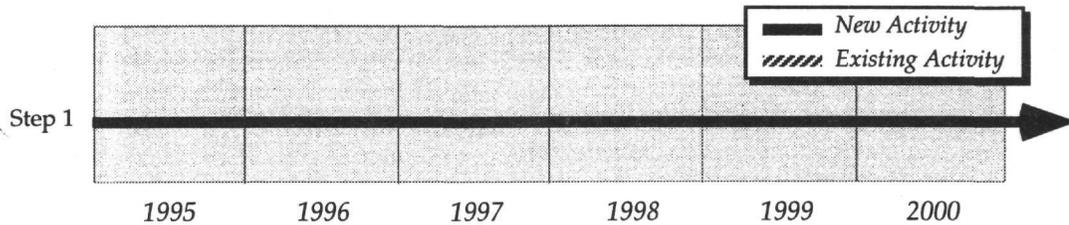
ACTION PH-2: Enhance the TDH Shellfish Sanitation Program

What Conduct more frequent water sampling in shellfish harvesting areas of Galveston Bay. With increased sampling, it is believed that unnecessary closures could be significantly reduced, opening more of the bay to commercial oyster harvest.

How

Step 1 TDH will increase the frequency of water sampling to more precisely determine the area and period of required molluscan shellfish closures. TDH will conduct public education and disseminate information regarding the closure process. TDH will pursue additional funding to implement this program.

When



Where Primarily in Conditionally Approved oyster harvest areas (see Figure PH-1).

Who Lead entity: TDH. Other participants: TPWD and USGS. Role of Galveston Bay Program: Tracking.

**Public Costs of
New Actions (5 years)**

• Program	\$ 11,250
• TDH	\$ 217,000
TOTAL.....	\$ 228,250

Potential Sources of Funding: NOAA, USFWS, and Texas Legislature.

Regulatory Issues Continue coordination with emerging federal actions and the NSSP program. Support the completion of the National Indicator Study and the development of an improved indicator parameter for the determination of molluscan shellfish closures.

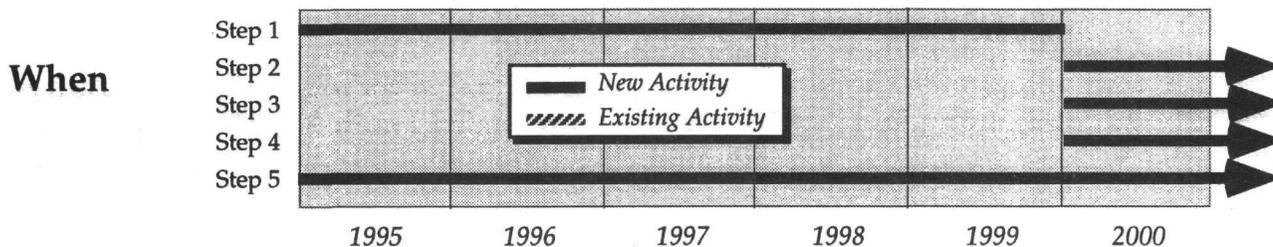
Related Actions: PS-1, PS-2, PS-5, NPS-3, NPS-4, NPS-6, NPS-14, NPS-15, and PPE-3.

ACTION PH-3: Develop a Contact Recreation Advisory Program

What Develop an effective contact recreation public health program to reduce the potential risk of bacterial infection.

How

- Step 1 TDH will, utilizing the current TNRCC fecal coliform standard for contact recreation (or other indicators, if developed), develop a methodology for determining if high-use areas are safe for contact recreation. This step will require research to investigate the relationship between waterborne illness, contact recreation and indicator organism concentration.
- Step 2 TDH will increase the frequency of monitoring in high-use areas to determine potential public health problems with contact recreation.
- Step 3 TDH will analyze the results of the monitoring, identify sources of contaminants, and link with pollution abatement and enforcement programs of state management agencies and local governments. These local governments and state and federal agencies (primarily the EPA and the TNRCC) will be responsible for enforcing effective control of the source(s) of contamination.
- Step 4 Local governments will coordinate with TDH to close unsafe areas to contact recreation. TDH will inform the public of potential health risks associated with contact recreation in contaminated areas, possibly by including the use of electronic bulletin boards that are accessible to the public.
- Step 5 In order to improve the long-term effectiveness of the contact recreation program, TDH will support the completion of the National Indicator Study and the development of an improved indicator parameter for contact recreation.



Where High-use contact recreation areas of the estuary (primarily west-side tributaries and side-bays).

Who Lead entity: TDH. Other participants: County and local health agencies, EPA, TNRCC, and USGS.
Role of Galveston Bay Program: Tracking.

**Public Costs of
New Actions (5 years)**

• TDH.....	\$ 810,000
• Program.....	\$ 11,250
TOTAL.....	\$ 821,250

Note: Operation of this program, currently scheduled to begin in the year 2000, will require an estimated \$578,530 per year, in addition to the costs included in the above table.

Potential Sources of Funding: NOAA.

Regulatory Issues None.

Related Actions: PS-1, PS-2, PS-5, NPS-3, NPS-4, NPS-6, NPS-14, NPS-15, and PPE-3.

Freshwater Inflow and Bay Circulation

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
FW-1	High	Complete current studies to determine freshwater inflow needs for the bay	102
FW-2	High	Expand streamflow, sediment loading, and rainfall monitoring	103
FW-3	High	Establish management strategies for meeting freshwater inflow needs.....	104
FW-4	High	Establish inflow regulations to protect the ecological needs of the estuary	105
FW-5	High	Explore means of providing sediment to the estuary.....	106
FW-6	High	Reduce water consumption.....	107
FW-7	Medium	Evaluate the effects of channels and structures on bay circulation, habitats, and species....	108

THE ISSUES

Among the most important factors governing the health of an estuary are the volume, timing, and quality of freshwater inflows to the estuary and the circulation and mixing of water within the estuary. The mix of river and sea water in Galveston Bay, in addition to the presence of key habitats like salt marshes, is responsible for the bay's high biological productivity. Alterations to the natural volume and timing of freshwater inflow and bay circulation patterns are important ecological concerns. Despite this fact, no statutory assurance exists to provide for freshwater resources and circulation necessary to maintain estuarine health and productivity. Rather, inflow to Galveston Bay is now dealt with on a case-by-case advocacy process presided over by the Texas Natural Resource Conservation Commission (TNRCC). To protect the health of the estuary, the management of freshwater inflow and circulation by monitoring freshwater inflow on a watershed basis is recommended in this action plan.

Tools for determining the amount, quality, location, and timing of inflow required to maintain biological productivity and diversity in the Galveston Bay Estuary are being developed as a part of studies mandated by the Texas legislature. This effort is scheduled for completion in 1994. Pending completion of these ongoing studies (including studies related to the Trans-

Texas Water Program), it is recommended that flexible management targets for freshwater inflow be established, and that Galveston Bay inflow requirements be given appropriate consideration in the watershed water allocation process. Further improvement of freshwater inflow management can be achieved by optimal routing of return flows and the conservation of water on a Galveston Bay watershed basis.

Due to their dependence on natural rainfall patterns and bay geography, freshwater inflow and circulation can only be managed to a limited extent. The results of ongoing and future research will provide additional information about how freshwater inflow to the estuary and circulation patterns within the estuary can best be managed. This action plan therefore supports a phased approach to the management of freshwater inflow, beginning with increased understanding of the issues and building towards improved management of the volume, timing, location, and quality of freshwater inflows to the estuary. The problems addressed by this action plan include:

- An incomplete understanding of the freshwater inflow needs of the estuary
- The lack of adequate monitoring data needed to accurately measure the volume and timing of freshwater inflow at different locations
- The absence of regulations and fully realized management strategies for ensuring adequate inflows to the estuary
- The role of impoundments, dikes, and levees in restricting the transport of sediment and nutrients to the bay, and their effects on bay circulation patterns
- A lack of public recognition of how water consumption can have an environmental impact on the estuary

Seven actions are proposed in *The Galveston Bay Plan* to address freshwater inflow and circulation problems:

- **Freshwater Inflow Management:** Six actions address the management of freshwater inflow adequate to maintain the productivity of economically important and ecologically characteristic species. Studies are needed to determine freshwater inflow and sediment requirements for the bay and to evaluate potential water conservation strategies. Monitoring of streamflow, sediment loading, and rainfall will provide data for the development of inflow regulations to protect the ecological needs of the estuary.
- **Ecosystem Protection:** An evaluation of the potential effects of bay circulation patterns on ecosystems is proposed in this action. Manmade structures and navigation channels will be studied to determine their impact on sediment and nutrient transport as well as circulation patterns within the bay.

ENVIRONMENTAL STATUS

Status and Trends

Freshwater Inflow

The characteristic natural community living in and around Galveston Bay is largely defined by the volume, timing, location, and quality of freshwater inflows into the bay from surrounding drainage basins. Freshwater inflows affect circulation and water quality within the estuary, and many species of fish, wildlife, aquatic plants, and shellfish depend on adequate freshwater inflows for survival. The continued high productivity of the Galveston Bay Estuary as we know it today is due to a great degree on the maintenance of adequate, high-quality freshwater inflow.

The 33,000-square-mile Galveston Bay watershed can be broken into three main elements: the Trinity River, the San Jacinto River, and the local watershed. From 1941 to 1987, freshwater inflows into the estuary averaged approximately 10.1 million acre-feet per year, the equivalent of 4.6 total "flushes" of the bay during an average year. Of the contributing basins, the Trinity River contributed the largest volume of freshwater (54 percent of the total), followed by the San Jacinto River basin (28 percent), and the local watershed (18 percent). Both the Trinity River and San Jacinto river flow through large reservoirs located close to the bay which have reduced sediment and nutrients entering the bay. This reduction of sediments and nutrients entering the bay should be monitored but does not imply that a negative condition exists. The 4500-square-mile local watershed is comprised of roughly equal portions of urban areas, agricultural lands, open/pasture lands, and forests. Within the local watershed, urbanized regions contribute the largest amounts of runoff reaching the bay as a result of impervious cover, such as parking lots, buildings, and roads. The runoff from urban areas greatly increases in wet years; a 30 percent increase in average annual rainfall results in about a 60 percent increase in runoff. Urban runoff is also much more polluted than rural runoff in this area, contributing to the bay's non-point source pollution problems.

The increased demands for freshwater by a growing population along with the construction of surface impoundments and diversions are widely perceived as having reduced freshwater inflow to the bay over time. Significant year-to-year variability in freshwater inflow is apparent, in conjunction with periods of drought and periods of heavy precipitation. However, an analysis of freshwater inflow trends for the period from 1968 to 1987 does not identify statistically significant trends which would indicate an overall reduction of freshwater inflow volume from the Trinity River, or within the estuary basin as a whole. However, some localized changes are apparent. Four of the most urbanized streams which discharge into the bay (White Oak Bayou, Brays Bayou, Sims Bayou, and Greens Bayou) all exhibit increasing flow since the 1960s (< five years) (1 to 3 percent per year on average), likely due to increases in impervious cover and increased return flows of wastewater from both groundwater and surface water.

On a seasonal basis, freshwater inflow to the estuary is normally characterized by peak springtime inflows in May followed by minimum inflows in August. Comparison of monthly mean flows before dam construction (1941-1969) and after dam construction (1972-1987)

indicates that peak flows have been cropped and low flows have been increased and that the timing of peak flows have been delayed slightly. Increasing return flows to the Trinity River and other watersheds have had the effect of elevating base flow during critical low-flow periods. Without the management of water resources, the remaining natural flows, return flows, and inter-basin transfer of water could further alter seasonal flow patterns and annual total quantities of water received by the bay, to the extent that the population dynamics for some estuarine species would likely be adversely affected.

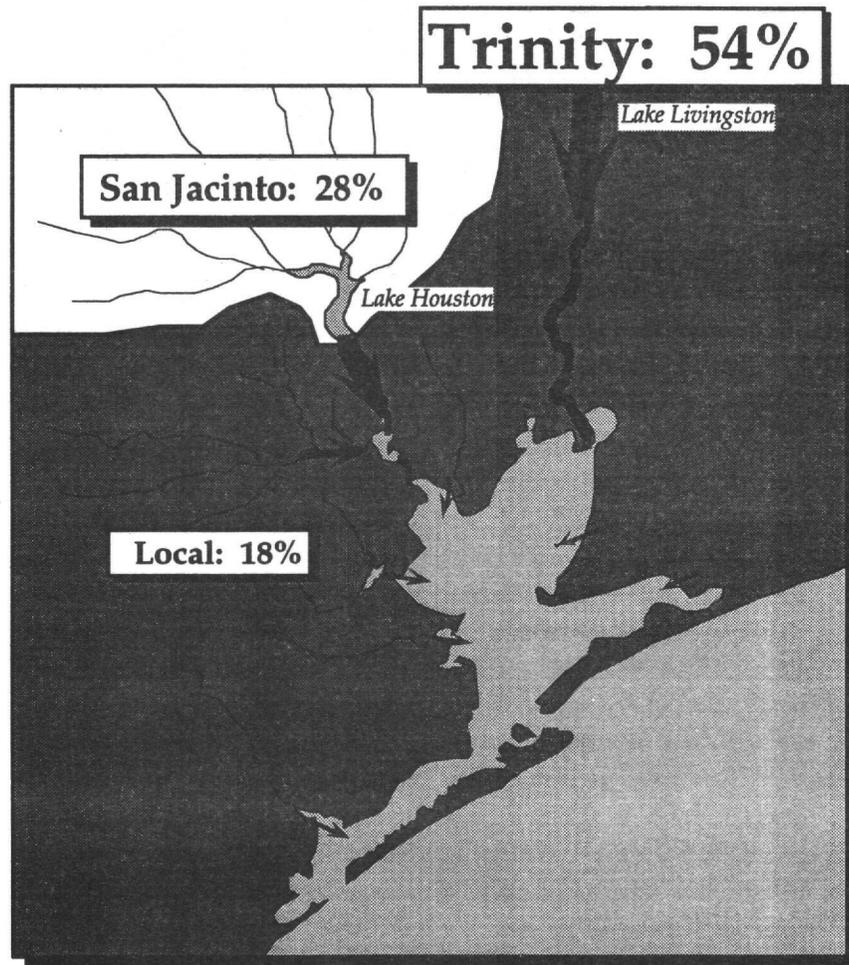


FIGURE FW-1: Average Freshwater Inflow Contributions

Two proposed water supply projects have the potential to alter freshwater inflow patterns to Galveston Bay. The Wallisville Project is a proposed reservoir on the lower Trinity River near Interstate Highway 10, now designed as a barrier to saltwater intrusion. This project would be a part of a larger effort to divert Trinity River water westward to the Houston metropolitan region for water supply purposes. Some diverted water would be lost through lawn watering, process use, and distribution losses, while some would be returned to the bay via wastewater treatment plants. A second project, the Texas Water Development Board's "Trans-Texas Project," would divert water westward from the Sabine River basin. This would result in

additional freshwater brought to Galveston Bay from outside the watershed, for a net increase in inflow.

Bay Circulation

The circulation of water in Galveston Bay is influenced by many bay features, including depth patterns, winds, tides, and freshwater inflow. In turn, circulation is a major force affecting the distribution of sediments, the location of oyster reefs, salinity gradients, and other habitat elements. When compared to other estuaries, Galveston Bay is affected much more by winds and less by tides than east and west coast bays.

The shallow nature of Galveston Bay has resulted in channel dredging for navigation, dike construction, and island creation, with corresponding significant influences on circulation. The Houston Ship Channel, the most prominent dredged feature in the bay, provides the primary mechanism for salt water intrusion, allowing higher salinity water to intrude farther into the bay. Dredged material areas on the margins of the Ship Channel form a barrier between the eastern and western portions of the bay. The Texas City Dike, originally constructed in 1915 to facilitate maintenance on the Texas City Ship Channel, has fundamentally altered the currents in the lower bay and has reduced circulation to West Bay. Some scientists have postulated that restricted circulation caused by the dike is responsible for reduced oyster reef productivity near Pelican Island and in central West Bay.

Cooling water intakes are another significant influence on circulation patterns within the bay. The combined annual volume of flow through two large power generating stations is equal to about half of the annual freshwater inflow to the bay.

Probable Causes

Freshwater inflows to the estuary are affected by year-to-year variability in precipitation, by impoundments, increases in return flows from wastewater treatment, urban development and the associated increase in impervious cover, and the import of water across watershed boundaries.

Circulation patterns are affected by a combination of natural factors and human activities. Primary natural factors included wind, bay geometry, tides, and rainfall patterns. Man-made structures and activities which affect bay circulation patterns include dredged channels, the Texas City Dike, and cooling water intakes.

MANAGEMENT STATUS

Freshwater inflow is regulated largely by the water rights provisions of the Texas Water Code administered by the Texas Natural Resource Conservation Commission (TNRCC). Permit applicants, such as municipalities, periodically apply for water allocation from state rivers and lakes based upon their projections of water usage. Planning and enforcement of the water allocation permitting process is based upon self-reporting by the permit holders. On a state-wide basis, the TNRCC annually processes 500 permits with a staff consisting of five members.

As a result, due to staffing and time restrictions, detailed evaluation of the environmental impacts of individual permits is generally not possible.

Management of freshwater inflow is handled on a watershed basis; however estuary needs for freshwater are often given the lowest priority. Current statutes for the prioritization of competing uses of state waters do not specifically identify the ecological needs of bays and estuaries. However, when issuing permits for surface water usage, the TNRCC must consider 1) studies by the Texas Parks and Wildlife Department (TPWD) and the Texas Water Development Board (TWDB) that determine inflow conditions necessary to maintain bays and estuaries and 2) effects on fish, wildlife, instream usage, and water quality.

Under the Texas Clean Rivers Program, the TNRCC contracts with regional councils of governments or river authorities to perform comprehensive water quality assessments of certain river basins or watersheds. The information is used by the TNRCC to develop regional water quality management plans for each basin or watershed.

Several agencies manage water development projects that may affect freshwater inflow. The U.S. Army Corps of Engineers (Corps) approves construction of dams and dikes across navigable waters. The TNRCC issues permits for the impoundment or diversion of state waters. The TWDB finances water storage projects subject to TNRCC permits. Special districts (e.g., drainage and storm water control) and river authorities also manage water development projects.

The TWDB is responsible for the establishment of a Texas Water Plan to conserve and develop the state's water resources. The first plan was prepared in 1969 and has been periodically revised since then to meet current and projected water needs. The plan currently emphasizes water supply, treatment, distribution, and conservation; and the collection and treatment of wastewater.

Management of freshwater inflow is generally handled on a watershed basis, with estuary inflow requirements are now evaluated a lower priority than other water use requirements in the water allocation process. There appears to be no documented evidence that indicates that the health of the estuary is suffering from current freshwater inflows. As estuary inflow targets are developed over the next several years, the permit allocation process will require modification if future monitoring of inflows in relation to the health of the estuary indicates a decline in the bay's biological activity.

Alterations to circulation changes are handled on a case-by-case basis. Deepening of the Houston Ship Channel, for, example, is predicted to increase the salinity of the Upper Bay to some degree. Currently issues like this are handled as part of each individual project's environmental impact statement.

FRESHWATER INFLOW AND BAY CIRCULATION ACTION PLAN

To ensure beneficial freshwater inflows necessary for a salinity, nutrient, and sediment loading regime adequate to maintain productivity of economically important and ecologically characteristic species in Galveston Bay.

OVERVIEW

Priority Problem

Future demands for freshwater and alterations to circulation may seriously affect productivity and overall ecosystem health. Freshwater inflows affect circulation and water quality within the estuary, and many species of fish, wildlife, aquatic plants, and shellfish depend on adequate freshwater inflows for survival. The continued high productivity of the Galveston Bay Estuary is due to a great degree on the maintenance of adequate, high-quality freshwater inflow.

Goal

Ensure beneficial freshwater inflows necessary for a salinity, nutrient, and sediment loading regime adequate to maintain productivity of economically important and ecologically characteristic species.

Objective

Determine annual and seasonal inflow needs to the bay by 1995.

- Action FW-1: Complete current studies to determine freshwater inflow needs for the bay.
- Action FW-2: Expand streamflow, sediment loading, and rainfall monitoring.

Objective

Incorporate inflow needs in regulatory authority and planning processes by the year 2000.

- Action FW-3: Establish management strategies for meeting freshwater inflow needs.
- Action FW-4: Establish inflow regulations to protect ecological needs of the estuary.
- Action FW-5: Explore means of providing sediment to the estuary.

Objective

Increase water use efficiency within the Galveston Bay Program area by 10 percent by 2005.

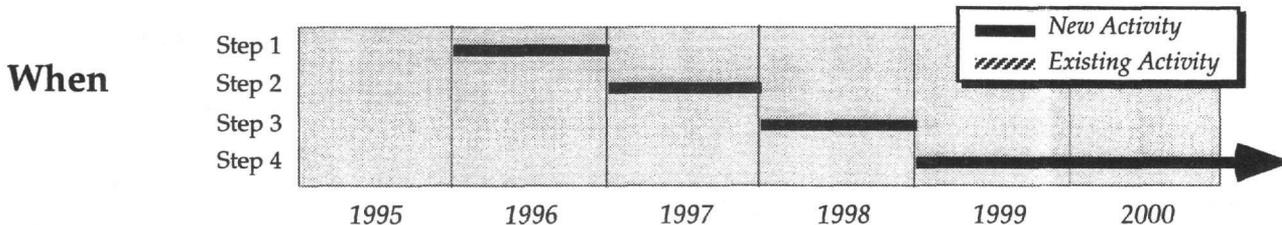
- Action FW-6: Reduce water consumption.

ACTION FW-3: Establish Management Strategies for Meeting Freshwater Inflow Needs

What Through a public and interagency process, establish management alternatives and strategies for meeting freshwater inflow needs.

How

- Step 1 The TNRCC will evaluate results of TWDB/TPWD freshwater inflow studies, working through the Clean Rivers Program (CRP) to set up a planning group.
- Step 2 The TNRCC will fund the multi-agency planning effort as a CRP pilot study. Quantity, seasonal, salinity and circulation effects, sediment and detrital transport, routing of return flows, and nutrient factors will all be considered in the development of management alternatives, leading to the development of a flexible management plan which provides for drought contingency. Development of the management plan will involve coordination of the findings of joint agency inflow studies, Clean Rivers Act programs, Trans-Texas Water Program, the Texas Coastal Management Program, and instream flow needs for rivers.
- Step 3 The results of the completed plan will be adopted by the following entities
 - Galveston Bay Program (*Galveston Bay Plan*)
 - TWDB (*Texas Water Plan*)
 - TPWD
 - TNRCC
 - The CCC may review the freshwater inflow plan and after public comment may incorporate it into the CMP.
- Step 4 Galveston Bay Program and/or CCC, TNRCC and TWDB will review water impoundments and diversion projects for consistency with *The Plan*.



Where All contributing river and coastal drainage basins.

Who Lead entity: TNRCC. Other participants: TPWD, TWDB, GLO, CCC, City of Houston, Trinity River Authority, San Jacinto River Authority, and other water consumers. Role of Galveston Bay Program: Tracking.

**Public Costs of
New Actions (5 years)**

• TNRCC.....	\$ 116,250	• TWDB.....	\$ 37,500
• Others.....	\$ 150,000	• Program....	\$ 11,250
TOTAL.....		\$ 315,000	

Potential Sources of Funding: SCS, Corps of Engineers, USGS, and EPA.

Regulatory Issues Implementation of the strategies developed by this action may require additional regulations and/or statutes. See Action FW-4.

Related Actions: FW-1, FW-4, and FW-7.

ACTION FW-4: Establish Inflow Regulations to Protect the Ecological Needs of the Estuary

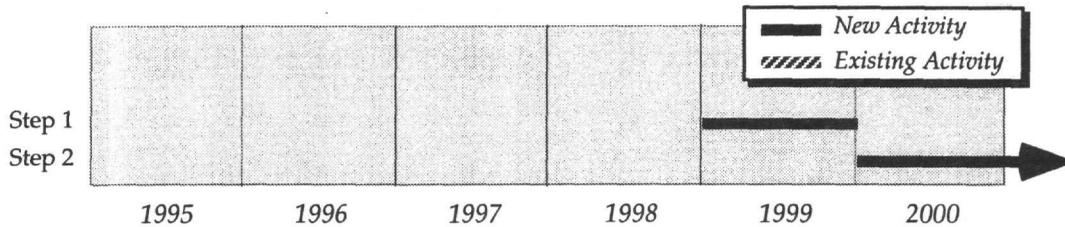
What Establish statutes and/or regulations to ensure more comprehensive watershed-based processes for management of inflow which recognizes the ecological needs of the estuary.

How

Step 1 In addition to consistency review provisions established through Action FW-3, TNRCC will promulgate rules, as necessary, to implement a basin or watershed-based approach to link individual water allocation permits to the ecological needs of the estuary.

Step 2 The TNRCC will pursue additional authority through the legislature, if necessary.

When



Where All contributing river and coastal drainage basins.

Who Lead entities: TNRCC. Other participants: TPWD, TWDB, GLO, CCC, USGS, Corps, EPA, USFWS, NMFS, City of Houston, and other water consumers. Role of Galveston Bay Program: Coordination.

**Public Costs of
New Actions (5 years)**

• TNRCC	\$ 30,000
• Program.....	\$ 4,500
TOTAL.....	\$ 34,500

Potential Sources of Funding:

Regulatory Issues At the state level, Sec. 11.147 of the Texas Water Code requires that the TNRCC include in the conditions for a permit to store, take or divert state water, specific requirements to maintain beneficial inflows to any affected bays and estuary systems. If necessary, the TNRCC could expand the scope of this authority and could, by a legislative change, include all of a watershed in the area in which conditions could be imposed in permits.

Related Actions: FW-1, FW-3, FW-6, and FW-7.

ACTION FW-5: Explore Means of Providing Sediment to the Estuary

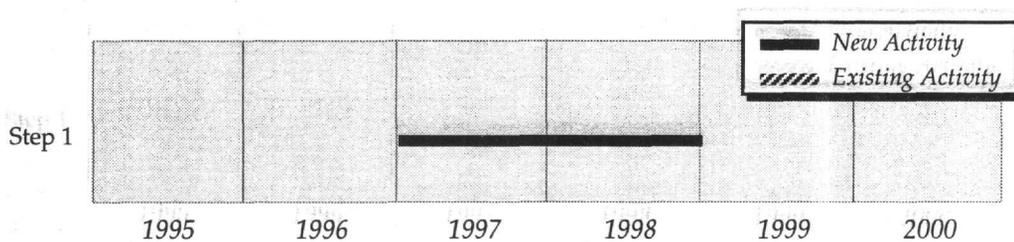
What Explore means of providing sediment to the estuary. The establishment of reservoirs near the coastline within the Galveston Bay watershed has had the effect of depriving the estuary of sediment. The net amount of sediment lost to the estuary is not known, and feasibility of remobilizing this sediment has not been extensively studied.

How

- Step 1 TNRCC will pursue and/or provide funding for USGS and the Corps of Engineers to conduct a study to:
- Determine the net quantity of sediment which has been prevented from reaching the estuary
 - Explore the feasibility of remobilizing sediment impounded behind watershed dams and transporting it to the estuary (including a generalized balancing of the costs and benefit and the impact on maintenance dredging).

Other participants and potential sponsors of this study are the GLO, Bureau of Reclamation, the Trinity River Authority, and the San Jacinto River Authority. This action will be coordinated with Action HP-9.

When



Where Trinity River delta and other areas within the estuary where additional sediment transport to the estuary is determined to be beneficial.

Who Lead entity: TNRCC. Other participants: TWDB, TPWD, USGS, Corps of Engineers, GLO, Bureau of Reclamation, Trinity River Authority, and San Jacinto River Authority. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TNRCC	\$ 22,500
• Program	\$ 2,250
TOTAL.....	\$ 24,750

Potential Sources of Funding: Rural Development Administration, SCS, NOAA, and USGS.

Regulatory Issues None.

Related Actions: HP-9.

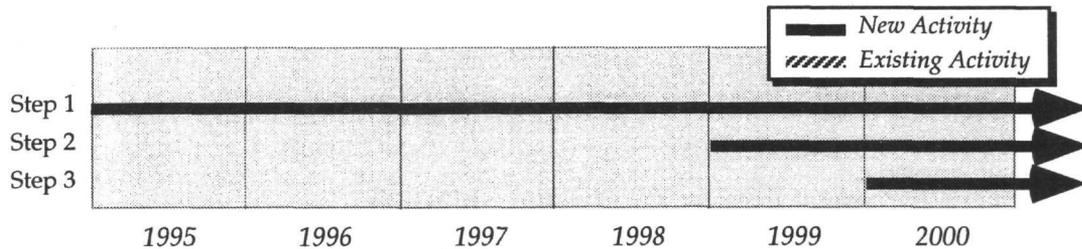
ACTION FW-6: Reduce Water Consumption

What Reduce water consumption. Future development within the watershed may put additional pressure on available water supplies, resulting in reduced freshwater inflows to the estuary. A long-term strategy of water conservation can help ensure that adequate freshwater inflows are provided to the bay.

How

- Step 1 Galveston Bay Program will work with the Subsidence District, municipalities and other local water utilities to encourage the use of existing surface-impounded water supplies instead of the development of new surface sources of water. This will include pursuing the Trans-Texas project. TWDB will incorporate this policy into the state water plan.
- Step 2 Galveston Bay Program and the TWDB will work with municipalities and other local water utilities to implement the state plumbing code and other codes that require low water use devices (e.g. low-flow faucets) on new or replacement fixtures and the adoption of strategies for reducing per capita water usage (e.g. educational programs, rate structure changes). TWDB will provide funding for pilot programs. Other possible long-term strategies: using recycled water for irrigation, watering, and cooling; develop water markets; and consumer water collection. Note that while per-capita reduction in water consumption is feasible, an overall net reduction is probably not practical as long as the area maintains its current growth rates.
- Step 3 Galveston Bay Program will seek funding from the TWDB to develop a regional water conservation plan. Once completed, TWDB will adopt the regional conservation plan into *The Texas Water Plan*.

When



Where Galveston Bay Program Area.

Who Lead entities: Galveston Bay Program, TWDB, and the Subsidence District. Other participants: TNRCC, municipalities including City of Houston, Trinity River Authority, San Jacinto River Authority, and water utilities. Role of Galveston Bay Program: Conduct/Coordinate Action.

Public Costs of New Actions (5 years)

• TWDB\$ 37,500	• Others..... \$ 55,000
• Program\$ 48,750	
TOTAL..... \$ 141,250	

Note: The above costs do not include costs associated with the Trans-Texas project. Potential Sources of Funding: USDA, EPA, and NSF.

Regulatory Issues None

Related Actions: HP-9.

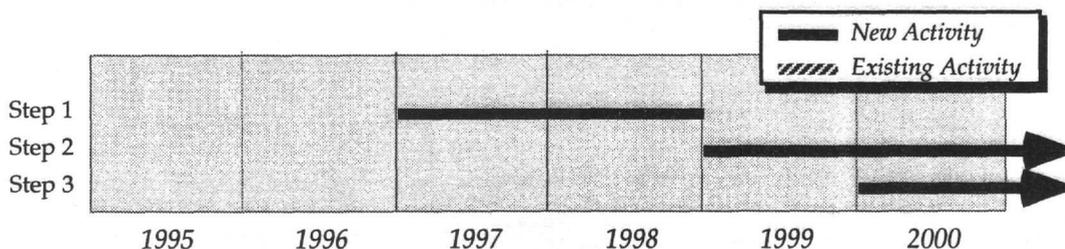
ACTION FW-7: Evaluate the Effects of Channels and Structures on Bay Circulation, Habitats, and Species

What Evaluate the effects of channels and structures on bay circulation, habitats, and species. Conduct a study to evaluate the effects of current structures and practices, such as navigation channels, the Texas City Dike, and cooling water intake. Ensure that freshwater inflow needs are taken into account in the proposed construction of tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc. These structures can potentially alter sediment and nutrient transport to the estuary, as well as circulation patterns within the bay.

How

- Step 1 TNRCC will pursue and/or provide funding for a study to:
- Evaluate the effect of existing bay structures (such as navigation channels and the Texas City Dike) and practices (such as water extraction) on circulation, and the effect of circulation alterations on bay habitats and species.
 - Develop a methodology to evaluate the effect of proposed structures (such as tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc.) on bay circulation patterns, habitats, and species.
 - Evaluate the feasibility and cost effectiveness of making alterations to existing structures and practices which have harmful effects on bay circulation.
- This study will be coordinated with the study proposed by Action FW-5.
- Step 2 The TNRCC will institute a review process for proposed structures (such as tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc.) to help ensure that the freshwater inflow and circulation needs of the estuary are protected.
- Step 3 If determined to be feasible and cost-effective, alter existing structures or practices which are identified in the study as being harmful to bay circulation, habitats, and/or species.

When



Where Throughout the Galveston Bay Estuary.

Who Lead entity: TNRCC. Other participants: TWDB, TPWD, USGS, and Corps. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TNRCC.....	\$ 187,500
• Program.....	\$ 6,750
TOTAL.....	\$ 194,250

Potential Sources of Funding: NOAA, Corps of Engineers, and USGS.

Regulatory Issues None.

Related Actions: FW-1, FW-3, FW-4, FW-5, SM-4, HP-2, and HP-8.

Spills/Dumping

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
SD-1	Medium	Promote planning to facilitate natural resource damage assessments	119
SD-2	Medium	Identify simplified procedures for damage assessment for small oil spills	120
SD-3	Medium	Facilitate effective restoration of Galveston Bay's natural resources damaged by spills	121
SD-4	Medium	Facilitate spill cleanup by advance shoreline characterization	122
SD-5	Low	Improve trash management near the shoreline	123
SD-6	Low	Remove trash from storm water discharges	124
SD-7	Low	Publicize environmental harm caused by illegal dumping	125

THE ISSUES

The Management Conference of the Galveston Bay National Estuary Program (GBNEP) identified two issues of importance relating to spills and dumping in the Galveston Bay system:

- Bay habitats and living resources are impacted by spills of toxic and hazardous materials during storage, handling, and transport: Accidental spills or deliberate dumping affect both the aesthetic, economic and the ecological aspects of Galveston Bay. Intensive petrochemical and refining industries, shipping operations, and the highly urbanized local watershed place the bay at risk from these major sources of pollution.
- Illegal dumping and water-borne and shoreline debris degrade water quality and aesthetics of Galveston Bay: Estuarine debris represents a serious aesthetic concern in Galveston Bay, particularly to citizens who live along the shoreline or who use the bay for recreational activities such as fishing or sailing.

This action plan provides strong support for major ongoing developments in spill contingency planning and response preparedness. In order to avoid duplication of the work already proceeding, spill contingency planning and response are not the main focus of this action plan.

Instead, the problems primarily addressed by this action plan are those identified above which have not received the attention they deserve. In general, this action plan focuses on the following targets:

- **Natural Resource Damage Assessments:** Three actions are favored to obtain the maximum benefits available for environmental restoration from the natural resource damage assessment process. *The Galveston Bay Plan* supports the efforts of natural resource trustee agencies to obtain compensation from responsible parties for restoration of Galveston Bay ecosystems damaged by spills. The development of plans to streamline the natural resource damage assessment process and the identification of bay-wide restoration needs are also promoted by *The Plan*.
- **Spill Management:** An action is proposed to conduct an advance shoreline characterization of bay features (e.g., access points, sensitive habitats, shoreline modifications, etc.) that potentially affect the spill cleanup process. The deployment of spill response equipment, construction of boom anchor points for critical areas, and other preparedness strategies are also encouraged in this action.
- **Trash Control:** Three initiatives to reduce debris and illegal dumping into the bay are recommended by *The Galveston Bay Plan*. Reductions in the amount of shoreline and water-borne debris can be achieved by improved trash management practices for shoreline areas and storm water discharge points. *The Plan* also fosters the development of educational programs publicizing the environmental harm caused by illegal dumping.

ENVIRONMENTAL STATUS

Status and Trends

Spills

Several factors must be considered to evaluate the effect of spills on the bay. In general, the more material released, the greater the repercussions on natural resources. However, even a small amount of a very toxic or concentrated substance has the capacity to affect large volumes of water. Most spills that occur in the Galveston Bay area on a regular basis are relatively small and involve constituents for which the ecosystem has a natural assimilative capacity. Although spills of all sizes cannot always be prevented, compensation for environmental damages can be provided by the responsible party.

Oil spill response records maintained by the U.S. Coast Guard Marine Safety Office in Galveston, Texas (USCG MSO), indicate that, on average, two small spills of toxic contaminants, oil, fuel, or other pollutants occur daily. Totals for oil alone show over a quarter of a million gallons of oil spilled into the channel area in 1989. However, usually no cleanup action is required for the smallest spills, because natural forces have a capacity to minimize their effect. Frequently, responsible parties or sources of these spills are unknown. However, heavy vessel traffic to and from on-shore facilities, and frequent transfer and lightering activities put Galveston Bay in the high risk category for catastrophic spills as well. Significant

spills are generally related to human error and require cleanup actions. Water commerce statistics issued by the Army Corps of Engineers (Corps) showed an increase in crude petroleum transport at the Port of Houston from 28.2 million tons in 1988 to 30.3 million tons in 1989.

Over Water Transfers: More oil is transferred over water in the Galveston Bay complex, Port of Houston, Port of Texas City, Port of Galveston, and the offshore lightering zone than in any other area of the country. Large volumes of oil are lightered from large oil carriers to smaller tankers able to navigate the width and draft restrictions of the Houston Ship Channel. This large number of over-water transfers between tankers in the Galveston offshore lightering zone and between bulk cargo vessels and waterfront facilities in Galveston Bay's major ports poses increased risk for spills. Southeasterly prevailing winds and the tidal influences through San Luis Pass, Rollover Pass, and the Galveston-Houston jetties force spills in the lightering zone to move into Galveston Bay where spilled materials may present high risks to Galveston Bay's ecology.

Collisions: The major petrochemical complex along the Houston Ship Channel presents the continuing possibility for a collision-caused spill of oil or hazardous materials. Significant oil spills may be caused by collisions. According to 1990 import and export statistics, the Port of Houston ranked third and Port of Texas City sixth in the country for the volume of oil transported (New York and New Orleans ranked first and second, respectively.) In the past several years three major incidents have resulted in spilled cargoes in the Houston Ship Channel inside of Galveston Bay Estuary:

- In 1989, the Tank Barge Coastal 2514 spilled 6,000 barrels of oil slurry.
- In 1990, the Tank Barge Apex Marine 3417 spilled 16,667 barrels of number six oil.
- In 1992, the Bottle Barge Duval II spilled 2,800 tons of molten sulfur.

Dumping

Waterborne trash such as cans, bottles, ropes, packing materials, plastic bags, or medical waste are pollutants classified as bay debris. Particular sources of debris, although difficult to locate with precision, may include 1) material dumped in rivers or offshore that becomes trapped in the shallow, enclosed waters of the bay, 2) debris from city streets that travels to the bay via storm water discharge, and 3) spillage of plastic pellets from loading docks.

Debris dumped in and around the bay degrades aesthetics, harms wildlife, clogs water intakes, and damages boat propellers. Birds may ingest plastic pellets, which can cause malnutrition and starvation in some cases. Plastic bags have been mistaken for food by sea turtles, causing malnutrition or starvation resulting from blockage of the digestive tract. Other types of debris have caused entanglement of wildlife, divers, and boat propellers; and have blocked cooling-water intake systems. The economy is also adversely affected by costly cleanup efforts and declines in tourism from bay debris.

A study was conducted recently to investigate the occurrence, magnitude, distribution, and effect of water-borne debris in the waters and along the shores of Galveston Bay. Samples of collected debris and trash from open water areas and the near-shore environment indicated

that plastic products composed over 50 percent of the items collected in open water areas, and metal made up most of the remainder. Near shore debris comprised a more diverse collection of materials: plastics, metals, construction debris, and rubber. Debris was most concentrated along the shoreline itself, where it tends to accumulate with the actions of winds, currents, and waves.

Analysis of samples taken from the Houston Ship Channel in a recent study indicated most debris to be storm water, rather than sewage, related. Items collected during the study included plastic pellets, bags, cups, fast food containers, toys, bottles, jugs, and general street litter. In comparison to other U.S. harbors, this study showed the Houston Ship Channel to have the highest incidence of plastic pellets.

Probable Causes

The causes of spills are generally evident. Spills may be caused by tanker collisions, rammings, groundings, and sinkings; human error during transfer operations; and natural catastrophes such as hurricanes, tornadoes or general flooding as seen in the San Jacinto River flood in the Fall of 1994. Dumping may be caused by lack of adequate collection facilities and trash pickup. A lack of education and public outreach coupled with inadequate enforcement of existing regulations leads people to consider only the convenience of dumping while ignoring the negative impacts on the bay.

MANAGEMENT STATUS

Regulatory Basis

Clearly the first priority in dealing effectively with spills and dumping should be prevention. Secondary activities should focus efforts on effective cleanup and compensation for environmental harm. Indeed, much progress has been made toward these goals as a result of federal and state legislation in the last several years. Further information regarding the role of various federal and state agencies in the management of spills and dumping is provided below.

Spills

Several federal and state laws govern spill prevention and response for discharges of oil and hazardous substances into surface waters. These statutes include the Clean Water Act (CWA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), and the Texas Hazardous Substances Spill Prevention and Control Act. Following the Exxon *Valdez* accident in Prince William Sound, the Oil Pollution Act of 1990 (OPA) and the Texas Oil Spill Prevention and Response Act (OSPRA) of 1991 were passed to protect coastal waters and adjacent shorelines from oil spills.

Spill Prevention and Response: Responsibility for spill response is divided up among no fewer than five federal and state entities. Federal spill response and cleanup is the responsibility of

the United States Coast Guard (USCG) for marine spills, or the Environmental Protection Agency (EPA) for inland spills of hazardous substances and of oil into water. Except for spills associated with oil and gas exploration, development, and production, including transport by pipelines, and oil spills in excess of 240 barrels into or that threaten coastal waters, the Texas Natural Resource Conservation Commission (TNRCC) is the lead state agency for oil and hazardous substance spill response and cleanup coordination on land and for hazardous substances spills in navigable waters of the state. The Texas Railroad Commission (RRC) has jurisdiction and spill response authority for all spills from oil and gas exploration, development, and production facilities, including crude oil and natural gas pipelines. The General Land Office (GLO) is the lead spill response agency for oil spills into coastal waters or that threaten coastal waters and exceed 240 barrels. For coastal oil spills of 240 bbls or less, the RRC acts as the state on-scene coordinator for abandonment, containment, removal, and cleanup.

Facility contingency plans describe the procedures to prevent spills of oil and hazardous substances and the methods to be followed to remove spills without undue delay. Current oil spill response plans are guided by rules issued pursuant to the CWA, the National Oil and Hazardous Substances Contingency Plan (NCP), and OSPRA. In accordance with provisions of OPA, state and federal agencies, private industry, and public organizations are currently developing and implementing local oil spill response contingency plans. OPA and OSPRA also require the state and federal agencies to certify facility and vessel spill contingency response plans. GLO is required to certify the spill prevention and response capabilities of coastal facilities managing oil. In conjunction with USCG, GLO also reviews vessel spill prevention and response plans, which include audits, drills, inspections and denial of port entry for noncompliant vessels.

When properly prepared and implemented, spill response contingency plans will facilitate a more rapid and efficient multi-agency response to oil and hazardous substance spill events. Key elements of these plans are detailed databases of spill response capabilities which include: 1) trained personnel; 2) equipment type and location; 3) communication capabilities. Spill response contingency plans should also address notification procedures, interagency coordination, and ability to respond to a "worst-case" spill event. In general, these elements are quickly developing in the Galveston Bay area and based on the response to the October 1994 pipeline break, response capability has improved.

Certain preparations may be made in advance of a spill so that cleanup may be accomplished quickly and effectively. These preparatory actions include identifying shorelines at risk, pre-constructing boom anchor points in sensitive areas, and amassing detailed information about shoreline features that may either help or hinder cleanup activities. However, little information is currently available about these factors. This means that last minute efforts must be made to acquire necessary information after the spill occurs, and many times cleanup is delayed.

Compensation for Environmental Injuries: Although spills of all sizes cannot always be prevented, in some cases state and federal laws may require the one responsible for the spill to provide compensation for injuries to public resources. The United States, states, and Indian

tribes are entitled to receive compensations from responsible parties for injury to, destruction of, or loss of public natural resources. The award of compensation for injured natural resources, however, has not been used extensively in Galveston Bay. Of the numerous spills, fewer than five have proceeded through the damage assessment process to final payment.

To help remedy this situation, the state of Texas passed Senate Bill 1049 (SB 1049) in June 1993. This legislation applies to coastal oil spills and includes provisions for the development of natural resource damage assessment methodologies, and requires parties responsible for coastal oil spills to take actions as soon as possible to restore, rehabilitate and/or replace injured natural resources. SB 1049 also requires the natural resource trustees for the state of Texas to formulate a baseline inventory of natural resources in several areas including Galveston Bay.

Natural resource damage assessments (NRDAs) are required under provisions of the CWA, CERCLA, OPA, and SB 1049. Five agencies act as "natural resource trustees," and are responsible for damage assessment in the Galveston Bay area. Federal natural resource trustees include the Department of the Interior and the National Oceanic and Atmospheric Administration. State trustees are the Texas Natural Resource Conservation Commission, the Texas Parks and Wildlife Department, and the Texas General Land Office.

Proposed Regulations: Several federal and state agencies are currently developing additional regulations to address recognized gaps in the statutes and rules discussed above. These additional efforts are as follows:

- **Areas of Special Importance:** EPA has recently proposed regulations under OPA, CWA, and CERCLA addressing facility and vessel planning and preparation for potential spills in areas of special economic or environmental importance. Plans are to be developed which provide for the immediate and effective protection, rescue, and rehabilitation of fish and wildlife resources (including habitat) that are harmed or jeopardized by a spill.
- **Contingency Plans for Additional Sources of Pollution:** TNRCC is in the process of developing Spill Prevention and Control rules under the provisions of the Hazardous Substances Spill Prevention and Control Act to prevent, control and manage discharges or spills. The new rules will require owners and operators of facilities and vessels to prepare spill contingency plans for any material capable of causing pollution. These rules have the goal of improving the timeliness, adequacy, coordination, efficiency, and effectiveness of responses to discharges or spills.

Dumping

Confusion over agency responsibilities has contributed to inadequate enforcement against deliberate dumping. A proliferation of deliberate dumping also results from lack of dockside garbage/sewage reception facilities. Individuals engaging in surreptitious and unauthorized disposal or discharge of litter or waste face little risk of apprehension.

Several federal and state laws regulate the dumping of refuse into surface waters. The disposal of marine solid waste is regulated by ports and navigation districts. Annex V of the

International Convention for the Prevention of Pollution from Ships and the Marine Plastics Pollution Research and Control Act (MARPOL) prohibit vessels and offshore platforms from dumping waste materials into U.S. lakes, rivers, bays, and sounds within three miles from shore. Marinas, marine terminals and ports are also required to maintain waste reception facilities.

Section 13 of the Rivers and Harbor Act of 1899 also prohibits depositing of refuse into any navigable water, and Section 10 of the Act deals with obstructions to navigation. Enforcement under this is cumbersome as criminal, rather than civil, sanctions are called for. Primary administration of the Refuse Act of 1899 rests with the Corps of Engineers.

As provided by the Texas Water Code and the Health and Safety Code, the TNRCC has jurisdiction over incidents involving the unauthorized disposal or discharge of litter or municipal solid waste into waters of the state. This type of discharge may be considered a violation of either the Texas Water Code, Chapter 26, or the Texas Health and Safety Code, Section 361.012, and both state and county governments have the authority to pursue and enforce violations of these state codes. The TNRCC may elect to delegate the incident to the county health department for investigation and enforcement or choose to investigate or conduct enforcement themselves. Often times the size or volume of the discharge is the discerning factor for determining whether the state or county will pursue the incident. The Harris County Pollution Control Department and the Galveston County Health Department can respond to reports of illegal dumping within their respective county areas.

SPILLS/DUMPING ACTION PLAN

To support a comprehensive natural resource damage assessment program by working in close coordination with federal, state, local, and private entities; enhance spill prevention and response by coordinating all involved parties; and eliminate dumping and accumulation of debris.

OVERVIEW

Priority Problem

Spills Impact Bay Habitats. Bay habitats and living resources are impacted by spills of toxic and hazardous materials during storage, handling, and transport.

Goal

Obtain Compensation for Environmental Injuries. Designated state and federal natural resource trustee agencies are authorized to seek compensation from responsible parties for injuries to natural resources resulting from spills of oil and hazardous substances. Compensation must be used by the trustees to restore the injured resources. *The Galveston Bay Plan* will facilitate the damage assessment and restoration process by providing a coordinating framework.

Objective

Support trustee actions to obtain compensation for environmental injuries and ensure that restoration funds are used effectively to benefit the Galveston Bay ecosystem to the maximum extent possible under the existing statutes and regulations.

- Action SD-1: Promote planning to facilitate natural resource damage assessments.
- Action SD-2: Identify simplified damage assessment procedures for small oil spills.
- Action SD-3: Facilitate effective restoration of Galveston Bay's natural resources injured by spills.

Goal

Reduce the impact from spills on the natural environment. Streamline spill response and cleanup procedures to reduce the impact of spills on bay resources.

Objective

Improve advance planning measures and on-the-ground readiness.

- Action SD-4: Facilitate spill cleanup by advance shoreline characterization.

Priority Problem

Debris and Illegal Dumping. Illegal dumping and water-borne and shoreline debris degrade water quality and aesthetics of Galveston Bay.

Goal

Eliminate water-borne debris. In addition to improving the general appearance of the bay, limiting the amount of water-borne debris will reduce harm and damage to wildlife, water intakes, and vessels.

Objective

Reduce the amount of shoreline and water-borne debris by half within five years.

- Action SD-5: Improve trash management near the shoreline.
- Action SD-6: Remove trash from storm water discharge.

Goal

Eliminate illegal dumping. Reduce illegal dumping of trash into the bay to improve water quality and provide a more pleasant recreational environment.

Objective

Decrease illegal dumping by half within five years.

- Action SD-7: Publicize environmental harm caused by illegal dumping.

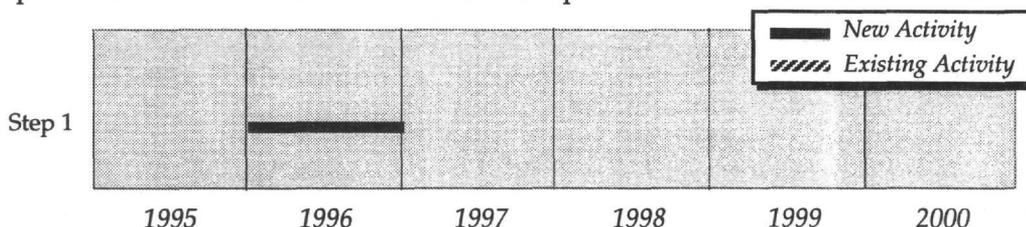
ACTION SD-2: Identify Simplified Damage Assessment Procedures for Small Oil Spills

What Develop simplified procedures, such as a compensation table, to assess natural resource damages from small oil spills within Galveston Bay. Establish a restoration framework to guide natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) in applying damage recoveries in an efficient and effective manner.

How

Step 1 Galveston Bay Program will assist natural resource trustees in developing a compensation table for oil spills in Galveston Bay based on the size, type, and location of a spill. Design of the table will be consistent with applicable state and federal statutes and regulations, and will describe special data collection procedures tailored to the conditions of each spill.

When



Where Galveston Bay Program area.

Who Lead entity: Galveston Bay Program; Other participants: natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD). Role of Galveston Bay Program: conduct action.

**Public Costs of
New Actions (5 years)**

• Program	\$ 2,250
TOTAL.....	\$ 2,250

Expenditures for spill-related activities are generally managed through the Coastal Protection Fund established by industry fees and administered by the GLO. Potential Sources of Funding: EPA.

Regulatory Issues Procedures for conducting damage assessments for spills of oil and hazardous substances are provided in federal regulations issued subsequent to the Clean Water Act and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund). NOAA is in the process of developing regulations to address damages assessments for oil spills as directed by OPA. Additionally, Texas Senate Bill 1049/HB 2188, effective September 1, 1993, requires the state to develop a damage assessment process for oil spills in coastal waters, and Galveston Bay is specifically named to be surveyed for the Natural Resource Inventory.

Related Actions: SD-1.

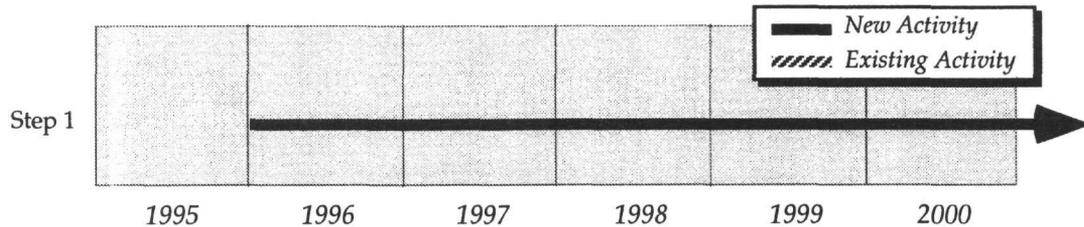
ACTION SD-3: Facilitate Effective Restoration of Galveston Bay's Natural Resources Damaged by Spills

What Identify bay-wide restoration needs to be considered by the natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) during planning for and restoration of natural resources injured by releases of oil or hazardous substances. The actual restoration of such resources will be accomplished by the natural resource trustees using recovered damages.

How

Step 1 Galveston Bay Program will contribute to an effective and coordinated restoration program 1) by providing available baseline data on pre-release conditions in affected areas of the bay, and 2) by facilitating public review of the restoration plan and approval of related permits. In turn, the natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) will provide Galveston Bay Program with data regarding the fate and effects of spilled oil and hazardous substances on Galveston Bay resources. Providing data gathered through the damage assessment process will be subject to applicable litigation constraints.

When



Where Galveston Bay Program jurisdictional area.

Who Lead entity: Galveston Bay Program; Other participants: natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD). Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program	\$ 30,000
TOTAL.....	\$ 30,000

Expenditures for spill-related activities are generally managed through the Coastal Protection Fund established by industry fees and administered by the GLO, and these costs are not included in the above table. NRDA regulations provide for cost effective assessments that avoid double counting of damages. Recovered damages must be used by the trustees on behalf of the public to restore the injured resources. Potential Sources of Funding: NOAA and EPA.

Regulatory Issues Existing legislation has established sufficient authority for these actions.

Related Actions: SD-1, SD-2.

ACTION SD-4:

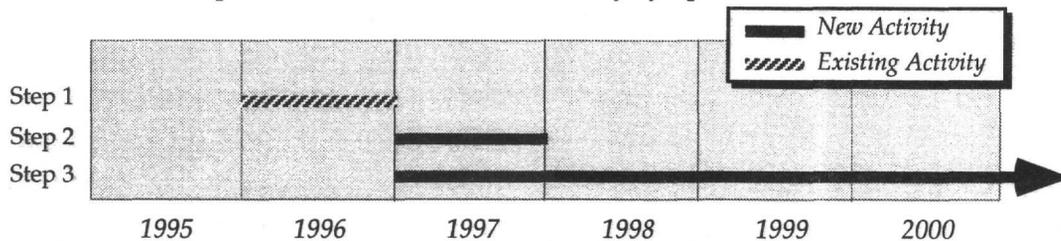
Facilitate Spill Cleanup by Advance Shoreline Characterization

What Facilitate a more timely and efficient spill response while minimizing injury to sensitive habitats by conducting an advance shoreline characterization of bay features that could help or hinder the cleanup process. The survey would inventory such features as access points, sensitive habitats, and shoreline modifications. Where practicable, deploy equipment and construct boom anchor points for critical areas based on advance survey information.

How

- Step 1 GLO will complete an initial geographic information system-based (GIS) survey of Galveston Bay shoreline features which could help or hinder response and cleanup activities in accordance with existing authority and legislative mandates for state spill response planning.
- Step 2 GLO will complete an assessment of existing state and federal response planning and equipment siting activities to determine if adjustments are needed in spill response preparedness strategies. This activity will be carried out in cooperation with the natural resource trustees (i.e., USFWS, NOAA, TNRCC, and TPWD), the USCG, and other private entities involved in spill response planning.
- Step 3 GLO will begin to publish updated GIS characterization information every five years and report on activities under this action plan in the biennial State of the Bay Symposia.

When



Where Galveston Bay shoreline and other features at risk from spills or influencing spill cleanup actions.

Who Lead entity: GLO; Other Participants: other natural resource trustees (i.e., USFWS, NOAA, TNRCC, and TPWD), monitoring agencies such as USGS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 11,250
TOTAL.....	\$ 11,250

Expenditures for spill-related activities are generally managed through the Coastal Protection Fund established by industry fees and administered by the GLO. Potential Sources of Funding: NOAA, EPA, and TWDB.

Regulatory Issues SB 1059/HB 2188, effective September 1, 1993, generally authorizes the use of a GIS to identify bay features helpful to cleanup activities, and the expenditure of Coastal Protection Fund moneys for such activities.

Related Actions: SD-3.

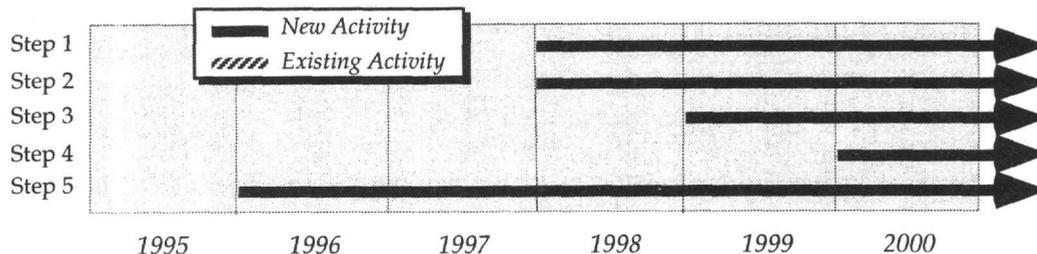
ACTION SD-5: Improve Trash Management Near the Shoreline

What Require placement and pickup of waste receptacles at commercial boating and fishing establishments, recreational boat marinas, and boat launch ramp facilities, shoreline parks, and other high-use shoreline locations around the bay.

How

- Step 1 GLO will continue to implement its requirement that marinas have adequate waste receptacles. Local governments will establish requirements ensuring adequate pickup of waste through ordinances.
- Step 2 Galveston Bay Program will coordinate with existing public/private litter abatement programs to encourage voluntary placement and maintenance of waste receptacles at other shoreline sites.
- Step 3 Galveston Bay Program will target an anti-litter/dumping public education effort at Galveston Bay in coordination with similar educational efforts (e.g., "Clean Texas 2000," "Don't Mess with Texas," "Keep Texas Beautiful," and "Adopt a Beach"). Galveston Bay Program will encourage greater coordination of anti-litter/dumping enforcement among federal, state and local law enforcement agencies and will consider advocating increased fines for littering. Sponsor bay shoreline cleanups by volunteers on a regular basis. Consider expanding TPWD "Don't Mess with Texas" program to "Don't Mess with Texas Bays."
- Step 4 Galveston Bay Program will oversee a new debris survey similar to one conducted previously under GBNEP and will update this survey every three years, and report on activities under this action plan in the biennial State of the Bay Symposia.
- Step 5 Galveston Bay Program will work with local industries to eliminate the release of plastic pellets to the Bay by 1) Encouraging adoption of the SPI 1991 Pellet Retention Environmental Code and the 1992 Processor's Pledge; 2) train employees to minimize pellet spillage; 3) encourage adoption of other measures listed in EPA guidance document "Plastic Pellets in the Aquatic Environment: Sources and Recommendations."

When



Where Galveston Bay Program area, emphasizing public use areas on the bay shoreline and on tributaries below Lakes Livingston and Houston.

Who Lead entity: Galveston Bay Program; Other participants: GLO, Corps, local governments for appropriate jurisdictions and commercial venture operators for private facilities. Role of GBC: Conduct Action.

Public Costs of New Actions (5 years)

• Munis	\$ 27,000	• TPWD	\$ 15,750
• Program	\$ 66,000	• Others	\$ 28,500
TOTAL.....		\$ 137,250	

Potential Sources of Funding: USDA, EPA, DOT, and TNRCC.

Regulatory Issues MARPOL Annex V establishes that facilities with more than 10 vessels supply shoreside trash handling facilities, and this addresses most marinas in the Galveston Bay system. A model ordinance is needed for incorporated areas encompassing shoreline parks and boat ramps, etc. Authority to require these actions is problematic for unincorporated areas such as county parks, where implementation would be voluntary and coordinated through county commissions and anti-littering campaigns.

Related Actions: PPE-2, PPE-4, PPE-5, NPS-3, RSC-3, SD-7, and WSQ-5.

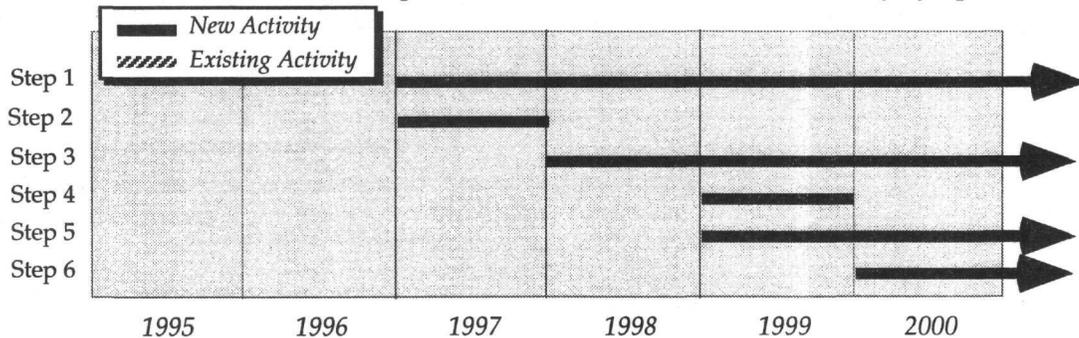
ACTION SD-6: Remove Trash from Storm Water Discharges

What Where technically feasible, require methods to remove floating trash and debris from significant storm water discharges into the bay or tributaries.

How

- Step 1 Local governments already subject to federal storm water permits will begin removing floatable debris (where applicable) from storm water discharges.
- Step 2 Local governments involved in trash screening will conduct pilot projects and sponsor technical reviews to evaluate the flooding potential of EPA-mandated trash removal methods. These investigations will address concerns regarding adverse impacts of captured floatable debris on the efficiency of storm water drainage during intense storm events common in the bay area.
- Step 3 Galveston Bay Program will incorporate appropriate methods determined from trash removal evaluations into the Galveston Bay BMP Performance Document in order to provide local governments with information regarding screening techniques.
- Step 4 EPA or TNRCC will extend trash removal requirements to smaller cities under the federal storm water permit program. Public comment periods are established for NPDES permits.
- Step 5 Galveston Bay Program will insure that adequate assistance is provided to local governments on effective implementation of trash removal as part of the overall technical assistance recommended for local governments.
- Step 6 Galveston Bay Program will conduct and periodically update a Galveston Bay debris survey to help the gauge the effectiveness of this action, and report results in the biennial State of the Bay Symposia.

When



Where Principle storm water outfalls throughout the immediate Galveston Bay watershed.

Who Local governments would implement this action under the authority of EPA, and TNRCC,. Role of Galveston Bay Program: Coordinate.

Public Costs of New Actions (5 years)

• Program	\$ 15,000
TOTAL.....	\$ 15,000

A substantial fraction of local governments costs associated with this action can be attributed to federal National Pollutant Discharge Elimination System (NPDES) regulations. Potential Sources of Funding: NOAA, HUD, and EPA.

Regulatory Issues This action would be implemented under NPDES storm water permits and provisions of the EPA/NOAA agreement for non-point source pollution control in coastal areas.

Related Actions: NPS-2, NPS-3, NPS-4, NPS-6, NPS-7, PPE-2, RSC-3, SD-5, and SD-7.

ACTION SD-7:

Publicize Environmental Harm Caused by Illegal Dumping

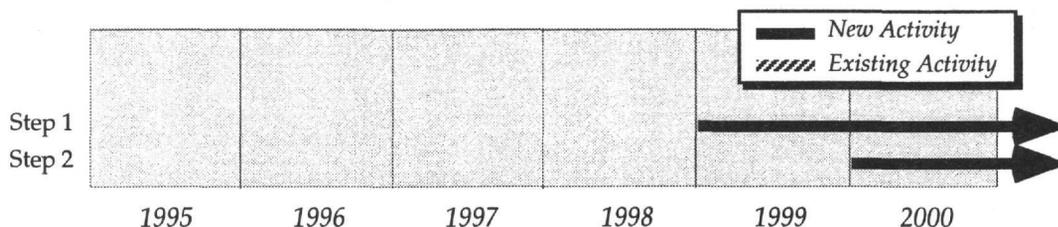
What Establish improved public education addressing harm to the estuarine environment caused by dumping trash and hazardous materials. Highlight associated fines for dumping, and improve the awareness in the enforcement community concerning the implications of dumping.

How

Step 1 Galveston Bay Program will focus public attention on the harm to the bay environment resulting from illegal dumping as part of an overall effort to reduce littering and dumping in the vicinity of Galveston Bay. Galveston Bay Program will conduct annual bay shore cleanup campaigns staffed by volunteers.

Step 2 Galveston Bay Program will conduct and periodically update a Galveston Bay debris survey. Through the results of this survey, the Authority also will be able to publicize evidence of the magnitude of the trash problem as well as the effectiveness of trash reduction efforts.

When



Where Waters of the State in the Galveston Bay Program area.

Who Lead entity: Galveston Bay Program; Other participants: GLO, TNRCC, local media, "Keep Texas Beautiful," HGAC, and similar campaigns. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 30,000
TOTAL.....	\$ 30,000

Costs for conducting a debris survey are included in Action SD-5. Potential Sources of Funding: USDA, NOAA, EPA, TNRCC.

Regulatory Issues This action can be accomplished under existing programs, and requires no new regulations.

Related Actions: NPS-4, PPE-3, PPE-4, SD-5, and SD-6.

Shoreline Management

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
SM-1	Medium	Establish a planning program for shoreline development.....	135
SM-2	Medium	Identify appropriate residential shoreline development guidelines	136
SM-3	Medium	Identify appropriate commercial and industrial shoreline development guidelines	137
SM-4	Medium	Minimize negative effects of structures and dredging on publicly owned lands	138
SM-5	Medium	Improve access to publicly owned shorelines.....	139

THE ISSUES

The Galveston Bay system is a dynamic environment continuously shaped by natural processes (e.g., tides, currents, wind, waves, subsidence, periodic violent storms, etc.) that redistribute sediments and alter habitats. The system has a natural recuperative ability to sustain itself. Damaged vegetation redevelops and marshes submerged by erosion or subsidence are reestablished further inland.

Galveston Bay is also shaped by human processes as the bay is a resource greatly enjoyed by many people. People are naturally attracted to the bay area by the mild climate, the benefits of living in waterfront locations, and exploitable natural resources such as fish and wildlife; oil, gas, and other minerals; and agricultural land. Human activities can upset the natural balance of the shoreline ecosystem and often inhibit or prohibit natural recuperative abilities of the shoreline. Disturbances in the natural flows of freshwater, sediment, and nutrients and activities such as tilling, paving, dredging, draining, excavating, and filling can alter habitat quality and quantity.

Continued development of the shoreline contributes to shore erosion, loss of wetlands, increased point and non-point source pollution, and reduced public access to the shore. The environmental impact of activities such as bulkhead, dock, and revetment construction may be larger than the actual physical modifications would suggest. About 70 miles of the bay

shoreline has been either bulkheaded or converted to docks or revetments; by one estimate, this corresponds to 10 percent of the entire bay shoreline.

In Texas, primary management of development and related activities occurs on a local level and shoreline management practices often do not address negative environmental impacts on the bay's resources. Along the Galveston Bay shoreline, many regulatory and governmental entities engage in shoreline management activities related to economic and energy development, facility siting and shoreline access. The main hindrance to effective management of shoreline resources is that no comprehensive system is in place to guide local planning and decision-making processes that affect the bay. Major initiatives proposed by *The Galveston Bay Plan* for shoreline management include the following:

- **Shoreline Development Plans:** Three actions are recommended to establish plans and guidelines that address the environmental impacts of shoreline development activities. Studies of land use patterns in relation to shorelines processes of erosion and accretion are recommended. The establishment of guidelines for residential, commercial, and industrial construction activities in shoreline areas is encouraged to prevent flooding, erosion, habitat loss, and accidental releases of hazardous materials during severe weather.
- **Consideration of Environmental Impacts:** An action is proposed to minimize the negative environmental effects posed by manmade structures located on publicly-owned lands. These structures include bulkheads, docks, pipelines, barges, abandoned petroleum structures and other shoreline fabrications that potentially alter bay circulation, impair existing aquatic habitat, threaten water quality and navigation and degrade aesthetics. An inventory of derelict structures to determine removal priorities is advocated. The consideration of environmental impacts and the development of alternatives to mitigate unavoidable impacts are encouraged for shoreline structure and dredge/fill disposal activities.
- **Access to Galveston Bay:** An action to improve access to publicly-owned shorelines in a manner protective to the bay ecosystem is endorsed by *The Galveston Bay Plan*. An inventory of existing public recreational facilities and an assessment of public use needs will aid in the development of a Galveston Bay public facility plan. Environmental impacts resulting from shoreline recreational uses will be investigated. *The Plan* also encourages the creation of educational programs designed to enhance public awareness of litter, sensitive habitats, and pollution prevention.

ENVIRONMENTAL STATUS

As an aesthetic and economic resource to society, shoreline property along Galveston Bay is exposed to significant development pressure. Use of these resources in a thoughtless manner may compromise the natural functions and ultimately strain the resilience of the bay as a healthy dynamic ecosystem.

Status and Trends

The sprawling city of Houston and associated urban communities occupies the western side of the bay, and the eastern side remains largely agricultural and undeveloped. Urban development contributes polluted rainfall runoff from parking lots, streets, highways, roofs, and yards, while the eastern shore remains largely grassland, marshes and rice fields, with the potential to contribute herbicides and pesticides to receiving waters.

Information is scarce on detailed historical patterns of population growth along the Galveston Bay shoreline. No research has been completed to date that summarizes construction data such as number of permits, type of structures, and building locations. However, the effects of population growth on the natural resources of the bay have begun to appear. Currently, up to 50 percent by area (corresponding to 20 percent by reef) of oyster harvesting areas in the bay are closed at any time due to elevated fecal coliform levels resulting from non-point source pollution. Increasing development of the shoreline contributes to shore erosion, loss of wetlands, increased point and non-point source pollution, and reduced public access to beaches and the shore. More detailed discussion of these issues is provided in other action plans included in this document.

Probable Causes

Galveston Bay shares many problems with other estuaries of a similar stature chiefly in the rapidly escalating demands placed upon its resources because of an expanding population and associated development. It is estimated that by 1996, the Houston-Galveston area will have a population exceeding 3.6 million, an 11 percent increase from 1990. The year 2010 population is expected to reach 4.5 million residents. These projected increases in population and the associated increasing use of the bay resources pose a significant resource management challenge.

Human use and development activities can produce unintended results, such as habitat alteration and destruction, eutrophication, pollution, loss of biodiversity and extinction of species. Ecological knowledge can be applied in the management of these activities to reduce the incidence of negative, unintended results.

The 4,238-sq.-mile coastal basins are comprised of roughly equal portions of urban Houston, agricultural lands, open/pasture lands, and forests. Events occurring in this local watershed have much more immediate and direct effects on Galveston Bay than do events in the upper watershed. For example, contributions from non-point source pollution are dominated by the local watershed due to the high volume of contaminated runoff from the urban region.

The natural aspects of the bay discussed above are subject to major influences from human activity. Since the 1850s, man-made modifications to the physical structure of the bay include the dredging of navigation channels, subsidence due to groundwater withdrawal, and isolation of secondary bays and marshes by erection of dikes. Approximately 10 percent of the bay shoreline has been bulkheaded or converted to docks or revetments.

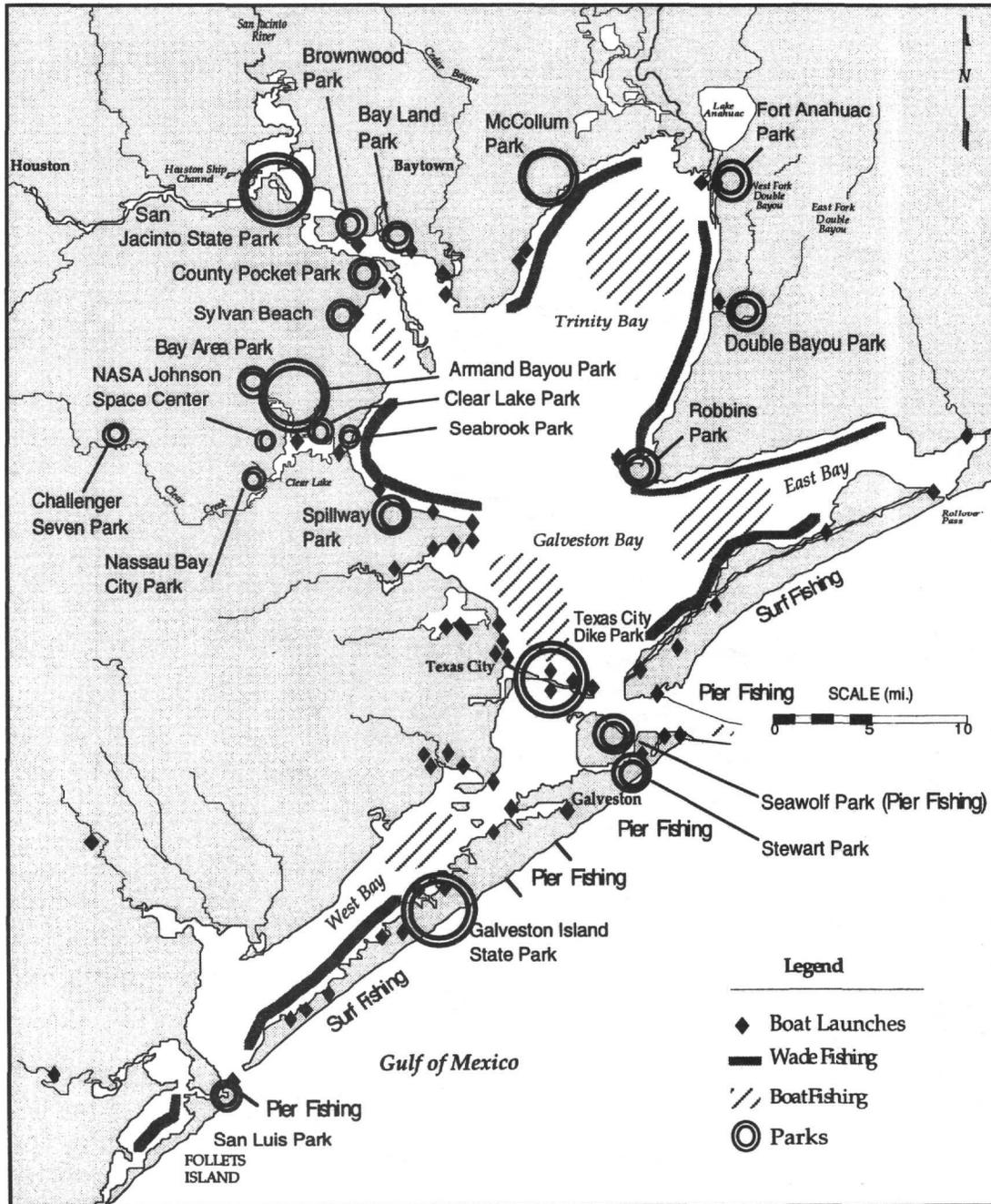


FIGURE SM-1. Access to Galveston Bay Shoreline

Steady growth has intensified competition for limited coastal resources. Uses that could easily coexist in the sparsely populated coastal area of a few decades ago are now in direct confrontation. Residential development is overtaking land formerly devoted to agriculture. Shoreline development raises issues of beach and marsh protection and preservation of open space as views are changed and avenues of easy access to the bay are closed. Coastal fisheries compete for freshwater with upstream users and suffer the effects of wetland loss and contamination of fishery habitat caused by human activities. Dredging, essential to many uses of the bay is a direct cause of habitat change and the disposal of dredged material is controversial in many areas.

As bayshore population and development increase, so do waste generation and the pollution of air, land, and water; so does the exposure of lives and property to hurricanes, flooding, and other hazards; so does the risk of irrevocable damage to the natural environment. Alteration of natural systems can bring damage to human systems; it can jeopardize our economy as well as our health and safety.

REGULATORY BASIS FOR MANAGEMENT STATUS

Development of shoreline areas is under the jurisdiction of local governments most of which have only basic land use planning authority. Municipal governments through ordinances or zoning power are authorized to affect development decisions, except for the Dune rules (see below). Counties in Texas do not have general ordinance making power (except for certain counties with powers granted under the Dune Protection Act). Land use regulation in Texas cities and counties has not made significant progress over the last several decades in comparison with other U.S. cities.

The state has passed legislation for managing shoreline development. Under the Open Beaches Act and the Dune Protection Act, local governments are required to adopt beach access and dune protection plans in accordance with regulations developed by the Texas General Land Office (GLO). The plans will control development within 1000 feet of mean high tide on the Gulf of Mexico shoreline. The GLO regulations require compliance with the standards established by the National Flood Insurance Program for construction in floodplains.

The GLO is the lead state agency for coordinating and planning erosion response measures in the coastal area. The state policy is to favor nonstructural erosion response techniques over structural methods.

The Coastal Coordination Act created the Coastal Coordination Council (CCC) to adopt and enforce a Coastal Management Program (CMP) for Texas based on the authority of existing laws and regulations. The CCC has no independent staff or budget and is composed of representatives of other state agencies and officials: the Commissioner of the General Land Office, the Attorney General, the chair of the Texas Parks and Wildlife Commission, the chairman of the Texas Natural Resource Conservation Commission, a member of the Railroad Commission of Texas, and one city or county elected official and one resident from the Coastal

area appointed by the governor for two-year terms. The goals of the Texas Coastal Management Program include the following: "(a) to protect, preserve, restore, and enhance the diversity, quality, quantity, functions and values of coastal natural resource areas; and (b) to ensure sound management of all coastal resources by allowing for compatible economic development and multiple human uses of the coastal area. Through uniform goals and policies, the CMP will be able to establish a unified state position on coastal resources management. The consistency review process will give the state the authority to require state and federal actions and projects in the Texas coastal area to comply with the CMP. Individual estuary management plans such as *The Galveston Bay Plan* maybe incorporated within the CMP in accordance with the proposed Special Area Management Planning Rule 31 TAC §§ SO4.1-8.

SHORELINE MANAGEMENT ACTION PLAN

To enhance long range conservation of living and non-living bay resources and improve aesthetic appeal and public access to Galveston Bay by managing human use of the shoreline and adjacent lands from a system-wide perspective.

OVERVIEW

Priority Problem:

Failure to reconcile use of bay resources with negative environmental consequences. Shoreline management practices frequently fail to balance the need for public access to bay resources with environmentally compatible development. Specific negative environmental consequences resulting from use of the bay shoreline include the following: 1) human-induced erosion; 2) water usage, point source, and non-point source impacts; 3) increased water-borne debris; 4) increased heavy metals, fecal coliforms, nutrients, and decreased dissolved oxygen concentrations.

For the purposes of this plan, the shoreline management boundary will be the same as the "coastal shore areas" established by the CMP within Brazoria, Chambers, Galveston, Harris, and Liberty, counties. In particular, activities within that area that are within 100 feet of the mean high tide are of concern.

Goal:

Reduce negative environmental consequences to the bay. Develop management plans and practices that minimize degradation of bay resources.

Objective:

Adopt a coordinated ecosystem approach to plan and permit shoreline development by 1996.

- Action SM-1: Establish a planning program for shoreline development.
- Action SM-2: Identify appropriate residential shoreline development guidelines.
- Action SM-3: Identify appropriate commercial and industrial shoreline development guidelines.
- Action SM-4: Minimize negative effects of structures and dredging on publicly owned lands.

Goal:

Increase environmentally compatible public access to bay resources.

Objective:

Increase recreational opportunities and access to the bay by providing facilities such as parks, boat ramps, piers, trails, etc., that do not damage the bay.

- Action SM-5: Improve access to publicly owned shorelines.

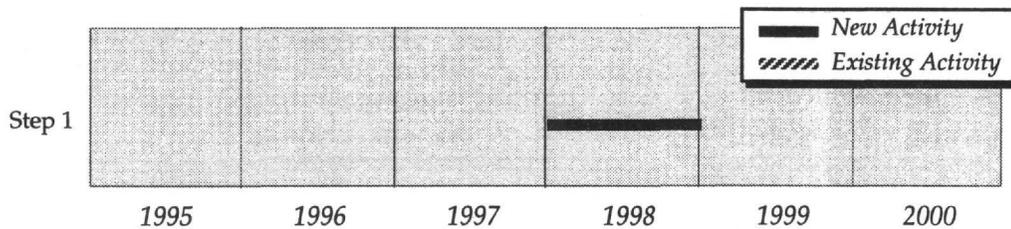
ACTION SM-2: Identify Appropriate Residential Shoreline Development Guidelines

What Incorporate cumulative impact elements and site-specific concerns during the permitting process for residential projects. Look at individual projects in the context of development of the bay as a whole and over time when considering environmental impacts.

How

Step 1 Galveston Bay Program, HGAC, and local governments will identify appropriate standards and establish regional residential development guidelines (on an advisory basis only) for shoreline areas that will be implemented by local municipalities. Development of guidelines will include public hearings during an adequate comment period for public review of proposed measures. CCC will consider funding to local entities to prepare plans based on bay-wide shoreline development planning.

When



Where Shoreline management area.

Who Lead entity: Galveston Bay Program and HGAC; Other Participants: Local governments and CCC. Role of Galveston Bay Program: Coordinating.

**Public Costs of
New Actions (5 years)**

• GLO.....	\$ 15,000	• Counties.....	\$ 187,500
• Munis	\$ 132,000	• Program	\$ 37,500
TOTAL.....		\$ 372,000	

Cost effective measures should be implemented to reap maximum benefit for minimum incremental costs to developers, land owners, and municipalities. Potential Sources of Funding: NOAA, DoD, Corps, EPA.

Regulatory Issues County ordinance-making power would enable more local participation in shoreline planning.

Related Actions: NPS-6, NPS-7, NPS-12, PPE-7, and SM-1.

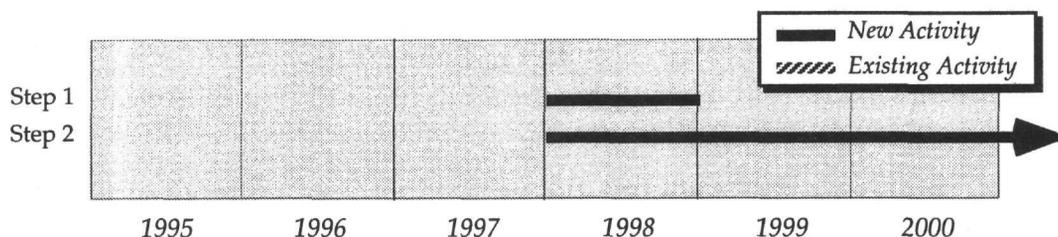
ACTION SM-3: Identify Appropriate Commercial and Industrial Shoreline Development Guidelines

What Incorporate cumulative impact elements and site-specific concerns for various shoreline types during the permitting process for individual projects. Implement controls over solid waste and sludge management facilities that may face inundation due to storm surge or general flooding.

How

- Step 1 Galveston Bay Program, HGAC, and local governments working with industry representatives and members of the public will identify appropriate commercial and industrial development and contingency planning guidelines for shoreline areas (on an advisory basis only). Development of guidelines will include ongoing hearings during an adequate comment period for public review. Close coordination will be required with the TNRCC to prevent accidental releases of hazardous materials during severe weather, and to modify the facility siting process for new industrial and commercial facilities to account for both flooding and hurricane threats in low-lying areas. Support contingency plans for existing facilities having hazardous or other wastes located in areas susceptible to hurricane washouts, storm surges, or erosion damage, as currently required under RCRA solid and hazardous waste regulations and SPCC requirements. Compile a list of appropriate actions (e.g., dike specifications, alternative waste storage locations) to prevent existing facilities and abandoned pits from adversely affecting the bay during severe weather conditions.
- Step 2 TNRCC and DPS will lead an interagency effort to inventory all existing solid/hazardous and sludge management facilities in the Galveston Bay Special Management Area and assess their hurricane damage potential.

When



Where Shoreline management area.

Who Lead entity: Galveston Bay Program, HGAC, TNRCC, and DPS; Other Participants: Local governments, GLO, industry, and the public. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• GLO.....	\$ 60,750
• Munis	\$ 132,000
TOTAL	\$ 192,750

Costs for Program are included in Action SM-2. Potential Sources of Funding: NOAA, DoD, Corps, and EPA.

Regulatory Issues County ordinance-making power would enable more local participation in shoreline planning. Standards are already a part of the RCRA facility siting process.

Related Actions: NPS-1, NPS-4, NPS-6, PPE-7, and SM-1.

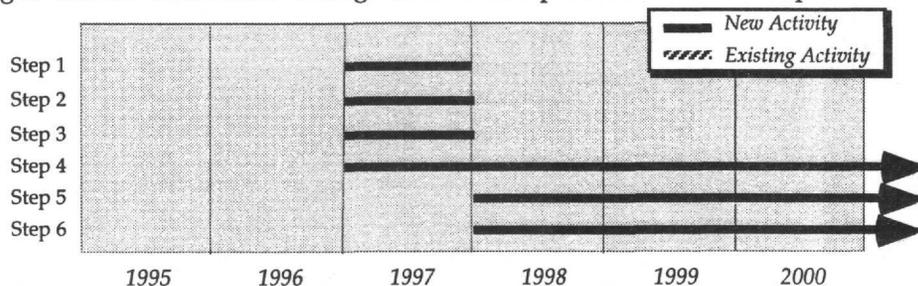
ACTION SM-4: Minimize Negative Effects of Structures and Dredging on Publicly Owned Lands

What Minimize negative effects of structures on submerged and emergent publicly owned lands. Any project on public lands is defined as a "structure;" including dredging (defined by GLO), docks, pipelines, and piers. This program will not include structures built for environmental benefits, such as artificial reefs, however.

How

- Step 1 GLO will inventory and assign removal priority to all derelict structures and pipelines on state-owned lands based on aesthetics, submerged habitat value, threat to shorelines, habitats, water quality, or safety. Structures determined to have positive environ. value (e.g., artificial reefs) are not subject to this action.
- Step 2 GLO will consider adopting rules to require, at the time of permit application, where practical, the deposit of funds into escrow or the posting of bond to cover future removal of the permitted structure if it is ever abandoned. GLO also will adopt rules to increase fines for abandonment of structures.
- Step 3 GLO and Corps will review rules for shoreline structure permitting and dredge/fill disposal activities to require consideration of specific & cumulative impacts and to require mitigation for unavoidable impacts.
- Step 4 USCG, TPWD, TDH and GLO will work to establish authority to expand enforcement against raw sewage discharges from cabins & houseboats.
- Step 5 GLO will begin removal of ownerless derelict structures based on priority ranking, and GLO will order the removal of structures where the owner is known.
- Step 6 GLO will begin the phase out of cabins on state-owned lands through a ban on lease transfers and renewals and by adopting rules to prohibit any new cabins or the rebuilding of damaged cabins according to criteria in the rules. Sewage containment procedures will be implemented for cabins.

When



Where Publicly owned shorelines and waters of the State in the Galveston Bay Program Area.

Who Lead entity: GLO; Other Participants: TNRCC, TDH, EPA, County health departments, Corps, private leaseholders, local governments, TPWD, USFWS, and USCG. Role of Galveston Bay Program: Coordinating.

**Public Costs of
New Actions (5 years)**

• GLO	\$ 153,500
• Program	\$ 37,500
TOTAL.....	\$ 191,000

Efforts should be made to ensure that expenses are incurred by those responsible for derelict structures. Potential Sources of Funding: NOAA and EPA.

Regulatory Issues GLO will consider adopting rules related to the following: 1) Escrow funds at time of construction permit application; 2) increase fines for abandonment; 3) provide for specific and cumulative impact assessment and mitigation against unavoidable impacts when permitting; 4) prohibit future cabin lease transfers; application renewals, new cabins on state lands; or rebuilding after damage to greater than half the cabin value; 4) obtain state authority to regulate placement of houseboats. RRC will revise rules to address oil and gas structures on submerged lands.

Related Actions: FW-7, NPS-1, NPS-8, and SM-1.

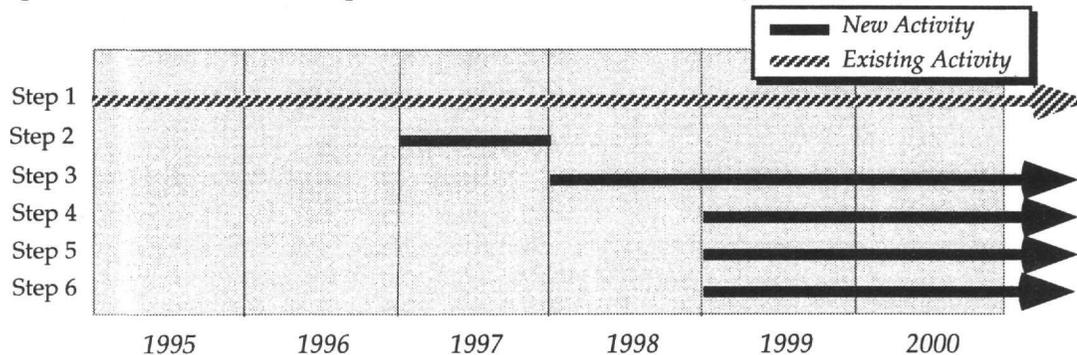
ACTION SM-5: Improve Access to Publicly Owned Shorelines

What Improve recreational opportunities and access to public shorelines in a manner consistent with protection of the ecosystem. Provide a sense of public ownership of the bay by providing facilities such as parks, boat ramps, piers, trails, roads, and walkways.

How

- Step 1 Federal, state and local agencies/entities will continue to increase resources available for acquisition of land and public recreational facilities on bay shoreline by coordinated funding and construction of public use facilities to improve bay access. Emphasize maintenance/improvement of existing facilities.
- Step 2 Galveston Bay Program will inventory and map existing public recreational facilities and access points and assess needs as the first step in development of a Galveston Bay public facility plan (see Action PPE-3). Investigate environmental impacts resulting from recreational uses of the shoreline, especially near submerged aquatic vegetation.
- Step 3 Galveston Bay Program will develop passive recreational opportunities around the bay and support for development of GBF Galveston Bay loop of Texas Coastal Trail.
- Step 4 Public entities such as TPWD and private entities will begin land acquisition based on public facility plan.
- Step 5 GLO and local governments will encourage voluntary land dedication in major new shoreline developments to provide for public access points based on public facility plan.
- Step 6 Maintenance costs and ecosystem damage may be reduced by informing the public about benefits (i.e., minimizing litter, reduced impact on sensitive habitats, and additional income from tourism) of using shoreline facilities wisely. Galveston Bay Program will lead public education effort to encourage pollution prevention and wise use of public facilities near Galveston Bay.

When



Where Publicly owned shorelines and waters of the State in the Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program; Other Participants: TPWD, USFWS, HGAC, GLO, local governments, GBF, National Park Service, and landowners. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• GLO	\$ 15,750
• Program.....	\$ 40,000
TOTAL.....	\$ 55,750

Costs for Step 3 are included in Action PPE-3. Costs will be determined by the area and value of land purchased for additional park areas. Potential Sources of Funding: USDA, NOAA, DOD, Corps, DOI, NPS, TPWD. Consistency review of the real property acquisitions or dispositions by federal agencies can be a source of potential land for parks and public areas to enhance public access.

Regulatory Issues None.

Related Actions: PPE-3 and SM-1.

