

Monitoring, Assessment, Data Management & Environmental Response Panel Report

EXECUTIVE SUMMARY

After two full panel meetings, numerous sub-panel meetings, and voluminous electronic discussion the *Monitoring, Assessment, Data Management, and Environmental Response Panel* has determined that the state has made significant progress in developing monitoring and assessment programs to meet specific legal mandates, resource management requirements, or scientific pursuits. Some of these programs have been systematically gathering high-quality data and disseminating important information for some time; examples include nutrient monitoring by the Narragansett Bay Commission, beach monitoring by the RI Department of Health, water quality monitoring by the URI Watershed Watch program, and fisheries monitoring by RI Department of Environmental Management (DEM) and the URI School of Oceanography. The RI DEM is currently completing the design for a comprehensive surface water monitoring program for Rhode Island. Although there are many monitoring initiatives in the Bay and watersheds, they are disconnected, underfunded, and do not complement each other. In sum, they provide an incomplete assessment of the environmental condition of the Bay and watersheds. Furthermore, the data that are collected are frequently not analyzed, and the resulting information not made available to decision-makers, resource managers, and citizens. There is currently no mechanism in Rhode Island to develop a coordinated, efficient, and effective monitoring network that unifies the work of state and federal agencies, and ensures that the information collected is readily available to decision-makers.

Charge 1: *Establish one or more Strategic Assessment Teams to identify and assess, in a proactive way, conditions that can lead to such Bay and watershed problems as large scale fish kills and beach closures.*

Recommendations:

- Through Executive Order establish a Bay Assessment and Response Team (BART).
- Identify scientific and technical personnel and agency resources available to assist with BART. This task is underway.

Charge 2 & 3: *Determine what would constitute the optimal data management system for the Bay and watersheds, to be implemented by January 2005. And, in coordination with DEM's efforts to establish a Comprehensive Statewide Monitoring Strategy for Rhode Island, develop a framework for a Bay and watershed-wide water quality and biological monitoring program.*

Recommendations:

- Immediately form a Rhode Island Monitoring Council (RIMC) that will:
 1. develop a comprehensive monitoring plan for the Bay and watersheds that integrates existing activities and fills in the gaps with a proposal for new monitoring, and
 2. develop an integrated and reliable system of data consolidation, synthesis, documentation, and dissemination to citizens, scientists, resource managers, and decision-makers.

- The Governor's Commission Monitoring Panel could serve as the basis for the RIMC. If initiated immediately, the RIMC could provide the Commission a budget for a comprehensive monitoring and data system for the Bay and watersheds by October 2004 and a comprehensive monitoring plan by the end of 2004. The panel requires 1 FTE of staff support to carry out this recommendation.

Conclusion: Without a reliable and comprehensive monitoring network, it is impossible to know whether the Bay and watersheds are getting better or worse, and if any of the programs designed to protect or enhance the condition of the Bay and watersheds are effective. Data collection, synthesis, analysis, and information dissemination are a continuum of activities that comprise the monitoring framework (see Figure 1). All must be implemented together. A break in the continuum renders the system ineffective. This is why we must consider all elements of the monitoring framework simultaneously. The monitoring program requires constant evaluation - adaptive management -- to ensure it is providing the information decision makers, resource-managers, and citizens need. If the monitoring system is not performing as required, or if monitoring goals and objectives change, the system should be adjusted.

INTRODUCTION

The Monitoring Panel focused on three major issues in our charge from Governor Carcieri:

Monitoring Narragansett Bay and Watersheds: Is Rhode Island's monitoring system adequate to measure the status and changes in the environmental condition of the Bay and watersheds in an accurate and timely manner; and is this information used to assess potential future disturbances to the Bay and watersheds?

Data and Information Dissemination: Is accurate and timely environmental monitoring data and information readily accessible to scientists, decision-makers, and citizens?

Bay and Watershed Rapid Assessment: Are we able to rapidly mobilize scientific and technical expertise to address sudden perturbations to the Bay and watersheds, such as the Greenwich Bay fish kill of 2003.

We recognize that the ultimate goal for a Bay and watersheds-wide system of monitoring, analysis, assessment, response, and information dissemination is a seamless continuum of activities (Figure 1). However, given that the short-term needs for each component of this system are unique at this time, we address each element separately in our report.

The geographic scope of our report is Narragansett Bay, the watershed for Narragansett Bay which covers extensive areas in Rhode Island and Massachusetts, and watersheds in Rhode Island that do not drain into the Bay but drain into Little Narragansett Bay on the Rhode Island and Connecticut border, and Block Island Sound off the south shore of Rhode Island. Collectively, we refer to these areas as Narragansett Bay and watersheds.

STATEMENT OF PROBLEM

Monitoring the Bay and Watershed: Current monitoring programs do not provide sufficient data to support the needs of water resource and natural resource programs including those targeted to the protection of Narragansett Bay. As a result, resource managers are not able to fully document, characterize or understand the causes and extent of water quality and ecological problems in the Bay and watersheds. Better ambient monitoring is needed to ensure that resources are invested wisely to achieve clean, safe water for both humans and wildlife (EPA2003). To measure effectiveness, programs can't afford not to invest in monitoring. Without accurate and reliable data on the current condition of the Bay and watersheds, and without reliable information on changes that are occurring in the Bay and watersheds, it is impossible to accurately predict future changes to the Bay and watersheds and the social, economic, and ecological consequences of these changes.

Data and Information Dissemination: The critical problems in the Bay and watersheds data/information distribution system are:

- ❖ Rhode Island decision-makers, scientists, and citizens do not have a central, permanent, web-based information dissemination system to obtain Bay or watersheds data/information. Nor do we have a funded system that can serve as a portal site for other Bay and watershed environmental data/information distribution systems. A central information clearinghouse would provide ready access to critical environmental information such as beach closures, fish kills, fisheries management issues, Geographic Information Systems (GIS) and core geospatial data, water quality and other information. The portal site www.narrbay.org was developed to serve this role, but has been without funding for 2 years.
- ❖ Currently, environmental managers lack access to data because of a failure of entities collecting the data to invest adequately in processing the information. A central clearinghouse will only be effective if the data gathered on the Bay and watersheds are compiled, analyzed and summarized in a timely manner and made accessible for linkage to the clearinghouse.
- ❖ No forum exists for discussing, partnering, coordinating, and advocating for Bay/watersheds data and information exchange. There is no vehicle in which to develop a unified, strategic vision for Bay and watersheds information dissemination.
- ❖ There is no system to maintain or enhance core geospatial data (e.g., land use, wetlands, soils, roads, hydrography, forests, communities, pollution sites, topography, bathymetry, etc.) used by all resource managers in the state at all levels of administration, including the private sector, non governmental organizations (NGO's), academia, and municipal, state, federal government. Many data are kept by multiple entities in various databases with few linkages among the data systems. Although the core geospatial data sets in the RIGIS database are maintained or enhanced by the independent contributing agencies, there is neither a unified approach to how or when this is done, nor a coordinated mechanism (or an identified secure funding source) to ensure that this happens.
- ❖ The office of the Rhode Island Chief Information Officer (CIO) is disconnected from the environmental information distribution community.

- ❖ Currently there is no clear definition of the audience and their requirements for monitoring data and resulting information. Three constituencies exist, the scientific community, the general public, and governmental agencies and policy makers. Each group has unique, but overlapping requirements for the kinds of data and its presentation.

Bay and Watershed Response Action: The critical problems in rapidly mobilizing a Bay and watershed response team are:

- ❖ It is essential that a uniform and agreed-upon methodology for deployment of the Bay Assessment and Response Team (BART) be developed. Decision-makers must consider the impact to other programs and responsibilities as well as the fiscal implications of activating a BART. A coordinated and committed response is essential.
- ❖ With the downsizing of state agencies and consequential increases in areas of individual responsibilities, there are not enough human resources available to respond to a non-anticipated event and continue to perform program-mandated tasks. In order to conduct a response action, other functions of the responding agency(s) may have to be temporarily discontinued. A commitment of the responding agencies is needed and the need to suspend services must be realized and accepted by administration, federal oversight agencies, the regulated community, and the public. An understanding and acceptance of this paradigm is necessary by all stakeholders before a successful and efficient response structure can be developed.
- ❖ During the panel discussion the phrase “*relying on the good will of individuals and organizations,*” was used to describe the make-up of the response team to the Greenwich Bay hypoxia and fish kill event. This is a non-sustainable response structure. Currently there is no means of rapidly engaging the technical expertise of academia or technical specialists beyond the “*goodwill*” (i.e., voluntary) model.
- ❖ Criteria for short-term assessment, long-term investigation and the determination of what an appropriate level of remedial activity must be developed. A pre-Incident prevention plan designed to prevent or minimize incidents needs to be established. There are significant costs associated with escalating assessment/response activities.
- ❖ Activities undertaken in response to Bay/watershed events must be communicated to the public in an effective and timely manner.
- ❖ Funding sources must be identified.

BACKGROUND

Monitoring the Bay and Watersheds: Monitoring is an essential component of resource protection and management programs. Despite this fact, in most states, monitoring programs are not adequately supported. On the national scale, the Environmental Protection

Agency (EPA) recently reported that the states collectively only had data sufficient to assess the conditions of 20% of river miles and 40% of lake acres and estuary square miles, despite thirty years of implementation of the Clean Water Act (EPA2003). Based on a 2002 survey, a shortfall of \$100 million annually exists in state monitoring programs (ASIWPCA2003).

Rhode Island has recognized the need to improve its ambient monitoring and assessment programs. Rhode Island state agencies do perform extensive monitoring of, for example, bacterial contamination of the State's waters, bathing beaches, and fishery resources. With respect to the Bay, the Narragansett Bay Estuary Program (NBEP) produced a report outlining a desired long-term bay monitoring strategy in 1992 (NBEP 1992). Unfortunately, a lack of funding prevented implementation of this strategy. The backbone of the monitoring strategy for the Bay is a network of fixed stations (buoys and docks) which collect data on a continuous basis. The result has been deployment of monitoring instruments at number of stations by collaborating parties (URI-GSO, DEM-NERR, NBC). However, the operation and maintenance of the network needs to be institutionalized and data management issues need to be further addressed. Furthermore, careful assessment of core data that are acquired among fixed stations should be made so that all stations in the Bay network collect the most important physical and biological parameters, and Bay-wide data are comparable. The NBEP capitalized on the voluntary commitment of time and resources by various scientists and agencies to conduct five years of intensive dissolved oxygen surveys. It should be noted that Bay Window funding, while recently renewed in 2004, is not a guaranteed long-term source of future funds. Within the RI Department of Health, monitoring of coastal beaches was also expanded with an infusion of \$210,000 annually in EPA funds under the Beach Act component of the Clean Water Act for the period. These funds are also not expected to continue indefinitely.

DEM acknowledged shortcomings in the monitoring of all surface waters in a review of its programs in 1997. Since that time actions have been taken to expand and improve various state monitoring programs. These actions include, but are not limited to, development of five-year cooperative agreements between DEM and URI for monitoring lakes and rivers and development of ambient river monitoring programs by the Narragansett Bay Commission. Within DEM, the actions to expand monitoring have been totally contingent on the use of federal funding. The lack of a commitment of state resources to baseline monitoring continues to be a major constraint to further expansion of monitoring programs. It has also limited the state's ability to leverage federal investment in monitoring; e.g., U.S. Geological Survey (USGS) cooperative agreements.

During the past three years, there has been a greater focus on baseline monitoring by water resource agencies, especially with respect to the Bay. Spearheaded by the Partnership for Narragansett Bay (PNB), with funding provided by the EPA, the NOAA National Estuarine Research Reserve, and the NBEP, technical workshops were held in 2001 and 2003 that led to a compilation of monitoring efforts in the state and the development of recommended core ecological indicators to measure in the Bay and its watershed (Kleinschmidt 2003; PNB 2002). A review of this information suggests that while there are many monitoring programs, relatively few focus on measuring baseline ambient conditions over a time scale of more than a few years. Additionally, data are being collected to measure some, but not all, of the recommended indicators.

DEM administers the state water quality standards consistent with the federal Clean Water Act and other authorities, and is completing a comprehensive monitoring strategy for surface

waters designed to meet multiple program needs as well as respond to new EPA mandates. The strategy must include ten minimum elements as specified in federal guidance (EPA 2003). Important among these elements is the understanding that effective monitoring is more than simply the collection of data in the field. Equally important are the elements of compiling and managing data, assessing and interpreting data, and conveying the results (see NWQMC framework available at <http://water.usgs.gov/wicp/acwi/monitoring/>). The strategy builds on the work of the PNB workshops and is consistent with the recommended ecological indicators. It will prioritize actions and outline the resources needed for implementation. It will recognize that the state works in partnership with other agencies and academic institutions as well as volunteer monitoring programs to execute monitoring. The strategy should provide an effective framework for monitoring baseline *ambient water quality conditions* in the Bay and the Rhode Island portion of the watershed. While the strategy will eventually address indicators reflecting water quality including water column measurements, sediments, groundwater, and wetlands, it is not intended to address the full range of indicators recommended in the Kleinschmidt report. Accordingly, another mechanism will be needed to ensure that data are being collected to measure indicators for landscape condition, changes in land cover, and changes in native and non-native biota, none of which are included in water quality monitoring strategies.

An additional mandate of the federal Clean Water Act is the completion of water quality restoration plans, known as Total Maximum Daily Load (TMDLs), for those waters identified as impaired (violating one or more water quality standards). Using data from intensive, targeted, monitoring studies, these plans identify the actions needed to restore the polluted waterbody to acceptable water quality conditions. At present, 130 waterbodies in Rhode Island have been designated as impaired and DEM has scheduled TMDL development out beyond 2012. As improved baseline monitoring identifies additional water quality impairments, it is likely that more resources will be needed to support the monitoring needs of the TMDL program. The program currently relies heavily on federal funding to support the water quality studies and modeling efforts that form the technical basis of individual TMDLs.

Long-term environmental data are essential to our understanding of change over time. Whether we are reviewing 50 years of fish landings from a standard trawl survey, analyzing historic water levels, or examining minute changes in climate or sea level rise, we depend on the scientific record to inform management decisions and to help forecast future changes. All the actions taken by Rhode Island to address environmental concerns in Narragansett Bay and waters of the State today will need to be monitored over the long-term if we are to measure their effectiveness and evaluate progress toward our goals.

Narragansett Bay and its watershed are dynamic and complex ecosystems, and cannot be accurately or adequately characterized by existing monitoring programs. Rhode Island's present approach to water quality monitoring, for its part, is largely focused on bathing beaches, shellfishing areas, and fishery resources (and is effective in these areas). The TMDL program, though designed to examine multiple inputs and types of pollution, has been stalled in its implementation due to funding limitations and technical/regulatory disputes. Clearly, nitrogen and other indicators of nutrient pollution must be monitored through a standardized approach in order to be useful to resource managers.

A number of long-term chronic perturbations are now occurring in the Bay and watershed and must be carefully assessed if we are to be successful in restoration and preservation efforts. These include the following:

Nutrient Pollution and Eutrophication -- Increases in nutrient inputs associated with increased development, lack of wastewater infrastructure and increased discharge of sewage effluent have occurred in all embayments around Narragansett Bay, Little Narragansett Bay, and in the coastal ponds. Eutrophication problems have been studied on a case by case basis, for example, Greenwich Bay and the coastal ponds by the Rhode Island Sea Grant Program. The increased awareness of the problem have led to better handling of waste waters with more sewer lines and better individual waste water treatment systems, but there is a continuing need to remove nutrient inputs to these shallow areas. Algae blooms, hypoxic/anoxic events, fish kills, and loss of eelgrass habitat will likely continue if nutrient inputs are unabated. Systematic monitoring for nutrients is *ad hoc* to non-existent. Management actions to limit/remove nutrients will require concomitant monitoring in order to be able to assess the efficacy of the control activities.

Instream Flow and Fresh Water Quantity – Knowing the volume of freshwater entering the Bay is critical to its management. Long-term measurements of flow in the Bay's major tributaries need to be continued. Additionally, the availability and allocation process for freshwater resources is another critical environmental issue for which we do very little comprehensive monitoring. Installing and monitoring stream gauge stations now will ensure that we have important data regarding flow conditions that will be needed, along with other data such as water use, to comprehensively plan for and allocation of these waters in the future. The USGS monitors some freshwater streams and rivers, but by no means all, and due to funding reductions have reduced their monitoring effort in recent years. The EPA has been developing protocols for sampling transition zones between fresh water habitat and saltwater habitat; these will be completed in 2004.

Urban Sprawl -- The impacts of urban development include increased pressure on freshwater aquifers, groundwater, streams, and rivers and increased nutrient inputs to freshwater sources and estuaries. Lower Narragansett Bay and the coastal ponds are experiencing rapid urban development, population increases, and significant increases in the density of homes. Reductions in freshwater inputs to the estuaries will change water residence times, circulation patterns and local habitat gradients of fresh to brackish to salt. There is no program to systematically measure land use and demographic changes in the watersheds of Narragansett Bay and coastal Rhode Island; however much of the core data to conduct these analyses are readily available.

Harmful Algal Blooms -- A global spreading in harming algal blooms (HABs) and red tides is occurring and affecting natural resources, human health, aquaculture, and tourism. Historically, such blooms have occurred in Narragansett Bay going back to the early 1900s; at least 19 phytoplankton species that are toxic or produce red tide blooms have occurred in the Bay. The devastating, bay-wide 1985 "brown tide" of a newly discovered species which lasted five months illustrates the prolonged impact that blooms of indigenous and novel species can have on the ecology of Narragansett Bay. The state (DEM and DOH) monitors harmful algae and surveys for the presence and abundance of these problem species. Such information provides an early warning system to alert shellfish harvesters and aquaculturists to potential problem blooms that may require remedial steps, including crop protection; to ensure seafood safety through increased shellfish sampling at standardized collection sites for shellfish borne phycotoxins, and to alert the Bay

Assessment and Response Team (see recommendations) to prepare for more detailed study to quantify causes, impacts of such blooms and to estimate their duration, trajectory and potential remediation options.

Fish Toxics -- The issue of whether freshwater or marine fish are safe to eat is another topic for which we have little scientific data. Certainly this is an area of interest and priority for health reasons. Moreover, the data on toxic compounds in fish is also an indicator of pollution levels in the environment.

Climate Change -- During the recent warming period from the 1970s to the 1990s Narragansett Bay water temperatures increased by about 2°C in winter and 1°C in summer according to the NOAA tide gauge in Newport, which operated until 1996. Ecological changes associated with this temperature rise have been followed by URI GSO monitoring programs for fish and plankton, and by the RI DEM fish survey studies and by directed research studies. We have seen a decrease in the abundance of northern species like winter flounder, an increase in southern species like small mouth flounder and an increase in invasive species like the *Hemigrapsus* crab, *Grateloupia* red algae, tunicates and the southern oyster disease Dermo. This warming trend may be a natural cycle like the warming trend of the 1930s with a colder period now starting and/or the prolonged period of the recent trend might be an indication of global warming. The changes associated with warming are complex, have large impacts on resource species, and require careful study.

Gradual changes in the species occurring in the Bay are proven sentinels of environmental change. For example, at the long-term GSO monitoring station off Fox Island, a major decrease in the abundance of the dominant winter bloom diatom species, *Detonula confervacea*, has accompanied the long-term increase in winter water temperature. And the major annual phytoplankton bloom has shifted from winter-spring to a late summer event. These changes have been accompanied by significant changes in the benthos and zooplankton of Narragansett Bay.

Sea level rise and the effects of hurricane-related storm surges are inevitable consequences of climate change. Both of these environmental changes have the potential to cause major negative economic impacts, as low-lying coastal areas most vulnerable to rising water levels are also some of the most economically valuable and productive in Rhode Island.

Invasive Species -- The State needs a program to prevent, monitor, and control the introduction of non-native species.

Data and Information Dissemination: Currently, the lead institutions in providing 24-7 Internet access to data and information for the Bay and watershed are the RI Department of Environmental Management (DEM), The RI Department of Health (HEALTH), the Narragansett Bay Commission (NBC), The URI Environmental Data Center (EDC), and the National Oceanic and Atmospheric Administration (NOAA). Although under funded and under staffed, the Rhode Island Geographic Information System (RIGIS) endeavors to provide coordination and leadership among the producers and consumers of geospatial data. There is no other form of coordination among Bay or watershed information distribution programs.

Web-based public access is new to Rhode Island. Agencies are still in their infancy in developing capacity to provide web-access to information. Major initiatives within some of the core institutions include the following:

DEM: Data management at DEM is, for the most part, occurs within divisions and departments. A significant percentage of data DEM collects is on paper. The data that are electronic are managed by individual programs, and in many cases individual people, with limited sharing with other programs within DEM and contained in various formats (Access, Excel, Word, etc.). The primary reasons why DEM finds itself with these islands of information today are: (1) historically, there has been no central information management office within DEM, and (2) data collection, storage and reporting has historically been media and site specific relating to EPA programs and mandates.

DEM is currently exploring numerous paths for improving the management of environmental data. First, they are implementing a permit tracking system that will lay the foundation for a department-wide data management system. The vision is to link environmental permit data to a facility/location/site where appropriate and have it readily available for any DEM program staff as well as the public. DEM is also partnering with EPA in additional efforts to improve data management. The National Environmental Information Exchange Network (Exchange Network or NEIEN) is a new approach for exchanging environmental data between EPA, States, and other partners. The Exchange Network is an Internet and standards-based secure data exchange between partners; built on the principles of integrated information, secure real-time access, and the electronic collection and storage of accurate information.

DEM established a central information management office to coordinate and improve data management efforts with the agency. This has improved agency efforts to compete successfully for federal grants that have helped DEM to participate in the NEIEN and to further efforts in the integrated permit information tracking system. However, limited MIS resources do not allow DEM to effectively create and maintain coordinated data systems fast enough. This results in the ongoing creation of new stand-alone systems and continued expansion of outdated stand-alone systems.

DEM does attempt to compile all available information for purposes of assessing surface water conditions. Water quality data are linked to specific waterbodies, which in turn support GIS applications with the data; for example, creating a map of impaired waters. DEM is pursuing enhancements to its water quality databases with a long-range view to making more information accessible via the Internet. The use of GIS is central to the applications being contemplated with an aim of improving both access to and presentation of water-related information.

RIGIS: The RIGIS consortium has been cataloging and sharing digital data for over fifteen years. External data distribution policy was formulated in 1990, and metadata standards were established in 1993. Distribution mechanisms progressed from the exchange of data on magnetic media optical to the establishment of publicly available web enabled FTP sites at URI. The RIGIS distributed over 30 gigabytes of data on CDROM in 2003. The RIGIS office has neither staff nor a budget for database administration, maintenance or data distribution.

URI Environmental Data Center (EDC): Established in 1986, the EDC became a lead cooperator in a joint project between the URI Department of Natural Resources Science and the RI Department of Environmental Management to develop the Rhode Island Geographic Information System or RIGIS. The goal of the RIGIS was to develop a comprehensive and detailed GIS database of RI's natural resources and to use these data and GIS tools to assist in the management and protection of these resources. Since 1986, considerable attention has been given to developing and distributing accurate and up-to-date GIS data to RI's resource managers.

The EDC works closely with the RIGIS Coordinator in the RI Department of Administration, Division of Statewide Planning. The integrity of the RIGIS database is protected through intellectual property copyright laws at URI and the database is distributed to the public over the internet through the EDC website <http://www.edc.uri.edu/rigis>. Currently, the RI Division of Planning, the RI Department of Environmental Management, Department of Transportation, RI Emergency Management Agency, RI Department of Health, and Coastal Resources Management Council make extensive use of the data and system. Every community in the state has accessed and used RIGIS data for municipal planning applications. Numerous federal agencies have used RIGIS data or collaborated with EDC staff and these include EPA, NOAA, USGS, NRCS (SCS), USFWS, AID, DoD, and the NPS. Non-profit organizations such as land trusts and conservation societies are using statewide GIS data to identify critical land use/cover and habitat in order to prioritize property acquisition and protection.

The RIGIS web-based data distribution system was built and continues to operate from grant funds received from federal agencies. There has been little, if any, state investment in building or maintaining the system. The URI web site provides approximately 80-100 Gigabytes of downloaded data per year.

Narragansett Bay Commission (NBC): The NBC began work in 2000 on an EPA-funded EMPACT Project. The buoy monitoring stations established under the EMPACT project extend water quality monitoring of Narragansett Bay into the upper, urbanized reaches of the estuary. These stations have been established in proximity to the Field's Point and Bucklin Point wastewater treatment plant outfalls, and directly benefit Narragansett Bay research by allowing for continuous, real-time water quality monitoring in the Providence and Seekonk Rivers. These data also provide a baseline of water quality across seasons, as well as prior to major waterway changes such as the dredging project. State-of-the-art technology at these sites collects measurements for temperature, salinity, pH, dissolved oxygen, and fluorescence (a proxy for chlorophyll and phytoplankton activity) at the surface. All parameters, except for fluorescence, are measured at the bottom as well. The NBC EMPACT website, <http://www.narrabay.com/empact/>, presents raw monitoring station data in an easy-to-use and easy-to-understand format. A summary of the NBC annual monitoring efforts, studies and findings are also available in the NBC Annual Pretreatment Report, available on-line at <http://www.narrabay.com/pretreatmentAnnRep.asp>.

RI Department of Health (HEALTH): HEALTH has been collecting and analyzing beach monitoring information since 1995. In 1999, HEALTH received an Environmental Protection Agency (EPA) EMPACT grant to collect and disseminate beach water

quality data to the public. This grant led to the creation of HEALTH's Beach Monitoring website, which contains all fecal coliform beach monitoring data since 1997 for public viewing. In 2001, HEALTH received funding through the EPA BEACH Program to categorize risk at bathing beaches through sanitary surveys and an expanded sampling program. During the summer of 2002, the HEALTH Beaches website had approximately 4,000 "hits" from individuals looking for information concerning Rhode Island beaches. In 2003, the number of hits with 67 beach closures, jumped to over 10,000 visits. Under development is a web-based data system that will allow government agencies, NGO's, and the public to query and download information about any Rhode Island beach through the Beach Monitoring website. This system will be available to the public by the summer of 2004.

Bay and Watershed Rapid Assessment: In response to the fish kill and hydrogen sulfide odors experienced during the summer of 2003, Governor Carcieri proposed forming a SWAT team approach to address these issues. A Bay Assessment and Response Team to investigate Bay-related environmental events would provide short-term assessment as well as provide long-term study as needed. This team would initiate remedial efforts, when appropriate.

ANALYSIS:

Monitoring the Bay and Watershed: In reviewing materials on this topic, we found that the findings of the PNB workshops are still valid with respect to the shortcomings in monitoring programs in Rhode Island today. These findings are summarized in a final report (PNB 2002) as follows:

Monitoring in Rhode Island is seriously under funded. We note that solving many of the items below would largely be contingent on addressing the issue of resources. Although there are many parties involved in monitoring, ranging from federal, state and local governmental entities, researchers, to watershed groups and volunteers, there is little, if any, duplication in effort. While re-examination of monitoring strategies may be able to create some efficiency, addressing the shortcomings in monitoring programs will require an additional investment of resources.

Significant Data Gaps Exist: Responding to major events like the North Cape spill of 1996 and Greenwich Bay fish kill this past summer has highlighted how a lack of baseline data limits the ability of resource managers to assess the adverse impacts of these significant events; e.g., understand what biota were affected. With regards to water quality conditions, DEM has documented gaps in the assessment of water quality conditions in RI: 64% of river miles and 21% of lake acres are unassessed due to a lack of data. While DEM reports 99% of coastal waters are assessed, the assessment pertains primarily to bacteriological data. In addition, with respect to certain parameters/indicators, there are additional gaps. Flow is measured only on selected rivers. Major gaps include fish tissue, nutrients, benthic habitat in the estuaries, sediments, the status of biodiversity and threats to it, invasive non-native species, and aquatic nuisance weeds. Fisheries programs need additional data on shellfish extent, diversity, and pathology. In 2002, monitoring on the state's largest rivers conducted by USGS under agreement to DEM was suspended due to state budget reductions. HEALTH notes that it has lacked the resources to expand

monitoring of freshwater beaches, including many used by at-risk populations (i.e., children at summer camps).

There is a serious lack of coordination of monitoring efforts. While many of the parties involved in monitoring in RI have successfully collaborated or coordinated on programs and projects, there is no mechanism that facilitates coordination on a holistic and on-going basis. DEM's water quality monitoring strategy will provide a framework for organizing baseline monitoring efforts. However, coordination of baseline efforts with other monitoring activities including targeted studies, research, watershed projects, etc., also should be improved. RI also needs to collaborate with Massachusetts in any overall program.

There is a lack of integration and analyses of existing data and interpretation as indicators. Data collected is only made useful when analyzed and interpreted in a meaningful way. Existing monitoring efforts, particularly with respect to those in the Bay, need to be improved to ensure that data collected in the field is analyzed and made available in a timely manner to meet multiple program needs.

There is increasing federal pressure to report environmental results to the public and decision-makers and increase accountability.

RECOMMENDED ACTIONS:

Monitoring the Bay and Watershed:

To address shortcomings in existing monitoring programs, the following actions are recommended:

Short-term Actions:

1. Immediately form a Rhode Island Monitoring Council (RIMC) that will:

- ❖ develop a comprehensive monitoring plan for the Bay and watersheds that integrates existing activities and fills in the gaps with a proposal for new monitoring, and
- ❖ develop an integrated and reliable system of data consolidation, synthesis, documentation, and dissemination to citizens, scientists, resource managers, and decision-makers.

The Governor's Commission Monitoring Panel could serve as the basis for the RIMC. If initiated immediately, the RIMC will provide the Commission a budget for a comprehensive monitoring and data system for the Bay and watersheds by October 2004 and a comprehensive monitoring plan by the end of 2004. The panel requires 1 FTE of staff support to carry out this recommendation.

2. Support implementation of the comprehensive monitoring strategy for surface waters in Rhode Island. The Monitoring Panel should review a draft of the strategy, expected to be available shortly. Anticipated initial implementation steps for 2004 include:

- ❖ Establish a position of monitoring coordinator for DEM-OWR. New funding will be required to achieve this step.
 - ❖ Undertake a pilot demonstration of the rotating basin sampling approach for rivers;
 - ❖ Restore monitoring of large rivers and increase frequency of sampling relative to nutrients at the river mouths to better characterize loadings to the Bay. New funding will be required to achieve this step.
 - ❖ Fill the vacant aquatic biologist position to restore expertise within DEM-OWR with respect to biological indices;
 - ❖ Expand lake monitoring via the URI Watershed Watch program;
 - ❖ Use the “Bay Window” Program to develop and implement a network of fixed monitoring stations in the Bay (buoy and land based locations) and ensure proper management of this system by developing cooperative agreements that govern the operation, maintenance, and data analysis from the stations; and
 - ❖ Use the “Bay Window” Program to develop and implement priority monitoring projects such as enhancing capability to conduct summer surveys of low oxygen conditions in portions of the Bay and assessment of benthic habitat.
3. Immediately review the 2004 monitoring activities being planned by the DEM and its partners as part of the Surface Water monitoring program.
 4. Ensure that monitoring of sampling sites in Massachusetts is executed; e.g., ambient water quality in Taunton River and nutrient discharges from Wastewater Treatment Facilities.
 5. Ensure that the existing network of USGS gauging stations and monitoring wells in the Bay and watersheds are kept operational, and if necessary, enhanced to provide broader geographic coverage of our measurement the quantity of freshwater in our rivers and groundwater reservoirs.
 6. Ensure that the long-term fixed-station monitoring sites that are sampled by scientists at the URI GSO and provide critical data to the state's resource management programs remain in operation. These include the fish trawl sampling and the phytoplankton sampling station off Fox Island. These datasets provide the long-term context by which short-term changes must be evaluated.
 7. Develop a program to systematically monitor and report land use change, habitat loss, impervious surface, and human demographic changes in the Bay watershed. These are frequently the root causes of environmental degradation in the Bay and estuaries.
 8. Improve capability to use existing data sets.
 - ❖ Ensure data collected from fixed stations in the Bay as well as other sources such as the monthly (NOAA) shuttle runs is processed, analyzed, and shared in a timely manner.
 - ❖ Examine existing freshwater fish population data (10 year survey effort) with the goal of developing a fish biological indicator of water quality.

- ❖ Continue work toward establishing a reference condition approach for evaluating macro invertebrate data on rivers and streams. This will require collection of additional reference site data.
 - ❖ Develop a watershed-wide policy on metadata to facilitate data sharing.
 - ❖ Develop and implement a program to “rescue” long-term or critical monitoring data that are presently not easily accessible to scientists, resource managers, decision-makers, and citizens and make these available on the Internet. Many datasets are lost because their owners do not have the technical knowledge or resources to make them readily available on the web.
9. Develop a program to systematically monitor for invasive, non-native species and aquatic nuisance weeds, which have a significant potential to adversely impact terrestrial and marine ecosystems.
 10. Ensure that all Bay and watersheds monitoring programs include plans and resources for ongoing data synthesis, analysis, and reporting to all audiences in a prompt and reliable fashion.
 11. Ensure that all Bay and watersheds monitoring programs embrace the paradigm of adaptive management where the efficacy of the monitoring is constantly evaluated to ensure it is meeting the explicit goals and objectives that drive the program.

Long-term Recommendations:

1. Establish reliable funding sources to support on-going implementation of a comprehensive monitoring program for the Bay and its watershed, in recognition that the existing reliance on federal funds for certain programs (e.g., Bay Window and Coastal Beach Monitoring Program) are temporary.
2. Expand the fixed station network in the Bay consistent to meet all program needs.
3. Develop capacity to assess conditions in coastal ponds, coves and embayments that are not otherwise monitored by the fixed station network or other means.
4. Ensure the multiple sources of data concerning coastal waters are properly integrated and analyzed in a timely manner. We recommend that a person be assigned to this task fulltime.
5. Consistent with the monitoring strategy, institute a rotating basin approach to assess rivers and streams on a periodic basis. A majority of states use this strategy (ASWIPCA 2004). Assessing two basins a year between 100–300 square miles each would allow DEM to complete statewide assessments during a five-year period.
6. Develop a fish tissue contamination program that would be implemented in conjunction with the rotating basin approach for rivers, streams, and lakes. By selecting a portion of the sites for sampling in each basin rotation, DEM estimates it would take 12–15 years to cover the freshwater portions of the entire state. Initially, priority would be given to sites known to be heavily fished or likely to have been contaminated by pollution sources. This responds to an EPA mandate.

7. Incorporate into baseline monitoring sampling, parameters needed to establish background conditions relating to petroleum hydrocarbons and selected other parameters. Emergency response and waste management programs need this data.
8. Develop a program to systematically monitor for invasive, non-native species and aquatic nuisance weeds, which have a significant potential to adversely impact fisheries, shellfishing, tourism, property values, and the landscape nursery industry. In addition, develop a program to systematically monitor levels of species diversity.
9. Develop a plan or mechanism to ensure that desired Bay and watershed indicators (Kleinschmidt), which are not addressed via the monitoring strategy, are being regularly measured. Include evaluation of monitoring stations and parameters that will yield useful information on topics such as climate change, water allocation, and stream flow.
10. Improve use of existing data sets:
 - ❖ Analyze the trends in river data using land use.
 - ❖ Develop presentation formats for data that facilitate communicating results.
 - ❖ Develop refined policy on interpreting dissolved oxygen data for coastal waters.
 - ❖ Develop and refine nutrient criteria for all surface waters.
11. Explore creative long-term financing to ensure that monitoring data are regularly collected and analyzed in a consistent and standardized format into the future.

Data and Information Dissemination: We recommend the following actions occur immediately:

1. The Rhode Island Geographic Information System Consortium should be administered by the Chief Information Officer (CIO) of Rhode Island.
2. The Rhode Island Information Resources Management Board (IRMB) should be expanded to include representation by the environmental data/information community. Or, a parallel Board be established under the auspices of the RI CIO to coordinate and advocate for environmental data and information distribution.
3. All entities expending public funds to collect pertinent data should be required to make these data available in an appropriate format (electronic) in a timely manner.
4. The Monitoring Panel of the Governor's Commission develop a plan by the end of 2004 to create a unified data/information distribution system for Rhode Island that provides advocacy and technical support within institutions, and serves to develop a proactive data maintenance and enhancement plan for the next 5 years. The panel should be provided with staff support to develop this plan. The data distribution plan should consider:
 - ❖ Sources of sustainable future funding.

- ❖ Review and assessment of data dissemination systems used by comparable states and/or institutions.
- ❖ Policies to ensure data security and integrity.
- ❖ Policies to ensure metadata standards.
- ❖ Assessment of current and future users of the system and their data/information needs.
- ❖ Annual budget needs for a 5-year period.
- ❖ A plan for monitoring of system performance and use.
- ❖ An adaptive management process to revise data/information coordination and dissemination based upon system benchmarks.

Bay and Watershed Assessment: The following suite of actions are recommended:

1. All references to a SWAT team should be changed to “Bay Assessment and Response Team (BART).”
2. Pre-Incident Prevention
 - ❖ Establish teams for generic Bay-related emergencies (fish kill, hydrogen sulfide odors, etc.).
 - ❖ Establish an NGO-based hotline to receive Bay-related complaints.
 - ❖ Develop a Bay alert message system similar to the Ozone alert system.
 - ❖ Organize volunteer and local organizations to undertake preventative actions such as removing seaweed before it can decay and release hydrogen sulfide.
3. Through Executive Order establish a Bay Assessment Response Team. This approach would clearly signify the importance and significance of the team and mandate that state agencies provide the necessary resources when called upon to participate.
4. Establish a BART activation procedure along the following lines:
 - ❖ Governor receives a request from a state agency to mobilize the team.
 - ❖ Governor issues a “Mobilization Order” and appoints a lead agency.
 - ❖ Lead agency coordinates activities of the team using the incident command system.
 - ❖ Additional resources and expertise obtained through academia and contractual services.
 - DEM has already issued an RFP for technical services for evaluating risks and consequences of pollutant contamination and oil/chemical emergencies. A RFP for services related to sample collection and analysis as well as other support services is being developed.

- A master price agreement needs to be developed with the URI Coastal Institute to facilitate the contracting of technical experts from the Universities on an as-needed real time basis.
 - It is essential that a roster of scientific, engineering, and technical skills expected to be needed by BART be compiled, the availability of personnel in at State, University and Federal units be established and grouped according to specialty. Where such skills are not available within these agencies, appropriate steps be formulated to fill these vacancies when needed.
5. A source of funding must be identified to support the activities of the team. A means to compensate individuals asked to participate needs to be established. This should include compensation for non-standard employees when asked to perform in extraordinary circumstances.

Implementation:

1.0 FTE staff support should be provided to administer the work of the RI Monitoring Council and data management program development outlined above.

Respectfully Submitted by:

Monitoring, Assessment, Data Management & Environmental Response Panel

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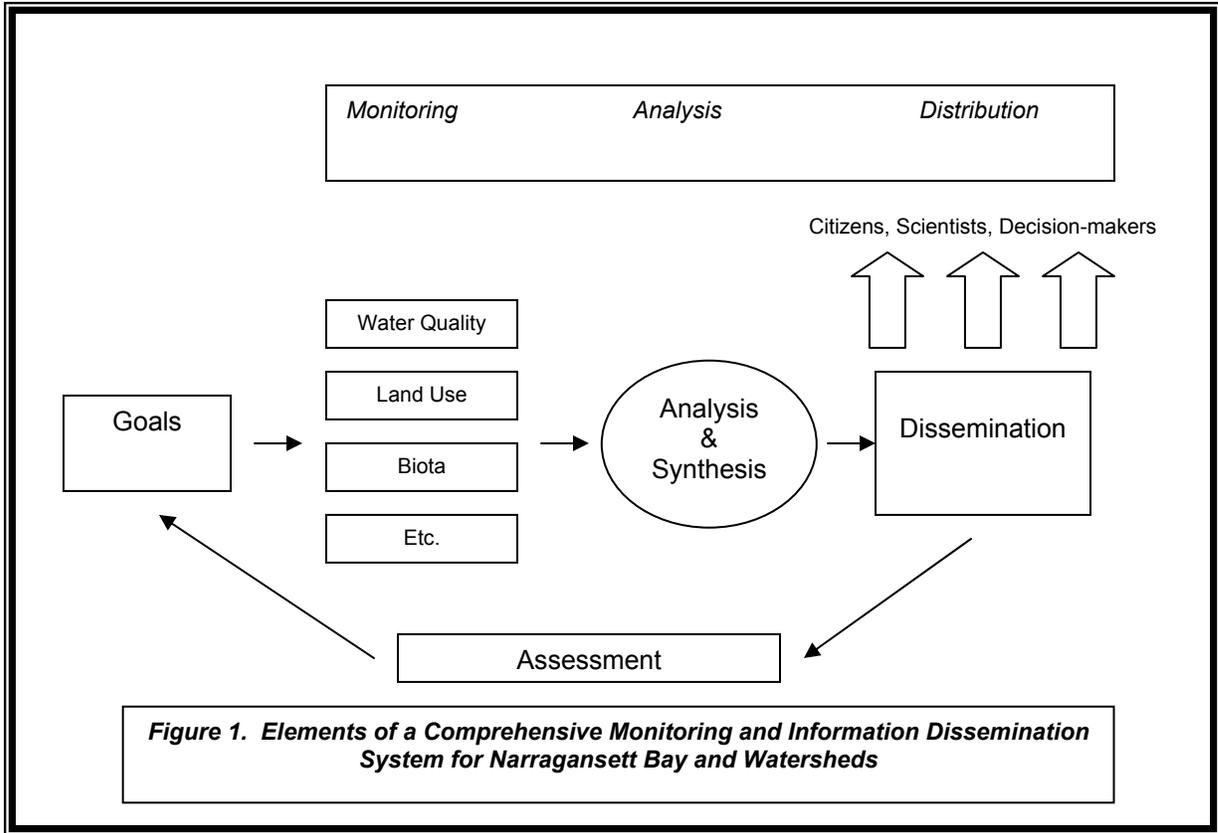


Figure 1. Elements of a Comprehensive Monitoring and Information Dissemination System for Narragansett Bay and Watersheds