

# Monitoring and Information Synthesis

# Development of the Galveston Bay Regional Monitoring and Data/Information Management Program

*Thomas M. Grieb and Mark F. Shibata  
Tetra Tech, Inc.*

A Regional Monitoring Workshop was held in July 1992 (GBNEP, 1992) to examine the need and feasibility of a regional monitoring program. The participants included policy-makers, resource managers, scientists, and representatives of public and commercial interest groups. There was both unanimous agreement among the participants on the need for a regional monitoring program and popular support for the development of ecological information to guide resource management decisions. It was also agreed that the establishment and management of a technically sound regional monitoring program is feasible. Based on this initial agreement, an ecosystem-level, regional monitoring program is being developed under the direction of the Monitoring and Data and Information Task Forces of the Galveston Bay National Estuary Program (GBNEP). This monitoring program, which is a required component of the Comprehensive Conservation and Management Plan (CCMP), has two primary goals: to measure the effectiveness of management actions and programs implemented under the CCMP, and to provide essential information that can be used to redirect and refocus the management plan.

Recently, there has been an increased interest in the development of sound, well-directed marine and estuarine monitoring programs, and a considerable amount of new information exists to guide the development of GBNEP's Monitoring Program. The recent report by the National Research Council, *Managing Troubled Waters. The Role of Marine Environmental Monitoring* (1990), evaluated previous marine monitoring programs and practices, identified needed improvements in monitoring strategies, and made a series of recommendations to improve the usefulness of monitoring information. The U.S. Environmental Protection Agency's Ocean and Coastal Protection Division has prepared the *Monitoring Guidance for the National Estuary Program* (U.S. EPA, 1992). This document provides guidance on the design, implementation, and evaluation of the required monitoring programs of the National Estuary Program. The U.S. Environmental Protection Agency's Office of Research and Development is also developing and testing new marine and estuarine sampling methods and indicators in support of the Environmental Monitoring and Assessment Program (EMAP).

The steps involved in the development of a regional monitoring program are shown in Figure 1. The initial steps, the definition of management goals and the translation of these goals into monitoring objectives, are being addressed in the characterization process, and the individual Task Forces of the Galveston Bay National Estuary Program are playing a key role in specifying ecological objectives

and performance criteria that the monitoring program must meet. Emphasis is also being placed on the evaluation of monitoring program performance. An evaluation of expected monitoring program performance is required during the design phase of the program to ensure that program objectives can be met and that sampling will be adequate, but not excessive and wasteful of resources. Historical data from previous monitoring efforts in the Galveston Bay Estuary are being used to evaluate expected monitoring performance. For example, existing data are being used to estimate the level of trend in trace element concentrations that can be detected at individual sediment sampling stations for different levels of sample replication, sampling frequencies, and duration of the monitoring program (Figures 2 and 3).

The development of a data and information management system (DIMS) is a key undertaking closely associated with the development of GBNEP's regional monitoring program. Management decisions often require the immediate access to and analyses of monitoring data. In addition, timely and understandable reporting of environmental information is a critical need often identified by managers and decision-makers. To fill the need to quickly and easily assimilate, integrate, analyze, and disseminate information gathered by GBNEP's monitoring program requires the development of a well-conceived, integrative DIMS.

A DIMS for the Galveston Bay Regional Monitoring Program is currently being developed under direction of the Data and Information and Monitoring Task Forces of the GBNEP. The tasks that are being conducted to design a DIMS for Galveston Bay' regional monitoring data include:

- conducting a regional data/information needs assessment;
- defining key DIMS objectives and attributes;
- evaluating existing systems;
- developing alternative DIMS designs; and
- select best DIMS design;

Based on the results of a regional data/information needs assessment, the Data and Information Task Force will be discussing the specifics of a number of DIMS attributes, including:

- Easy to access, easy to use;
- Standard data formats and codes;
- Comprehensive, standardized, performance-based data quality assurance protocols;
- Standard data loading and retrieval protocols;
- Linkage to graphical, statistical, and report generating tools;
- Connectivity to existing DIMS;
- Long-term availability and flexibility;
- Comprehensive, standardized, performance-based system quality assurance protocols;

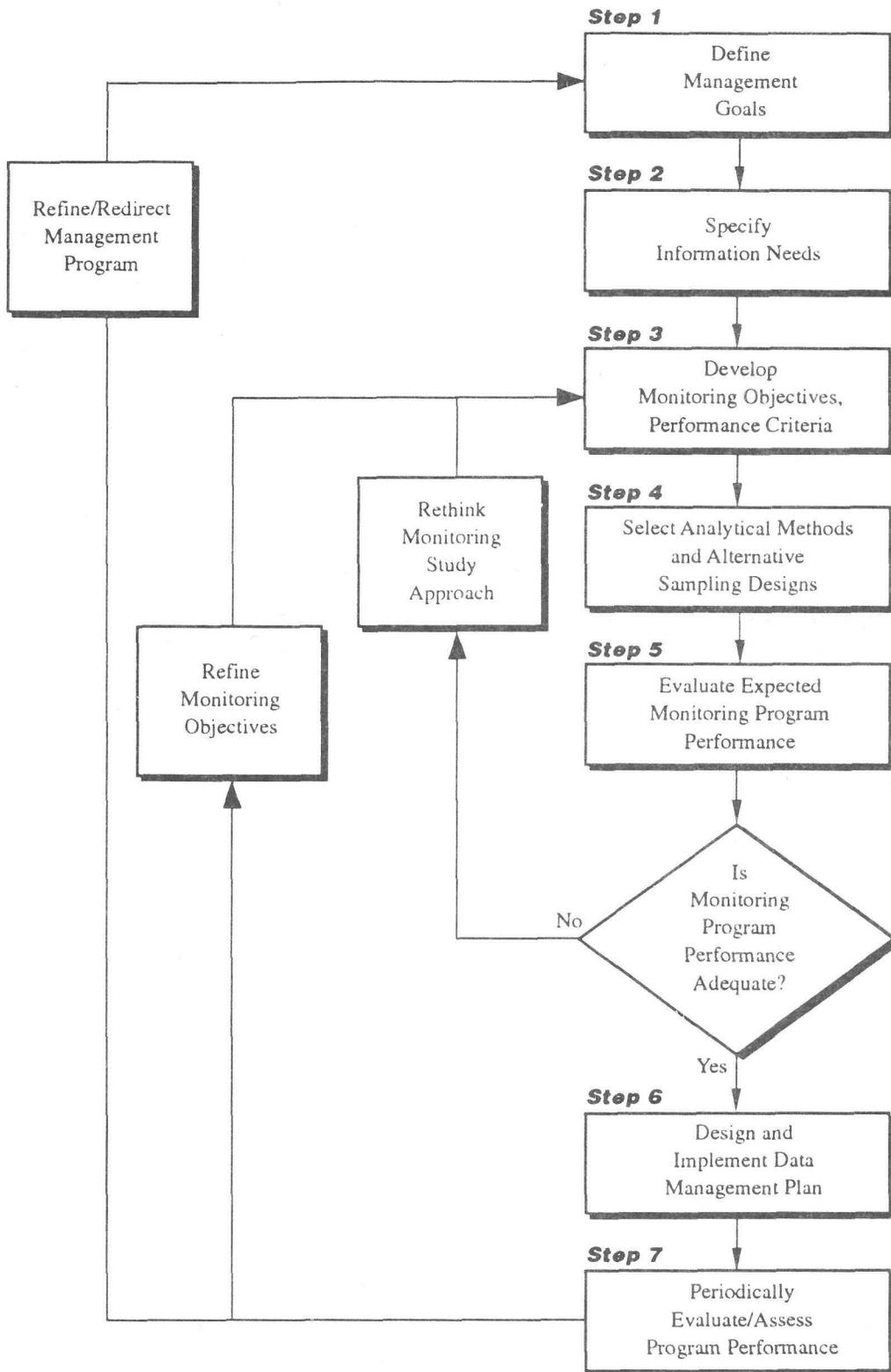


Figure 1. Steps in the design of a monitoring program (modified from US EPA, 1992).

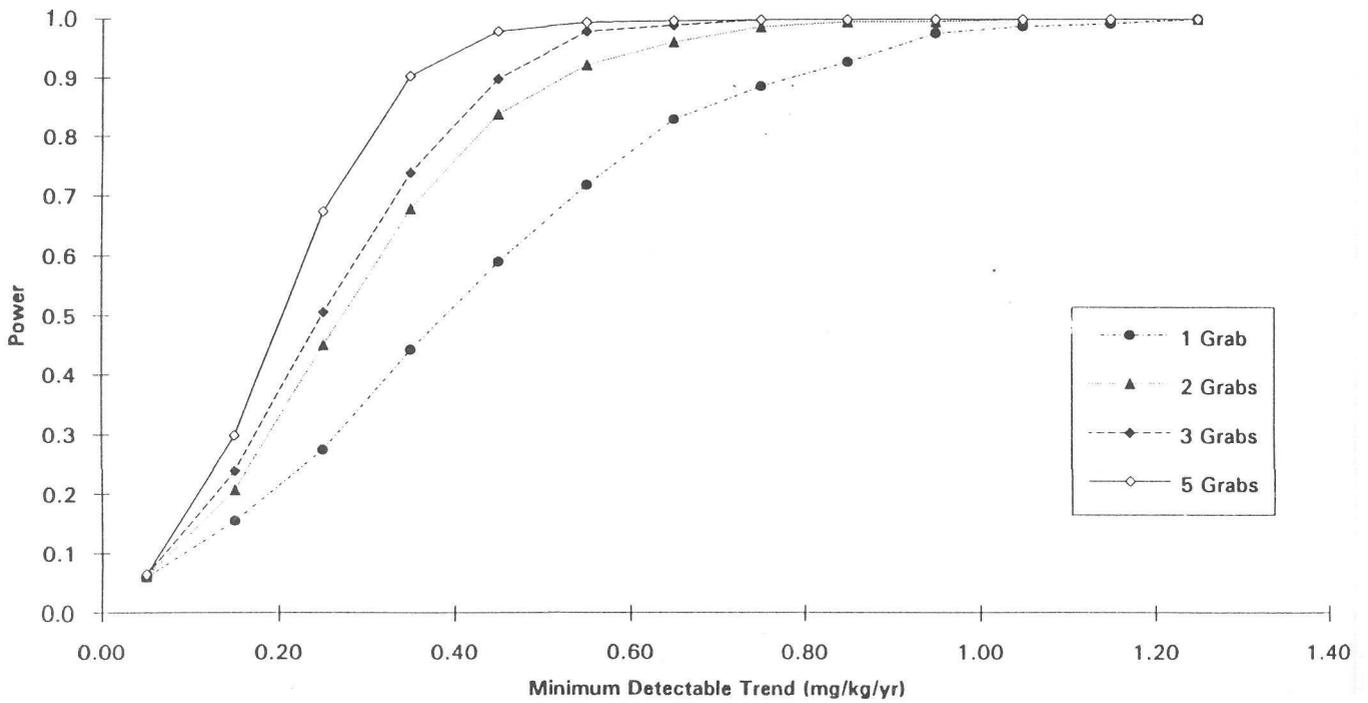


Figure 2. Minimum detectable trend in sediment calcium concentration for alternative levels of sampling effort.

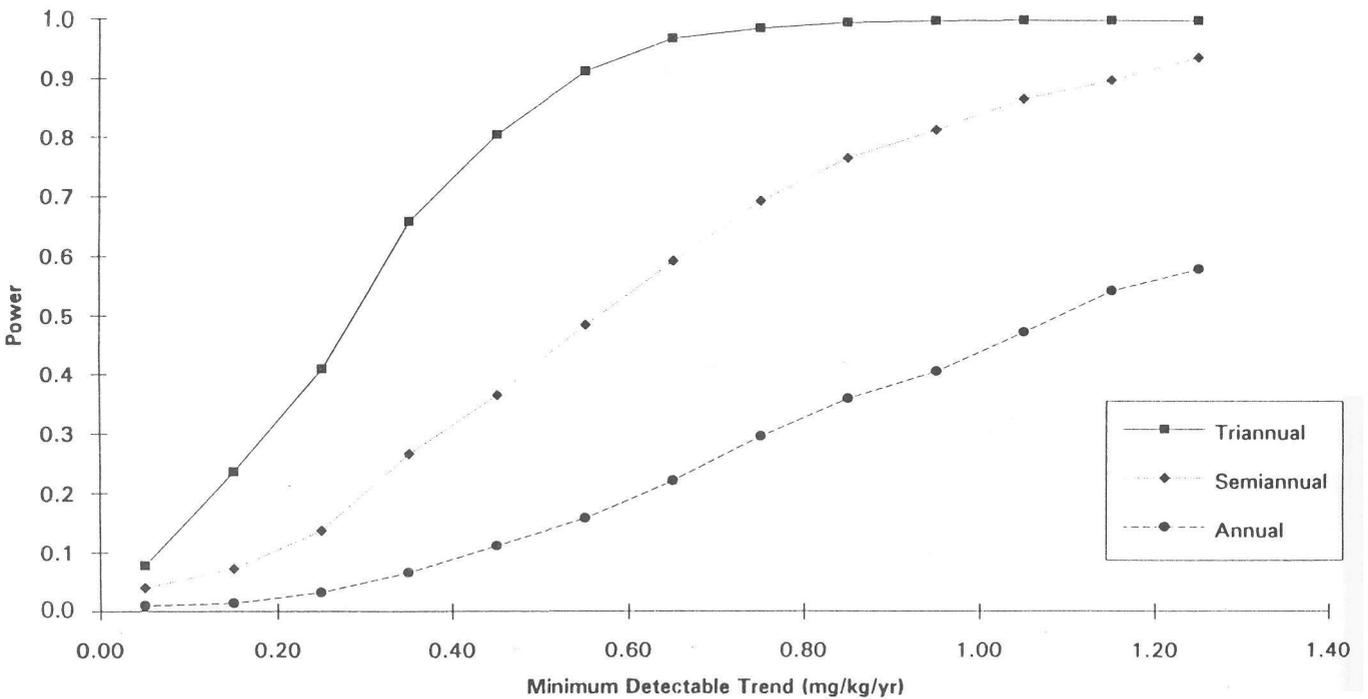


Figure 3. Minimum detectable trend for alternative sampling frequencies over a five-year period.

- System documentation and technical support; and
- Reasonable development and maintenance costs.

An effective DIMS facilitates the access to and analysis of monitoring data, and the dissemination of environmental information useful in making management decisions. The DIMS must promote the use of data — data which are used, are rarely archived, and, therefore, rarely lost. The DIMS should possess attributes ensuring stable database integrity to establish user confidence in its ability to provide long-term data storage and access. Easy access, user-friendly features, and technical support will promote the use of the system and enhance sharing of data among agencies and other interested parties. Coordination with local, state, and federal agency systems is essential.

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# Development of Integrated GIS Databases for Galveston Bay

*Marcia E. McNiff*

*U.S. Fish and Wildlife Service, National Wetlands Research Center  
and*

*Pasquale F. Roscigno*

*U.S. Minerals Management Service, Gulf of Mexico OCS Region  
and*

*Mary C. Watzin*

*U.S. Fish and Wildlife Service, Vermont Cooperative Fish and Wildlife Research  
Unit*

*and*

*Wei Ji*

*TGS Technology Inc., National Wetlands Research Center Operations*

Geographic Information Systems (GIS) offer policymakers and regulatory agencies a tool for storing and retrieving complex databases. Patterns of spatial distribution can be plotted for different variables offering resource managers the capability to develop comprehensive plans within an overall framework. GIS can be used to identify sensitive areas and to study trends over periods of time. The cartographic modeling capabilities of GIS also offer promise for more complex analyses.

Data sources from various Texas State Agencies were examined for the Galveston Bay area. Each potential data set was evaluated for appropriate scale, accurate locational coordinates, regional extent, and proper quality assurance/quality control. The goal was to integrate information into a computerized database and produce maps with which to study the impacts of human activity on the natural resources.

Databases in point, line, and polygonal format were compiled using ARC/INFO GIS software (Environmental Systems Research Institute, Redlands, CA). Point data, such as waste water discharges and oil wells, are associated with a particular geographic location. Line data are used to represent linear features such as pipelines. Polygonal data are used to represent enclosed areas, for example, living resource distributions such as oyster reefs.

The Texas Bureau of Economic Geology (TBEG) provided data on surficial sediment samples taken from approximately 530 stations in the Galveston Bay system. The point data files were produced from the latitude and longitude coordinates and incorporated specific chemical data on chromium, copper, lead, nickel, strontium, and zinc associated with each station.

The National Pollution Discharge Elimination System (NPDES) permits provided information on waste disposal into the Galveston Bay watershed (Texas Department

of Water Resources). These databases were converted to ASCII format and entered to the GIS as point data by latitude and longitude coordinates. Each NPDES point contained related database information.

The Texas General Land Office (TGLO) provided a digitizable map (1:57,000 scale) which included: bird rookeries, oyster reefs, marshes, navigational channels, and oil and gas infrastructure. The map was digitized by using the Wetland Analytical Mapping System (WAMS) and converted to ARC/INFO format for analysis. The ARC PLOT module of ARC/INFO was used to generate map products. Our project is the first attempt to combine the information from these sources into one GIS-integrated database.

Once multiple data layers are combined in a GIS, models might be constructed to index and predict low-, medium-, and high-risk areas under variety of criteria. Complex decision-making procedures can be made more accessible with expert systems or spatial decision support systems (SDSS). Coupling GIS with these capabilities is an approach that would bring the analytical power of these tools to environmental resource management and planning. Presented here are a series of maps which represent a preliminary step towards the development of a cartographic model.

# Citizen's Pollution Reporting and Response System — One Year Later

*Karen A. Prince*  
*Galveston Bay National Estuary Program*

Pollution reporting and response by cleanup and enforcement agencies have long been perceived by the public as a problem. Numerous federal, state, and local agencies have jurisdiction over various types of pollution incidents, and these responsibilities are not always obvious to the public. For example, the Texas General Land Office has jurisdiction over oil spills in the waters of the state and the Texas Water Commission has jurisdiction over spills on land. More than 20 agencies have jurisdiction over environmental affairs in the immediate Galveston Bay watershed alone. With this overwhelming number of reporting options to choose from, the average citizen cannot be expected to know whom to call when air, land, or water pollution is observed. Even in the rare instances when a citizen does know which response agency to contact, it is unlikely that the citizen would know the division or individual responsible for his or her specific complaint. This makes following-up on a complaint extremely difficult and frustrating for the citizen. In the absence of an effective pollution reporting system, citizens may feel compelled to report pollution using a hit-or-miss strategy. The problem with this method is that agency personnel and field investigators operate within the boundaries of strict jurisdictional mandates, and when a problem cannot be solved within those mandates they are typically unable to help by referring the citizen to the proper agency. The confusion is further compounded because government entities frequently seem to be in a continual state of flux; consequently, agency personnel are sometimes unsure of their own agency's responsibilities.

In the absence of an effective pollution reporting system, there is no centralized mechanism for recording and compiling the various types of pollution events that affect Galveston Bay and its watershed. Currently, each of the many agencies with jurisdiction over environmental affairs in the Galveston Bay area has its own system of managing data regarding specific pollution events. This fragmented approach creates a management problem because data is neither comparable among response agencies nor readily available to resource managers for a given geographic region like the Bay ecosystem. With each agency collecting its own data, the overall scope of pollution problems being reported and their cumulative are unknown.

The Citizens' Pollution Reporting and Response System, which was established in the Fall of 1991 under the auspices of the Galveston Bay National Estuary Program (GBNEP), was designed to address the problems mentioned above. The program was implemented in the GBNEP program office to take advantage of Management Conference guidance and support. The Management Conference is composed of more than one hundred individuals representing local, state, and federal

government, as well as private interest groups and the public. The conference has served as a source of information for designing the pollution reporting system as well as facilitated cooperation from response agencies. The GBNEP staff have obtained formal Memoranda of Understanding (MOU) from several agencies, ensuring a coordinated effort essential to the success of the program. Participating agencies include the Railroad Commission of Texas, the Texas Department of Health, the Texas Parks and Wildlife Department, the Texas Air Control Board, the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, the U.S. Army Corp of Engineers, and the Texas City Terminal Railway Company (MOU are between cooperating agencies and the TWC). The Staff has also had extensive meetings and communications with many of the agencies to discuss further coordination of efforts.

The program, which is funded by a grant from the U.S. Environmental Protection Agency through the Texas Water Commission, is targeted at citizens living and working in the five counties around Galveston Bay: Brazoria, Chambers, Galveston, Harris, and Liberty Counties (see Figure 1). The Pollution Reporting System provides citizens with one toll-free phone number to report all types of pollution, such as land and water debris, oil and hazardous substance spills, fish and bird kills, bilge pumping, air emissions, storm drain dumping, improper waste disposal, groundwater contamination, and any other activities that may produce pollution. Callers are asked to describe the details of the pollution event to a response coordinator who then contacts the local, state, and federal agencies having responsibility to regulate or control the type of pollution reported. The GBNEP response coordinator then continues to monitor the response to the pollution report throughout the authority's response process. This comprehensive approach was designed to ensure that appropriate agencies are notified in a timely manner and have the opportunity to investigate and take appropriate action. The program guarantees that citizens are informed about the status of their report throughout all phases of the investigation.

An incident report form was developed to facilitate consistent record keeping. Each report is recorded on this form and assigned an incident report number. All data generated from reports is maintained in a database at the program office. In the first eight months of operation, the Pollution Reporting System has handled nearly 400 calls despite a minimum of publicity. Twenty percent of the calls have been water pollution events, including reports of oil slicks, algae blooms, and dumping of debris into the water. Twenty-six percent of the calls have been related to air pollution, comprised mostly of reports of foul odors and smoking flares. Twenty-seven percent of the calls have been land related, and include reports of dumping raw sewage, used motor oil, and large debris. Twenty-six percent of the calls have been requests for information and comments about pollution in general. Data is also being collected on referrals to response agencies, and the follow-up calls required for each report. The database will continue to evolve as information needs are identified.

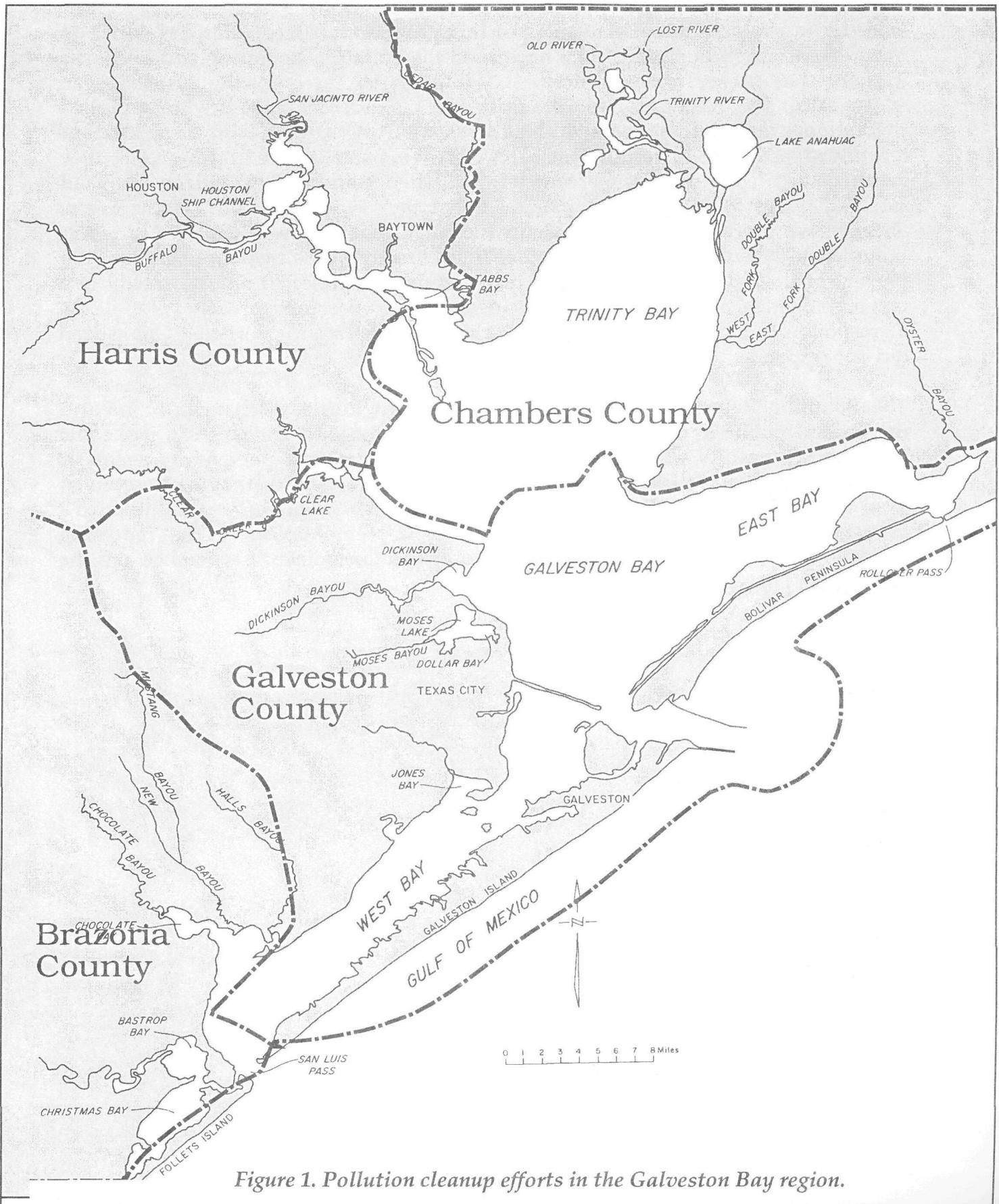


Figure 1. Pollution cleanup efforts in the Galveston Bay region.

In order to evaluate the effectiveness of this program, a survey was developed to obtain feedback from citizens who have used the Pollution Reporting and Response System. The survey was conducted six months after the reporting system began taking calls. The questionnaires were mailed to 134 different citizens who had called the number and left a name and address. Fifty-one (38%) of these citizens responded. Of these 51 respondents, 76% felt "very satisfied" with the service they had received. Twenty-one percent felt "satisfied", and 1 (2%) citizen felt "not satisfied". All 51 respondents indicated that they would use the service again. Seventy-five percent of the respondents indicated that they would prefer to report pollution to a centralized number rather than directly to the response agency. Ten percent of the respondents indicated that they would prefer to report directly to a response agency, and 16% of the respondents had no preference. Fifty (98%) of the 51 respondents indicated that they would like the program to continue. One citizen did not respond.

The Pollution Reporting and Response System provides a mechanism to involve the general public in ongoing monitoring of Galveston Bay. Citizens can make one call and see results without being transferred to multiple persons or agencies. Overall, citizens have been extremely pleased with the service they have received from the Pollution Response System. The Fiscal Year 1993 work effort will produce a report of recommendations for institutional implementation of the reporting system. This report will be submitted to both the Management Conference and the Texas State Legislature.