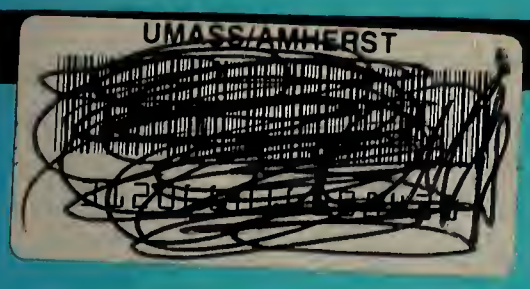

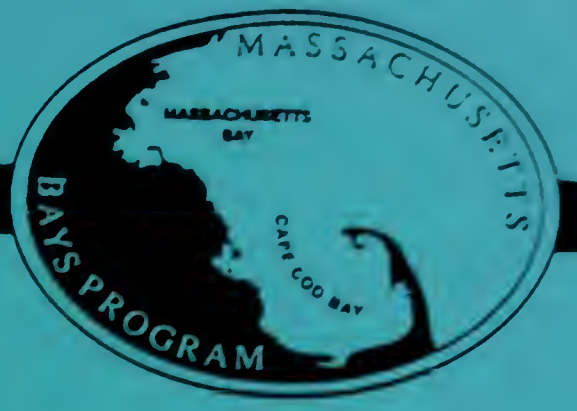

THE MASSACHUSETTS BAYS MANAGEMENT SYSTEM: A VALUATION OF BAYS RESOURCES AND USES AND AN ANALYSIS OF ITS REGULATORY AND MANAGEMENT STRUCTURE

EXECUTIVE SUMMARY

submitted to

the Massachusetts Bays Program

and the

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FOREWORD

The roots of the Massachusetts Bays Program extend back to 1982, when the City of Quincy filed suit against the Metropolitan District Commission and the Boston Water and Sewer Commission over the chronic pollution of Boston Harbor, Quincy Bay, and adjacent waters. Outdated and poorly maintained sewage treatment plants on Deer Island and Nut Island were being overwhelmed daily by sewage from the forty-three communities in the Metropolitan Boston area. Untreated and partially treated sewage were spilling into Boston Harbor.

Litigation over the pollution of Boston Harbor culminated in 1985 when the United States Attorney filed suit on behalf of the Environmental Protection Agency against the Commonwealth of Massachusetts for violations of the Federal Clean Water Act. The settlement of this suit resulted, in 1988, in the creation of the Massachusetts Water Resources Authority, the agency currently overseeing a multi-billion dollar project to repair and upgrade Metropolitan Boston's sewage treatment system. In addition, the settlement resulted in the establishment of the Massachusetts Environmental Trust - an environmental philanthropy dedicated to improving the Commonwealth's coastal and marine resources. Two millon dollars in settlement proceeds are administered by the Trust to support projects dedicated to the restoration and protection of Boston Harbor and Massachusetts Bay.

The Trust provided $1.6 million to establish the Massachusetts Bays Program, a collaborative effort of public officials, civic organizations, business leaders, and environmental groups to work towards improved coastal water quality. The funding was used to support both a program of public education and a scientific research program focusing on the sources, fate, transport and effects of contaminants in the Massachusetts and Cape Cod Bays ecosystem. To maximize the efficiency of limited research funding, the sponsored research program was developed in coordination with research funded by the MWRA, the United States Geological Survey, and the Massachusetts Institute of Technology Sea Grant Program. The study described in this report provides a strategy for assessing the value of the resources and uses of the Bays and their relationship to water quality. In addition, it provides an analysis of the regulatory and management structure of the Bays.

In April, 1990, following a formal process of nomination, the Massachusetts Bays Program became part of the National Estuary Program. The additional funding provided as part of this joint program of the Environmental Protection Agency and the Commonwealth of Massachusetts is being used to continue a coordinated program of research in the Massachusetts Bays ecosystem, as well as supporting the development of a comprehensive conservation and management plan for the coastal and marine resources of Massachusetts and Cape Cod Bays.

The information in this document has been subject to Massachusetts Bays Program peer and administrative review and has been accepted for publication as a Massachusetts Bays Program document. The contents of this document do not necessarily reflect the views and policies of the Management Conference. The reader is advised to keep in mind the limitations acknowledged by the authors of this report. In particular, note that in several key areas, reliable data is unavailable (e.g., the value of recreational shellfishing). Further, note that the public health focus used in this report is only one possible approach to specifying the relationship between water quality and Bays resource values.

The Massachusetts Bays Program is sponsored by the Massachusetts Executive Office of Environmental Affairs through the Coastal Zone Management Office and the U.S. Environmental Protection Agency, Region I, John F. Kennedy Federal Building, Boston, MA 02203.

EXECUTIVE SUMMARY

Research for this project was designed to address two overall goals. First, we develop an approach to enhance the ability of Massachusetts Bays managers to assess the likely impact of changes in Bays water quality on the use and value of coastal resources. Second, we analyze the existing mix of coastal management strategies in order to determine the degree to which existing governance practices are sufficient for Bayswide resource management. These two goals are addressed in Parts I and II of our report.

Part I

Determination and Benefit Valuation of the Uses and Resources of the Massachusetts Bays

The central organizing theme of Part I is to focus on the social value provided by the Bays system. We provide a strategy to articulate and value those uses and resources which supply value to humans. Accordingly, this part of the report addresses three major tasks. First, we discuss the broad range of resources and uses within the Massachusetts Bays system that provide value to the people of the Commonwealth. Second, we describe and analyze those resources and uses for which anthropogenic contaminants limit their value and benefit to society. To the degree allowed by available data, we also characterize the relationship among: (i) resources/uses which provide the most direct human benefit, (ii) the contaminants limiting those human uses, and, (iii) the management strategies designed to reduce environmental contaminants and enhance human use. And, third, we evaluate the methods available to determine the benefit value of Bays system uses and resources, and provide estimates of such values where data are sufficient.

Modeling Human Influences

An assertion that human activities influence both ecological and public health attributes is hardly controversial. However, effective management practices require not only the assertion of a relationship but insights sufficient to enable quantification. The ability to quantify those relationships requires a dynamic and interactive model which describes the nature of important relationships and provides a mechanism to analyze critical information. Such a model is represented in Figure 2 (from the report).

This model describes a system in which various **environmental control** strategies (such as Combined Sewer Overflow (CSO) controls, chlorination of wastewater effluent, or non-point source controls) regulate the level of critical environmental attributes/limiting factors (such as enteric pathogens or residual chemicals). These **limiting factors** can impact directly the nature of **resources and uses** (such as commercial shellfishing or recreational bathing) within the Bays system. The importance of this part of the model is that it more precisely defines a set of discrete relationships which affect the ability of humans to use Bays system resources.

However, simply characterizing the impact on use levels does not add directly to our understanding of effective management regimes. A central thrust of our work has been to focus on the need to calculate the social value gained from reductions in contaminant loads. Considerations of **use/resource value** (for individual uses) and for bay-wide total **benefit value** should contribute to the development of **management options** to enhance sustainable human use. While conceptualizing such a model may be easy, developing a fully specified, parametarized and operational version is not. Indeed it is important to distinguish between the process of specifying critical relationships and generating sufficient, focused and detailed information to allow for a fully dynamic and parameterized model.

In order be able to move beyond the general conceptual model illustrated in Figure 2, the first step is to specify the nature of a series of critical relationships that articulate the influence of various environmental controls on environmental factors which limit the sustainable use of Massachusetts Bays resources and uses. For example, what would be the impact of fully chlorinating all Boston Harbor wastewater effluent (including CSO discharges) on levels of enteric pathogens in nearshore areas?; what would be the impact on benthic finfish populations of broad-based dredging of residual chemical contaminated sediments?; and, what impact would shifting the Massachusetts Water Resources Authority (MWRA) outfall have on bay-wide productivity of potentially toxic phytoplankton species?

However, for the proposed model to be fully operational an additional quantification or parameterization step must follow specification. Not only must the system be sufficiently understood to define critical relationships but data describing the degree to which changes will occur need to be available. When such insights and data are available the model herein described would provide managers with a dynamic, iterative and implementable model.

In general, one can articulate two ways in which human activity can influence the value of marine resources and coastal uses: those that affect the **ecological health** of the system and those that impact **public health.** The focus of the approach described in this report was to use public health parameters as an illustration of how Massachusetts Bays managers could use such an approach to better specify the relationship between changes in water quality and Bays resource value. We chose this strategy not because of a lack of interest in or concern for parameters that affect general ecological health, but rather, because these relationships lack, in general, the kind of empirical specifity required of the model. Alternatively, for questions relating to public health, the establishment of state and federal

regulatory limits which define an "adulterated product" provide at least some minimum criteria to specify part of our resource valuation problem.

Estimating Benefit Value

Indeed, it is primarily because of the lack of clear insights concerning the relationship between water quality levels and resource use that made a determination of overall benefit value difficult. The estimates of Bays system use values provided in the report are admittedly incomplete and substantially underestimate the total value of the Bays resources. This is not only because of incomplete data, but also because many of the linkages between improvements in ecosystem health and various human uses are not yet understood enough to enable their value to be quantified.

Also, for management policy purposes, it is the change in human use value, rather than the current human use values, resulting from changes in water quality initiated by particular policies that is of greater interest. Each proposed regulatory change will have a unique impact on the Bays ecosystem and thus will require its own individual benefit valuation and thus the estimates discussed in this report cannot serve as general evaluative tools for potential policy changes, but only as a guide to the uses that need more investigation and that are likely to result in the largest value improvements if expanded or enhanced.

We are not presenting a comprehensive number of the total benefit value of the Mass Bays because this would be misleading. All values of the Mass Bays have not been measured because of insufficient data. Also, due to data constraints in some cases economic benefits (consumer surplus or the difference between total benefit value and current expenditures on the resource) are estimated in relation to hypothesized scenarios, while in other cases gross benefits are estimated (usually as a minimum value based on gross expenditures), and in other cases estimation of neither is possible.

In what follows, we summarize our key findings and valuation estimates for each of the major resources identified in our report as being limited by environmental contamination in the Mass Bays. The context for this discussion will be the model introduced in Section I and the subsequent valuations of the resources derived from it.

Commercial Fishing

Commercial fishing was divided into two areas: finfishing and lobstering; and shellfishing. This division was necessitated by the inability to quantify one of the linkages in our model (illustrated in Figure 2) for finfish and lobstering. This was the relationship between limiting factors and impacts on the finfish and lobster resources. The knowledge of how specified improvements in water quality affect the primary limiting factors of residual chemicals and natural toxins and how specified changes in these limiting factors impact the stocks of these resources was not available. However, in the case of shellfish, except for the case of natural toxins, we were able to be much more precise about this linkage. A reduction of fecal coliform counts to a point at or below the existing regulatory limit would clearly enable most shellfish beds to legally reopen.

In the case of finfish and lobsters, the absence of the limiting factors/use-resource impacts linkage prevented us from estimating changes in these resource values from likely water quality control scenarios. Instead, we provided market value estimates of these species caught in Mass Bays waters and divided the species into groups to identify those species likely to be of longest residence in the Bays system. This provides a minimum value of the gross benefit of these species of $53 million annually, although as we have shown the additional consumer surplus value produced from any change in water quality is likely to be small because Mass Bays does not appear to contribute a significant enough portion of market supply to influence price. Moreover, additional producer surplus is also likely to be small

because of the existence of substantial overfishing. A key point raised here is that if overfishing is allowed to continue, any gains in the value of finfish or lobster stocks through environmental improvements will be substantially lower than in the case of a properly managed finfish industry.

For shellfishing, we estimated the annual benefits from the elimination of depuration due to lower fecal coliform counts to be at least $174,000 annually. The minimum gross benefit - measured by the market value of additional product - from opening currently closed commercial shellfish beds is estimated to be $500,000 annually. As in the case of finfish, the Mass Bays contribution to the overall shellfish market is too small for the opening of these beds to result in any significant impact on shellfish prices. Likewise, there are substantial dangers of overfishing in the shellfish industry due primarily to the fact that shellfish management is focused on health issues and is substantially understaffed at the state level. Further, shellfish management is controlled by the towns and thus there is no overall statewide management of the commercial resources devoted to shellfishing.

Key Results:

*** The presence of overfishing in the finfish industry and the likely presence in the shellfishing industry reduces the value of any improvements in these stocks resulting from improvements in Bays water quality.**

*** There is insufficient scientific information available to allow for the quantification of likely improvements in finfish or lobster stocks from specified improvements in Mass Bays water quality parameters.**

*** The contribution of Mass Bays finfish and shellfish to the New England market is too small to substantially impact prices of these seafoods.**

*** Herring and pollock, which may be active spawners in Mass Bays, and cod, flounder, and hake, which are the most highly valued resident species in the Mass Bays should be the focus of initial studies to determine the impact of changes in Bays water quality on their health and development.**

Recreational Fishing

Obviously, the same lack of knowledge of the limiting factors/use-resource impact linkage discussed above constrained this analysis also. Another key missing data set was survey data on the socioeconomic characteristics and fishing habits of Mass Bays recreational marine fishermen. In lieu of these data, we first described the approach Mass Bays managers can use to create the survey database. We then use the Massachusetts sample from national survey data to estimate the average number of recreational finfishing trips conducted in Bays waters over the 1984-1989 period. A different national sample is used to report the number of recreational shellfishing trips conducted in 1985. This same study reveals that recreational shellfishermen readily substitute saltwater fishing for shellfishing and that they tend to be much more highly educated and from households with much higher incomes than the general population.

The range of estimates from many studies from all around the country on the consumer surplus value of a recreational marine fishing day is used to estimate a range of $45-$355 million in annual economic benefit of Mass Bays recreational finfishing. Similar estimates for recreational shellfishing were not calculated because of the lack of recreational shellfishing day value estimates in the literature. The only available scenario from the literature to estimate changes in recreational fishing value (additional annual economic benefits) from assumed changes in water quality from the Boston Harbor cleanup reported a range of $299,000-$7,911,000 in 1982 dollars. However, this study readily acknowledges the lack of scientific basis for the assumed affects of water quality on recreational fish populations and subsequent changes in the behavior of recreational fishermen.

Key Results/Suggestions for Further Research:

*** Mass Bays should sponsor, maybe in conjunction with the Division of Marine Fisheries, a survey of recreational fishermen to develop a database on the degree of participation, what influences this participation and the socioeconomic characteristics of this population. Such a survey could probably be conducted relatively cheaply as an attachment to the annual survey conducted by the National Marine Fisheries Service. This could serve as a basis for the calculation of recreational fishing day values for the Mass Bays region.**

*** A similar survey should be conducted for Mass Bays recreational shellfishermen to see if the higher income/higher education profile found nationally applies in Mass Bays and to enable us to understand how fishermen substitute among different Mass Bays recreational activities.**

Swimming and Beach Recreation

As in the case of shellfish, one of the key limiting factor/use-resource impacts is fecal coliform counts. Moreover, debris, oil and floating garbage are also key limiting factors. In this case, the key missing linkage was use-resource impacts/use-resource value. This was because of the lack of beach attendance data to help identify the degree of beach usage. We were able to identify all of the beaches and those beaches that experienced postings in past years, but not the length of time that they were posted. Data on other water quality parameters (such as counts of viral pathogens, debris, oil and floating garbage) that could influence the quality of the beach experience were not available for beaches in the Mass Bays system. Therefore, calculations of the value of beach use were not conducted, but instead estimates of a previous study of the annual benefit value from increased usage of Boston Harbor area beaches resulting from assumed improvements in water quality due to upgrading of primary treatment and treatment of CSOs were reported. However, as discussed, the linkage between improvements in water quality and possible increased beach use was poorly documented and based on very weak data. **Key Results/Suggestions for Further Research**:

*** The Mass Bays program should strongly encourage the state to implement a procedure for the collection of beach attendance data. This could possibly be organized through the newly created Beach Manager's Association.**

*** A survey of beach users and nonusers should be conducted in the Mass Bays region to develop an up-to-date accurate database on the socioeconomic profile of beach users and nonusers, the influence of different water quality characteristics on beach use, and the valuation these people place on different beach characteristics.**

Other Recreational Activities

The linkages of water quality changes to Bays resources that are likely to affect other activities such as whale watching, other wildlife watching, hiking, and general boating are also not able to be parameterized at this time. In lieu of this data, we did report on two of these activities, for which some participation data were available - general boating and whale watching. However, we were not able to specify precisely how these activities would be changed by different levels of water quality. We estimate the annual economic benefit to recreational boaters of the Bays system to range from $138-$472 million and note that the minimum gross annual benefit from whale watching, based on revenues generated in the industry, is $23 million. One other study has estimated the non-use value of the presence of whales in the Bays system to be an additional $25 million.

Key Findings/Suggestions for Future Research

*** We need to develop more specific parameters that relate water quality changes to changes in wildlife stocks and aesthetic characteristics likely to influence participation of boaters, hikers, and other recreationists.**

*** Along with the survey suggested for recreational fishermen, a survey of the Bays population concerning their uses of the Bays and the water quality characteristics that affect these uses, similar to the Chesapeake Bay survey cited, would allow for much more precise specification of use value and potential use conflict.**

Transportation and Port Management

Key Findings/Suggestions for Future Research

*** The impact of contaminated sediments on port and harbor development and recreational access is potentially very large and is currently being grossly underestimated. Increased dredging and dredging disposal costs and in some cases prohibition of dredging because of inadequate disposal sites need to be documented in order to boost the case for preventing contaminants from entering the Bays system. While many areas around Boston**

Harbor are already contaminated, the costs of incurring such contamination in other areas is likely to be substantial. Hopefully, one of the outcomes of the current State Dredging Disposal Task Force will be some estimates of the cost such contaminated sediments impose on ports and harbors.

Public Health

Key Findings/Suggestions for Future Research

*** One of the costs of not improving Bays water quality is the risk to public health both through seafood consumption and viral contamination from water contact. Although the data required to measure both health risks are not available for Mass Bays, we use national data and Massachusetts Department of Public Health data to estimate that the cost of seafoodborne disease in the Commonwealth generally in terms of lost work, medical expenses, and liability claims could be as high as $60 million annually.**

Ecosystem Benefits

The valuation of ecosystem benefits suffers from the same missing linkage in our model present in the case of fisheries. We do not yet know enough about the Mass Bays ecosystem to precisely link specific changes in water quality to specific improvements in characteristics of the ecosystem that can be further linked to direct human uses. However, one component of the ecosystem that has received considerable attention recently is wetlands. Although the precise contribution of Mass Bays wetlands to the Mass Bays ecosystem has not been documented, we illustrate the worthiness of such an undertaking by estimating the potential magnitude of just the recreational benefits such wetlands might generate. We do not attempt to value other benefits of wetlands, such as flood control, fish spawning sites, and groundwater filtration systems.

Key Results/Suggestions for Future Research

*** Valuation of Mass Bays ecosystem benefits related to direct human use requires a more precise understanding of the relationship between water quality and characteristics of the ecosystem and these characteristics and human uses of the Bays.**

*** An illustration of the methodology available for measuring one component of this value, the recreational value of wetlands, is illustrated, but because of lack of Mass Bays recreational day value estimates, per acre day value estimates from a recently published study on Louisiana wetlands were used. Applying such values to Mass Bays wetlands yields a**

recreational value estimate of $600,000 annually in economic benefits and $3.2 million annually in gross economic benefits.

* Some of the Mass Bays ecosystem benefits are not captured by their relationship to direct human uses, but have a perceived value among the general population even if direct use is not contemplated. This non-use value (willingness to pay for cleaner Mass Bays waters even if one is not a current user of the system or does not contemplate future use) has been found to be quite substantial in several recently conducted studies looking at a variety of resources in other parts of the country. The Mass Bays program should seriously consider conducting such a study for the Mass Bays system as a whole as this non-use valuation is likely to be sizable and should be used as part of the justification for expenditures on water quality improvements.

Part II

Analyzing the Current Massachusetts Bays Management System and Assessing Its Impacts

Part II examines major legal authorities comprising the extant Bays governance structure at federal, state and local levels. Two distinguishable sets of interactions, local-state and state-federal, serve as the analytical framework for discussion of issues selected as vital to strengthen and improve the Mass Bays system.

At the local level, principal issues include the role of local decisionmakers and planners in Bays management, the use of local regulatory tools for Bays resource protection, and some remaining problems with such key land use management areas as stormwater and sediment erosion control, groundwater protection and cumulative effects. Because such environmental concerns also significantly intersect with federal and/or state authority, some overlap of issues is inevitable. Consequently, some of the topics reviewed under the heading of federal and state programs, for example, non-point source pollution control, and special and critical area and resource management, including wetlands, will be redundant. Rather than a simple research artifact, however, this repetition more importantly reflects the historic development of pollution control efforts if not completely the current political reality.

Under federal and state rubrics, as discussed below, this report also explores new directions (the "quiet revolution") in environmental policy and two doctrinal areas of legal note: takings and the public trust doctrine.

With respect to critical area management at the local level (wetlands, Areas of Critical Environmental Concern (ACECs), river protection, etc.), hard-won protective measures currently in-place have been put at risk by the changes proposed to statutes and federal Corp of Engineers (COE) regulations. At the same time, projections for steady growth in coastal communities make further environmental degradation likely unless land use planning and management practices are bolstered. Information and data needs, including a permanent monitoring program for coastal water quality, fish and shellfish resources, nearshore sediments, and wetlands, is urgently needed. In addition, funding for staffing and enforcement remain inadequate.

Priority non-point sources affecting Bays resources, such as stormwater and On-Site Disposal System (OSDS) leachate, point up the need for technical assistance which might be addressed by regional agencies or by the establishment of incentives for municipalities to share technical staff, and possibly local funds for site inspections and other activities of mutual concern. Enabling statutes need to be updated, among other things, to reflect current scientific understanding, to encourage local board members on a sustained basis to pursue training opportunities and to enhance the local use of administrative penalties.

While it is not an official focus of this report, public education efforts should be supported and expanded. At a time when the amount of oil improperly disposed of by home mechanics has been estimated as greater than the Exxon Valdez debacle, the individual's role in pollution prevention clearly matters. This is more true, given the findings of the report, because pollution prevention constitutes one of two major emphases in what has been termed

the "quiet revolution" in environmental policy. The other major emphasis - enforcement, while scarcely new, needs to be re-integrated within a comprehensive, more cost-effective approach which incorporates nonregulatory as well as regulatory paradigms. Generally, the strategies of "targeting" and "cross-compliance" - need to be more dexterously woven into the current multi-dimensional structure.

At the same time, because the U.S. Supreme Court has devoted renewed attention to the law of takings, leaving local government officials uncertain, if not alarmed, over the possible extent of the fifth amendment "just compensation" requirement, this report urges that supplementary strategies be explored to augment the traditional reliance upon a purely police power approach. Thus, where feasible this report recommends recourse to the property-based common law "Public Trust" doctrine. In addition, tax-based incentives to preserve privately-owned wetlands, and funding to purchase fee simple interests and development rights in wetlands and other critical areas may also be necessary.

With some exceptions, this report concludes that sufficient authority exists to operate an effective Mass Bays program. Given the management perspective informing this report, namely that the cross-media nature of environmental pollution requires an area or basin-wide ecosystemic approach, this report recommends reliance upon the coordinative intergovernmental mechanisms of Massachusetts Coastal Zone Management Program (MCZMP) to define and/or resolve Bays management problems. In addition, and given adequate funding, the authors also urge that the MCZMP take the lead in pursuing the other recommendations with which the report concludes.