

A Blueprint for the Bays

*Comprehensive Conservation and Management Plan
2023 – 2033*



Massachusetts Bays
NATIONAL ESTUARY PARTNERSHIP

March, 2023



Massachusetts Bays
NATIONAL ESTUARY PARTNERSHIP

Comprehensive Conservation and Management Plan

A Blueprint for the Bays

Final Revision of the 2003 CCMP
In accordance with EPA guidance dated May 2016

Submitted to the U.S. Environmental Protection Agency
February 5, 2023

Pam DiBona

Director, MassBays

Juliet Simpson

Chair, MassBays Management Committee

Approved by U.S. EPA Region 1
February 8, 2023

With concurrence from U.S. EPA Partnership Programs Branch
March 27, 2023

Forward

New England's compact landscape foster such intimate relationships between its people and its iconic lands, towns, and waters that those relationships made their way into the historical term "thread of the stream" as the way to define the boundaries of political jurisdictions.¹ Because of this intimacy, we in Massachusetts understand scale – both how the local and the regional are intertwined, and also how very hard it is to get the scale of action just right. Grand designs excite imagination, but implementing the designs not so much.

This CCMP acknowledges this reality, and offers a new model to inject excitement into results. As summed up by Charles H.W. Foster's 1984 study on the environmental sense of place:

Gone will be the inevitable comprehensive, basin plan, devised and carried out by a distant technical agency with only token input from nongovernmental advisors. The new regionalism must be bottom-up, rooted in a sense of place, and composed of a series of modest, short-term steps. It is likely to begin with a single river reach or issue, coalesce around tangible problems and doable remedies, and only then grow to ...watershed or basin proportions. . . In the new regionalism, ... the results will be messy, incomplete, and disappointing at times - a far cry from the grand designs that have graced our nation in the past - but they are the only approaches that can properly... put together the right combinations of resources and talents. If all of this comes to pass, we might end up like that famous New Englander, Henry David Thoreau, in his journal entry for March 20, 1858.

"The fishes are going up the brooks as they open," [Thoreau] wrote. "The water running down meets the fishes running up. They hear the latest news."

The latest news could be very good, indeed.

¹ Foster, Charles H.W. Experiments in Bioregionalism book series: Foster, Charles H.W. 1984. *The New England River Basins Story*. Hanover NH: University Press of New England.

Executive Summary

The legislation that established the National Estuary Program (NEP) in 1987 was unique for its approach to environmental protection, conceived broadly to focus on maintaining the integrity of whole systems — their chemical, physical, and biological properties, as well as their economic, recreational, and aesthetic values. In keeping with this ambitious goal, each NEP is charged with developing Comprehensive Conservation and Management Plans (CCMPs). These are living documents, serving as blueprints for actions that are detailed and implemented in annual workplans, and like all blueprints, they look into the future, describing something that will be realized through over time. And also like all blueprints, there is no guarantee that all will go according to plan. CCMPs must be reality-based, but also aspirational and nimble enough to seize opportunities strategically. CCMPs are required to be updated or revised periodically, at least every 10 years; the program itself is evaluated for progress in achieving goals every five years. MassBays' first CCMP was released in 1996, followed by updates to goals in 2003 and 2013.

The 2023-2033 CCMP for the Ipswich, Massachusetts, and Cape Cod Bays is the product of multiple years of effort, extensive stakeholder input, and the application of innovative methods for ecosystem-based, active management. It highlights recent accomplishments as well as areas where more work is needed – or where approaches must be changed. Impacts and responses to climate change, and engagement in environmental justice are consistent and core strands to the proposed goals, strategies, and actions. We know we cannot predict our successes in the next 10 years, and that even 10 years is not enough time to fix the legacies of past activities or to address the coming impacts of new conditions. But we do know how we propose to spend those next 10 years: prioritizing habitat restoration and protection in the Bays; tracking and reporting on habitat conditions; and building capacity across the region to support this work.

A New Blueprint for the Bays

With this revision, the Management Committee (MC) is updating MassBays' approach to improving and protecting coastal resources, building on MassBays' unique local relationships to build capacity for locally significant efforts that contribute to system-wide improvements in habitat, connectivity, and resilience. Previous CCMPs for our region, dated 1996 and 2003, focused on large projects ("Projects of Regional Scope and Impact") and laid responsibility at the feet of local and state agencies for a wide range of tasks under 17 Action Plans. ***Our new CCMP focuses on achieving specific management and environmental outcomes by means determined at the local level, informed by MassBays' work.***

The principles that guide our day-to-day work will help us to realize the CCMP goals. They include:

- ***Collaboration and Cooperation.*** The complex issues before us cannot be handled by any single entity. We will work with partners in all sectors, engage environmental justice communities, and where there is not already an effort underway, and an issue is identified as a priority through our CCMP, we will build capacity locally – providing technical support, grant writing, and regional connections – that get projects done.
- ***Ecosystem-based Management.*** MassBays seeks fundamental improvement in our estuaries. This requires a holistic approach to problem-solving and decision making. Cross-cutting impacts and implications of any action will be considered before we make significant investments.
- ***Climate Change Resiliency.*** We know that our estuarine systems will be impacted over the coming decades by the multiple manifestations of climate change. MassBays will draw on the most current understanding of those impacts to evaluate proposed actions.

- **Long-term Sustainability.** As long as the National Estuary Program exists, MassBays will play a role in meeting the goals of CWA §320. Our ability to do this work requires both Management Committee and staff commitment to implementing well-laid plans – and our success in doing so will set the stage for claiming even more success in the future.

These principles were also incorporated into a new vision and mission statements for MassBays, endorsed by the Management Committee in 2013:

<p>Vision</p> <p>We envision a network of healthy and resilient estuaries, sustainable ecosystems that support the life and communities dependent upon them.</p> <p>Mission</p> <p>To empower 50 coastal communities to protect, restore, and enhance their coastal habitats. To fulfill this mission, MassBays engages local, state, and federal entities to advance the use of scientific information and provide technical support for decision making.</p>
--

Taken together, our vision and mission drive MassBays’ priorities for habitat and management, and serve as the basis for the broad Goals, focusing Strategies, and concrete Actions that we will take up under this CCMP. The ten-year plan described in this document will be implemented through execution of annual workplans, carrying out incremental steps (Activities) according to details vetted by the Local Governance and Management Committees.

Responding to New Conditions

A CCMP is not only a requirement, but it is an important blueprint to guide future actions. In the 20 years since the last CCMP update (in 2003), the context for planning and the universe of environmental conditions, management priorities, and agency capacities have changed significantly. For example:

- **New programs are in place** within state agencies, volunteer monitoring capabilities have expanded, and powerful computer tools such as GIS and Shiny for Python and R have become easily accessible.
- **Programs to protect and improve water quality have been discontinued** making it imperative to find other ways to address problems holistically.²
- **Regional projects with significant impact have been completed** (e.g., the Boston Harbor cleanup), and meanwhile addressing localized impacts and restoration has become more important.
- **Impacts of climate change are incontrovertible and are disproportionately affecting Environmental Justice (EJ) communities.**
- **New resources are now available and focused on supporting municipal action,** especially with regard to climate change.
- **Funding for Massachusetts environmental agencies and EPA has declined.**
- **MassBays’ influence on local decision making has increased** by virtue of 20 years’ effort on the part of the RSPs and RCs, staff, and Management Committee.

At the same time, the MC determined the time was right to evaluate MassBays’ position within CZM and investigate opportunities to broaden partnerships and outreach. A transparent assessment of

² For example, the Merrimack River continues to be subject to untreated CSO discharges: <https://www.epa.gov/merrimackriver/environmental-challenges-merrimack-river#CSO>

host options resulted in the MC 's full endorsement of the program's move to the University of Massachusetts School for the Environment at the Boston campus. The Committee also determined that this CCMP should reflect conditions through June 2022, and that the CCMP Attachments will be updated (Monitoring Framework and Communications Plan in calendar year 2023; Finance Plan by end of calendar year 2024) to incorporate more recent developments, including:

- A new milieu for communications and diversification of funding, with MassBays as a Center within UMass Boston's School for the Environment.
- New opportunities for project implementation with supplemental funding under the Infrastructure Investment and Jobs Act of 2021 (also known as the Bipartisan Infrastructure Law, or BIL). Spending of these funds aligns with corresponding EPA program guidance.

The context established by these changes reflects the impacts of emerging issues, technologies, management frameworks. In response, MassBays' MC worked from 2013 through 2022 to revise our programmatic and organizational goals, bring forward the environmental outcomes those goals supported, and identify strategic actions needed to reach those goals. Section V provides a flowchart and details of the revision process.

Cross-cutting concerns

As we developed this revised CCMP, two cross-cutting concerns in particular provided focus for our work over the next 10 years – addressing environmental injustice and responding to climate change – neither of which had been included in our previous CCMPs.

Environmental justice

In spite of awareness of environmental injustices, highlighted by local communities and officially recognized by President Bill Clinton in 1994, progress in addressing inequities in access to the coast and open space, disproportionate exposures to toxic waste and environmental contamination, and lack of access to arenas where policy and management decisions has been slow. ***Meeting the needs of communities that have routinely borne the brunt of pollution and been excluded from realizing benefits of restoration is critical to sustaining resilient communities.*** MassBays has a role to play in implementing initiatives to respond to these needs, including highlighting the social, economic, and demographic displacements and realignments that climate change will introduce. We will make full use of resources offered by both EPA and EEA's Offices of Environmental Justice to advancing environmental justice in the MassBays study area. The Programmatic Goals detailed in Section VI include means for taking up this work.

Climate change

Emerging and predicted risks from climate change have directly informed MassBays' Programmatic Goals. Massachusetts has conducted comprehensive vulnerability studies and reports with input from local and regional experts, assembled in a web-based clearinghouse, www.resilientma.gov, which provide significant and solid underpinning to this CCMP. Our long-term planning recognizes that past conditions and the current state are not predictive of future conditions. For example:

- ***Sea level rise***, which will be significant in MassBays' study area compared to other regions, results in marsh subsidence and other changes in coastal habitat extent and distribution.
- ***Warmer water and warmer seasons*** are already changing species distribution and abundance, especially with observed northward migration of aquatic species.
- ***More frequent and more severe storms*** increase the influence of stormwater and combined sewer overflow discharges on water quality, change freshwater/saltwater interfaces, and stress existing stormwater and tidal infrastructure.

Planned responses to these and other climate change impacts are described in Section VI.

Challenges determine Goals and Strategies; Actions result in Outcomes

Figure ES1 diagrams the challenges, goals, and outcomes that frame the CCMP; Figure ES2 provides an “at-a-glance” view of the strategies and actions that comprise MassBays’ response to those challenges, and means to realize the outcomes. Each year, our annual workplan will implement activities and tasks under those actions to move us to our ecological and program goals based on priorities vetted with local partners.

Over the next 10 years, and with this CCMP, the MC expects MassBays to consider fundamental questions of what the future should be and work towards two sets of complementary goals depicted in Table ES1, Organizational Goals and Programmatic Goals. Both must be addressed if MassBays is to realize our desired environmental outcomes. The new operational framework provided in this CCMP will enable us and our partners to generate and point to real and substantial improvements in the MassBays ecosystems. And ultimately, the CCMP will help empower our program’s 50 coastal communities through a collective investment of partner time, money, and expertise in protecting, restoring, and enhancing our shared coastal habitats.

Table ES1. Goals and Outcomes for the MassBays CCMP

Organizational Goals	+ Programmatic Goals	→ Environmental Outcomes
MassBays is a primary source for information about conditions and trends in Ipswich Bay, Massachusetts Bay, and Cape Cod Bay.	MassBays provides new resources to support research and management in the Bays.	Locally significant habitats and ecosystems assessed and prioritized for research, assessment, and implementation actions.
MassBays is an important influence on local decision making that recognizes the roles, functions, and values of healthy habitats in the Bays.	MassBays reaches all study-area municipalities with actionable information about coastal habitats.	Ambient water quality supports biodiversity; observed improvements in habitat continuity and hydrological connectivity at the local level.
MassBays is a model program for management and planning that addresses diversity among estuaries.	MassBays provides regular and locally informed State of the Bays reporting that reflects the unique characteristics of MassBays assessment areas, and documents progress toward target conditions.	Locally relevant improvements in water quality, habitat, biodiversity, and resilience.

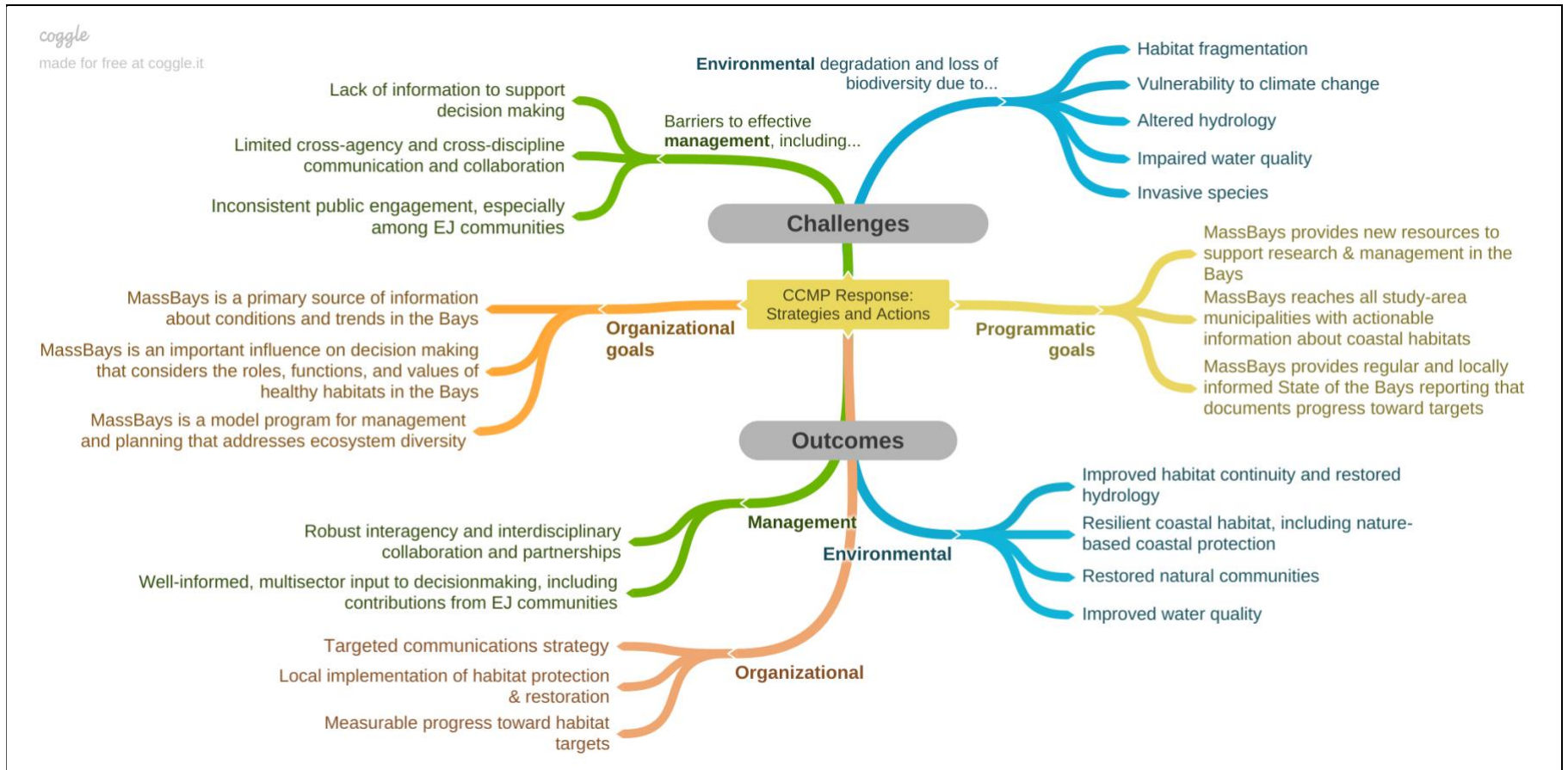


Figure ES1. Relationship between the Challenges in the Bays, the CCMP Goals MassBays will take up with this CCMP, and the anticipated Outcomes resulting from its implementation.

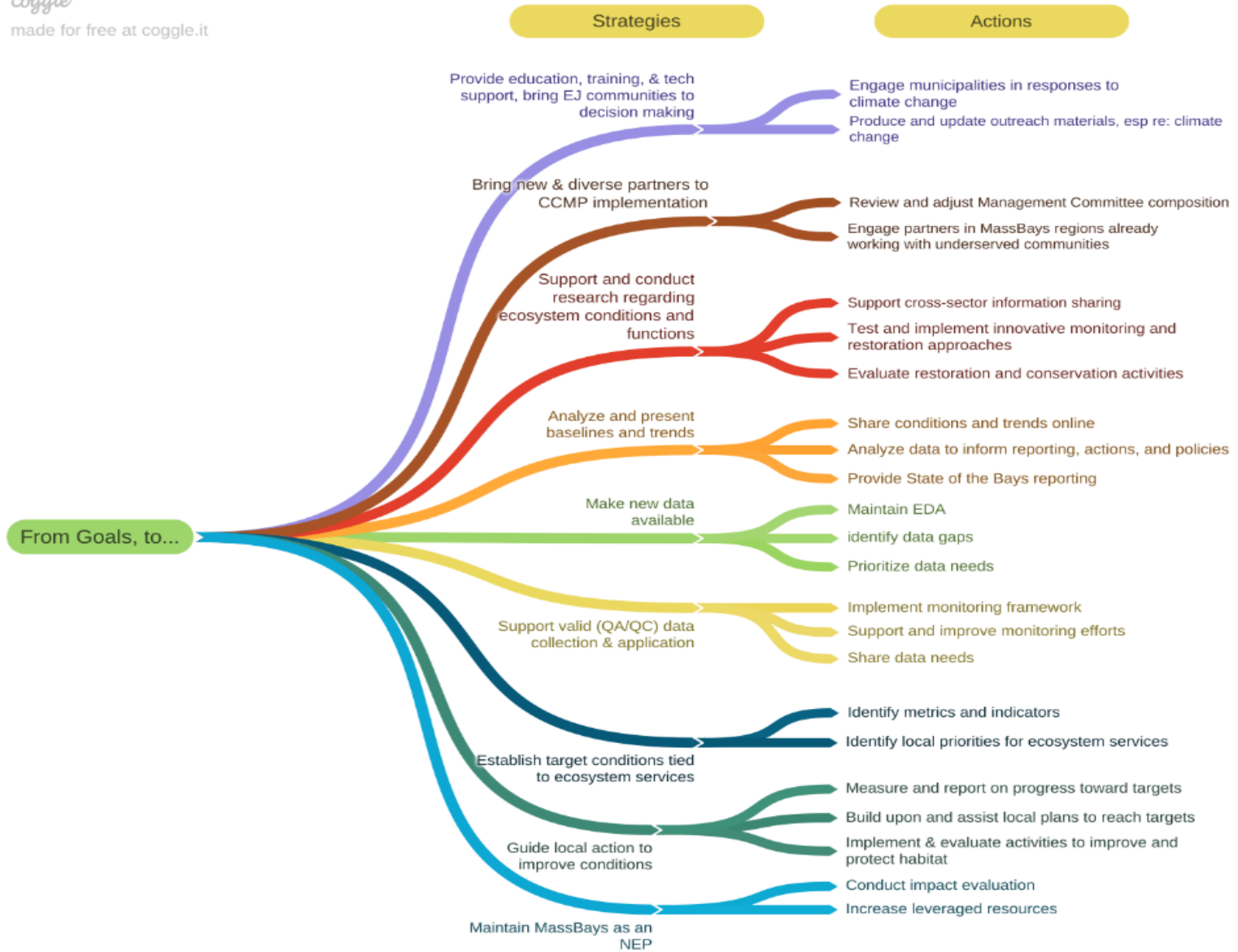


Figure ES2. Compilation of the MassBays CCMP Strategies and Actions planned through 2033.

MassBays' Study Area and Organizational Structure

MassBays was designated an Estuary of National Significance under the NEP on Earth Day in 1990, with an area including 50 coastal communities from Salisbury to Provincetown and more than 1100 miles of coastline around three Bays: Ipswich, Massachusetts, and Cape Cod (Figure ES3).

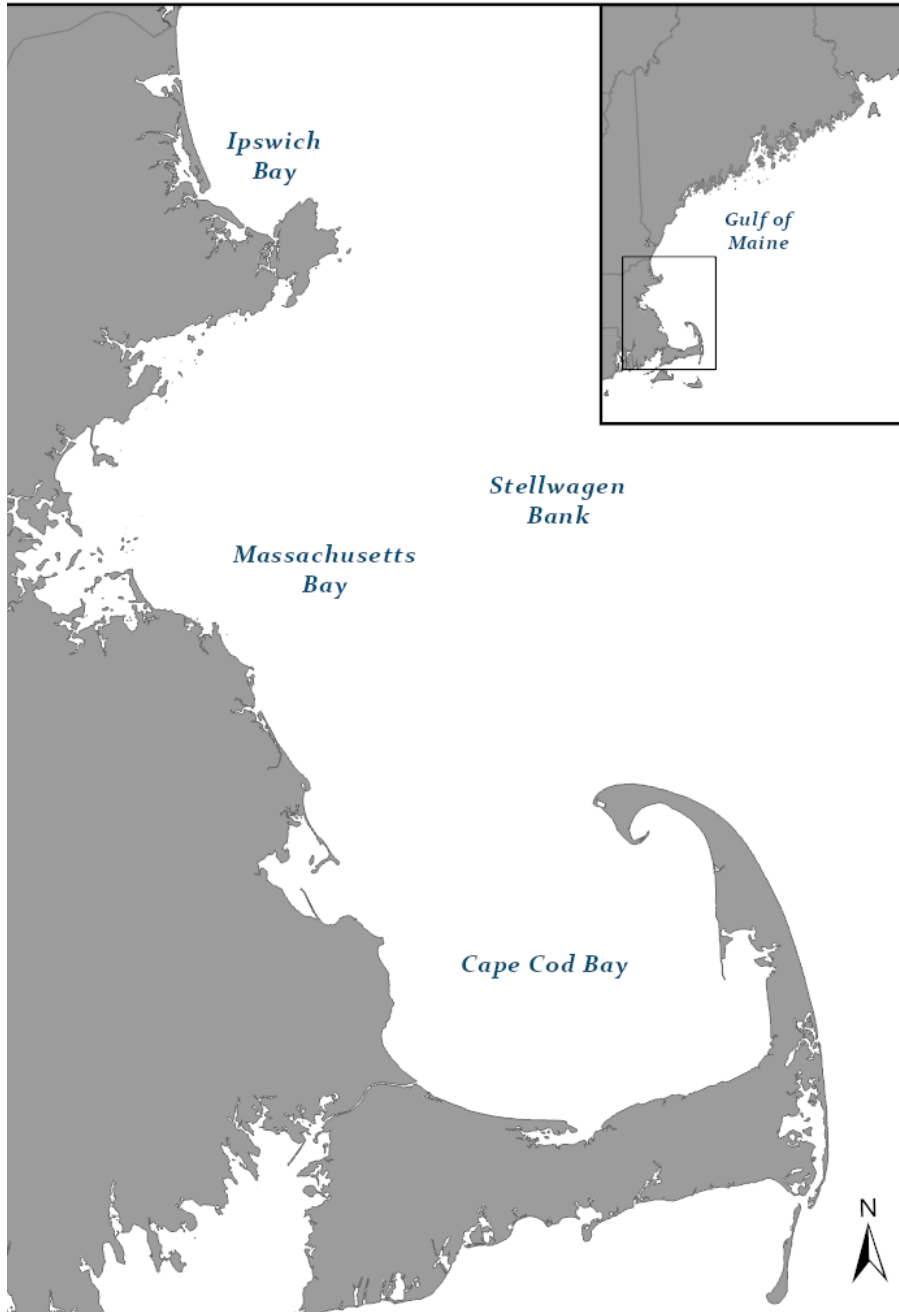


Figure ES3. MassBays' work is focused on Ipswich Bay, Massachusetts Bay, and Cape Cod Bay.

Local expertise to effectively engage stakeholders across this broad study area is critical, and early in its history MassBays engaged Regional Service Providers (RSPs) as MassBays' representatives to provide region-specific technical assistance, outreach to stakeholders, and priority-setting for habitat protection and restoration (Figure ES4). With annual funding from MassBays, each RSP



Figure ES4. MassBays' Regional Service Providers and the municipalities they serve.

designates a Regional Coordinator, who in turn convenes and staffs a Local Governance Committee to ensure that yearly regional plans are driven by local priorities and capacities, informed by the CCMP (Figure ES5).

At the same time, MassBays’ overall planning and programming is guided by a Management Committee, which includes public officials, environmental organizations, business leaders, and scientists. The Management Committee, through a process described by EPA in NEP funding guidance, endorses the CCMP and yearly implementation workplans submitted for EPA’s approval, both prerequisites to receiving EPA funding. The Committee provides input through quarterly meetings and participation in subcommittees dedicated to specific needs, such as the Science and Technical Advisory Committee.

Appendix L lists the Management Committee members in place during the 2013-2022 CCMP revision process; the process itself is described in Section IV.

All of this expertise – from local experts and advisors – is brought to bear on the work carried out by MassBays’ staff, currently 2.8 full-time equivalents, hosted through October 1, 2022 by the Massachusetts Office of Coastal Zone Management, and currently by the University of Massachusetts Boston (UMB) (see “Responding to new conditions,” above).

Conditions in the Bays

MassBays’ study area is large and diverse, encompassing approximately 1,650 square miles, from coastal wetlands offshore to Stellwagen Bank, 25 miles east of Boston in the Northwestern Atlantic Ocean. The inland watershed covers more than 7,000 square miles. Its 1100-mile coastline from Salisbury to Provincetown is characterized by a diverse and complex geomorphology that has shaped the largest contiguous salt marsh north of Long Island Sound (Great Marsh), expansive shellfish beds, feeding grounds for endangered whales (e.g., North Atlantic Right Whale), and refugia for migrating shorebirds (e.g., endangered Roseate terns). Through a comprehensive Ecosystem Assessment and Delineation (EDA), MassBays has defined 65 assessment units, subwatersheds consisting of 44 estuarine embayments and 21 rocky intertidal areas and barrier beaches (Figure ES6).

Massachusetts Bays support a complex of natural systems, including salt marsh, barrier beaches, dunes, tidal rivers, estuaries, shellfish beds, and mudflats extending from the upper watersheds to the estuaries and the Gulf of Maine. This unique complex of natural systems adds ecological, economic, recreational, and cultural value to the daily lives of both coastal and inland communities where land is connected by river and stream networks. They are home to hundreds of breeding and migratory birds, marine mammals, and fish; serve as nurseries for culturally, recreationally, and commercially valuable fish and shellfish; and provide ecosystem services to millions of people, including their increasingly vital role in blunting the impacts of climate change through nutrient processing and flood protection.



Figure ES5. MassBays’ organizational structure.

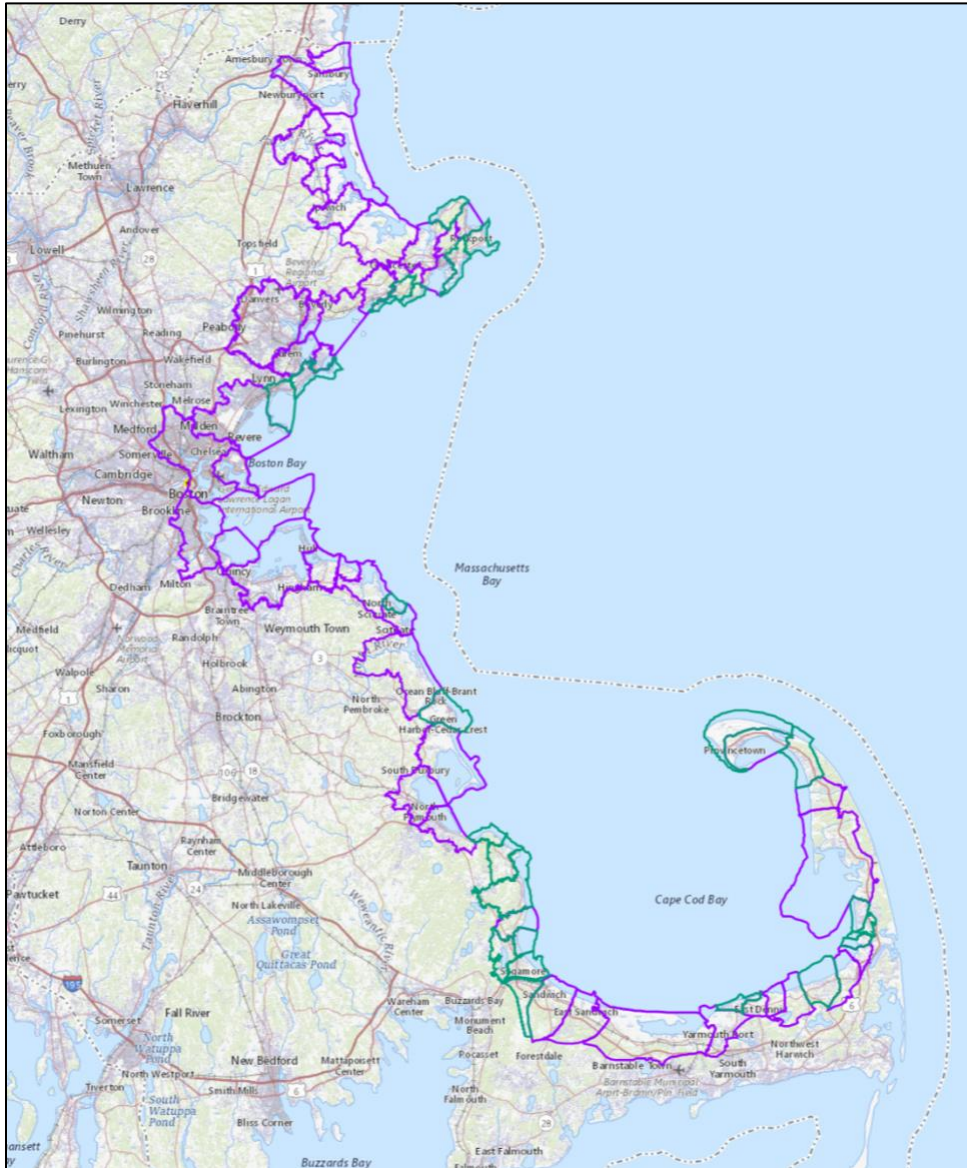


Figure ES6. MassBays has delineated 44 estuarine embayments (purple) and 21 “interestuarine areas,” dominated by rocky shores and barrier beaches.

Together these habitats support a varied fishery and aquaculture industry which, along with recreation, shipping, transportation, and tourism, are economic drivers for Eastern Massachusetts if not the entire Commonwealth. Some of these uses and industries are now facing challenges from foreign and domestic competition and the harmful impacts of development patterns and conditions in land use and land cover over time; above all, climate change and its impacts are fundamentally transforming the ecosystems and resources of the Bays, altering conditions as basic as water temperature, pH, and precipitation patterns. Addressing these challenges requires characterizing the system, tracking conditions, and reporting changes to decision makers.

Characterizing the MassBays Ecosystem

Capturing the interplay between physical conditions, water quality, and habitats supported in each assessment area is critical to understanding the status of the study area, from individual embayments to the system as a whole. Section II of the CCMP provides a detailed overview of monitoring mapping programs and their findings for MassBays’ study area, summarized here.

Physical characteristics

The Bays form the southern boundary of the Gulf of Maine, and its seascape is a patchwork of mud, sand, gravel, and boulders, with a general habitat gradient from Ipswich Bay, where salt marshes dominate, to the southern coast of Massachusetts Bay where rocky intertidal habitat mingles with marshes, and finally to Cape Cod Bay, which is dominated by sand beaches, dunes, and tidal flats⁴. The Bays have a tidal range of up to 4.1m (12ft). Although nutrients and pollutants are carried from upland parts of the watershed to coastal wetlands and into Ipswich and Massachusetts Bays, a recent study⁵ essentially confirmed that in spite of the many rivers discharging into MassBays, tidal influence vastly exceeds that of freshwater, even with a documented increase in flow from the Merrimack River since the 1960s. Cape Cod Bay, on the other hand, is a dynamic environment that receives most freshwater input from groundwater inflow, a source that is heavily affected by Cape Cod communities' primary reliance on septic systems.

This information, taken together with characterization of water quality and habitat extent and condition described in the following sections, is critical to enabling MassBays to implement adaptive management. This CCMP lays the groundwork for an approach that employs “lumping” and “splitting” of embayments (and the inter-estuarine areas in the future) for generalized education and outreach for example, and for more specific site planning.

Water column conditions

MassBays follows four primary elements of water quality: temperature, dissolved oxygen, nutrients, and phytoplankton. All of these are shifting rapidly due to climate change, and those shifts are likely to have significant impacts on the habitats, species, and uses of the bays in the future.

Temperature

Continuous surface and bottom sea temperature data for areas north of Cape Cod from 2001-2020 show that the temperature of Massachusetts Bays is on a rising trend.⁶ Sea temperatures recorded in 2012 were the warmest since 2000, causing early molting in American lobster (*Homarus americanus*) in the Gulf of Maine.⁷ Another notable maximum was observed in 2015 in the winter sea surface temperature (45.6°F), and again in 2016 a maximum was recorded in 2016 for annual sea bottom temperature (45.8°F). A longer continuous time series for northern Massachusetts waters is required before long-term trends can be confidently described.⁸ However, variations in water temperature at different depths create “layers” or thermocline in ocean waters; depending on the temperature, the water column above and below the thermocline can store oxygen and nutrients differently, impacting microbial growth and concentrations over time.

³ Knebel, H., R. Rendings, and M. Bothner. Modern Sedimentary Environments in Boston Harbor, Massachusetts. *Journal of Sedimentary Petrology*, 61(5): 791-804.

⁴ Massachusetts Ocean Management Plan Volume 2. Commonwealth of Massachusetts 2021. <https://www.mass.gov/files/documents/2022/02/25/ma-ocean-plan-2021-vol-2a.pdf>

⁵ Woods Hole Group Inc., 2019. MassBays Water Transport Times Estimation Project. Report prepared for MassBays National Estuary Partnership.

⁶ http://neracoos.org/datatools/climatologies_display

⁷ Pershing, A. et al. 2015. Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. *Science* V. 350 (6262): 809-812.

⁸ Massachusetts Ocean Management Plan Volume 2. Commonwealth of Massachusetts 2021. <https://www.mass.gov/files/documents/2022/02/25/ma-ocean-plan-2021-vol-2a.pdf>

Dissolved Oxygen

Massachusetts Bay and Cape Cod Bay both follow a seasonal dissolved oxygen (DO) cycle.⁹ Massachusetts Bay experiences its highest DO concentrations during the spring and its lowest during the fall; those for Cape Cod Bay are higher in May-September. The cycle of warmer water temperatures and higher microbial activity in summer contributes to the reduced concentration of DO in bottom waters, and to the formation of hypoxic areas of depleted oxygen. Reduced DO can impact fish and other biota, with extreme oxygen depletion (<2 mg/L) resulting in fish kills.¹⁰ In 2019 an unusually intense thermocline created hypoxic conditions, with DO < 1 mg/L in the bottom nearshore waters of Cape Cod Bay, resulting in the death of trapped lobsters and crabs.¹¹ These anoxic and hypoxic episodes in Cape Cod Bay prompted further investigation, including monitoring to catch signs of deleterious effects on fauna in Cape Cod Bay and other areas. Results of a 2022 study to identify the primary influences on water quality in Cape Cod Bay are pending.

Nutrients

Excessive nutrient inputs to coastal waters – primarily nitrogen from land-side sources like stormwater runoff and wastewater treatment plant discharges – often result in algal blooms in coastal systems. To date, MassBays has relied on data from MWRA and the Center for Coastal Studies for information about nutrient loading in Massachusetts Bay and Cape Cod Bay (both programs date from the construction of the Deer Island treatment plant to serve 43 cities and towns in Eastern MA). Nitrogen discharges have exceeded the “caution” level set in 1996 based on modelling data for 2020 only once, in 2019,¹² with no evident decrease in water quality in the vicinity of the treatment plant outfall. Otherwise, discharge concentrations of nutrients have been steady over time, and decrease with distance from the outfall. Data showed normal and improving total nutrient concentrations in Cape Cod Bay.

Phytoplankton

The MassBays study area experiences annual Spring and Fall phytoplankton blooms. MWRA monitoring in Massachusetts Bay indicates that during the Spring bloom (which coincides with freshwater flow from spring rains and snowmelt), chlorophyll averages just about 2.5 mg/L. Surface concentrations decrease to less than 2 mg/L during the summer, and then spike in September through November to about 4 mg/L (after nutrients are replenished when layers mix, bringing the end to stratification).¹³ MWRA monitoring stations found that total dinoflagellate concentration increased substantially from 2018 to 2019, with the 2019 concentration ranking third highest in 28 years of monitoring.¹⁴ Some blooms can be harmful or even toxic, requiring shellfish closures; they can also cause turbidity and consequent loss of eelgrass.

⁹ Xue P., Chen C., Qi J., Beardsley RC., Tian R., Zhao L., Lin H. 2013. Mechanism studies of seasonal variability of dissolved oxygen in Mass Bay: A multi-scale FVCOM/UG-RCA application. *Journal of Marine Systems* 131, 102-119. <https://www.sciencedirect.com/science/article/abs/pii/S0924796313002935?via%3Dihub>

¹⁰ <https://www.epa.gov/nutrient-policy-data/documented-hypoxia-and-associated-risk-factors-estuaries-coastal-waters-and>

¹¹ Scully, M. E., Geyer, W. R., Borkman, D., Pugh, T. L., Costa, A., and Nichols, O. C.: Unprecedented summer hypoxia in southern Cape Cod Bay: an ecological response to regional climate change? *Biogeosciences*, 19, 3523–3536, <https://doi.org/10.5194/bg-19-3523-2022>

¹² <https://www.mwra.com/harbor/enquad/pdf/2020-11.pdf>; pg. vi

¹³ Geyer W., G.B. Gardner, W. Brown, J. Irish, B. Butman, T. Loder, and R.P. Signell. 1992. Physical Oceanographic Investigation of Massachusetts and Cape Cod Bays, Technical Report MBP-92-03. Massachusetts Bays Program, Boston, Massachusetts.

¹⁴ <https://www.mwra.com/harbor/enquad/pdf/2020-11.pdf>; pg. 20

Habitat status

Salt marsh

There are approximately 34,000 acres of salt marsh in the MassBays study area (DEP Wetland data MassGIS 2005). The Great Marsh, a full 25,000 acres in the northern region, the largest contiguous salt marsh in New England, is an internationally recognized Important Bird Area, supporting more than 300 species of breeding and migratory birds. Other large salt marshes are located in Scituate/Marshfield and Duxbury Bay on the South Shore, and in Barnstable on Cape Cod. Historically, salt marshes ringed the Boston Harbor region and extended well into the Saugus, Mystic, Charles, and Neponset watershed.¹⁵ Now only a fraction of those historic marshes remain, namely Rumney Marsh and Belle Isle Marsh (areas where MassBays continues to support assessment and restoration). It is estimated that salt marsh loss in the Boston Harbor region is close to 81% since pre-colonial times (see Appendix 1, title here). These losses are largely due to placement of fill during the 19th century,¹⁶ but are also a result of salt marsh ditching and restriction of marsh-supporting tidal inundation with dams and tide gates – structures that remain to this day. Sea level rise and the impacts of development adjacent to marshes add modern challenges to the health of salt marshes in the MassBays study area.

Tidal flats

There are roughly 28,000 acres of tidal flats in MassBays. About 40% are located along Cape Cod Bay and constitute the largest flats in North America, extending 9.7 miles along the shore from Brewster to North Eastham.¹⁷ Duxbury and Plymouth Bays on the South Shore, and Ipswich Bay on the North Shore, also contain extensive tidal flats.¹⁸ Conditions in intertidal flats are variable given the unconsolidated nature of the sediment, changes in temperature, and presence or absence of water related to tides. Despite the variability, or maybe because of it, tidal flats support a high degree of biodiversity. Like salt marshes, coastal dunes, barrier beaches, and other coastal habitats, tidal flats are protected by the Wetlands Protection Act as “likely to be significant to storm damage prevention and flood control.” Yet erosion poses an important threat to tidal flats and the beaches behind them. Sea level rise also poses a threat to tidal flats from complete submergence, putting organisms they support – like shorebirds, shellfish, and crustaceans – at risk.¹⁹

Eelgrass

Measuring the extent of eelgrass (*Zostera marina*) in Massachusetts’ coastal waters is challenging due to cost, availability of resources, and variable methods used. MassDEP established the Eelgrass Mapping Project in 1995, the most comprehensive eelgrass survey effort in the state. The project involves mapping embayments across the state with a combination of aerial photography, digital imagery, and ground truth verification through diving. Findings of the first 12 years of the project

¹⁵ Carlisle, B.K., et al. 2005. *100 Years of Estuarine Marsh Trends in Massachusetts (1893 to 1995): Boston Harbor, Cape Cod, Nantucket, Martha’s Vineyard, and the Elizabeth Islands*. Massachusetts Office of Coastal Zone Management, Boston, MA; U.S. Fish and Wildlife Service, Hadley, MA; and University of Massachusetts, Amherst, MA. Cooperative Report. <https://www.mass.gov/files/documents/2016/08/or/ma-estuarine-trends.pdf>

¹⁶ <https://www.hiddenhydrology.org/bostons-made-land/>

¹⁷ Setterlund, C. 2016. “The Changing Shape of the Cape & Islands: The tidal flats of Brewster, Orleans, & Eastham.” *Cape Cod Life*, September/October accessed 12/20/2018 at <https://capecodlife.com/the-changing-shape-of-the-cape-islands-the-tidal-flats-of-brewster-orleans-eastham/>

¹⁸ Hankin, A. L. et al. 1985. Barrier Bleachers, Salt Marshes, and Tidal Flats. An Inventory of the Coastal Resources of the Commonwealth of Massachusetts. CZM publication 13899-27-600-1-85 C.R.

¹⁹ Galbraith et al. 2005. Global Climate Change and Sea Level Rise: Potential Losses of Intertidal Habitat for Shorebird. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. 2005.

are documented in Costello and Kenworthy²⁰ revealing increased eelgrass coverage in only three embayments and documenting an overall loss of 1,865 acres of eelgrass. Since 1995, Duxbury-Kingston-Plymouth Bays in western Cape Cod Bay collectively lost 54% of its eelgrass. Large losses have also been documented from other embayments such as Wellfleet (eastern Cape Cod Bay). Plum Island Sound, in Ipswich Bay, used to have extensive beds that disappeared decades ago. Surveys of this area were conducted by MassDEP in 2021 and results are still pending.

In spite of ongoing research, spatial fluctuations in eelgrass location and extent from year to year have not yet been fully explained. Major threats to eelgrass come from wastewater and stormwater discharge causing turbidity and eutrophication, and from physical damage and increase in turbidity caused by certain fishing gear, moorings, dredging, aquaculture, and boating activities. Eelgrass is also vulnerable to population fluctuations resulting from intense coastal storms, wasting disease, epifauna and impacts from invasive species including green crabs.

Rocky shores, Barrier Beaches and Dunes

Rocky intertidal shorelines are prevalent in the North Shore region extending from Nahant through Cape Ann. Several rocky shorelines are also found around areas of Salem Sound and around Boston Harbor. There are approximately 105 acres of rocky intertidal habitat in the Boston Harbor area, both natural and manmade (DEP Wetland Layer MassGIS 2005). Most of the natural rocky intertidal shorelines occur on the Boston Harbor Islands, with a total of almost 800 acres of rocky intertidal area across the study area. This habitat is vulnerable to human development which has often resulted in degradation, including development of shoreline protection structures such as seawalls, jetties, and riprap.

MassBays' study area includes more than 100 miles of beach, primarily in the Upper North Shore along Plum Island Sound, along Duxbury Bay on the South Shore, and along most of Eastern Cape Cod Bay. In terms of area, there are 11,000 acres of dunes and sandy beaches in MassBays' study area, nearly every one vulnerable to impacts of climate change and development. Construction of hard structures such as groins and jetties is often seen as a solution to protect eroding beaches and the land and communities behind it. However, appropriate design and maintenance of these structures is important for preventing more damage to the beach morphology that naturally maintains habitat values.

Fish runs and spawning areas

The MassBays study area has hosted spawning areas and migration routes for diadromous fish including American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*), and rainbow smelt (*Osmerus mordax*). Fish populations and associated habitat have diminished over the past centuries because of dams, habitat alterations, pollution, and overfishing. MassBays' study area includes more than 200 potential, in-process, or completed fish run restoration sites along migration routes for herring, smelt, and American eel.²¹

Shellfish beds

Shellfish habitat is found across all MassBays with hotspots on the south shore and around Cape Cod Bay. The Massachusetts coast is characterized by quahogs (*Mercenaria mercenaria*), soft shell clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), oysters

²⁰ Costello, C. and W.J. Kenworthy (2011) Twelve-year mapping and change analysis of eelgrass (*Zostera marina*) areal abundance in Massachusetts (USA) identifies statewide declines. *Estuaries and Coasts* 34(2):232-242. DOI 10.1007/s12237-010-9371-5.

²¹ <https://www.mass.gov/info-details/massgis-data-diadromous-fish>

(*Crassostrea virginica*), and bay scallops (*Argopecten irradians*). Areas within MassBays with vulnerable shellfish resources include: Cape Cod Bay (ocean quahogs and sea scallops), and the North Shore (sea scallops). Shellfish beds are threatened by pollution from land, harmful algal blooms, and construction, among others.

Setting habitat goals

A central component informing MassBays’ new CCMP was the establishment of specific goals for habitat condition and extent across the entire study area. Setting goals for 68 embayments, rocky shores, and barrier beaches is a daunting task, however, and one that could take the entire 10 years’ timeline for its implementation. Instead, MassBays undertook a stepwise process, beginning in 2018 that involved sorting the 44 delineated estuarine embayments according to their physical and chemical characteristics, and then setting habitat goals for each grouping informed by local priorities. This multi-year effort is detailed in Appendix A. Goal 3 of the CCMP calls for similar analysis and goal-setting for habitats in rocky shore and beach areas.

Defining ecotypes

To establish similarities and differences across the embayments and support resource management and planning, MassBays and EPA researchers undertook a detailed assessment of the hydrogeology and other physical characteristics. The analysis revealed four embayment ecotypes, depicted in Figure ES7 and referred to as Yellow, Orange, Green, and Blue. Only one embayment falls into the Blue category: Rockport Harbor, at the border between Ipswich Bay and Massachusetts Bay.

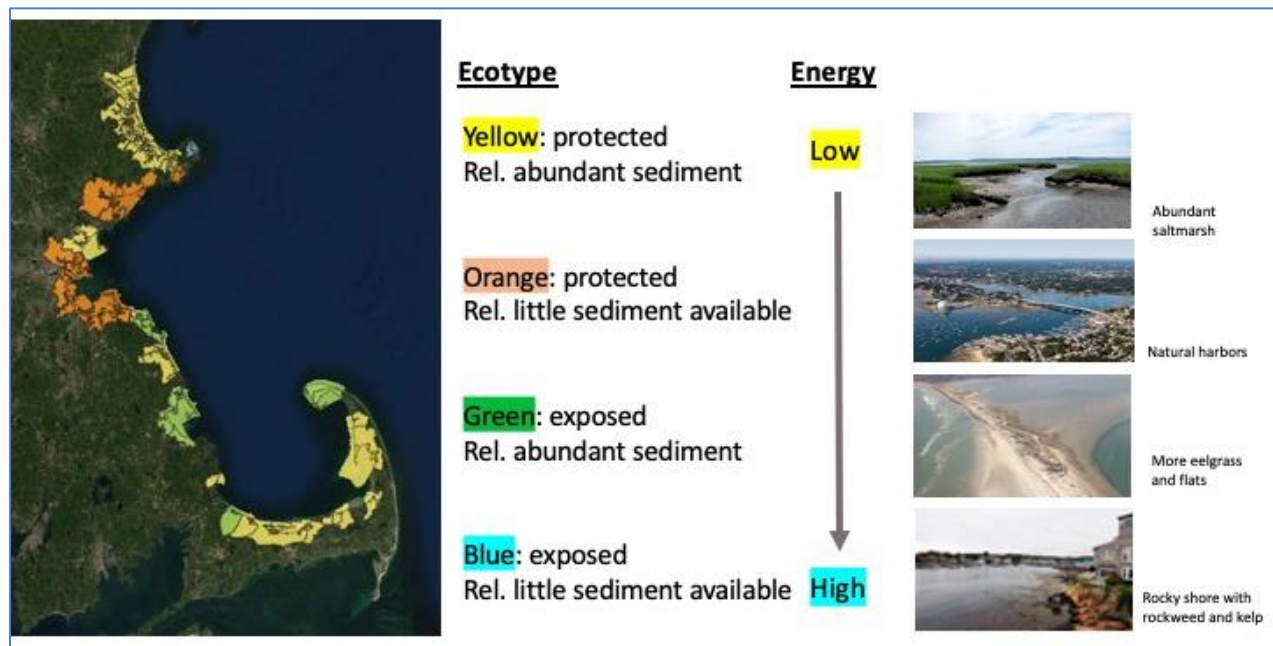


Figure ES7. MassBays’ embayments were classified into four ecotypes based on physical characteristics including exposure to wind and wave action, velocity of tidal exchange (energy), and sediment abundance. Photographs illustrate the dominant habitats supported by each ecotype.

Identifying stressor-resource categories

Simply referring to historic habitat conditions for goal-setting is not a defensible position for systems like MassBays’ study area, which has been impacted over centuries by increasing development. To set habitat goals that acknowledge existing local conditions, stressors and resources were quantified for each embayment (Table ES3). Then, Northeastern University’s Marine Science Center conducted statistical analysis to group the 44 estuarine embayments into

categories based on similarities (Figure ES8). With this information in hand, MassBays could proceed to define habitat goals for each ecotype-category combination, avoiding a situation where a more rural or shallow embayment might be compared with an embayment characterized by dense development and a protected harbor.

Table ES3. Attributes analyzed for each embayment in the MassBays study area.

Estuarine Resources	<i>Elgrass, salt marsh (% shoreline length), salt marsh (areal extent), tidal flats, rocky intertidal (natural unhardenable shoreline),</i>
Stressors	<i>High-intensity land use, annual stormwater discharge, population density, % population using septic systems, 303(d) impairments estuaries (bacteria & nutrients), septic system use; tidal restrictions, extent of hardened shoreline</i>

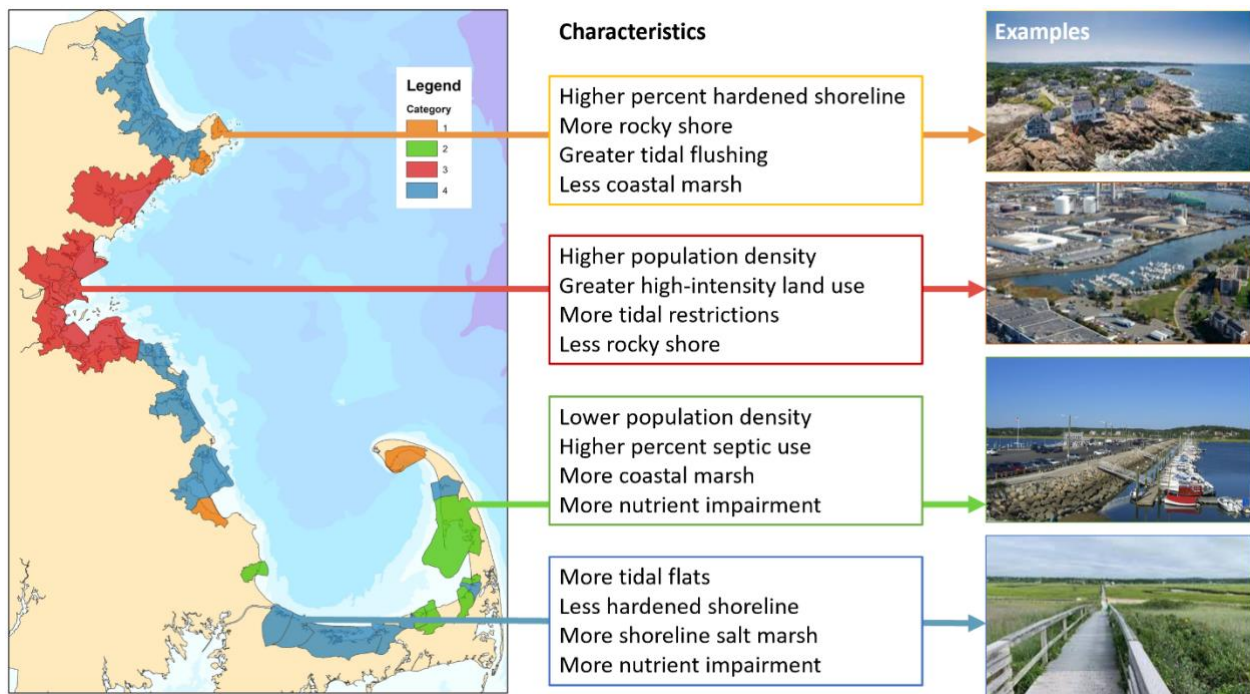


Figure ES8. Stressor-resource categories 1 through 4, with their signature characteristics. Photographs provide an example of each category.

Applying the Biological Condition Gradient approach

The Biological Condition Gradient process begins with defining the ideal, unimpacted habitat condition (represented by historical conditions) and estimates conditions that can be attained going forward under different scenarios: increased conservation and restoration, some conservation, or business as usual (Figure ES8).

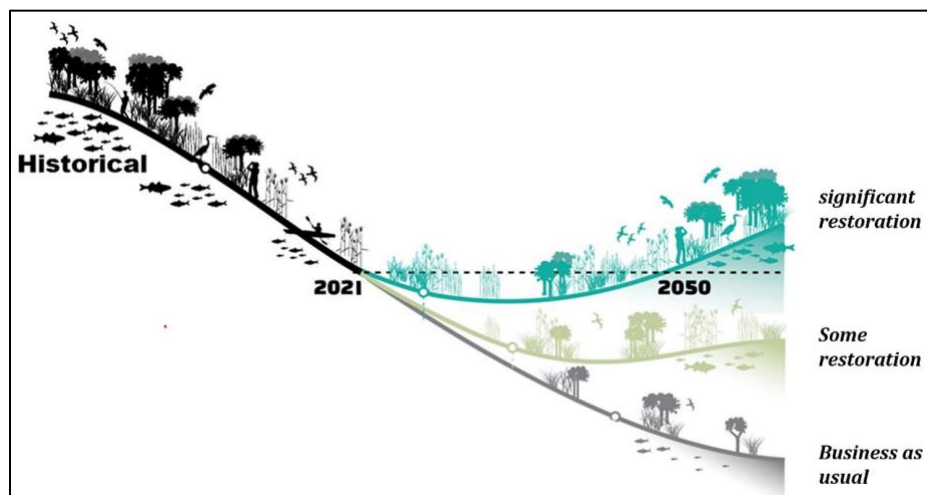


Figure ES8. The Biological Condition Gradient. Illustration courtesy of Emily Shumchenia using Integration and Application Network vector graphics (ian.umces.edu/media-library)

Step 1. Examine historical habitat extent and condition

A team from EPA’s Office of Research and Development and Office of Science and Technology used maps from the 1770s to 2021 to assess changes in habitat extent for the entire planning area. In some cases, coastal change would preclude returning to those conditions (the filling of Boston Harbor tidelands to create the modern waterfront is the most dramatic example), but in others this information provided valuable insights for our goal-setting. Analysis of these data summarized in Table ES2 also provides evidence that the ecotypes defined for MassBays can accurately be associated with distinct habitats and their distribution as depicted in Figure ES7.

Table ES2. Summary of habitat loss in MassBays’ study area over time

	Acres lost	% Lost	Data quality	
Salt marsh 1700s-2005	16125	36	Good	Significant losses will have occurred after 2005 with increasing stressors including Sea Level Rise, population density, nutrient pollution; new surveys are needed.
Tidal flats 1700s-2005	5030	22	Fair	
Eelgrass 1995-2017	5510	46	Excellent	Reflects huge seagrass loss in Wellfleet Harbor
Eelgrass 1995-2017 (Wellfleet excluded)	1827	33	Excellent	MassBays lost 33% of eelgrass over 22 yrs The rate of eelgrass loss from 2012 to 2017 was twice that of the previous 17 years.

Step 2. Collect information on local priorities

MassBays Each coastal habitat offers unique benefits to people as well as the creatures that rely on those habitats for food and protection. EPA researchers analyzed municipal planning documents for local priorities, while MassBays worked with University of Massachusetts Boston researchers to ask local experts – residents of representative communities – which benefits they consider most important to future generations.

Step 3. Consult with scientists on the potential for future restoration

Multiple factors influence habitat restoration potential. Sea level rise, coastal erosion, and temperature changes associated with climate change; development that hems in salt marshes and shoreline hardening with seawalls; water pollution; invasive species; dredging; and poor fishing and boating practices all impact the ability of coastal habitats to thrive. These factors were taken into account when setting out possibilities for 2050 (Table ES3).

The resulting targets are visualized as “habitat goals” in MassBays’ Ecohealth Tracking Tool (ETT), a web-based State of the Bays reporting platform launched in 2022. The targets are described in terms of “healthy acres” of each habitat and are based primarily on the suitability for the habitat offered by geophysical conditions (exposure, coastal geology, and shallow-water habitat area) and not influenced by anthropogenic factors. with two take-home considerations:

- Goals for salt marsh and tidal flat extent are equal to “current” acreage as of June 2005. Due to sea level rise and existing development and infrastructure encroaching along the coastline, it is unclear whether those habitats have the potential to expand, so MassBays’ goals for salt marsh and tidal flats are focused on maintaining and improving the health of existing habitat rather than expansion. As we look forward (see Goal 3), we will develop additional information regarding potential for habitat expansion and improved health in terms of water quality using Habitat Potential Indices (HPIs). We will thus be able to track progress toward our environmental outcomes: expanded coastal habitat, improved habitat continuity and hydrology, restored natural communities, and improved water quality through implementation of our monitoring framework (Attachment 3).
- Some embayments are already meeting or exceeding habitat goals. MassBays set the habitat goals using a process that looks across embayment ecotypes (described above) in an effort to compare like-with-like, thus individual embayments might be in better condition compared to similarly categorized embayments. In addition, habitat maps are a snapshot of habitat extent, and change in area can shift dramatically from year to year; there are also limitations to the remote sensing data used.

Table ES3. Habitat goals for MassBays estuarine embayments

Ecotype	Habitat	Goal by 2050	Acres to restore/maintain	Associated ecosystem benefits
Green	Eelgrass	Increase acres, improve quality	2,040	<ul style="list-style-type: none"> • Habitat for fish, birds, invertebrates • Improved water quality • Nitrogen uptake • Carbon sequestration • Shoreline protection & erosion control • Aesthetics • Shellfish production • Food sources • Recreational opportunities
	Salt Marsh	Maintain acreage, improve quality	2,800	
	Tidal flats	Maintain acreage, improve quality	4,060	
Yellow	Eelgrass	Increase acres, improve quality	4,560	
	Salt Marsh	Maintain acreage, improve quality	27,170	
	Tidal flats	Maintain acreage, improve quality	11,720	
Orange	Eelgrass	Increase acres, improve quality	10	
	Salt Marsh	Maintain acres, improve quality	1,730	
	Tidal flats	Maintain acres, improve quality	3,270	
Blue	Eelgrass	Maintain acreage, improve quality	2	
	Salt Marsh	Maintain acreage, improve quality	0	
	Tidal flats	Maintain acreage, improve quality	4	

MassBays' Role into the Future

Despite the 81 universities and colleges and at least 60 nonprofit organizations working within 25 miles of Boston, MassBays is the only entity that has taken up the challenge of characterizing the habitats and water quality in each coastal subwatershed, from Salisbury to Provincetown, across three bays. MassBays' efforts to drive improvements in habitats and water quality across our study area will be informed by site-specific targets.

Our regional purview places MassBays in a unique position to look across individual data sets to identify common challenges and opportunities. Reporting from the Regional Coordinators, insights from members of our Management Committee and Science and Technical Advisory Subcommittee, and access to an extensive network of state, federal, and local partners and collaborators provide MassBays with the context needed to respond to emerging concerns.

At the same time, NEPs' non-regulatory mandate under the Clean Water Act allows MassBays to bring together disparate stakeholders as a neutral convener, and to provide direct assistance to local implementers. This role becomes even more important as federal and state governments direct investments in infrastructure and responses to climate change, revealing the need for increased capacity among communities. MassBays has taken up this task, providing training, tools, and one-on-one support to efforts by municipalities, and local and regional nonprofit organizations.

Finally, aligned with the NEP focus on coastal habitat protection and restoration, MassBays identifies, develops, and implements investigations and programs that incorporate holistic, ecosystem-based solutions. This approach acknowledges the interconnectedness of human and coastal systems, a concept that will be integral to our work with communities and decision makers, while also taking into account the need for long-term, adaptive response to current conditions.

Tracking and Reporting

The new operational framework provided in this CCMP will enable us and our partners to generate and point to real and substantial improvements in the MassBays ecosystems, including:

- Greater habitat continuity and hydrological connectivity at the local level.
- Local investment in and long-term maintenance of natural systems for coastal resilience.
- Spatial expansion of natural communities.
- Ambient water quality that supports biodiversity.

To document these changes, and as required under the Clean Water Act, MassBays will produce a State of the Bays report or conference every five years. To now, the scope of that reporting has been limited by the availability of data for such assessments, especially for water quality data outside Boston Harbor and Cape Cod Bay, and for habitat and species information. With the new blueprint for the bays, we will be able to provide more granular documentation of trends and conditions, as compared to the targets described above. MassBays' tools for tracking and sharing this information include:

- A **Monitoring Framework** that builds on governmental and nongovernmental monitoring programs, using data gathered by community-based groups that may be overlooked. (The 2021 version is included as Attachment 3).
- **Ecohealth Tracking Tool**, an online data visualization tool providing access to long-term data sets relevant to MassBays' targets for coastal habitats and relevant water quality data. Data trends and conditions are currently available at the embayment level for eelgrass, salt marshes, and tidal flats along with progress towards habitat targets, as well as a suite of water quality parameters. Work under this CCMP will continue to expand the coverage of

the ETT to include diadromous fish runs and spawning habitat, barrier beaches and dunes, rocky shores, and benthic health.

- **Ecosystem Delineation and Assessment**, and an interactive Story Map online at <https://bit.ly/3QDi8P9>, which provides geolocated data from the full assessment, everything from the locations of shellfishing areas and wastewater discharge pipes to upland population density and land use.
- MassBays also developed two tools for use by partners: **AquaQAPP**, a “wizard”-like online application that helps users build Quality Assurance Project Plans to guide their monitoring and improve project outputs (www.aquaqapp.com); and **MassWaterR**, a package of R-based tools for data analysis, including generating a QA/QC report and data suitable for upload to EPA’s Water Quality Portal (<https://massbays-tech.github.io/MassWaterR/index.html>).

Goals, Strategies, and Actions: 2023 through 2033

Section VI of the CCMP presents the adaptive and nimble approach MassBays will use to meet the Environmental and Management Challenges in the Bays. Activated by year-by-year implementation of Activities specified in annual workplans, this structure, characterized by broad Goals, focusing Strategies, and concrete Actions, provides flexibility to take advantage of opportunities for projects with the highest likelihood of success given funding, local support, and complementary efforts by other entities that may join us in advancing CCMP implementation. A sample workplan (Appendix M) for FFY2022 illustrates the tight connection between the CCMP and yearly activities.

In Section VI, three sets of Organizational and Programmatic Goals provide the context for Strategies to be employed, with Actions and Activities identified through the CCMP development process, presented in the following layout:

- Description of **Organizational Goal***
- Description of associated **Programmatic Goal***
- Description of **Strategy [1]***
- Description of **Action [1.1]***
- List of **Activities***
- Description of **Environmental Outcomes expected***
- Estimate of **Resources Required***
- List of **Outputs***
- List of **Measures***
- Estimated **Timeline***
- List of anticipated **Partners and their [Roles]***

We encourage you to review the range of Actions and Activities included in the full CCMP, and to join us in our work toward realizing significant environmental outcomes.

A Blueprint for the Bays

Contents

Executive Summary.....	ES-1
Acronyms and Abbreviations.....	4
New Challenge, New Mission, New CCMP.....	6
I. MassBays’ History and Structure.....	7
II. Current Conditions in the Bays.....	11
Geography, Geomorphology and Hydrology of the Bays.....	12
Tracking conditions across the Bays.....	14
Ecosystem Delineation and Assessment	15
Conditions in the Water Column.....	16
Living resources and habitat types.....	19
Setting habitat goals.....	30
Ecotypes.....	30
Resource-Stressor Categories.....	31
Applying the Biological Condition Gradient approach.....	33
III. MassBays’ Evolution.....	35
Planning documents.....	35
Responding to new conditions.....	36
A shift in focus	40
Climate change.....	40
Environmental justice.....	42
IV. MassBays’ Role into the Future	43
New Vision, New Mission.....	43
A New CCMP.....	44
Guiding Principles.....	45
Revision Process.....	45
A Blueprint for the Bays.....	50
Challenges.....	50
Outcomes.....	52

V.	The New CCMP	55
	History Informing the Future: MassBays’ Habitat Targets.....	56
VI.	Blueprint for the Bays: Goals, Strategies, and Actions 2023 through 2033	57
	Goal 1.....	58
	Strategy 1.1 Make new data available, especially to address specific gaps in knowledge.	59
	Strategy 1.2 Support valid (QA/QC) data collection and application.	62
	Strategy 1.3 Analyze and present existing data in multiple formats to document baselines and trends.....	69
	Goal 2.....	73
	Strategy 2.1 Support, conduct, and disseminate research regarding ecosystem conditions and functions to inform state policy and local action.....	73
	Strategy 2.2 Provide education, training, and technical support; provide access to, and increase influence on decision making by EJ communities.....	77
	Strategy 2.3 Increase and maintain input from new and diverse partners for CCMP implementation and updates, through MassBays’ organizational structure and operations.....	80
	Goal 3.....	83
	Strategy 3.1 Establish target (improved) water quality and habitat conditions	84
	Strategy 3.2 Guide local action to expand habitat and improve water quality according to community-prioritized targets.....	86
	Strategy 3.3 Meet National Estuary Program requirements	90
VII.	Conclusion.....	93

Appendices

- A Development of long-term estuaries habitat targets
- B 2003 CCMP Action items
- C Progress and accomplishments, 2004 through 2017
- D 2005-2009 Strategic Plan progress reports
- E Results of regional meetings
- F Results of stakeholder interviews
- G Agenda and results of interagency information sharing sessions
- H Roadmap to a revised CCMP for MassBays
- I Results of public outreach, November 2018
- J CCMP development logic model
- K EPA/State Management Conference agreement, 1990
- L Management Committee membership, 2013 to 2022
- M Sample workplan, FFY2022
- N Sample Healthy Estuaries Grant Request for Proposals, 2022

Acronyms and Abbreviations

AGM	Associated Grantmakers of Massachusetts
ANEP	Association of National Estuary Programs
ARCGIS	Proprietary GIS display software
BCG	Biological Condition Gradient
CCMP	Comprehensive Conservation and Management Plan
Chla	Chlorophyll a
CWA	Federal Clean Water Act
CZM	MA Office of Coastal Zone Management
DCR	MA Department of Conservation and Recreation
DEP	MA Department of Environmental Protection
DER	MA Department of Fish and Game, Division of Ecological Restoration
DMF	MA Department of Fish and Game, Division of Marine Fisheries
DO	Dissolved Oxygen
EDA	Estuary Delineation and Assessment
EEA	Executive Office of Energy and Environmental Affairs
EPA	United States Environmental Protection Agency
ETT	Ecohealth Tracking Tool
FEGS	Final Ecosystem Goods and Services
FTE	Full-time Equivalent
GIS	Geographic Information Systems
ISMN	Integrated Sentinel Monitoring Network
LGC	Local Governance Committee
MACC	Massachusetts Association of Conservation Commissions
MassBays	Massachusetts Bays National Estuary Partnership
MassDOT	MA Department of Transportation
MET	Massachusetts Environmental Trust
MGD	Million gallons per day
MIT	Massachusetts Institute of Technology
MOTN	Marine and Oceanographic Technology Network
MS4	Municipal Separate Storm Sewer Systems
MT	Metric ton
MWRA	Massachusetts Water Resources Authority
NEIWPCC	New England Interstate Water Pollution Control Commission
NEOSEC	New England Ocean Science Education Collaborative
NEP	National Estuary Program
NEPORT	NEP Online Reporting Tool
NERACOOS	Northeast Regional Association of Coastal and Ocean Observing Systems
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NROC	Northeast Regional Ocean Council
PE	Program Evaluation
QAPP	Quality Assurance Project Plan
RAE	Restore America's Estuaries
RC	Regional Coordinator
RCC	Restoration Coordination Center (Cape Cod)

Acronyms and Abbreviations, continued

RPA	Regional Planning Agency
RSP	Regional Service Provider
SSU	Special, Sensitive or Unique (marine species or habitats)
STAC	Science and Technical Advisory Subcommittee, MassBays
TNC	The Nature Conservancy
TTOR	The Trustees of Reservations
UMB	University of Massachusetts Boston
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
YOY	Young of Year

New Challenge, New Mission, New CCMP

All National Estuary Programs (NEPs) are required under Clean Water Act (CWA) §320 to prepare a Comprehensive Conservation and Management Plan (CCMP). CCMPs are living documents, reflecting the NEPs' achievements in meeting earlier goals even as we struggle to maintain environmental gains in the face of more pervasive and more difficult new challenges. They serve as blueprints for more detailed actions over time, providing a framework for setting priorities and making crucial science, management, and funding decisions. They are also critical components of the NEP model of adaptive management, enabling and facilitating a continual process of integrating new data and results. And finally, because NEPs focus on varied inputs and impacts on estuaries – where the rivers meet the sea, and the ocean meets the shore – we are in a unique position to address holistic, intersectional ecosystem-based management issues.

This CCMP represents ten years of planning, public input, and stakeholder reviews. It highlights our past accomplishments and recognizes where we must do more or do things differently. New areas include heightened focus on impacts and responses to climate change, and the need for greater inclusiveness in our decision-making to genuinely address concerns for environmental justice. The CCMP also provides a clearer understanding of MassBays' role in the Commonwealth's rich and varied environmental community. As articulated in our new vision and mission, **MassBays envisions** a network of healthy and resilient estuaries, sustainable ecosystems that support the life and communities dependent upon them; **our mission** is to empower 50 coastal communities to protect, restore, and enhance their coastal habitats. To fulfill this mission, MassBays engages local, state, and federal entities to advance the use of scientific information and provide technical support for better decision making.

These principles form the basis of our annual workplans and underlie the commitments for action found in the CCMP and the role MassBays will play in promoting and implementing them in our study area (see Figure 1).

We look forward to working with partners across the Bays – at the local, state, and federal levels – to implement this comprehensive plan. We have designed this plan to ensure that our collective investments of time, money, and expertise will be directed to priority challenges and concrete results. We invite any and all to join us in this effort to bring new research to inform resource management, invest in new tools for decision makers, encourage and enable practical actions by individuals and institutions, and steer communities toward investments that result in restored and resilient ecosystems.

I. MassBays' History and Structure

In the 1980's, Boston Harbor was considered one of the filthiest in the nation. A significant cause of the pollution problem was an antiquated sewage treatment facility located on Deer Island, which discharged approximately 138 tons of wastewater solids and sludge just one-half mile offshore into the harbor every day. In 1982, the City of Quincy and EPA filed suit against the Commonwealth of Massachusetts for violations of the Clean Water Act in Boston Harbor and won. The Massachusetts Bays Program was launched in 1988 with a charge to administer a portion of the settlement payments from this lawsuit to bring researchers to diagnose the problem and suggest solutions. That same year, the program was nominated into the National Estuary Program (NEP) with the support of public officials, environmental organizations, state and federal legislators, business leaders, scientists, and private citizens. On Earth Day in April 1990 EPA announced its favorable decision, and the NEP was formed through a cooperative agreement between the Commonwealth and EPA, with CZM named the host institution. In June of 2022 the Management Committee voted to transfer hosting to the University of Massachusetts Boston (UMB), to better fulfill the goals of the NEP and respond to EPA Program Evaluation findings. The study area was defined to include 50 coastal communities and more than 1100 miles of coastline around three Bays: Ipswich, Massachusetts, and Cape Cod (Figure 1).

In the early years, the Program led a major scientific research initiative to determine specific pollution problems in Boston Harbor. MassBays administered a \$1.6 million Environmental Trust from payments made by Boston Harbor dischargers. From 1990 to 1992, MassBays distributed more than \$1 million of the Trust Fund for research primarily in Boston Harbor and Cape Cod Bay, in an effort to begin characterizing the major physical and biological features of the Bays.

At the same time, a Management Conference was convened to provide a forum for open discussion and collaborative decision-making. The Conference included nearly 300 representatives serving through Committees. Figure 2 is taken from the EPA/State Management Conference Agreement dated November 1990 and signed by EPA and Commonwealth officials, included here as Appendix K. In the document summary, the parties to the agreement state:

The Management Committee has set out a plan to identify priority problems, characterize the Bays, develop management and action plans, and translate plans into actions. The Management Committee recognizes the importance of informing, educating, and involving the public about the pollution in the Massachusetts Bays and how we can all help to improve the Bays' health. At the end of five years, our success will not be measured by how many reports we have produced, but by whether our actions have resulted in reduced pollutant loadings to the Bays and in the formation of a comprehensive management plan that enjoys a broad-based public commitment to the restoration and preservation of Massachusetts and Cape Cod Bays.²²

²² Massachusetts Bays National Estuary Program. 1990. EPA/State Management Conference Agreement.

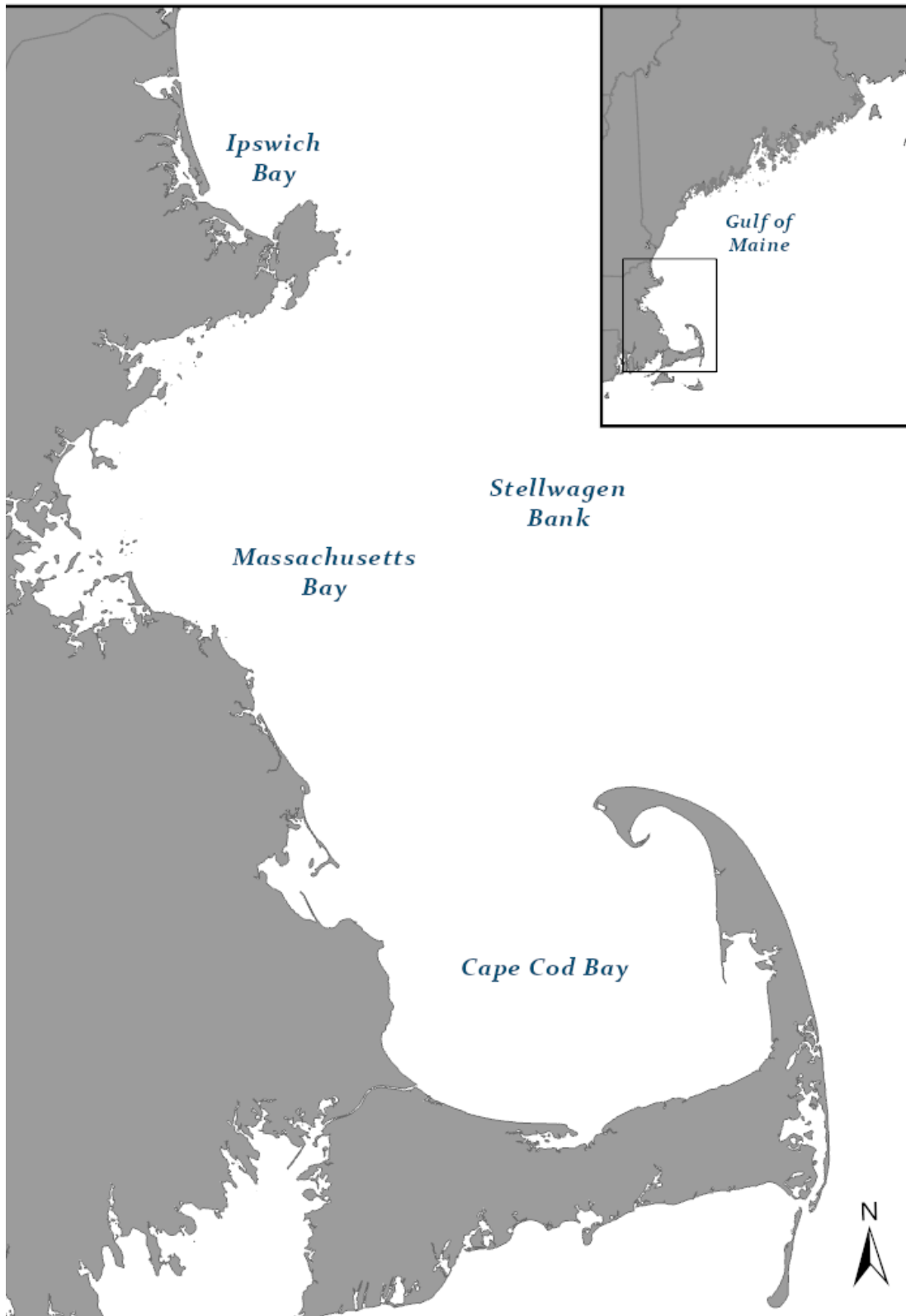


Figure 1. The Bays

Conference members were organized into a network of committees to oversee Program activities and research. Drawing on the research results, staff led a collaborative process to develop MassBays' first CCMP in 1996. Since then, the CCMP was updated in 2003 with new initiatives and Action Plans, the Management Conference and associated committees evolved into a smaller Management Committee (MC) with a broader purview, and in 2013 the Program name was changed to emphasize the organization's basis in the Clean Water Act: Massachusetts Bays National Estuary Program. Then, in 2018 the MC voted to refer to MasssBays as a National Estuary Partnership, deemed a more descriptive named that reflects our principles.²³

Committee	Members	Role
Policy	EOEA Secretary EPA Regional Administrator	Sets overall policy
Management	Local, State, and Federal agency representatives TAC representatives CAC representatives	Develops program goals and 5-year plan Approves budgets Awards contracts Approves and accepts reports
Technical Advisory (TAC)	Scientists, planners, state and federal agency staff	Recommends scientific and technical direction Recommends funding of specific projects
Citizens Advisory (CAC)	Representatives from citizen groups, e.g., industry, education, environmental, legislative, advocacy	Recommends priorities for all aspects of program Mobilizes public support Coordinates outreach

Figure 2. Organization of the MassBays Management Conference, 1990

With 65 distinct assessment areas (embayments, flat rocky shoreline, and barrier beaches) from the town of Salisbury to the town of Provincetown (See Section II), effective stakeholder engagement requires local expertise. Early in its establishment, MassBays created a regional structure which facilitates technical support on a town-by-town basis. Locally connected Regional Service Providers (RSPs) not only bring extensive area-specific knowledge to MassBays' work, this unique structure also maximizes EPA's investment in MassBays, providing efficiency in personnel expenditures.

MassBays provides annual subawards to five RSPs selected based on the following:

- A record of local engagement in their region, including setting priorities for actions that improve coastal habitats and promote habitat protection and restoration.
- Adequate regional visibility and reputation to provide leadership and technical support to local partners.
- Capacity and willingness to leverage additional resources in service of MassBays' mission.

²³ Massachusetts also has a second NEP, the Buzzards Bay National Estuary Program (buzzardsbay.org)

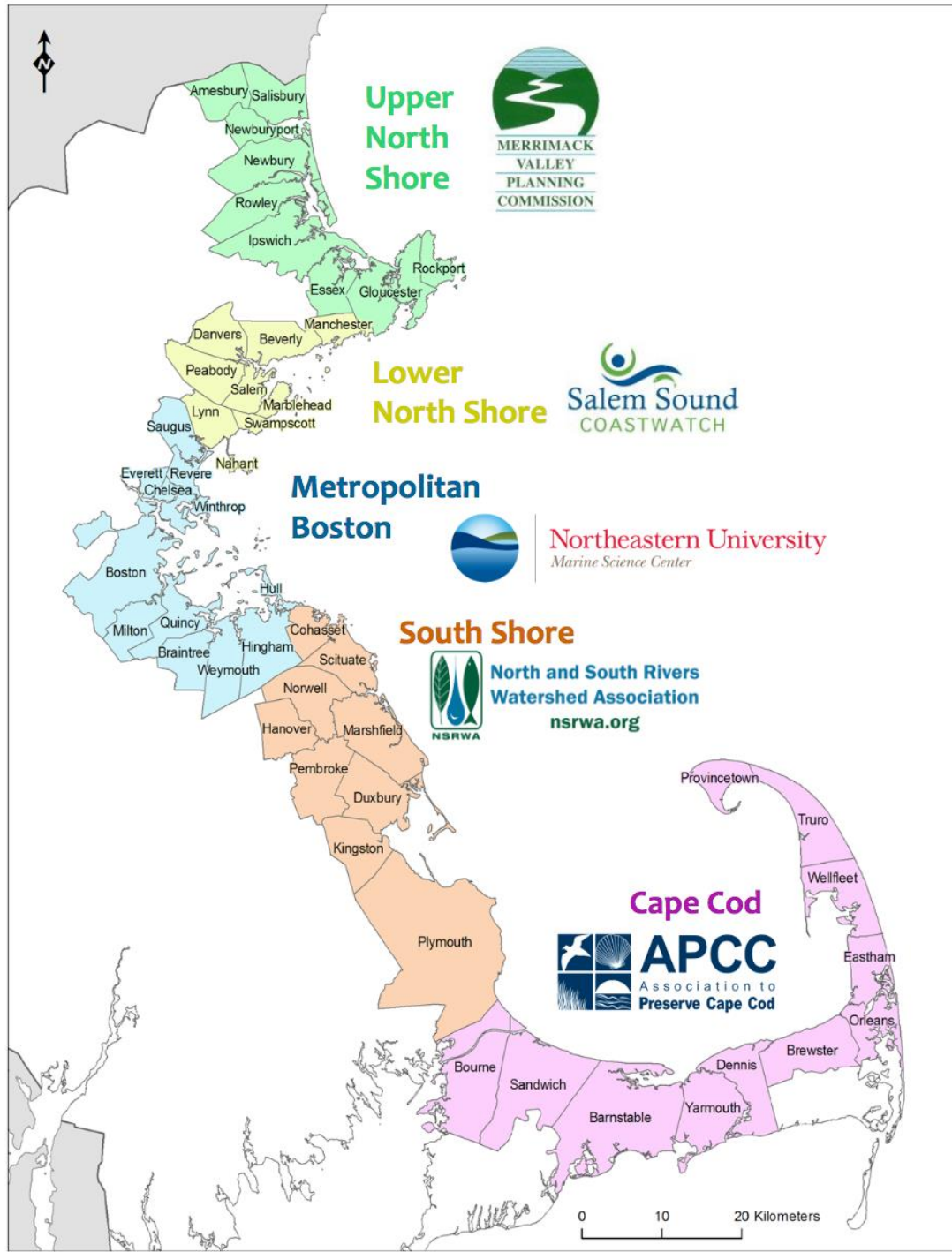


Figure 3. MassBays Regions in the Study Area, and 2023 Regional Service Providers

Each RSP employs a Regional Coordinator (RC), who in turn convenes a Local Governance Committee (LGC). Those local partners provided important input to the CCMP, vetting goals and strategies, and will contribute to building realistic yearly regional workplans to implement the long-term plan.

Figure 4 is an organizational chart for MassBays which highlights the importance of the MC for oversight and advice to MassBays' work through quarterly meetings and Subcommittee activities dedicated to specific needs. In accordance with our Structure and Operating Procedures (2013)²⁴, members represent:

- Federal and state agencies
- State-wide nonprofit environmental organizations
- Sub-regional nonprofit environmental organizations
- Business community
- Research and/or academic institutions
- Local government

Appendix L lists the MC members in place during the 2013-2022 CCMP revision process.



Figure 4. MassBays organizational chart

II. Current Conditions in the Bays

MassBays' study area encompasses an area of about 1,650 square miles from coastal wetlands offshore to Stellwagen Bank, 25 miles east of Boston. It consists of an inland watershed covering over 7,000 square miles. Its 1100-mile coastline from Salisbury to Provincetown is characterized by a diverse and complex geomorphology that has shaped unique estuaries where some of the harshest environmental challenges exist. By the very nature of their location and hydrography, these estuaries are rich in natural resources (e.g., salt marsh, tidal flats, eelgrass beds, and diadromous fish habitat), attracting a wide variety of commercial and recreational uses. The MassBays study area is home to the largest contiguous salt marsh north of Long Island Sound (Great Marsh), hosts expansive shellfish beds, provides feeding grounds for endangered whales (e.g., North Atlantic Right Whale), serves as refuge to migrating shorebirds (e.g., endangered Roseate terns), and supports a varied and rich fishery and aquaculture industry.

The MassBays study area provides opportunities for many commercial and recreational uses. Boston Harbor is the largest seaport in New England, supporting a thriving maritime industry. On the other hand, America's oldest seaport, Gloucester, for centuries serving as a major hub for fishing, has recently been facing economic challenges from a less lucrative fishing industry. Cape Cod's beaches host hundreds of thousands of tourists each summer.

At the same time, the Bays are influenced from changing conditions in land use and land cover over time. Increase in human population results in increase in wastewater from treatment plants as well as discharge from septic systems. Increase in development and impervious surface results in

²⁴ Structure and Operating Procedures (2013)
<http://www.mass.gov/files/documents/2017/10/06/2013%20MassBays%20SOPs.pdfw>

increase in discharge from nonpoint sources such as stormwater, impacting water quality conditions. Invasive species like the European green crab (*Carcinus maenas*) threaten the biodiversity of our coastal habitats.

Above all, climate change and its impacts are fundamentally transforming the ecosystems and resources of the Bays, altering conditions as basic as surface water temperature, pH, and precipitation patterns. Currents, bathymetry, and geography influence the water quality, biological communities, and climate of the Bays. The following sections summarize these drivers, and the current conditions in the water column and habitats.

Geography, Geomorphology and Hydrology of the Bays

The Bays form the southern boundary of the Gulf of Maine. The shoreline includes beaches of sand and gravel deposited by glaciers, and intertidal rocky shores with exposed bedrock. The seascape of the Bays is a patchwork of mud, sand, gravel, and boulders.²⁵ Shoreline habitats in the Bays are determined by geology, slope and orientation, and exposure to wind and waves, as well as adjacent land use and freshwater flow from inland. In general, there is a habitat gradient from Ipswich Bay, where salt marshes dominate, to the southern coast of Massachusetts Bay where rocky intertidal habitat mingles with marshes, and finally to Cape Cod Bay, which is dominated by sand beaches, dunes, and tidal flats²⁶.

The Bays have a tidal range of up to 4.1m (12ft). Changing tides, riverine flow, and winds generate currents which can be substantial in some areas, for example Boston Harbor, around Cape Ann, and at the tip of Cape Cod off Provincetown's Race Point.

In general, the strength and direction of currents flowing south from the Gulf of Maine vary seasonally, with cold water flowing through Ipswich and Massachusetts Bays south to Cape Cod Bay and exiting the region around the Provincetown peninsula (Figure 5).^{27, 28, 29} The residence time of Massachusetts Bay varies with the inflow from the Gulf of Maine, and sometimes Massachusetts Bay is somewhat isolated from Cape Cod Bay. This flow is also influenced by riverine inputs, especially during spring. Several rivers carry nutrients and pollutants from upland parts of the watershed to coastal wetlands and into Ipswich and Massachusetts Bays. A study by Woods Hole Group to better understand water transport time in MassBays embayments used modeling to calculate water

²⁵ Knebel, H., R. Rendings, and M. Bothner. Modern Sedimentary Environments in Boston Harbor, Massachusetts. *Journal of Sedimentary Petrology*, 61(5): 791-804. <https://doi.org/10.1306/D42677D5-2B26-11D7-8648000102C1865D>

²⁶ Massachusetts Ocean Management Plan Volume 2. Commonwealth of Massachusetts 2021. <https://www.mass.gov/files/documents/2022/02/25/ma-ocean-plan-2021-vol-2a.pdf>

²⁷ Geyer et al. 1992. Physical Oceanographic Investigation of Massachusetts and Cape Cod Bays. MBP-92-03. Boston, MA. <https://archive.org/details/physicaloceanogr00geye>

²⁸ Geyer et al. 1992. Physical Oceanographic Investigation of Massachusetts and Cape Cod Bays. MBP-92-03. Boston, MA. <https://archive.org/details/physicaloceanogr00geye>

²⁹ Lermusiaux, PFJ. 2001. Evolving the subspace of the three-dimensional multiscale ocean variability: Massachusetts Bay. *J. Marine Systems*, Special issue on "Three-dimensional ocean circulation: Lagrangian measurements and diagnostic analyses", (29), 1-4, 385-422. https://www.researchgate.net/publication/242195120_Evolving_the_subspace_of_the_three-dimensional_multiscale_ocean_variability_Massachusetts_Bay



Figure 5. Subsurface currents and circulation in the Bays.

cycling and productivity patterns between open coastal waters and shallow embayments. Cape Cod Bay receives most freshwater input from groundwater inflow. Because Cape Cod residents rely primarily on septic systems, the groundwater that seeps into Cape Cod Bay often carries more nutrients into coastal waters than the coastal rivers. The Center for Coastal Studies (CCS) has been monitoring the waters of Cape Cod Bay for well over a decade, keeping track of nutrients and overall water quality condition.³² Over the past 4 years, the Association to Preserve Cape Cod (APCC) has been compiling data from CCS as well as other groups and developed an index to produce the annual State of the Waters: Cape Cod.³³ This report provides information on conditions for various stakeholders and serves to inform managers on changing conditions that could spur action.

Long-term monitoring is important to track conditions so that sudden changes can be noticed and addressed immediately. In 2018 lobstermen noted a large number of dead lobsters when they were retrieving their traps in nearshore Sandwich and Barnstable Harbor in Cape Cod Bay. Immediate response by scientists from the Division of Marine Fisheries (DMF) and CCS revealed a drastic drop in DO, down to <1mg/L, indicating severely hypoxic conditions which lasted for several days. An

transport time which ranged from 0 hrs (Ellisville, Plymouth) to 70.5 hrs (Rockport Harbor), with an average of 17.2 hrs, depending on the shape and depth of the embayment.³⁰

The study revealed that only three riverine embayments had more than 2% freshwater influence (Merrimack River, Charles River, and Ipswich River), essentially confirming that despite the many rivers discharging into MassBays, tidal influence vastly exceeds that of freshwater. The largest river is the Merrimack River with a 10-year average flow $245 \text{ m}^3 \text{ s}^{-1}$ ($8,745 \text{ ft}^3 \text{ s}^{-1}$); spring maximum up to $616 \text{ m}^3 \text{ s}^{-1}$ ($22,000 \text{ ft}^3 \text{ s}^{-1}$). USGS has documented an increase in flow from the Merrimack River since the 1960s, as measured using a federally funded stream gauge.³¹ A brief analysis of potential conditions in 2050 seemed to indicate that flushing time varied when taking sea level rise modeling results into consideration.

Cape Cod Bay is a dynamic environment and has its own hydrologic “regime” that influences observed differences in nutrient

³⁰ Woods Hole Group Inc., 2019. MassBays Water Transport Times Estimation Project. Report prepared for MassBays National Estuary Partnership.

³¹ USGS Current Water Data for Massachusetts <https://waterdata.usgs.gov/ma/nwis/rt>

³² Center for Coastal Studies Water Quality Program <http://www.capecodbay-monitor.org/>

³³ State of the Waters: Cape Cod 2021 <https://capecodwaters.org/>

intensive investigation was launched by DMF with assistance from volunteer lobstermen; this partnership formed the Cape Cod Study Fleet, which since 2019 has been conducting monitoring every year from July through October. Indications of very low DO were observed in 2019, but less alarming drops which lasted only a short time were observed in 2020 and in 2021. Since then, scientists from WHOI have joined the team to better understand possible causes, including the possibility of HABs, specifically *Karenia mikimotoi*, recently observed in Massachusetts Bays and Cape Cod Bay since 2018. In 2021 MassBays, at the request of EPA and the Massachusetts Water Resources Authority (MRWA)'s Outfall Monitoring Science Advisory Panel (OMSAP), convened and facilitated a forum to bring all of the research, both local and further afield, for a technical discussion of the factors contributing to this situation. The importance of long-term targeted monitoring to answer critical questions and inform remedial actions was underscored during the discussion.

Tracking conditions across the Bays

As required under the Clean Water Act, MassBays reports on the condition of the Bays approximately every five years. This usually takes the form of a State of the Bays report or conference to provide snapshots of estuarine conditions in the MassBays study area. The scope of that reporting has been limited by the availability of data for such assessments. Although water quality data are available for Boston Harbor and Cape Cod Bay, such data for other embayments are sporadic and often associated with specific studies that are limited by the time of the study and resources. This is also the case for habitat and species surveys. Currently, MassBays relies on state-wide presence/absence of salt marsh and eelgrass (based on DEP mapping), shellfish and fish landings (using DMF statistics), and region-wide land use assessments documented by CZM.

To reach our desired outcomes of restored natural communities and improved conditions across the entire study area, and meet targets for individual embayments, we must document existing conditions, and track water quality and habitat health at the local level. MassBays has invested considerable resources through the several tools, including:

- Providing funding to Regional Service Providers who lead monitoring and assessment efforts in their communities. They track numerous parameters on a regular basis, including anadromous fish migration counts, horseshoe crab spawning and green crab population assessments, rapid eelgrass assessments, assessment of salt marsh health and monitoring of salt marsh communities, and water quality. Some examples include Clean Beaches and Streams Program;³⁴ Horseshoe Crab Monitoring;³⁵ Herring Monitoring Program (Cape Cod).³⁶
- Documentation of existing stressors and resources in 44 delineated embayments, using data provided by government entities. The 2017 Ecosystem Delineation and Assessment identified 65 assessment areas that include 44 embayments, and 21 inter-estuarine areas (including straight rocky intertidal areas and barrier beaches) (Figure 6).³⁷
- Development of a monitoring framework that builds on governmental and nongovernmental monitoring programs, using data gathered by community-based groups

³⁴ Salem Sound Coastwatch Clean Beaches and Seas Program <https://www.salemsound.org/CB&S.html>

³⁵ North and South Rivers Watershed Association Horseshoe Crab Monitoring <https://www.nsrwa.org/get-involved/citizen-science/horseshoe-crab-monitoring/>

³⁶ Association to Preserve Cape Cod Herring Monitoring Program <https://apcc.org/our-work/science/community-science/herring/>

³⁷ Estuary Delineation and Assessment: Report <https://www.mass.gov/service-details/estuary-delineation-and-assessment> and Story Map <https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=1b4ed0e72ccd4942a78b6ae36d6f6f36>

that may be overlooked. A draft is attached at publication time as Attachment 3; it will be updated during 2023.

- Development of a web-based tool, AquaQAPP, to help users build Quality Assurance Project Plans that will guide their monitoring and make their data usable by government, academic and other entities.³⁸
- Development of long-term estuarine habitat targets for eelgrass, salt marsh and tidal flats using the Biological Condition Gradient (BCG) Framework (Appendix A).
- Development of an Ecohealth Tracking Tool to track trends and conditions in habitats and water quality. The tool is based on data collected by local groups as well as environmental entities and MassBays and accessed through EPA's Water Quality Portal and serves to report on the State of the Bays, at the embayment level and follow progress towards habitat targets.

Ecosystem Delineation and Assessment

MassBays' Estuary Delineation and Assessment (EDA) physically defines the estuarine seaward and landward boundaries of the MassBays study area and describes important biological features as well as human stressors of 65 assessment areas (Figure 6). These include 44 estuarine embayments, the rest are flat rocky shorelines (sometimes hardened) and barrier beaches. The attributes selected to characterize the embayments were based on a set of criteria including data availability, data confidence level, and applicability. Datasets for 10 ecological resources, 15 stressors, and 8 socioeconomic attributes were used for spatial analysis of each embayment. This list is by necessity limited to habitats and parameters for which data are available. Goal 1 of this CCMP focuses on identifying and filling data gaps that would allow broader characterization of the assessment areas (e.g., benthic communities, emerging contaminants, sentinel species assessments).

An online, an interactive version of the EDA is presented as an ArcGIS Story Map³⁹ for public access. MassBays will continue to update the EDA as ecological, physical, and human use metrics data become available to keep the information current.

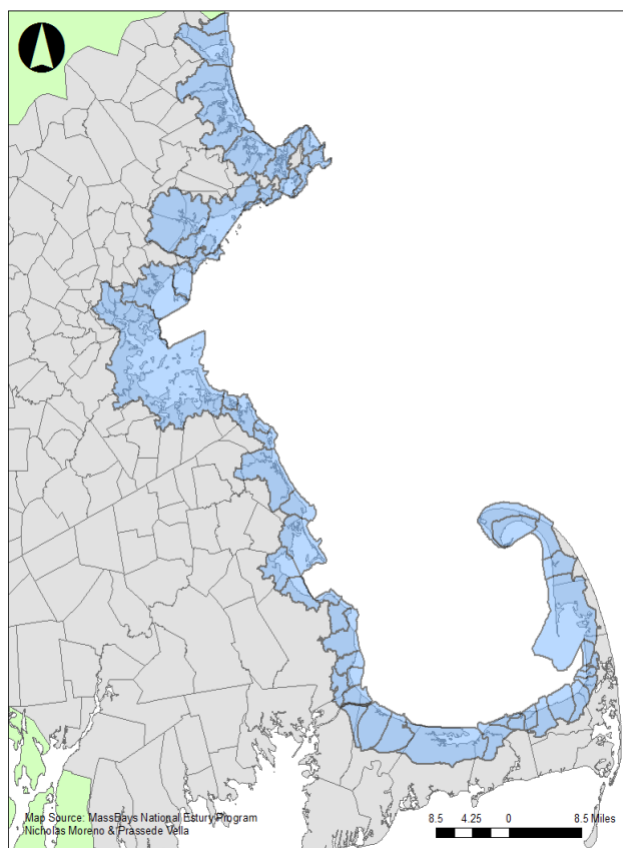


Figure 6. Estuarine embayments and inter-estuarine areas identified by the EDA process.

³⁸ AquaQAPP (a product of MassBays) <https://www.aquaqapp.com/>

³⁹ Estuary Delineation and Assessment: Report <https://www.mass.gov/service-details/estuary-delineation-and-assessment> and EDA Story Map <https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=1b4ed0e72ccd4942a78b6ae36d6f6f36>

The sources of information can be used by stakeholders and communities to better understand the setting of their area of interest, the resources that need protection, and the stressors that are driving environmental conditions. In this way, communities can focus on the unique conditions and concerns of their embayment and can also coordinate with similar embayments in order to reach their goals. The EDA forms the basis for two characterizations MassBays has used to support target-setting across the embayments, described below.⁴⁰

Conditions in the Water Column

Temperature

Sea surface temperature influences many aspects of an organism’s life history, including breeding and spawning, migration, predator/prey interaction, and basic physiological functions. Data compiled by the Northeast Regional Association of Coastal Oceanographic Observing Systems (NERACOOS) from the Massachusetts A01 Buoy remains the strongest source of continuous surface and bottom sea temperature data for areas north of Cape Cod (Figures 7 and 8 show the time series 2000-2020). These data show that the temperature of Massachusetts Bays is on a rising trend.⁴¹ For example, sea temperatures recorded in 2012 were the warmest since 2000, causing early molting in American lobster (*Homarus americanus*) in the Gulf of Maine. Scientists predict that the continuing increase in water temperature will make lobster eggs less likely to survive their first year of life, resulting in fewer numbers of lobsters through 2050.⁴² Another notable maximum was observed in 2015 in the winter sea surface temperature (45.6°F) (Figure 7), and again in 2016 a maximum was recorded in 2016 for annual sea bottom temperature (45.8°F) (Figure 8). Until a

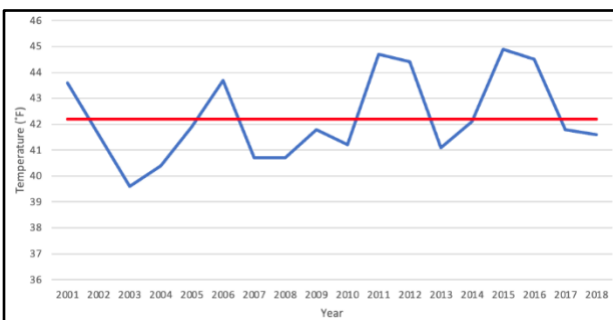


Figure 7. Average annual winter (Dec-Feb) sea surface temperature (°F) at the Massachusetts A01 buoy (2001-2018). The red line is the mean (42.2°F).

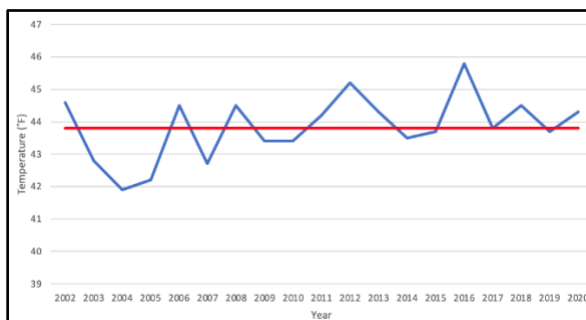


Figure 8. Average annual sea bottom (50 m) temperature (°F) at the Massachusetts A01 buoy (2002-2020). The red line is the mean (43.8°F).

longer continuous time series becomes available for northern Massachusetts waters, long-term trends cannot be confidently described.⁴³

Variations in water temperature at different depths create “layers” or thermocline in ocean waters. Depending on the temperature, the water column above and below the thermocline can hold oxygen and nutrients differently, impacting microbial growth and concentrations over the course of

⁴⁰ As of 2021, MassBays’ target-setting has been carried out for the estuaries of MassBays’ study area only. Implementation of this CCMP will address target-setting for diadromous fish runs, barrier beaches, and other inter-estuarine assessment units (see Goal 3).

⁴¹ <http://www.neracoos.org/data/index.html>

⁴² Pershing, A. et al. 2015. Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. *Science* V. 350 (6262): 809-812. <https://doi.org/10.1126/science.aac9819>

⁴³ Massachusetts Ocean Management Plan Volume 2. Commonwealth of Massachusetts 2021. <https://www.mass.gov/files/documents/2022/02/25/ma-ocean-plan-2021-vol-2a.pdf>

the year. These effects are felt more strongly in nearshore and estuarine waters where shallow seas can result in stronger and longer-lasting thermoclines that can impact nearshore ecosystems.

Dissolved Oxygen

Dissolved oxygen (DO) is an important indicator of water quality. Too little DO (< 4mg/L) impacts fish and other biota, and extreme oxygen depletion (<2 mg/L) can result in fish kills.⁴⁴ Warmer water temperatures and higher microbial activity in summer reduce the concentration of DO in bottom waters. Hypoxic areas (where an influx of nutrients creates an algal bloom and the algae die, sink to the bottom, and decompose, resulting in DO depletion) move based on upwelling or downwelling events and their corresponding wind speed and direction. Therefore, hypoxic zones can occur close to shore as well as in deeper waters. Lower DO concentrations may cause the movement of species away from the hypoxic area and may result in a decrease in feeding, reproduction, and spawning.

Massachusetts Bay and Cape Cod Bay both follow a seasonal DO cycle (Xue et al. 2013).⁴⁵ Massachusetts Bay experiences its highest DO concentrations during the spring and its lowest during the fall. On the other hand, DO concentrations in Cape Cod Bay were higher in May-September while in Massachusetts Bay levels were higher in January-March.

DO is impacted by surface and bottom temperatures as well as by weather conditions. For example, in 2019 an unusually intense thermocline created hypoxic conditions, with DO < 1 mg/L in the bottom nearshore waters of Cape Cod Bay, resulting in the death of trapped lobsters and crabs⁴⁶. Both CCS and MWRA reported similar hypoxic conditions at their respective monitoring stations in late August and early September. This condition was exacerbated by the incidence of a large dinoflagellate bloom, *Karenia mikimotoi*, identified as the suspect cause of the hypoxic conditions in bottom waters.⁴⁷ *K. mikimotoi* was first observed in 2018 in Massachusetts Bay. In Spring 2020, DMF and the Lobster Foundation of Massachusetts created the Cape Cod Bay Study Fleet to increase monitoring capacity of the area, deploying 25 data loggers on lobster traps.²² The data were analyzed by scientists from DMF and WHOI. With funding from NOAA Sea Grant, the study was repeated in 2020 (DO < 2mg/L lasted less than two days) and in 2021 (DO of 2-4 mg/L) to identify the primary influences on water quality in Cape Cod Bay. Results of a 2022 study are pending.

Nutrients

Nitrogen is a limiting nutrient in marine water, so when nitrogen or its compounds are added to coastal waters algal blooms often result. In 2019, the MWRA's Deer Island Treatment Plant discharged 13,217 metric tons of nitrogen, exceeding for the first time MWRA's Contingency Plan caution level of 12,500 metric tons.⁴⁸ This warning level reflected the predicted nitrogen load of 2020 that had modeled in 1996. MWRA did not consider the warning level exceedance an environmental concern because monitoring indicated no decrease in water quality in the vicinity of the outfall. Nutrient concentrations followed similar ranges from previous years, and concentrations of nutrients decreased with distance from the outfall. Data from CCS showed normal

⁴⁴ <https://www.epa.gov/nutrient-policy-data/documented-hypoxia-and-associated-risk-factors-estuaries-coastal-waters-and>

⁴⁵ Xue P., Chen C., Qi J., Beardsley RC., Tian R., Zhao L., Lin H. 2013. Mechanism studies of seasonal variability of dissolved oxygen in Mass Bay: A multi-scale FVCOM/UG-RCA application. *Journal of Marine Systems* 131, 102-119. <https://www.sciencedirect.com/science/article/abs/pii/S0924796313002935?via%3Dihub>

⁴⁶ Scully, M. E., Geyer, W. R., Borkman, D., Pugh, T. L., Costa, A., and Nichols, O. C.: Unprecedented summer hypoxia in southern Cape Cod Bay: an ecological response to regional climate change? *Biogeosciences*, 19, 3523–3536, <https://doi.org/10.5194/bg-19-3523-2022>

⁴⁷ 2019 Annual Outfall Report <https://www.mwra.com/harbor/enquad/pdf/2020-11.pdf>; pg. 50

⁴⁸ 2019 Annual Outfall Report <https://www.mwra.com/harbor/enquad/pdf/2020-11.pdf>; pg. vi

and improving total nutrient concentrations in Cape Cod Bay.⁴⁹ In Cape Cod Bay, peaks of total nitrogen and total phosphorus were recorded at 35.68 μM and 3.21 μM , respectively, in late 2010 and early 2012 (Figure 9, bottom panel⁵⁰), the last time these levels were exceeded.⁵¹

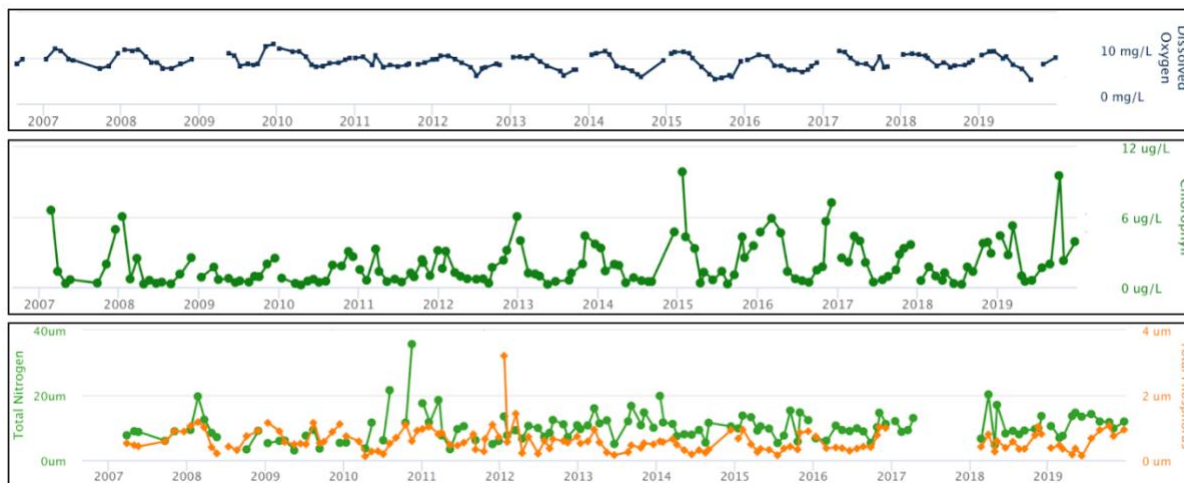


Figure 9. Dissolved oxygen (top), chlorophyll a (middle), and total nitrogen/total phosphorus (bottom) from the Center for Coastal Studies 7S station in Cape Cod Bay, August 2006 - December 2019. In the bottom graph, nitrogen is green, and phosphorus is orange.

Phytoplankton

The MassBays study area experiences annual Spring and Fall phytoplankton blooms. MWRA monitoring in Massachusetts Bay indicates that during the Spring bloom (which coincides with freshwater flow from spring rains and snowmelt), chlorophyll averages just about 2.5 mg/L. Surface concentrations decrease to less than 2 mg/L during the summer, and then spike in September through November to about 4 mg/L (after nutrients are replenished when layers mix, bringing the end to stratification).⁵² At MWRA monitoring stations, total dinoflagellate concentration increased substantially from 2018 to 2019, with the 2019 concentration ranking third highest in 28 years of monitoring.⁵³ In 2019, large blooms of *Alexandrium catenella* required seven rapid-response surveys in two months. In 2020, none of the samples taken at 15 locations exceeded the “closed to all shellfishing” biotoxin levels of 80 $\mu\text{g}/100\text{g}$.⁵⁴

Phytoplankton blooms have been observed in several areas. In 2012, scientists from Salem State University coordinated with Salem Sound Coastwatch to explore potential causes of turbidity and consequent loss of eelgrass in Salem Harbor. Data since 2010 and 2012 indicated that

⁴⁹ <http://www.capecodbay-monitor.org>

⁵⁰ *ibid.*

⁵¹ 2021 Massachusetts Ocean Management Plan. Volume 2.

<https://www.mass.gov/files/documents/2022/02/25/ma-ocean-plan-2021-vol-2a.pdf>

⁵² Geyer W., G.B. Gardner, W. Brown, J. Irish, B. Butman, T. Loder, and R.P. Signell. 1992. Physical Oceanographic Investigation of Massachusetts and Cape Cod Bays, Technical Report MBP-92-03. Massachusetts Bays Program, Boston, Massachusetts.

⁵³ Werme C, Keay K, Libby PS, Taylor D, Codiga DL, Charlestra L, Carroll SR. 2020. 2019 outfall monitoring overview. Boston: Massachusetts Water Resources Authority. Report 2020-11. 58 pages.

<https://www.mwra.com/harbor/enquad/pdf/2020-11.pdf>

⁵⁴ <https://www.mass.gov/service-details/psp-red-tide-monitoring>

phytoplankton blooms were the main cause of observed turbidity in Salem Harbor.^{55,56} In subsequent studies funded by MassBays, efforts are focusing on identifying the phytoplankton community responsible for these blooms in Salem Harbor.

Karenia mikimotoi has been observed off the coast of Maine for a few decades but was not found in MWRA samples until 2017. In 2017, *K. mikimotoi* concentration was around 300,000 cells/L. In 2019 and 2020, its concentration was close to 850,000 cells/L and 880,000 cells/L respectively at the mouth of Boston Harbor, which temporarily caused the harbor to appear brown. The toxicity of *K. mikimotoi* is not well understood, but its presence in Cape Cod Bay, where targeted sampling by CCS found more than 1 million cells/L at the pycnocline in 2019 and 2020, appears to be a major factor in the low-oxygen conditions measured in shallow inshore Cape Cod Bay over the past several years. These observations emphasize the need for targeted monitoring to catch signs of increase that may cause deleterious effects on fauna in Cape Cod Bay and other areas.⁵⁷

Living resources and habitat types

The study area is characterized by estuarine and coastal habitats that support many species of flora and fauna. This section provides a description of the main coastal habitats, but not all habitats have comprehensive and complete data. Based on the data quality and availability, MassBays selected four main estuarine habitats and established long-term restoration targets. These include **salt marsh, tidal flats, eelgrass, and diadromous fish habitat** (the last is in progress). In the future MassBays will work to gather data on other estuarine habitats and species to establish targets.

Salt marsh

There are approximately 34,000 acres of salt marsh in the MassBays study area (DEP Wetland data MassGIS 2005). Great Marsh includes 25,000 acres of salt marsh, barrier beach, tidal river, estuary, mudflats, and upland islands extending from Salisbury to Gloucester. This unique complex of natural systems adds ecological, economic, recreational, and cultural value to the daily lives of both coastal and inland communities where land is connected by river and stream networks. The Great Marsh (Figure 10) is an internationally recognized Important Bird Area, supporting many breeding and migratory birds.

More than 300 bird species have been recorded within the Great Marsh. Recent studies on the health of the marsh indicate that the ecosystem is currently in good shape; however, there are significant threats to its ecological health that need to be addressed.⁵⁸

MassBays works closely with federal, state, local and academic partners on several projects to address threats to the Great Marsh ecosystem including removal of invasive species, habitat restoration, and extensive monitoring on its condition. More information on these projects, many of the funded by National Wildlife Federation and by US Fish and Wildlife Service, is available from the Great Marsh Partnership which was established by dedicated scientists and managers led by MassBays' regional coordinator on the Upper North Shore.

⁵⁵ Hubeny, B. et al. 2017. Multi-faceted monitoring of estuarine turbidity and particulate matter provenance: Case study from Salem Harbor, USA. *Science of The Total Environment* 574:629-641.

⁵⁶ Hubeny, B. 2012. Determining the nature and causes of turbidity events in Salem Harbor (MA) through estuarine water quality monitoring. Massachusetts Bays National Estuary Program Grant. Boston, Massachusetts.

⁵⁷ Werme C, Wu D, Libby PS, Carroll SR, Codiga DL, Charlestra L, Ellis-Hibbett D, Goodwin C. 2022. 2021 outfall monitoring overview. Boston: Massachusetts Water Resources Authority. Report 2022-11. 65 pages. <https://www.mwra.com/harbor/enquad/pdf/omo.pdf>

⁵⁸ <https://www.greatmarshpartnership.com/>



Figure 10. Great Marsh covers a swath of the northern Massachusetts coast.

Other large salt marshes are located in Scituate/Marshfield and Duxbury Bay on the South Shore, and in Barnstable on Cape Cod. Historically, salt marshes ringed the Boston Harbor region and extended well into the Saugus, Mystic, Charles, and Neponset watershed.⁵⁹ Now only a fraction of those historic marshes remains, namely Rumney Marsh and Belle Isle Marsh. It is estimated that salt marsh loss in the Boston Harbor region is close to 81% since pre-colonial times (documented by EPA in support of the BCG process, see Appendix A). This loss is largely due to placement of fill but is also a result of salt marsh ditching and the restriction of adequate tidal inundation.

Belle Isle Marsh is a 300-acre salt marsh in East Boston. It has been designated as an International Bird Area (IBA) and includes salt marsh, tidal creeks, and salt pans. Because of its location, it is highly vulnerable to pollution and degradation due to urban sprawl. Over the past several years, the Department of Conservation and Recreation (DCR), Mystic River Watershed Association (MyRWA) and Friends of Belle Isle Marsh have teamed up to develop an inventory

of natural resources (with funding from the MassBays Healthy Estuaries Grant, 2020) as well as develop a list of restoration priorities and designs. Since 2021, EPA Office of Research and

The importance of salt marshes for coastal resilience

In addition to their role in nutrient cycling, water quality improvement, and providing habitat for the life cycle of various organisms, healthy salt marshes are important for coastal resilience, protecting coastal areas from the potential impacts of climate change and sea level rise. Where they are able to migrate spatially and adapt unimpeded, salt marshes attenuate the adverse impacts associated with storms and sea level rise including increase in coastal flooding, storm surge and waves, and erosion. With increase in sea level, a healthy and resilient salt marsh is more likely to capture sediment and keep pace with rising sea levels. In urban areas salt marsh habitat may be limited and may eventually be lost, taking with it beneficial ecosystem services that are important for the protection and wellbeing of surrounding human communities. Local, state, federal and non-profit organizations are involved in salt marsh conservation and restoration. The goal is to restore the trajectories of salt marsh building forces so that this important habitat can sustain itself and maintain a high degree of integrity over time (U.S. Fish and Wildlife 2016).

⁵⁹ Carlisle, B.K., et al. 2005. *100 Years of Estuarine Marsh Trends in Massachusetts (1893 to 1995): Boston Harbor, Cape Cod, Nantucket, Martha's Vineyard, and the Elizabeth Islands*. MassCZM, Boston, MA; USFWS, Hadley, MA; and UMass, Amherst, MA. Cooperative Report. <https://www.mass.gov/files/documents/2016/08/or/ma-estuarine-trends.pdf>

Development (ORD) have been working closely with MyRWA to apply the Ecosystem Services Gradient (ESG) to this work. The additional ecosystem services information will help communities identify restoration priorities that will have additional value not only to the natural ecosystem but also to the surrounding communities. The application of the ESG to Belle Isle Marsh will serve as a pilot study to better understand how this can be implemented in other embayments in MassBays and beyond. The work is currently ongoing and once completed we will start applying the concept to other embayments, bringing the concept of ecosystem benefits to better inform management actions.

While the Massachusetts Wetlands Protection Act was enacted in 1972 (and incorporates the Rivers Protection Act of 1996), development, pollution, changes in hydrology (including activities for mosquito control), invasive species, and climate change still threaten salt marshes. When natural flushing by tides is restricted by road crossings or tide gates, salt marsh grasses are displaced by invasive species like *Phragmites australis* or purple loosestrife (*Lythrum salicaria*). Sea level rise and the impacts of development adjacent to marshes present challenges to the health of salt marshes in the MassBays study area. Over the past decades several efforts have been underway to restore salt marshes in various locations through removal of tidal restrictions and other efforts to restore the hydrological conditions that support this habitat. Managers and scientists are assessing opportunities and capacity for salt marshes to migrate inland and remain a vital feature of the coast (Figure 11).⁶⁰ As awareness of the ecological and economic value that salt marshes provide to surrounding communities increases, more protection and restoration opportunities are being identified and implemented across the MassBays study area, especially with regard to mitigation of climate change vulnerability.

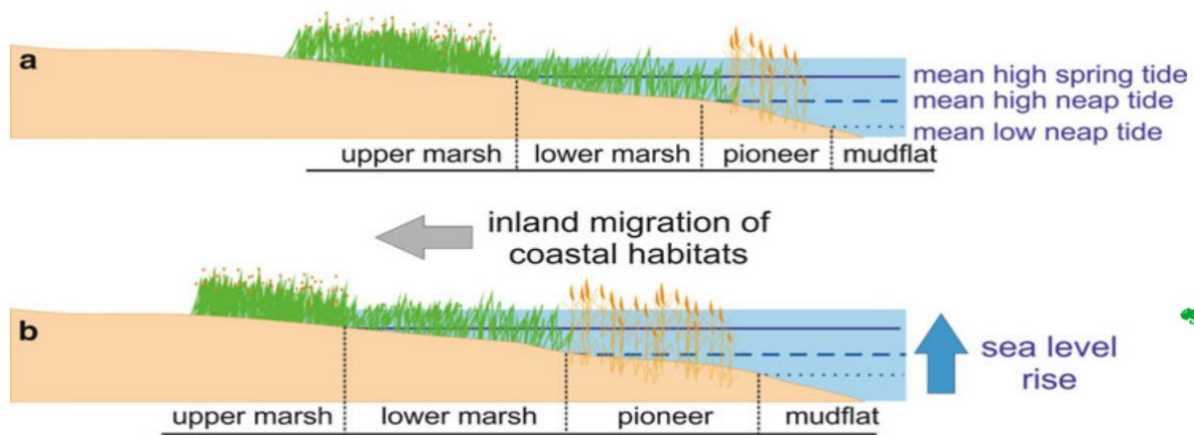


Figure 11. Current salt marsh extent (a) and with sea level rise (b). The latter (b) depicts migration of upper- and lower-marsh plants inland as the tide reaches further upslope. Image source: <https://placeslr.org>

Tidal Flats

There are roughly 28,000 acres of tidal flats in MassBays. About 40% are located along Cape Cod Bay and constitute the largest flats in North America, extending 9.7 miles along the shore from

⁶⁰ Luciana S. Esteves, 2015. Coastal Squeeze In: M.J. Kennish (ed.), Encyclopedia of Estuaries, Dordrecht: Springer Science+Business Media, DOI 10.1007/978-94-017-8801-4

Brewster to North Eastham.⁶¹ Duxbury and Plymouth Bays on the South Shore, and Ipswich Bay on the North Shore, also contain extensive tidal flats.⁶²

Tidal flats are relatively level and sparsely vegetated areas of loose sand and mud that are exposed at low tide and submerged at high tide. These flats, which provide a critical link between the terrestrial and marine systems, are typically found in areas sheltered from wave action where fine-grained sediments settle. Conditions in intertidal flats are variable given the unconsolidated nature of the sediment, changes in temperature, and presence or absence of water related to tides. Despite the variability, or maybe because of it, tidal flats support a high degree of biodiversity, as well as

Vulnerability of tidal flats to climate change

Intertidal flats help mitigate impacts from storm damage; more specifically, the gradual slope of these areas helps to slow the advances of floodwaters and attenuate the impacts of waves. Like salt marshes, coastal dunes, barrier beaches, and other coastal habitats, tidal flats are protected by the Wetlands Protection Act as “likely to be significant to storm damage prevention and flood control.” However, coastal infrastructure such as seawalls, wharves and jetties often contribute to erosion of tidal flats as does climate change particularly in areas such as Skaket Beach in Orleans and Breakwater Beach and Paine’s Creek in Brewster. Skaket Beach has been losing 3-4 inches/year and up to five feet in certain areas from erosion.

endangered species such as the piping plover and roseate tern. Like salt marshes, coastal dunes, barrier beaches, and other coastal habitats, tidal flats are protected by the Wetlands Protection Act as “likely to be significant to storm damage prevention and flood control.” Yet erosion poses an important threat to tidal flats and the beaches behind them. Sea level rise also poses a threat to tidal flats from complete submergence, putting organisms they support at risk.⁶³

As tides rise to cover the flats, juvenile fish often swim in from nearby shallow subtidal zone to feed. High densities of commercially important crustaceans and shellfish thrive in sheltered tidal flats, creating an excellent foraging ground for migrating and wading shorebirds, including threatened species.

Eelgrass

Eelgrass (*Zostera marina*) beds inhabit the intertidal and shallow subtidal coastal zones. Within the MassBays study area, the exposed shoreline tends to restrict eelgrass to protected harbors and inlets, sheltered from storms and waves. Because it supports commercially important species of fish and other nekton, eelgrass has been studied extensively and there is a wealth of information about this habitat. However, there are major data gaps mainly tied to the spatial fluctuations in location and extent from year to year that have not yet been fully explained. Major threats to eelgrass come from wastewater and stormwater discharge causing turbidity and eutrophication, and from physical damage and increase in turbidity caused by certain fishing gear, moorings, dredging, aquaculture, and boating activities. Eelgrass is also vulnerable to population fluctuations

⁶¹ Setterlund, C. 2016. “The Changing Shape of the Cape & Islands: The tidal flats of Brewster, Orleans, & Eastham.” *Cape Cod Life*, September/October accessed 12/20/2018 at <https://capecodlife.com/the-changing-shape-of-the-cape-islands-the-tidal-flats-of-brewster-orleans-eastham/>

⁶² Hankin, A. L. et al. 1985. Barrier Bleachers, Salt Marshes, and Tidal Flats. An Inventory of the Coastal Resources of the Commonwealth of Massachusetts. CZM publication 13899-27-600-1-85 C.R.

⁶³ Galbraith et al. 2005. Global Climate Change and Sea Level Rise: Potential Losses of Intertidal Habitat for Shorebird. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. 2005.

resulting from intense coastal storms, wasting disease, epifauna and impacts from invasive species including green crabs.

There are several efforts to measure the extent of eelgrass in Massachusetts, as scientists and managers strive to understand its natural variability and are looking for ways to keep track of changing conditions (Figures 12 and 13). MassDEP established the Eelgrass Mapping Project in 1995, the most comprehensive eelgrass survey effort in the state. The project involves mapping embayments across the state with a combination of aerial photography, digital imagery, and ground truth verification through diving. Findings of the first 12 years of the project are documented in Costello and Kenworthy⁶⁴ revealing increased eelgrass coverage in only three embayments and documenting an overall loss of 1,865 acres of eelgrass. Since 1995, Duxbury-Kingston-Plymouth Bays collectively lost 54% of its eelgrass. Large losses have also been documented from other embayments such as Wellfleet. Plum Island Sound used to have extensive beds that disappeared decades ago. Limited resources have only enabled aerial surveys of this area by MassDEP in 2021 and results are still pending.

Eelgrass monitoring by volunteers

Because the methods mentioned above cannot always be conducted annually, in 2017, with funding from EPA, MassBays and DMF developed a rapid assessment protocol to monitor eelgrass to be implemented by trained citizen scientists. The protocol was successfully piloted in 2018 in Duxbury-Kingston-Plymouth Bays where significant loss of eelgrass has been documented since 1995. The survey has been conducted every August and has enabled MassBays and DMF scientists to document losses of eelgrass as well as changes in patterns. The investigation is currently ongoing to identify the source/sources of eelgrass loss. An important outcome of this survey is the involvement by volunteers who have come to own the rapid assessment survey and are proud to participate every year. The method is also easily transferable, and several local groups have reached out to MassBays' regional coordinator on the South Shore to apply the method in their embayments.

Regular and frequent eelgrass monitoring across Massachusetts is challenging, due to cost, availability of resources, and issue with methods used. Since 2011 DMF has conducted acoustic mapping of eelgrass beds in select embayments, compiling detailed information on changes in aerial extent of eelgrass beds over time, in particular where eelgrass restoration has taken place. Both aerial surveys and acoustic monitoring are costly and cannot be conducted with the frequency that an ephemeral species like eelgrass demands. In 2021 MassBays and CZM received funding under a NOAA Project of Special Merit to conduct a study that compares the sensitivity of various methods to measure eelgrass and minimize errors. This project, led by MassBays, is ongoing and data are expected in 2023. The results are expected to inform permitting and provide support for better surveys of this important habitat.

⁶⁴ Costello, C. and W.J. Kenworthy (2011) Twelve-year mapping and change analysis of eelgrass (*Zostera marina*) areal abundance in Massachusetts (USA) identifies statewide declines. *Estuaries and Coasts* 34(2):232-242. DOI 10.1007/s12237-010-9371-5.

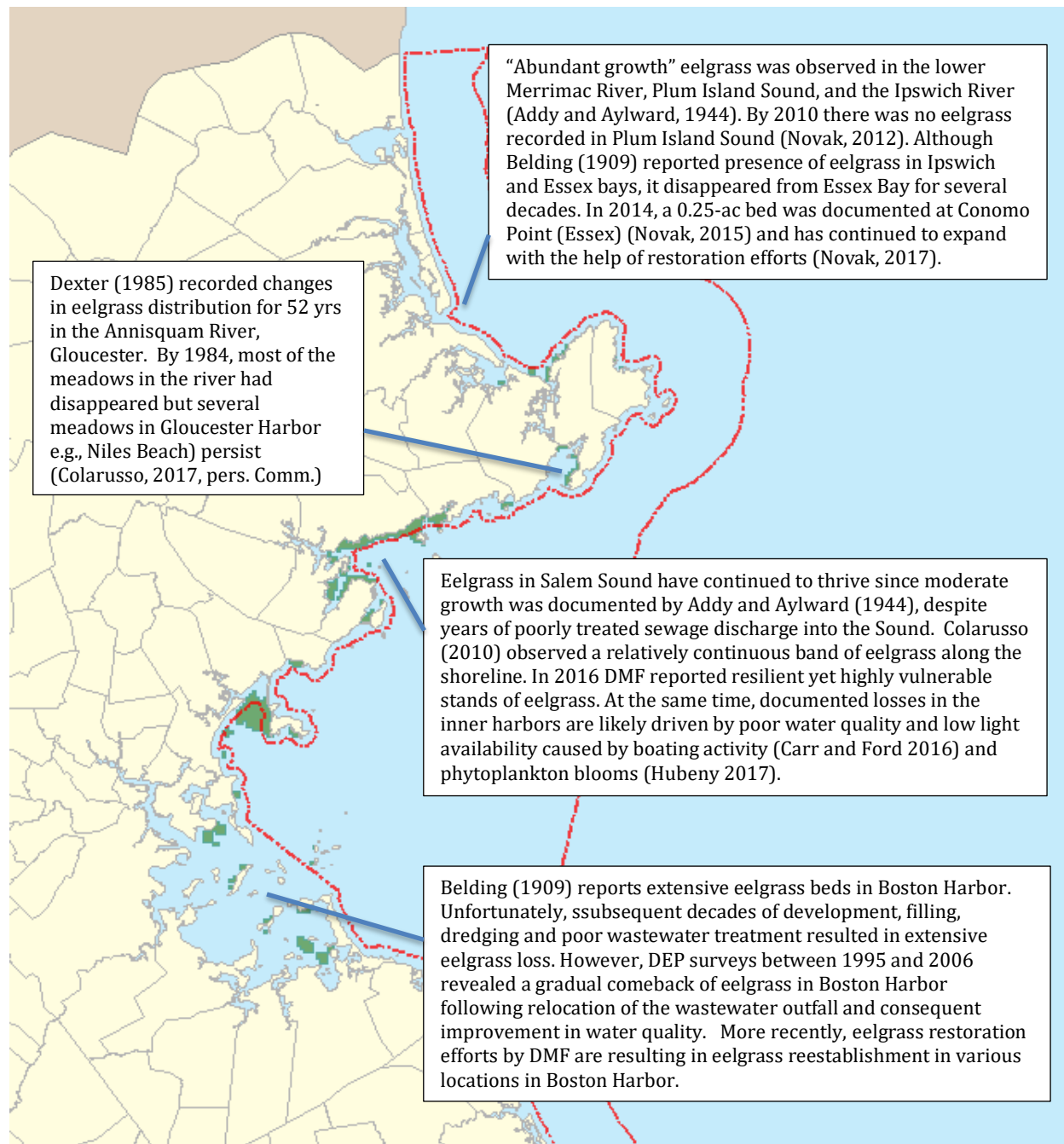


Figure 12. Eelgrass distribution in the North Shore and Boston regions as of 2017, including details of observed changes in eelgrass extent in sample embayments over the past several decades.

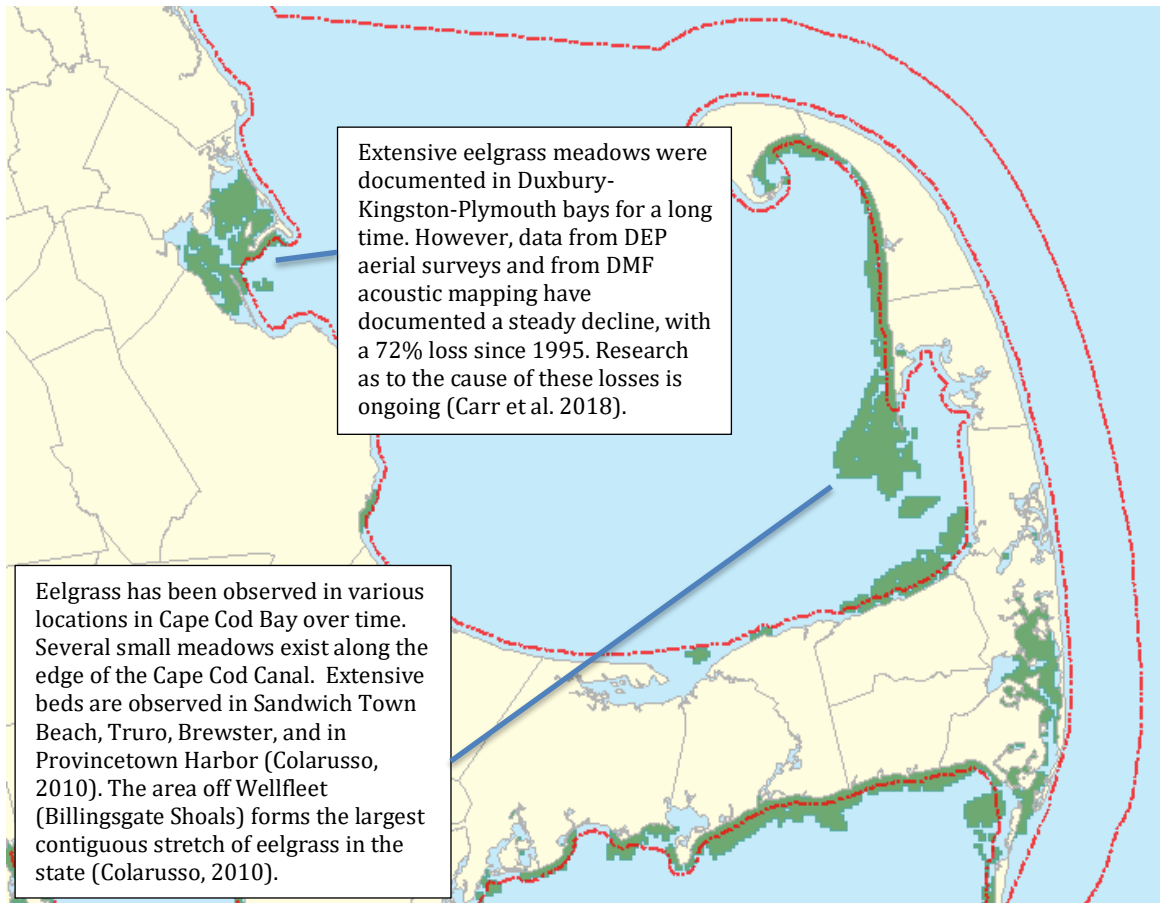


Figure 13. Eelgrass distribution in the South Shore and Cape Cod regions as of 2017 (the most recent data set), including details of observed changes in eelgrass extent in sample embayments over the past several decades.

Fish runs and spawning areas

Numerous coastal and offshore fish species spend at least part of their lives in estuaries. These habitats are important nursery areas to several economically important species e.g., winter flounder. Many migrate further upstream. Migratory fish habitat includes areas that support nurseries, feeding, migration and spawning grounds for diadromous fish. Ecosystem services provided by fish runs include recreation and commercial fishing as well as the flushing of nutrients and pollutants discharged up in the watershed.

Diadromous fish runs provide forage for a wide range of fish and wildlife and were important for native peoples who lived in Massachusetts as long as 12,000 years ago.⁶⁵ In fact, although there has been a state-wide moratorium on herring fishing and harvesting in Massachusetts, state and federally recognized tribes still have access to fish and harvest river herring for sustenance under native rights.

Forty-eight towns in Massachusetts report a total of approximately 100 river herring runs^{[1][66]}. DMF is responsible for the management of diadromous fish populations, and the restoration, improvement, and maintenance of migratory pathways in coastal rivers, issuing Fishway

⁶⁵ <https://www.sec.state.ma.us/mhc/mhcarchexhibitsonline/massachusettsbay.htm>

Construction Permits, operation and maintenance plans, and diadromous fish stream maintenance plans. In 2022 DMF released data layers that represent diadromous fish passageways, impediments, habitat, species presence and sampling stations along coastal rivers and in lakes and ponds. The data layers, available through an interactive viewer (<https://www.mass.gov/info-details/massgis-data-diadromous-fish>) include time-of-year recommendations to avoid impacts to present species and on restoration priorities and actions.

Unfortunately, diadromous fish populations and associated habitat have diminished over the past centuries throughout southern New England, in some areas more than others. Dams, habitat alterations, pollution, and overfishing have led to declines in migratory fish numbers. Species such as American shad (*Alosa sapidissima*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*), and rainbow smelt (*Osmerus mordax*) were all declining in southern New England by 1870.⁶⁶ Although volunteer counts are indicating a slow comeback of river herring into several of MassBays' waterways, stock assessments lack sufficient data to detect discernable trends in over half of the rivers assessed. Of the remainder, 16 showed increasing abundance, two decreasing abundances, and eight were stable. Despite this, managers are still reluctant to declare recovery of the fishery due to low abundance relative to historic levels, and the uncertain role of various stressors on the different river herring population.

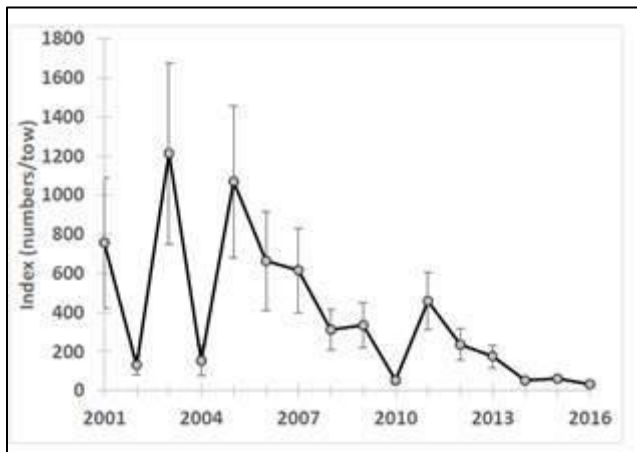


Figure 14. GLM-standardized index of abundance for Young-of-year American eels, Jones River, MA, 2001–2016.

American eel (Figure 14) is the only catadromous species in North America. Small-scale, commercial eel fisheries occur in Massachusetts and Rhode Island and are mainly conducted in coastal rivers and embayments with pots during May through November. The first benchmark stock assessment (2012) was updated in 2017 using YOY indices. Data for Massachusetts were obtained from the only YOY index station in New England, located on Jones River, Kingston. As in the 2012 assessment, the stock was considered depleted based on trend analyses and commercial landings.⁶⁷

River herring habitat and resource use in MassBays embayments

River herring play an important ecological and cultural role in Massachusetts. River herring are currently listed as a species of concern by NOAA, citing the importance of developing better understanding of habitat requirements. Petitions to list river herring under the Endangered Species Act resulted in a court decision in [year] to evaluate the coast-wide status of their population, including habitat and resource requirements. With funding from MassBays, a project team led by MIT Sea Grant and including the towns of Plymouth and Eastham conducted a comprehensive characterization of habitat preferences and resource use by Alewife (*Alosa pseudoharengus*) at three different river and pond systems, including a recently restored cranberry bog lying between the Eel River/Plymouth Harbor and Ellisville Harbor embayments. The results were shared with resource managers in Massachusetts, and are also transferable, suitable to inform management and restoration of river herring habitat for utilization by migrating and spawning fish.

⁶⁶ Reback, K. E., and J. S. Dicarlo. 1972. Completion report anadromous fish project. *Mass. Div. Mar. Fish. Publ.* 6496, 113 p.

⁶⁷ ASFMC Stock Assessment Overview: American Eel 2017 https://www.asfmc.org/uploads/file/59e8c077AmericanEelStockAssessmentOverview_Oct2017.pdf

Rocky shores, Barrier Beaches, and Dunes

Rocky intertidal shorelines are prevalent in the North Shore region extending from Nahant through Cape Ann. Several rocky shorelines are also found around areas of Salem Sound and around Boston Harbor. There are approximately 105 acres of rocky intertidal habitat in the Boston Harbor area, both natural and manmade (DEP Wetland Layer MassGIS 2005). Most of the natural rocky intertidal shorelines occur on the Boston Harbor Islands, with a total of almost 800 acres of rocky intertidal area across the study area.⁶⁸ Rocky intertidal habitats support organisms that are uniquely adapted to relatively harsh environments including exposure to wave action and exposure to dry conditions and predators at low tides. Examples include mussels, limpets, snails, and some species of algae.

Rocky intertidal shorelines contribute to coastal resilience as they help stabilize shorelines against erosion. Rocky intertidal shorelines provide haul-out areas for seals and feeding grounds for foraging birds. Because they are well flushed by wave action, rocky intertidal shores tend to be less affected by pollutants than other coastal habitats. Nonetheless even rocky shores can be degraded by severe pollution; in particular, oil spills constitute a potential threat. On the other hand, sea level rise may cause shifting in zones and associated organisms. Warming waters may also cause changes in the species component that dominate this habitat, replacing native communities by invasive species including sea squirts and green crab. Rocky shorelines are primarily vulnerable to human development which has often resulted in degradation through development of shoreline protection structures such as seawalls, jetties, and riprap. Rocky shorelines are therefore protected by regulating proximal development under the Massachusetts Wetlands Protection Act.

Shoreline change in Massachusetts

A 2013 study conducted by USGS and CZM examined rates of shoreline change along the Massachusetts coast. The goal of the projects was to develop and distribute scientific data that will support local land used decision making. The 2013 study reported that the highest long-term erosion rate, over the span of 150 years, averaged to -1.5 m y^{-1} at Lovells Island in Boston Harbor. Short-term erosion was experienced in tidal flats in Quincy Bay at a rate of -7.7 m y^{-1} from 1994 to 2008. With climate change, greater rates of erosion are expected to occur along with the predicted increase in intensity and frequency of storms. Since the 2013 study, CZM has developed an online interactive viewer of changes in shoreline extent over the years, available at <https://www.mass.gov/service-details/massachusetts-shoreline-change-project>.

Barrier beaches are popular for recreational uses and are sought-after locations for residential and commercial development. MassBays' study area includes more than 100 miles of beach⁶⁹ primarily in the Upper North Shore along Plum Island Sound, along Duxbury Bay on the South Shore, and along most of Eastern Cape Cod Bay. Barrier beaches are dynamic shorelines that constantly change by the forces of wind and wave action. At the same time, barrier beaches act as protective barriers to areas behind them from waves generated by powerful storms. Barrier beaches offer important foraging, nesting, and staging habitats for various bird species such as the Piping Plover.

⁶⁸ Geosyntec Consultants, LLC. Estuary Delineation and Assessment 2.0. Prepared for Massachusetts Bays National Estuary Program. 2017. 26pp.

⁶⁹ 2021 Massachusetts Ocean Management Plan. Volume 2.

<https://www.mass.gov/files/documents/2022/02/25/ma-ocean-plan-2021-vol-2a.pdf>

The 11,000 acres of dunes and sandy beaches in MassBays' study area are vulnerable to impacts of climate change and development.⁷⁰ In response to their dynamic properties and vulnerability to erosion and accretion episodes, construction of engineered structures such as groins and jetties is often seen as a solution to protect eroding beaches and the land and communities behind it. However, appropriate design and maintenance of these structures is important for preventing more damage to the beach morphology. A 2013 study conducted by the United States Geological Survey (USGS) and CZM examined rates of shoreline change along the Massachusetts coast. Beach nourishment (depositing sand dredged offshore onto the beach) is regarded as a coastal resilience action that can protect against the impacts of climate change. In Massachusetts, beach nourishment conducted by the state can only occur on public beaches, or beaches made accessible to the public.

The 1994 publication *Guidelines for Barrier Beach Management in Massachusetts*⁷¹ reviews best management practices for a broad range of barrier beach activities and interests. Some management practices carried out on sandy beaches can impact their value as a habitat. For example, beach raking is conducted to remove wrack and larger cobble stones – along with the insects and small shellfish that live in the damp detritus. This practice reduces the amount of food available to resident and migrating shorebirds. Fact sheets developed by CZM in 2013 (<https://www.mass.gov/doc/managing-seaweed-accumulations-on-recreational-beaches/download>) and WHOI Sea Grant in 2017 (https://www.capecod.gov/wp-content/uploads/2022/03/BeachRakingPrimer_FINAL.pdf) address special considerations for specific species of concern. To foster broader awareness of the value of beaches as habitat, MassBays initiated an iNaturalist-based citizen science project (#MassWrack, <https://www.inaturalist.org/projects/masswrack>) to encourage exploration of the beach habitat and to highlight the many creatures that live and rely on the wrack. Analysis of those data, an activity listed in this CCMP, will help MassBays characterize local conditions and inform education and outreach efforts.

Waterfowl

The beaches, marshes, estuaries, rocky outcrops, and islands along the Massachusetts coastline provide valuable habitat for the foraging and reproduction of native and migratory bird species. In fact, 16 species of protected birds use coastal habitats in Massachusetts for at least part of their life cycle. Significant numbers of federally listed species, including Roseate and Least Terns and Piping Plovers, nest on beaches and small islands within Massachusetts coastal areas. There has been an effort to identify and conserve areas that provide habitat of significance to avifauna in Massachusetts. An example is the Important Bird Area Program⁷² coordinated by Mass Audubon. The program lists 28 coastal sites in Massachusetts as IBAs for their value as feeding, nesting, and migration locations. The MassBays study area includes key shorebird stopover sites, mainly the Parker River National Wildlife Refuge and the Great Marsh Important Bird Area (IBA) on the North Shore, and Duxbury and Plymouth Bay IBA on the South Shore.

⁷⁰ Yee, S., Sharpe, L., Branoff, B., Jackson, C., Cicchetti, G., Jackson, S., Pryor, M. and Shumchenia, E. In Review. Beneficial Uses of National Estuary Program Habitats for Communities along the Massachusetts Coast, USA.

⁷¹ Massachusetts Barrier Beach Task Force. 1994. *Guidelines for Barrier Beach Management in Massachusetts*. <https://www.mass.gov/files/documents/2016/08/vh/barrier-beach-guidelines.pdf>

⁷² Massachusetts Important Bird Areas, <https://www.massaudubon.org/our-conservation-work/wildlife-research-conservation/bird-conservation-monitoring/massachusetts-important-bird-areas-iba>

Several species of migrant shorebirds are common in coastal Massachusetts during spring migration, the most numerous include Piping Plover, American Oystercatcher, and Willet.⁷³ The Piping Plover is a threatened species and a significant proportion of the population breeds in Massachusetts. During autumn migration, Lesser Yellowlegs, Whimbrel, Hudsonian Godwit, and Semipalmated and White-rumped Sandpipers are observed.⁷⁴

The estuarine embayments and ponds within the MassBays study area are regularly visited by waterfowl during the spring and fall migration, and a few also support foraging and nesting habitat for resident species. From late summer through fall, Gadwall, American Widgeon, American Black Duck, Mallard, Northern Shoveler, Northern Pintail, and Green-winged Teal, migrate through the study area, while mid- to late fall brings huge numbers of coastally migrating eiders, scoters, and Long-tailed Ducks.^{36,75}

Shellfish beds

Shellfish habitat is found across all MassBays with hotspots on the south shore and around Cape Cod Bay. The Massachusetts coast is characterized by quahogs (*Mercenaria mercenaria*), soft shell clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), oysters (*Crassostrea virginica*), and bay scallops (*Argopecten irradians*). Shellfish beds are threatened by pollution from land, harmful algal blooms, and construction, among others.

Shellfish areas are classified as open, closed, or conditionally open for harvest by DMF depending on water quality and rainfall.⁷⁶ Stormwater remediation is contributing to the opening of shellfish beds for harvesting. For example, with funding partially provided by MassBays, the Town of Kingston designed and installed stormwater BMPs – the improved water quality resulted in DMF reopening 313 acres of viable shellfish habitat in Kingston Bay in 2013.⁷⁷ Communities must ensure that the water quality conditions required are maintained in order to keep shellfish beds open. The north shore is also striving to assess and improve water quality conditions in order to reopen previously lucrative beds. To this end, towns around Salem Sound, led by MassBays' Lower North Shore regional coordinator, are working with DMF to monitor water quality and implement water quality remediation to reopen shellfish beds in these embayments.

⁷³ Callaghan, T., K. Ford and P. Vella. 2009. Massachusetts Ocean Management Plan. Volume 2: Baseline Assessment and Science Framework. Commonwealth of Massachusetts.

⁷⁴ USFWS, 2011. Birding in the United States: A Demographic and Economic Analysis. Addendum to the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation Report 2011-1.

⁷⁵ Callaghan, T., K. Ford and P. Vella. 2015. Massachusetts Ocean Management Plan. Volume 2: Baseline Assessment and Science Framework. Commonwealth of Massachusetts.

⁷⁶ DMF. "Shellfish classification areas," <https://www.mass.gov/service-details/shellfish-classification-areas>

⁷⁷ Ford, K. and Carr, J. 2016. Eelgrass loss over time in Duxbury, Kingston, and Plymouth Bays, Massachusetts. Division of Marine Fisheries. <https://www.mass.gov/files/2017-08/2015%20DuxburyKingstonPlymouth%20Eelgrass.pdf>

Shellfish beds are also being developed to grow shellfish as part of nutrient reduction especially in Cape Cod where the prevalence of septic systems has contributed to nutrient enrichment. Although there is no statewide resource assessment for shellfish, shellfish suitability maps were updated in 2009 to illustrate areas of known or anticipated shellfish resource. Some of the regions with shellfish resources that could be considered more vulnerable, or at greater risk of impact include Cape Cod Bay (ocean quahogs and sea scallops), and the North Shore (sea scallops). As with other resources, the risk of impact is highly dependent on the proposed use.

Shellfish beds in MassBays

Shellfish habitat is found across all MassBays. The coast is characterized by quahogs (*Mercenaria mercenaria*), soft shell clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), oysters (*Crassostrea virginica*), and bay scallops (*Argopecten irradians*). Some areas have vulnerable shellfish resources including Cape Cod Bay (ocean quahogs and sea scallops), and the North Shore (sea scallops). Shellfish beds are threatened by pollution from land, harmful algal blooms, and construction, among others. Shellfish areas are classified as open, closed, or conditionally open for harvest by DMF depending on water quality and rainfall.¹ Stormwater remediation is contributing to opening of shellfish beds for harvesting. E.g., a MassBays grant followed by a 604(b) grant allowed the Town of Kingston, MA. to design and install stormwater BMPs – improved water quality resulted in reopening 313 acres of viable shellfish habitat in Kingston Bay in 2013. Communities must ensure that the water quality conditions required are maintained in order to keep shellfish beds open.

Setting habitat goals

A central component informing implementation of this CCMP are a suite specific goals for habitat condition and extent across the entire study area. Setting goals for 68 embayments, rocky shores, and barrier beaches is a daunting task, however, and one that could take the entire 10 years' timeline for its implementation. Instead, MassBays undertook a stepwise process, beginning in 2018 that involved sorting the 44 delineated estuarine embayments according to their physical and chemical characteristics, and then setting habitat goals for each grouping informed by local priorities. This multi-year effort is summarized in this section, and detailed in Appendix A. Goal 3 of the CCMP calls for similar analysis and goal-setting for habitats for diadromous fish, rocky shores, and dune-beach areas.

Ecotypes

Information about intrinsic physical characteristics of the 44 embayments including current and wave exposure, depth, and relative sediment abundance was compiled by MassBays and applied by EPA Office of Research and Development (ORD) to categorize embayments into four eco-types. **Ecotypes** represent the suitability of an embayment to support certain habitats when no anthropogenic impacts are present (Figure 15).

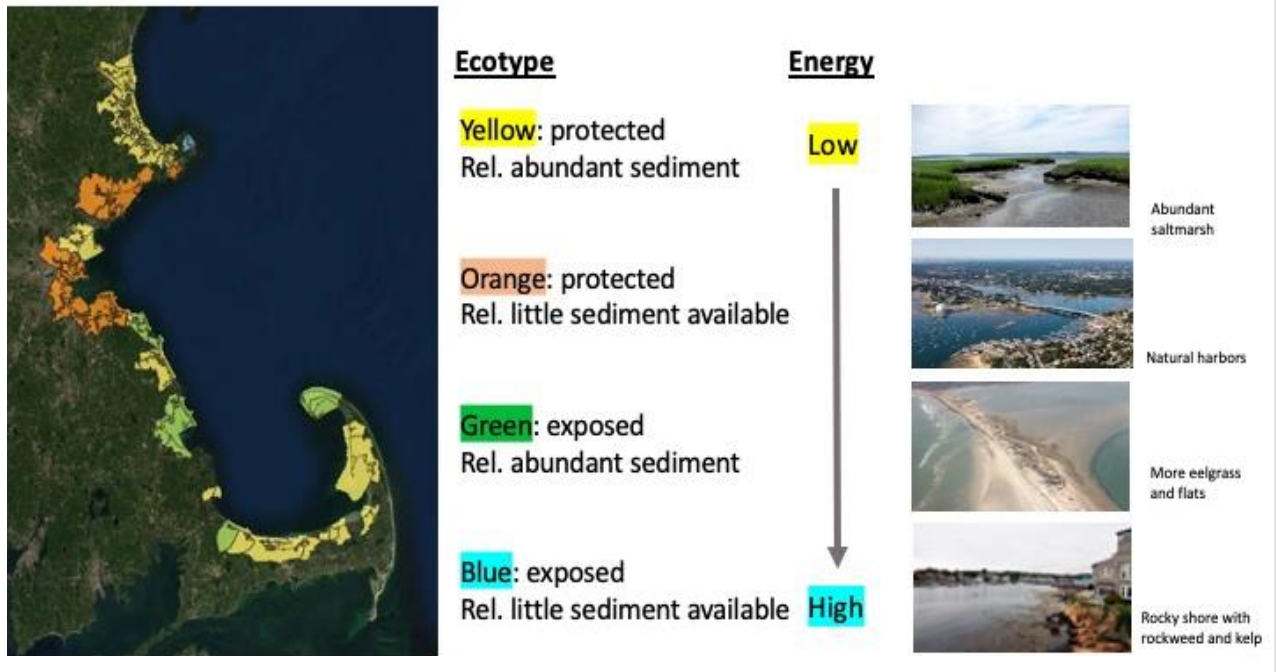


Figure 15. Embayment ecotypes based on physical conditions: exposure, depth, and relative sediment abundance.

Resource-Stressor Categories

Using the data characterizing each embayment in EDA 2017, MassBays and Northeastern University conducted analyses using the data collected in the EDA to identify the primary stressors driving natural resource conditions in embayments, listed in Table 1. While the Ecotype analysis focuses on physical conditions that are more or less permanent, the Principal Component Analysis (PCA) focused on factors, many anthropogenic, that characterize local conditions and can be used to describe differences among the embayments.

Table 1. Resource and stressor attribute analysis (2020)

Estuarine Resources	<i>Eelgrass extent, salt marsh (% shoreline length), salt marsh (areal extent), tidal flats extent, rocky intertidal (natural unhardenable shoreline)</i>
Stressors	<i>High-intensity land use, annual stormwater discharge, population density, % population using septic systems, 303(d) impairments estuaries (bacteria & nutrients), septic system use⁷⁸; CAPS⁷⁹ tidal restrictions, shoreline hardened</i>

The output of this analysis is clusters of embayments depicted spatially in Figure 16 and described in Table 2. Information at this scale allows MassBays to suggest relevant solutions for groups of embayments at once, and supports cross-region planning and management actions. For example, embayments around Boston Harbor and Salem Sound (Cluster 4, colored blue in Figure 16) are

⁷⁸ Percent of population using septic systems: number of people using septic divided by the total population; septic system use: number of people using septic systems divided by embayment land acreage

⁷⁹ Conservation Assessment and Prioritization System (CAPS), a model for assessment of ecological integrity developed at University of Massachusetts Amherst (<https://umasscaps.org>).

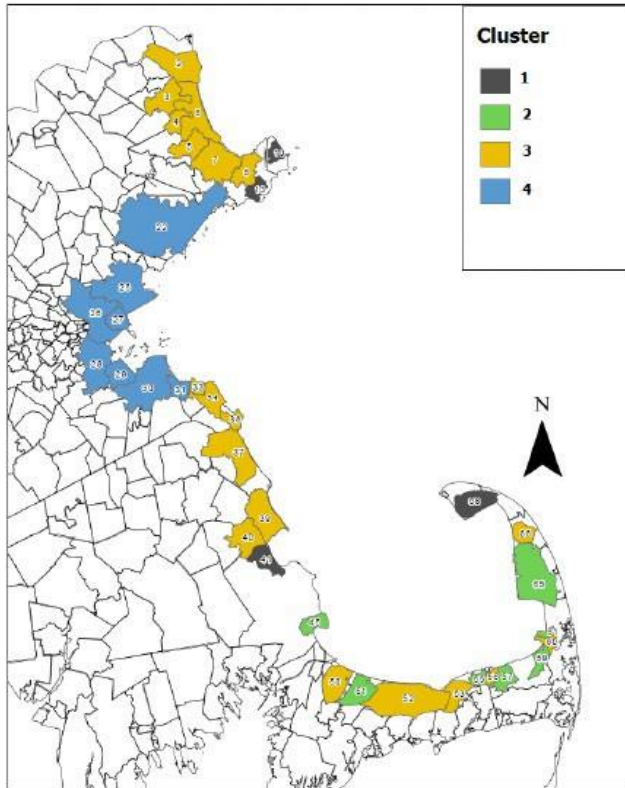


Figure 16. Resource-stressor embayment clusters, indicated by color coding.

adjacent to more developed and highly populated areas, and resource managers face similar concerns, such as high percentage of impervious surface which increases stormwater runoff. Embayments with less development and more salt marsh – Cluster 3 (yellow) for example – are more likely to focus on habitat loss due to inundation by sea-level rise or storm surge.

MassBays refers to these Clusters as **Resource-Stressor Categories**, a more descriptive term that emphasizes the significance of primary stressors driving water quality and condition of local habitats for work to be undertaken in particular embayments. With this information, MassBays’ RCs can guide responses to critical questions and address deteriorating conditions, for example: Which stormwater BMPs should be constructed to improve conditions in this embayment to restore eelgrass? What water treatment method should be used to reduce pollution in our embayment and improve shellfish habitat?

Table 2. Characteristics of resource-stressor embayment clusters.

Cluster 1 – Salt marsh extent and tidal flat area	Cluster 2 – Hardened shoreline and seagrass extent	Cluster 3 – Salt marsh shoreline and impairment for nutrients	Cluster 4 – High intensity land use, mean pop. density, CAPS tidal restriction
High % population using septic systems and septic system use	Highest mean shoreline hardened	Highest impairment for nutrients (not significant)	High mean shoreline hardened
Low impairment for bacteria	High mean population density	High % of population using septic systems and septic system use	Highest mean high intensity land use
Low mean CAPS tidal restriction	High impairment for bacteria	High impairment for bacteria	Highest mean population density
Highest mean salt marsh extent	No impairment for nutrients	High mean CAPS tidal restriction	Low % of population using septic systems
High mean salt marsh shoreline	Low mean CAPS tidal restriction	Highest salt marsh shoreline	High impairment for bacteria
Highest mean tidal flat area	Lowest mean salt marsh shoreline	High saltmarsh extent	No impairment for nutrients
	Low salt marsh extent		Highest mean CAPS
	Highest mean eelgrass Lowest mean tidal flat		Low salt marsh extent

Applying the Biological Condition Gradient approach

The Biological Condition Gradient process begins with defining the ideal, unimpacted habitat condition (represented by historical conditions) and estimates conditions that can be attained going forward under different scenarios: increased conservation and restoration, some conservation, or business as usual (Figure 17).

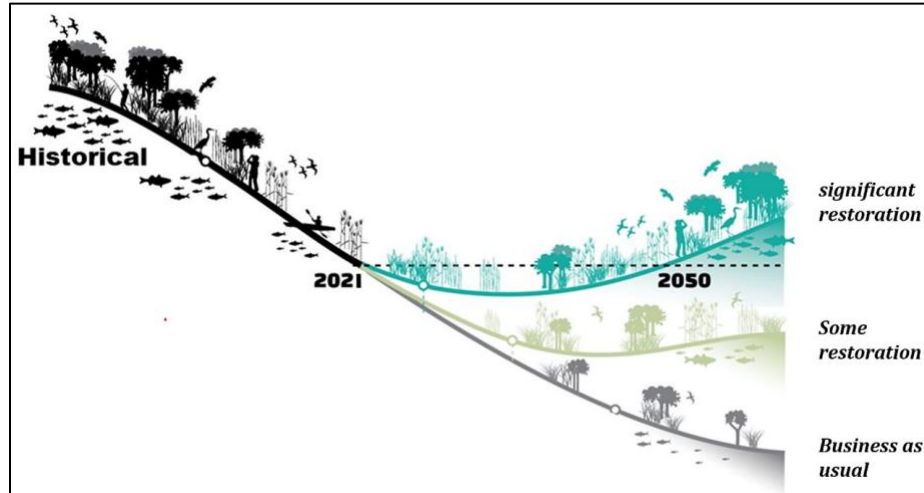


Figure 17. The Biological Condition Gradient. Illustration courtesy of E. Shumchenia/Integration and Application Network vector graphics (ian.umces.edu/media-library)

Step 1. Examine historical habitat extent and condition

A team from EPA’s Office of Research and Development and Office of Science and Technology used maps from the 1770s to 2021 to assess changes in habitat extent for the entire planning area. In some cases, coastal change would preclude returning to those conditions (the filling of Boston Harbor tidelands to create the modern waterfront is the most dramatic example), but in others this information provided valuable insights for our goal-setting. Analysis of these data summarized in Table 3 also provides evidence that the ecotypes defined for MassBays can accurately be associated with distinct habitats and their distribution as depicted in Figure 15.

Table 3. Summary of habitat loss in MassBays’ study area over time

	Acres lost	% Lost	Data quality	
Salt marsh 1700s-2005	16125	36	Good	Significant losses will have occurred after 2005 with increasing stressors including Sea Level Rise, population density, nutrient pollution; new surveys are needed.
Tidal flats 1700s-2005	5030	22	Fair	
Eelgrass 1995-2017	5510	46	Excellent	Reflects huge seagrass loss in Wellfleet Harbor
Eelgrass 1995-2017 (Wellfleet excluded)	1827	33	Excellent	MassBays lost 33% of eelgrass over 22 yrs The rate of eelgrass loss from 2012 to 2017 was twice that of the previous 17 years.

Step 2. Collect information on local priorities

MassBays Each coastal habitat offers unique benefits to people as well as the creatures that rely on those habitats for food and protection. EPA researchers analyzed municipal planning documents for local priorities, while MassBays worked with UMass Boston researchers to ask local experts – residents of representative communities – which benefits they consider most important to future generations.

Step 3. Consult with scientists on the potential for future restoration

Multiple factors influence habitat restoration potential. Sea level rise, coastal erosion, and temperature changes associated with climate change; development that hems in salt marshes and shoreline hardening with seawalls; water pollution; invasive species; dredging; and poor fishing and boating practices all impact the ability of coastal habitats to thrive. These factors were taken into account when setting out possibilities for 2050 (Table 4).

The resulting targets are visualized as “habitat goals” in MassBays’ ETT, our web-based State of the Bays reporting platform launched in 2022. The targets are described in terms of “healthy acres” of each habitat and are based primarily on the suitability for the habitat offered by geophysical conditions (exposure, coastal geology, and shallow-water habitat area) and not influenced by anthropogenic factors. These are presented here and in the ETT with two notes:

- Goals for salt marsh and tidal flat extent are equal to “current” acreage as of June 2005. Due to sea level rise and existing development and infrastructure encroaching along the coastline, it is unclear whether those habitats have the potential to expand, so MassBays’ goals for salt marsh and tidal flats are focused on maintaining and improving the health of existing habitat rather than expansion. As we look forward (see Goal 3), we will develop additional information regarding potential for habitat expansion and improved health in terms of water quality using Habitat Potential Indices (HPIs). We will thus be able to track progress toward our environmental outcomes: expanded coastal habitat, improved habitat continuity and hydrology, restored natural communities, and improved water quality through implementation of our monitoring framework (Attachment 3).
- Some embayments are already meeting or exceeding habitat goals. MassBays set the habitat goals using a process that looks across embayment ecotypes (described above) in an effort to compare like-with-like, thus individual embayments might be in better condition compared to similarly categorized embayments. In addition, habitat maps are a snapshot of habitat extent, and change in area can shift dramatically from year to year; there are also limitations to the remote sensing data used.

Table 4. Habitat goals for MassBays estuarine embayments

Ecotype	Habitat	Goal by 2050	Acres to restore/maintain	Associated ecosystem benefits
Green	Eelgrass	Increase acres, improve quality	2,040	<ul style="list-style-type: none"> • Habitat for fish, birds, invertebrates • Improved water quality • Nitrogen uptake • Carbon sequestration • Shoreline protection & erosion control • Aesthetics • Shellfish production • Food sources • Recreational opportunities
	Salt Marsh	Maintain acreage, improve quality	2,800	
	Tidal flats	Maintain acreage, improve quality	4,060	
Yellow	Eelgrass	Increase acres, improve quality	4,560	
	Salt Marsh	Maintain acreage, improve quality	27,170	
	Tidal flats	Maintain acreage, improve quality	11,720	
Orange	Eelgrass	Increase acres, improve quality	10	
	Salt Marsh	Maintain acres, improve quality	1,730	
	Tidal flats	Maintain acres, improve quality	3,270	
Blue	Eelgrass	Maintain acreage, improve quality	2	
	Salt Marsh	Maintain acreage, improve quality	0	
	Tidal flats	Maintain acreage, improve quality	4	

III. MassBays' Evolution

MassBays' comprehensive plans – the 1996 original CCMP, an update to that completed in 2003, and strategic planning that followed – have each addressed the needs of its time, at the scale needed to address current issues in the Bays. Previous documents are summarized here.

Planning documents

1996: the First CCMP

MassBays' first CCMP, published in 1996, was the result of 6 years' effort and approximately \$6million investment. It featured 15 Action Plans containing 72 specific recommended Actions for preventing pollution, preserving habitat, and restoring degraded resources. Responsibility for those Actions was laid at the feet of local and state agencies; expected outcomes included new policies and programs to be implemented by state and local decisionmakers. At the first CCMP, several major construction projects ("Projects of Regional Scope and Impact") were underway or proposed that would have significantly influenced conditions in the Bays, and MassBays positioned itself to ensure that they would be "held to the highest standards of public review."

2003 Update

In 1998, "realizing that it routinely monitors the progress of each Action Plan... staff and Management Committee members agreed that the staff should focus on the five Action Plans that contained the majority of 'urgent' Action Items." Five years later, an update to the CCMP generated 2 more Action Plans (Table 5) and 17 additional Action Items, expanding the plan's scope to a total of 88 individual Action Items (Appendix B). That 2003 CCMP update recommended a web-based tracking system to measure progress on the Action Plans – system which was not realized. For the current CCMP, MassBays staff and partners have documented progress under these categories; Appendix C provides a summary of accomplishments through 2017.

Table 5. MassBays' 1996 and 2003 CCMP Action Plan Topics

Action Plan	Topic
1	Protecting Public Health
2	Protecting and Enhancing Shellfish Resources
3	Protecting and Enhancing Coastal Habitat
4	Reducing and Preventing Stormwater Pollution
5	Reducing and Preventing Toxic Pollution
6	Reducing and Preventing Oil Pollution
7	Managing Municipal Wastewater
8	Managing Boat Wastes and Marine Pollution
9	Managing Dredging and Dredged Materials Disposal
10	Reducing Marine Debris and Marine Floatables
11	Protecting Nitrogen Sensitive Embayments
12	Enhancing Public Access and the Working Waterfront
13	Planning for a Shifting Shoreline
14	Managing Local Land Use and Growth (expanded in 2003)
15	Enhancing Public Education and Participation
16	Preventing Marine Invasive Species (new in 2003)
17	Monitoring the Marine Environment (new in 2003)

2005-2008, 2009-2014 Strategic Plans

MassBays' struggle to gain ground relative to the broad mandate of the 2003 CCMP is evident in the program's effort to develop more focused strategic plans between 2005 and 2014. Efforts to track progress on CCMP actions had been all but abandoned by this time. Instead, two documents (dated 2005-2008 and 2009-2014) identified activities, subsets of the longer list of actions called for in the CCMP, as priorities for specific lengths of time. The strategic plans were described as the "second level" of planning, between the "first-level" CCMP and the annual workplans at the "third layer:" At the second level, this Strategic Plan gives program direction, addressing and reflecting the strengths and limitations of staff and partners in terms of realistic capacity for implementation.

The annual Work Plan is the third layer of planning, which identifies the timeframes, responsible parties, and specific steps for MassBays staff and Regional Service Providers to complete program actions within each fiscal year. Its development is guided heavily by the programmatic intentions articulated in the Strategic Plan.⁸⁰

The 2005-2008 plan focused on "two major areas: producing significant environmental results in the MBP region and building organizational sustainability."⁸¹ Appendix D is a progress report on the tasks laid out in 2005-2008 Strategic Plan, documented in 2009 as Boston staff prepared the 2009-2014 plan.

The 2009-2014 Strategic Plan described its purpose as setting out "program direction, addressing and reflecting the strengths and limitations of staff and partners in terms of realistic capacity for implementation."⁸² It was a concerted effort to develop goals both within and across the regions, to support a cohesive story of MassBays' efforts and accomplishments that also acknowledged the differing challenges in each. A significant accomplishment during this time was an Estuary Delineation and Assessment, described in Chapter 2 and Appendix A, compiling GIS-linked data for parameters available across the MassBays planning, and delineating the landward and seaward boundaries for 65 estuarine watersheds or assessment units. The EDA establishes a baseline from which MassBays can track changes in the condition of the estuaries over time and serves as the foundation of the new CCMP.

Responding to new conditions

A CCMP is not only a CWA requirement, but it is an important "blueprint" to guide future actions. MassBays' 2003 updated CCMP, however, no longer meets our organizational, programmatic, or ecosystem-based goals. Indeed, in the 20 years since the last CCMP update, environmental conditions, management priorities, and agency capacities have changed significantly. For example:

- ***New programs are in place***, including NPDES MS4 regulations requiring municipal stormwater remediation, a state-wide Environmental Justice Policy first published in 2002 and subsequently updated in 2017 and 2021, and reorganization of Massachusetts' Environmental Secretariat to incorporate Energy, and form the Department of Conservation and Recreation (DCR) by combining the state and Boston metropolitan parks departments. Cape Cod completed a CWA §208 plan in 2015, laying out "a watershed-based approach to restoring embayment water quality on Cape Cod."⁸³ Also over the last 20 years, MassBays

⁸⁰ Massachusetts Bays Program Strategic Plan, July 2009 – June 2014

⁸¹ Massachusetts Bays Program Strategic Plan, July 2005 – July 2008

⁸² Massachusetts Bays Program Strategic Plan, July 2009 – June 2014

⁸³ Cape Cod Commission. 2015. 208 Plan: Cape Cod Area Wide Quality Management Plan Update.

https://sp.barnstablecounty.org/ccc/public/Documents/208%20Final/Cape_Cod_Area_Wide_Water_Quality_Management_Plan_Update_June_15_2015-Printable.pdf

has supported a new and robust volunteer diadromous fish counting program: in MassBays' study area more than 20 runs are now monitored each spring.⁸⁴

- **Programs to protect and improve water quality have been discontinued**, for example the Massachusetts Watershed Initiative,⁸⁵ which provided direct funding and technical support to watershed groups. DEP discontinued its regular coastal monitoring program in 1990s. EPA's plan to promulgate a national stormwater rule, recommended by the National Research Council of NAS in 2009, was abandoned in 2014.⁸⁶ Hundreds of millions of dollars have been invested to eliminate combined sewer outfalls (CSOs)⁸⁷ resulting in water quality improvements,⁸⁸ but many CSOs remain and continue to cause significant impact on residents' use of coastal resources, sending bacteria, metals, and nutrients into receiving waters.⁸⁹
- **Regional projects with significant impact have been completed**. MassBays' early focus was dominated by large, pollution-oriented challenges, called "megaprojects" in the 1996 CCMP. They included the Boston Harbor cleanup, the Central Artery/Tunnel project (i.e., the "Big Dig"), and South Essex (North Shore) and Plymouth (South Shore) sewage treatment projects. All of these projects have been completed in the intervening years, including the Boston Harbor cleanup. At the time of the 2003 CCMP update, the MWRA had only begun monitoring the 9-mile outfall originating from the plant; we now have 20 years of data characterizing the discharge and ambient effects (see Section II). In addition, the Massachusetts Division of Ecological Restoration has funded and provided technical assistance for hundreds of dam removals and culvert replacements, opening miles of rivers to anadromous fish, restoring historic runs for alewife, smelt, and herring.⁹⁰
- **Impacts of climate change are evident**,⁹¹ with new invasive species, changes in fisheries distribution, increased intensity of storms, and more frequent flooding events. At the same time, policymakers have taken up efforts to anticipate and respond to future impacts at the state and local level. Massachusetts completed a State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) in 2018,⁹² currently being updated. MassBays' Director is a member of the team developing the 2023 Massachusetts Climate Change Assessment, a core component of update of the SHMCAP. The Climate Assessment evaluates impacts – and the

⁸⁴ Chase, Brad. 2018. "Diadromous Fish Management Update – 2018." Presented at the Annual Meeting of the River Herring Network. http://riverherringnetwork.com/add-file/doc_download/129-dmf-diadromous-fish-management-update-brad-chase-2018.html

⁸⁵ EPA. 1997. Watershed Progress: Massachusetts' Approach. EPA 840-F-96-004. <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=20004I38.pdf>

⁸⁶ Copeland, Claudia. 2016. Stormwater Permits: Status of EPA's Regulatory Program. Washington DC: Congressional Research Service. <https://crsreports.congress.gov/product/pdf/RS/97-290>

⁸⁷ MWRA. 2016. CSO Control Plan Goals and Costs by Receiving Water. <https://www.mwra.com/03sewer/html/sewco.htm#cost>

⁸⁸ For example, see MWRA. 2022. *Summary of CSO Receiving Water Quality Monitoring in Upper Mystic River/Alewife Brook and Charles River*. <https://www.mwra.com/harbor/enquad/pdf/2022-09.pdf>

⁸⁹ For example, the Merrimack River continues to be subject to untreated CSO discharges: <https://www.epa.gov/merrimackriver/environmental-challenges-merrimack-river#CSO>

⁹⁰ Division of Ecological Restoration Project Map, <https://www.mass.gov/service-details/the-division-of-ecological-restoration-project-map>

⁹¹ EPA. 2016. *Climate Change Indicators in the United States: A Closer Look: Marine Species Distribution*. <https://19january2017snapshot.epa.gov/climate-indicators/climate-change-indicators-marine-species-distribution.html>

⁹² AECOM. 2018. Massachusetts Hazard Mitigation and Climate Adaptation Plan. <https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf>

disproportionality of those impacts on EJ communities – from climate stressors (temperature, precipitation, sea level rise, etc.) and climate hazards (extreme heat, flooding, droughts, etc.) across five sectors: Human, Infrastructure, Natural Environment, Economy, and Governance. The content draws from up-to-date data and predictions of impact to identify coastal vulnerabilities, including coastal habitats. For example, see Figures 18 and 19 (both excerpted from the Draft Natural Resources/Marine Ecosystems Chapter of the Massachusetts Climate Change Assessment).

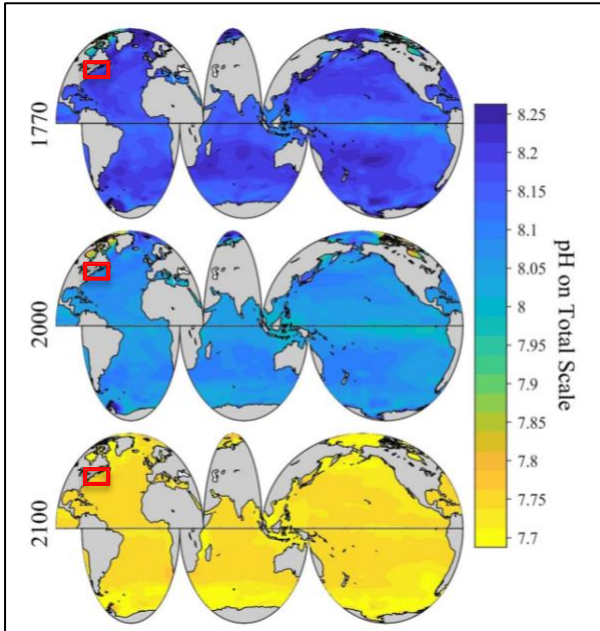


Figure 18. Historic (1770), measured (2000), and predicted (2100) pH in the global oceans. Red boxes mark our region, the NW Atlantic.⁹³

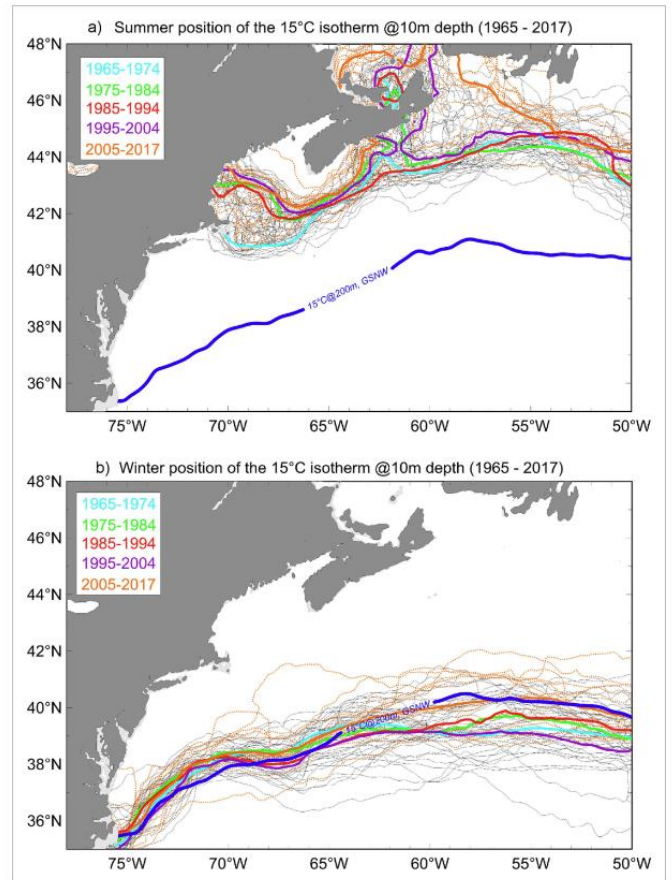


Figure 19. Summer (a) and Winter (b) positions of the 15°C isotherm at 10m depth from 1965 to 2017.

- **New resources are available to support municipal action, especially with regard to climate change.** A Commonwealth website, resilientma.mass.gov, provides a range of information and planning tools for Massachusetts communities relevant to natural resources and infrastructure. Massachusetts’ coastal communities have recognized the need to adapt to climate change, as evidenced by consistent applications for funding and technical assistance from state entities. Between 2015 and 2022, CZM’s Coastal Resilience Grant Program awarded \$35.7 million,⁹⁴ and EEA’s Municipal Vulnerability Program distributed \$100 million to communities around the Commonwealth between 2017 and 2022.⁹⁵

⁹³ Jiang, L. Q., Carter, B. R., Feely, R. A., Lauvset, S. K., & Olsen, A. (2019). Surface ocean pH and buffer capacity: past, present, and future. *Scientific reports*, 9(1), 1-11

⁹⁴ <https://www.mass.gov/news/baker-polito-administration-invests-126-million-in-coastal-community-resilience> accessed 10/31/22

⁹⁵ <https://www.mass.gov/news/baker-polito-administration-awards-over-32-million-in-climate-change-funding-to-cities-and-towns-bringing-total-investment-to-100-million> accessed 10/31/22

- Funding for Massachusetts environmental agencies and EPA have declined.** In FY2009, investment in environmental protection was 0.83 percent of the state budget.⁹⁶ In FY2021, environmental spending made up only 0.62 percent of the state budget.⁹⁷ DEP, a significant partner in MassBays' work to assess and improve water quality, had 25 percent fewer full-time employees in 2021 compared to 2009.⁹⁸ EPA staffing has also declined, by 15 percent overall between FFY2009 and FFY2022.⁹⁹ Early retirements and buy-outs in 2019-2021 led to attrition in both numbers and expertise in EPA Region 1.¹⁰⁰

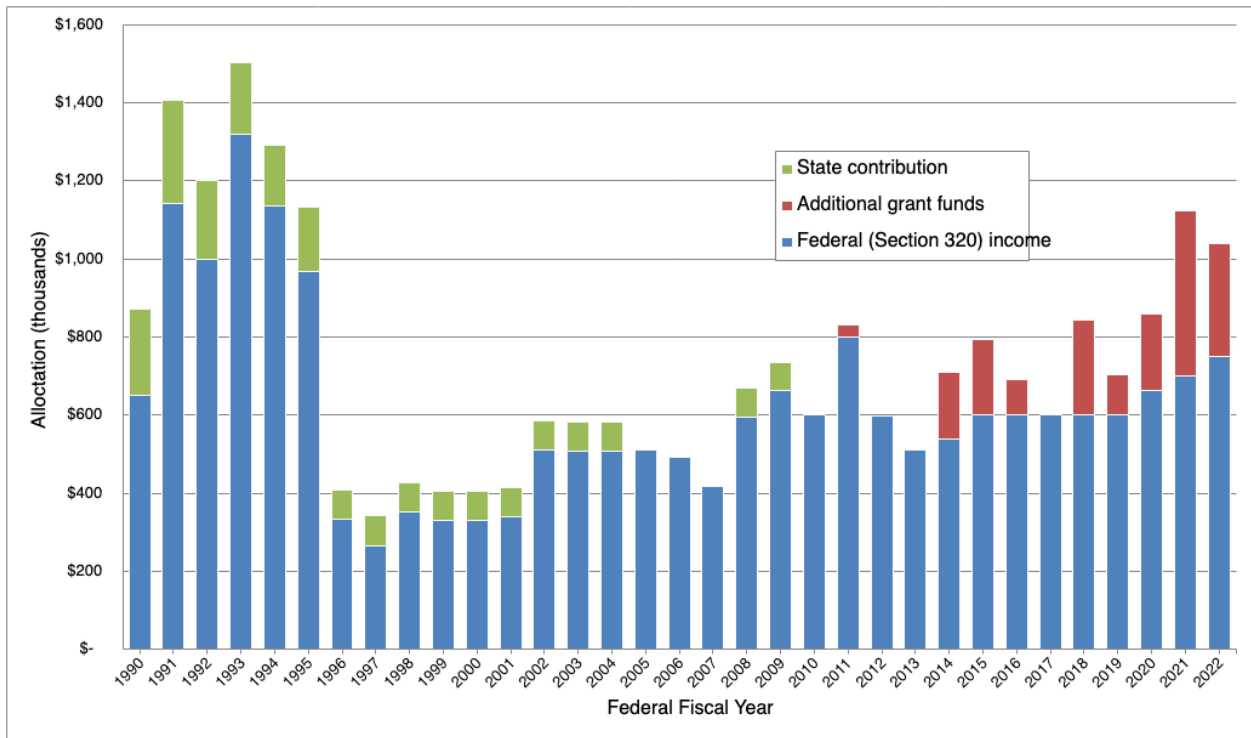


Figure 20. MassBays funding history 1990-2022. “Additional grant funds” refers to funding secured through competitive applications for Federal funds. Figures for 2022 do not include Infrastructure Investment and Jobs Act funding (\$909,800) received that year.

- MassBays’ influence on local decision making has increased** by virtue of 19 years’ effort on the part of the RSPs and RCs. With funding from MassBays, they have, for example, partnered with municipal staff and officials to update septic system, wetlands, and stormwater bylaws, engaged residents in coastal habitat protection and restoration, devised practices for maintaining river flow during drought conditions, and secured funding for coastal resiliency measures. Our RSPs are EEA-certified Municipal

⁹⁶ Green Budget FY2022 <https://www.environmentalleague.org/wp-content/uploads/2022/07/ALL-Green-budget-docs-FY22-4.pdf> Green Budget FY2022 (<https://www.environmentalleague.org/wp-content/uploads/2022/07/ALL-Green-budget-docs-FY22-4.pdf>). accessed 8/22/22

⁹⁷ Ibid.

⁹⁸ Ibid.

⁹⁹ EPA. 2022. EPA’s Budget and Spending. <https://www.epa.gov/planandbudget/budget> accessed 8/22/22

¹⁰⁰ LeMoult, Craig. 2019. Boston’s EPA Office is Shrinking, And Employees Are Speaking Out. WGBH News, February 15. <https://www.wgbh.org/news/local-news/2019/02/15/bostons-epa-office-is-shrinking-and-employees-are-speaking-out> accessed 9/12/19

Vulnerability Program service providers¹⁰¹ and sit on state-wide advisory commissions. Both MassBays staff and RCs serve on the boards of regional research, monitoring, and educational associations, sharing our successes with regional and national audiences and bringing best practices back to our local partners.

A shift in focus

The context established by these changes reflects the impacts of new issues, technologies, management frameworks, and above all the emerging impacts of climate change. In response, MassBays' Management Committee determined that a Revised CCMP (as defined under EPA Guidance) would be necessary to guide the evolution of MassBays' focus. The Committee worked from 2013 to 2022 to revise our programmatic and organizational goals. With the current revision, MassBays shifts from programming that focuses on large pollution sources to watershed-specific restoration efforts. Our Programmatic Goals are to facilitate action at the local level, which requires site-specific information about the impacts of climate change, water quality, and ecosystem conditions. Real change at the local level requires opportunities for collaboration, technical support, documentation of improvements, and local ownership of results in order to succeed.

The revision also affords MassBays the opportunity to directly address two significant challenges not included in MassBays' previous CCMPs: environmental justice and climate change.

Environmental justice

In 1994, President Bill Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directing federal agencies to address environmental injustices in their operations and in communities across the country. Progress in this arena has been slow, and yet addressing inequities in access to the coast and open space, disproportionate exposures to toxic waste and environmental contamination, and lack of access to arenas where policy and management decisions are taking place are critical to sustainable and resilient communities.

U.S. EPA Environmental Justice Statement

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EPA's goal is to provide an environment where all people enjoy the same degree of protection from environmental and health hazards and equal access to the decision-making process to maintain a healthy environment in which to live, learn, and work.

<https://www.epa.gov/environmentaljustice/learn-about-environmental-justice>

MassBays has a role to play in implementing initiatives to respond to those needs, including highlighting the social, economic, and demographic displacements and realignments that climate change will introduce. MassBays cannot cure the expected ills, but we can ensure that the challenges are fully recognized and opportunities for action are encouraged.

We will make full use of resources offered by both EPA and EEA's Offices of Environmental Justice to advance environmental justice in the MassBays study area. The Programmatic Goals detailed in Section VI include means for taking up this issue.

¹⁰¹ <https://www.mass.gov/doc/mvp-approved-vendors-2> accessed 8/22/22

Massachusetts Environmental Justice Policy, 2021

Environmental justice is based on the principle that all people have a right to be protected from environmental hazards and to live in and enjoy a clean and healthful environment regardless of race, color, national origin, income, or English language proficiency. Environmental justice is the equal protection and meaningful involvement of all people and communities with respect to the development, implementation, and enforcement of energy, climate change, and environmental laws, regulations, and policies and the equitable distribution of energy and environmental benefits and burdens.

<https://www.mass.gov/doc/environmental-justice-policy6242021-update/download>

Climate change

Emerging and predicted risks from climate change have directly informed MassBays' Programmatic Goals. Our long-term planning recognizes that past conditions and the current state is not a prediction of future conditions. For example:

- Sea level rise results in marsh subsidence and other changes in coastal habitat extent and distribution. Efforts to protect and improve resilience of these shoreline habitats need to take future conditions into account.
- Warmer water and warmer seasons are already changing species distribution and abundance, especially with observed northward migration of aquatic species. Responses to invasive species will need to be evaluated from the perspective of the ability of native species to persist in a new climate.
- Increased and more severe storms increase the influence of stormwater and combined sewer overflow discharges on water quality, change freshwater/saltwater interfaces, and stress existing stormwater and tidal infrastructure (including culverts and tide gates). MassBays must be positioned to help municipalities update water infrastructure in ways that do not accelerate loss of habitat or increase coastal erosion.

A vulnerability assessment conducted for the EPA Region 1 NEPs¹⁰² in 2016 (Figure 21) predicted the following for Massachusetts:

1. High risk by 2050 of impacts on habitat and fish, wildlife, and plants due to increased drought and storminess, sea level rise, warmer summers and winters, and warmer water.
2. High risk by 2100 of impacts on recreation and public water supplies, due to increased storminess, sea level rise, warmer summers and winters, and warmer water temperatures.
3. High risk by 2050 of impacts on pollution control, due to increased storminess, warmer winters, and warmer water; by 2100 sea level rise and increasing drought will also contribute to high risk of impacts on pollution control.

¹⁰² Battelle. 2016. *Climate Change Vulnerabilities Scoping Report: Risks to Clean Water Act Goals in Northeast Sub-regions*. Prepared under EPA Contract No. EP-C-14-017, Work Assignment 1-14.

Likelihood of Occurrence	High	<ul style="list-style-type: none"> 1. Increasing Drought - Base flow in streams may decrease 2. Increasing Drought - Groundwater tables may drop 3. Increasing Drought - Stream water may become warmer 4. Increasing Storminess - Stronger storms may cause more intense flooding and runoff 5. Increasing Storminess - The number of storms reaching an intensity that causes problems may increase 6. Warmer Winters - Less snow, more rain may change the runoff/infiltration balance; base flow in streams may change 	<ul style="list-style-type: none"> 1. Increasing Storminess - Coastal overwash or island breaching may occur 2. Sea Level Rise - Ability of tidal marsh elevation to match rate of Sea Level Rise 3. Sea Level Rise - Ability of tidal marsh to migrate landward 4. Sea Level Rise - Higher salinity may kill targeted species 5. Sea Level Rise - Shoreline erosion may lead to loss of beaches, wetlands and salt marshes 6. Warmer Water - Warmer water may promote invasive species or disease 	
	Medium	<ul style="list-style-type: none"> 1. Increasing Storminess - Increased intensity of precipitation may yield less infiltration 2. Warmer Summers - Greater electricity demand may affect operation decisions at hydropower dams 3. Warmer Summers - Switching between surface and groundwater sources for public water supplies may affect the integrity of water bodies 4. Warmer Winters - Marshes and beaches may erode from loss of protecting ice 5. Warmer Winters - Rivers may no longer freeze; a spring thaw would be obsolete 	<ul style="list-style-type: none"> 1. Increasing Storminess - Turbidity of surface waters may increase 2. Warmer Summers - Higher temperatures may lead to greater evaporation and lower groundwater tables 3. Warmer Water - Desired fish may no longer be present 4. Warmer Water - Warmer Water may lead to greater likelihood of stratification 	<ul style="list-style-type: none"> 1. Increasing Storminess - Stream erosion may lead to high turbidity and greater sedimentation 2. Sea Level Rise - Bulkheads, sea walls and revetments may become more widespread 3. Sea Level Rise - Saline water may move farther upstream and freshwater habitat may become brackish 4. Sea Level Rise - Salinization of non-tidal freshwater coastal marshes 5. Sea Level Rise - Tidal influence may move farther upstream
	Low	<ul style="list-style-type: none"> 1. Increasing Drought - Increased human use of groundwater during drought may reduce stream baseflow 2. Increasing Drought - New water supply reservoirs may affect the integrity of freshwater streams 3. Ocean Acidification - Long term shellfish sustainability may be an open question 4. Warmer Winters - A spring runoff pulse may disappear along with the snow 	<ul style="list-style-type: none"> 1. Increasing Storminess - Lower pH for NPS pollution may affect target species 2. Ocean Acidification - Fish may be adversely affected during development stages 3. Sea Level Rise - Light may not penetrate through deeper water 	
		Low	Medium	High
Consequence of Impact				

Figure 21. Risks associated with habitat in the MassBays study area by 2050, determined “similar to those in the Northeast Study Area” by Battelle analysts. Green cells have low risk, yellow cells have medium risk, and red cells have high risk.¹⁰³

Given that neither climate change nor environmental justice are addressed in the existing (2003) CCMP, and the central nature of both to any comprehensive environmental management plan, it is clear that MassBays needs a new CCMP.

¹⁰³ Battelle. 2016. *Climate Change Vulnerabilities Scoping Report: Risks to Clean Water Act Goals in Northeast Sub-regions*. Prepared under EPA Contract No. EP-C-14-017, Work Assignment 1-14.

IV. MassBays' Role into the Future

Within 25 miles of Boston there are 81 universities and colleges,¹⁰⁴ and at least 60 nonprofit organizations working in the MassBays study area. MassBays, however, is the only entity that has taken up the challenge of characterizing the habitats and water quality in each coastal subwatershed from Salisbury to Provincetown, across three bays. MassBays' efforts to drive improvements in habitats and water quality across our study area will be informed by site-specific targets. No longer comparing apples to oranges – or Salem Harbor to Wellfleet Harbor – the MassBays Science and Technical Advisory Subcommittee (STAC) worked with EPA's Office of Research and Development and Office of Water to apply the BCG framework for the Bays. MassBays is in the forefront of efforts to apply BCG in the National Estuary Program; the result is a suite of targets for eelgrass, salt marsh, and tidal flats to guide local action (see Appendix A).

Our regional purview also places MassBays in a unique position to look across individual data sets to identify common challenges and opportunities. Reporting from the RCs, insights from STAC and MC members, and access to an extensive network of partners and collaborators provide MassBays with the context needed to respond to emerging concerns.

At the same time, NEPs' non-regulatory mandate under the Clean Water Act allows MassBays to bring together disparate stakeholders as a neutral convener, and to provide direct assistance to practitioners. This role becomes even more important as federal and state governments direct investments in infrastructure and responses to climate change and obligates us to build communities' capacity to plan, implement, and monitor the results of restoration projects. MassBays has taken up the task of providing capacity-building – training, tools, and one-on-one support – to support local efforts to respond.

Finally, in response to the NEP focus on coastal habitat protection and restoration, MassBays identifies, develops, and implements investigations and programs that incorporate holistic, ecosystem-based solutions. This approach acknowledges the interconnectedness of human and coastal systems, a concept that will be integral to our work with communities and decision makers, and also takes into account the need for long-term, adaptive response to conditions.

New Vision, New Mission

Vision – Defining the Environmental Outcomes of CCMP Implementation

From its beginnings in 1988, MassBays has been dedicated to protecting, restoring, and enhancing the estuarine resources of Massachusetts and Cape Cod Bays. In Spring 2013 the Management Committee endorsed a Vision and Mission for MassBays that would drive subsequent work to develop goals, strategies, and actions.

MassBays' Vision

We envision a network of healthy and resilient estuaries, sustainable ecosystems that support the life and communities dependent upon them.

¹⁰⁴ https://study.com/list_of_colleges_in_boston_massachusetts.html

MassBays' Vision encompasses the **environmental outcomes** anticipated when the CCMP is fully implemented:

- Improved habitat continuity and hydrology
- Resilient coastal habitat, including implementation of nature-based coastal protection measures
- Restored natural communities
- Improved water quality

Mission – Toward Management Outcomes of CCMP Implementation

Following three years of CCMP planning activities, and recommendations from a strategic communications consultant, MassBays' mission was revised once more.

MassBays' Mission

To empower 50 coastal communities to protect, restore, and enhance their coastal habitats. To fulfill this mission, MassBays engages local, state, and federal entities to advance the use of scientific information and provide technical support for better decision making.

This mission statement serves as a stand-alone, easily shared description of the organization's role relative to the array of groups working on Massachusetts coastal issues, and the work needed to address both environmental and management challenges in the Bays.

Taken together, our vision and mission drive MassBays' priorities for habitat and management, and serve as the basis for the broad goals, strategies, and actions that we will take up under this CCMP as implemented via annual workplans.

A New CCMP

With this revision, the Management Committee is updating MassBays' approach to improving and protecting coastal resources over the next 10 years. This new, more nimble approach is intended to be collaborative, inclusive, and transparent. It builds on MassBays unique local relationships to build capacity for locally significant efforts. It prioritizes efforts that contribute to system-wide improvements in habitat, connectivity, and resilience. And it enhances and makes use of our ability to gather, synthesize, and communicate region-wide conditions in a meaningful way. The new CCMP:

- **Relies on local-scale approaches** to assessments and solutions.
- **Incorporates biological and other indicators of habitat health and measurable outcomes.**
- **Relies on complementary efforts** underway at the local, state, and federal level.
- **Acts on information about climate change**, and its realized and predicted impacts.
- **Recognizes environmental justice as an underlying requirement** for meaningful and sustainable improvements in the Bays.
- **Seeks to increase MassBays' effectiveness** through strategic communication and financial sustainability.
- Establishes a means for gaining access to and supporting **collection of quality-assured data** from across the study area.

The goals, strategies, actions, and implementation timelines articulated in this 2023-2033 CCMP represent MassBays' contribution to and support of a region-wide, multi-jurisdictional effort to improve conditions and monitoring in Ipswich Bay, Massachusetts Bay, and Cape Cod Bay.

Guiding Principles

MassBays' CCMP documents our organizational and programmatic approaches to improving natural conditions in the Bays. The principles that guide our day-to-day work also guided the development of the CCMP, and characterize the strategies MassBays will employ to realize our goals:

- **Collaboration and Cooperation.** The complex and multidimensional issues before us cannot be handled by any single entity. We will work with partners in all sectors, engage underserved communities, and where there is not already an effort underway, and an issue is identified as a priority through our CCMP, we will build capacity locally – providing technical support, grant writing, and regional connections – that get projects done.
- **Ecosystem-based Management.** MassBays seeks fundamental improvement in our estuaries. This requires a holistic approach to problem-solving and decision making. Cross-cutting impacts and implications of any action will be considered before we make significant investments.
- **Environmental Equity.** MassBays' study area encompasses urban, suburban, and rural communities, native and immigrant populations, and a multitude of races and cultures. We commit ourselves to actions that will increase access to technical resources, funding, and coastal resources for all people of the Commonwealth.
- **Climate Resiliency.** We know that our estuarine systems will be impacted over the coming decades by the multiple manifestations of climate change. MassBays will draw on the most current understanding of those impacts to scope proposed actions.
- **Long-term Sustainability.** As long as the National Estuary Program exists, MassBays will play a role in meeting the goals of CWA §320. Our ability to do this work requires both the Management Committee and staff commitment to implementation – and our success in doing so will set the stage for claiming even more success in the future.

Revision Process

This revised CCMP was nearly 10 years in the making (Figure 22). With the EDA and a comprehensive literature review (see Section III) as scaffolding, the process began with a scoping exercise with the Management Committee and RCs. The group looked in detail at the actions listed in the 2003 CCMP (Table 5), and by consensus, decided whether to *Stop*, *Start* (where an action had not already been taken up) or *Continue* each activity. During a subsequent full-day meeting, the Management Committee adopted a mission and vision, then developed overarching goals and strategies to guide outreach and solicitation of input from those interested in our work. From this core group we reached out to an ever-widening circle of stakeholders, gathering additional perspectives on MassBays' organizational and programmatic goals. Methods of engagement included:

- MassBays RCs provided practical insights and connections to communities to ensure that our plan would be practical and valuable to resource managers and decisionmakers.
- Citizen-scientist volunteers, municipal officials, local and regional nonprofits, and federal and state government agencies were polled through a series of **regional workshops** and an online survey. Outcomes from these meetings are included in Appendix E.
- A social anthropologist conducted **one-on-one interviews** with individuals who may not have realized that they have a stake in the health of the Bays. His findings are in Appendix F.
- State, federal, and regional planning agency partners joined the MassBays Executive Director for **information exchange sessions** to identify efforts already underway, and areas where MassBays can augment existing work or fill in gaps. Their contributions are compiled in Appendix G.

- A **public review** period began with the 2015 State of the Bays Symposium, itself an opportunity for MassBays to connect past trends and existing conditions to future actions.
- Soon after, EPA initiated a reassessment of their own Guidance for CCMP Updates and Revisions. The final version, released May 2016, sent MassBays back to the drawing board to produce new components now required with a revised CCMP. The Management Committee approved a **roadmap to a revised CCMP**, as negotiated between MassBays staff and EPA Region 1 (Appendix H), in July 2017.
- MassBays staff began anew to develop a Revised CCMP in March 2018, in accordance with the roadmap. The Management Committee invested numerous hours in the work of three Subcommittees to develop three component plans of the CCMP. They include: **Finance, Strategic Communications, and Monitoring Plans**, included as Attachments 1, 2, and 3, respectively, to this document. These plans were reviewed and endorsed by the Management Committee in October and November 2018. These will be updated during calendar years 2023 and 2024 to reflect new conditions.
- A **second Public Review Draft** CCMP, developed in accordance with the 2016 EPA Guidance and informally reviewed by EPA Region 1, was released to the public for comment in November 2018. MassBays Regional Coordinators convened their Local Governance Committees (LGCs) (the regional equivalent to our own Management Committee) to examine the long-term plan's implications for their own area, especially where local priorities have changed since the 2015 Public Review Draft CCMP was released. Feedback from that outreach is included here as Appendix I. With the close of the **comment period**, and comments incorporated, MassBays provided a full Revised CCMP to the Management Committee in December 2018 for final endorsement, prior to submission to EPA for approval in January 2019.
- Seeking further specificity in MassBays' plans and target conditions, EPA's response to the 2019 CCMP was to request **numerical targets to track improvements in estuarine habitats** across the Bays. MassBays had included a task to produce these targets for 44 delineated embayments using the BCG approach as a Strategy in the CCMP; this became a prerequisite for EPA's endorsement. The two-year process and its outcomes are described in Appendix A.

Even as we worked to bring this CCMP to completion in 2022, the ground was shifting under our feet. Thus the Management Committee determined that the time was right for an evaluation of MassBays' position within CZM and the opportunities to broaden partnerships and outreach through a transparent assessment of host options. The result of this assessment was the Management Committee's full endorsement of the program's move to the University of Massachusetts Boston's School for the Environment. The Committee also has determined that this CCMP should reflect conditions through June 2022, and that the three CCMP Attachments – Monitoring, Finance, and Communications Plans – should be updated by December 31, 2024 to incorporate more recent developments, including:

- A new milieu for communications and diversification of funding, as MassBays becomes a Center within UMass Boston's School for the Environment.
- New opportunities for project implementation with supplemental funding under the Infrastructure Investment and Jobs Act of 2021 (also known as the Bipartisan Infrastructure Law, or BIL). Spending for this five-year, \$909,800-per-year appropriation must align with corresponding EPA program guidance, including planning and reporting requirements related to EJ community benefits.

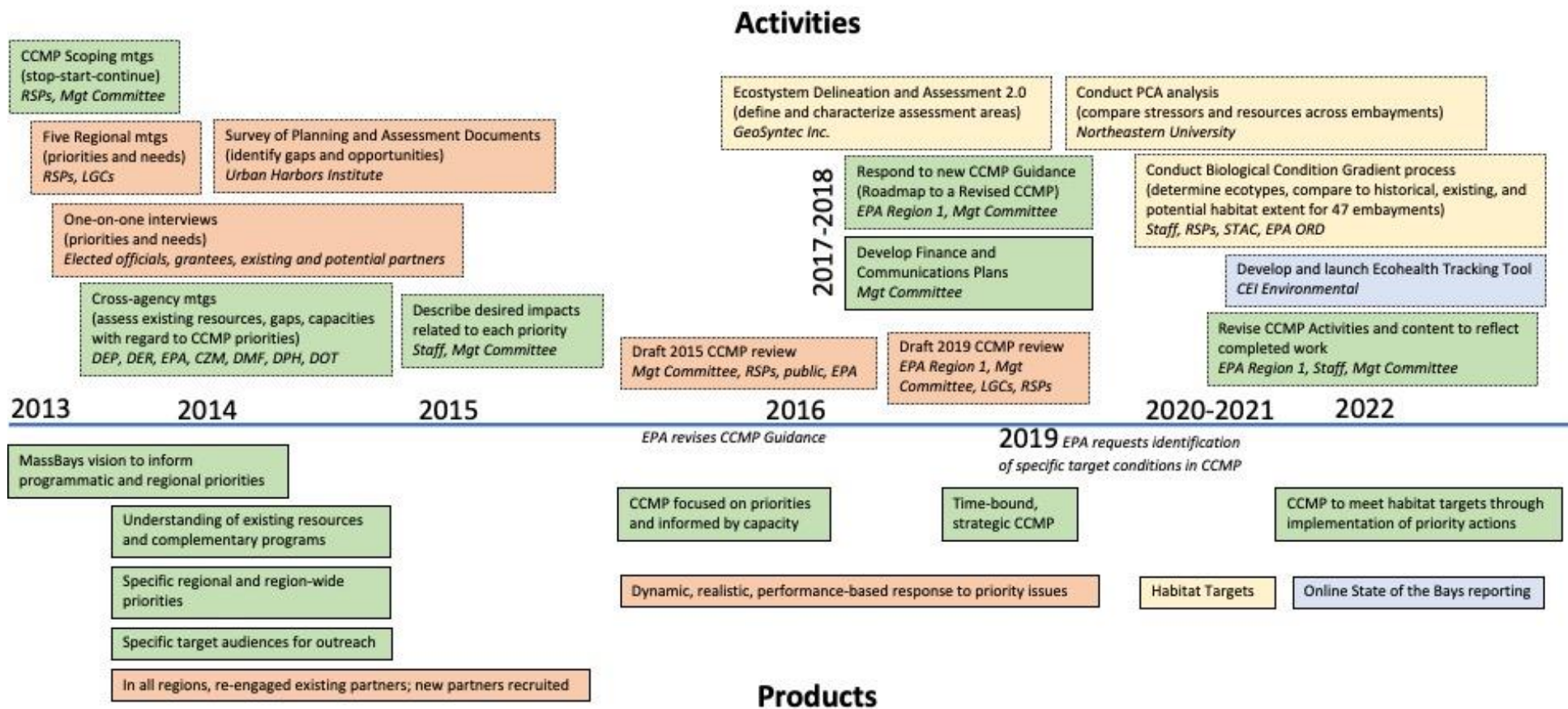


Figure 22. Components of MassBays' CCMP development process. Boxed items below the timeline are products of similarly shaded activities described above the timeline. For full details, refer to Appendices E through I.

The remaining sections of this document describe the Programmatic and Environmental Outcomes we seek to realize by meeting three primary Goals for MassBays as an entity (Organizational Goals) and an Estuary of National Significance (Programmatic Goals). Figure 23 illustrates how implementing the CCMP will result in Outcomes that directly respond to the Challenges identified.

A Blueprint for the Bays

CCMPs can be thought of as management blueprints that translate environmental goals into concrete schedules and activities. Like all blueprints, they look into the future, describing something that will be realized through stepwise actions. And like all blueprints, they can't guarantee that all will go according to plan. A CCMP must be reality-based and be both aspirational and nimble enough to seize opportunities strategically. We know we cannot predict our successes in the next 10 years, and we know that even 10 years is not enough time to fix the legacies of past activities or to address the coming impacts of new conditions. But we do know how we propose to spend those next 10 years: prioritizing restoration and protection in the Bays; reporting on condition and results; and building capacity where work needs to happen. A first step toward developing our blueprint has been to identify and recognize the challenges MassBays (the organization and the geographic region) faces.

Challenges

The Management Committee, with input from the RCs and LGCs, identified two primary categories of challenges impeding progress toward our vision: environmental challenges and management challenges.

Environmental Challenges

The environmental issues identified by stakeholders across MassBays' study area can be described quite succinctly as "Coastal habitat degradation and loss of biodiversity, characterized by altered hydrology, impaired water quality, vulnerability to climate change, establishment of invasive species, and fragmentation." Specific examples of these issues include:

- Dams and stream crossings, tide gates, and water withdrawals often result in **altered hydrology** that adversely impacts coastal habitat, impeding anadromous fish passage, changing natural inundation cycles of salt marshes, and reducing in-stream flow that otherwise supports benthic communities and habitat. This challenge was highlighted by multiple partners seeking healthier marshes for coastal resilience and expanded habitat for anadromous fish.
- **Impaired water quality** is tracked primarily through ongoing and periodic monitoring of nutrient concentrations, temperature, and dissolved oxygen and biological oxygen demand, and is the result of contaminated stormwater inputs and inadequately treated wastewater discharges. Poor water quality can be exacerbated by changes in hydrology and climate. As described in Section II, water quality in the Bays has varied over time, though historical data are available for only a subset of the study area. With improved water quality, MassBays expects increased biodiversity and restored habitat for shellfish and eelgrass especially.
- A new and significant challenge for MassBays is region-wide **vulnerability to climate change**. Evidence of sea level rise, increased water temperatures, and increased severity and frequency of storms are being experienced in Massachusetts. The Commonwealth has invested significant funding and expertise into determining vulnerability of highway and transit infrastructure,¹⁰⁵ examining options for protecting Boston Harbor economic

¹⁰⁵ Massachusetts Department of Transportation (MassDOT) Statewide Climate Change Adaptation Plan, <https://www.mass.gov/massdot-statewide-climate-change-adaptation-plan>

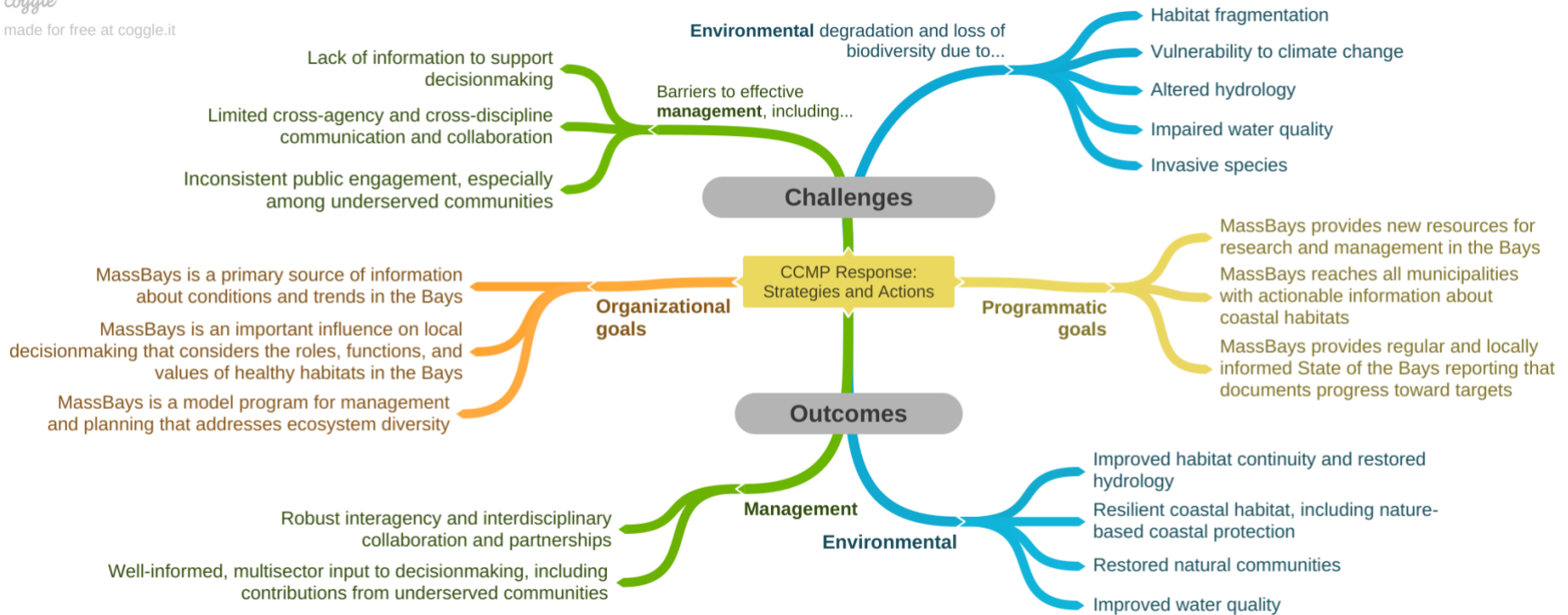


Figure 23. Relationship between the Challenges in the Bays, the CCMP Goals MassBays will take up with this CCMP, and the anticipated Outcomes.

assets,¹⁰⁶ and supporting municipalities in vulnerability assessments and adaptation (e.g., through the Municipal Vulnerability Program and the Coastal Resiliency Grant Program). The 2018 (Fourth) National Climate Assessment (the fifth Assessment will be completed in 2023) documents evidence that the Northeastern U.S. is seeing more rapid ocean warming and higher sea level rise than other portions of the world.¹⁰⁷ The “new normal” for the Massachusetts coast – significantly higher high tides, new invasive species, and flashier stream flows – presents a challenge for natural systems and coastal species, as well as organizations focused on conservation of existing ecosystems. By supporting adaptive measures at the local and regional level, MassBays will play a role in maintaining coastal habitats into the future.

- ***Invasive species*** can be considered a symptom of the stressors above – marine invasives from warmer waters are appearing more frequently due to climate change, for example.¹⁰⁸ Invasives like pepperweed and green crabs pose a specific challenge in themselves, threatening biodiversity and destroying habitat for endemic species. MassBays’ RSPs have chosen to address this threat by documenting their presence and undertaking eradication efforts where feasible. These efforts help to raise the alarm when diverse ecosystems are under threat, with the intent of making them more resilient in the face of natural and human impacts.
- Development across the MassBays study area has resulted in ***fragmentation*** of coastal wildlife corridors and ecosystems, which in turn undermines natural systems’ ability to support biodiversity or serve effectively as habitat. MassBays works to document both the variety of mammals, invertebrates, and birds that live in the coastal zone, and the geographic extent and condition of habitats that support them. This information, when communicated to decisionmakers, can prompt planning and environmentally sensitive development that preserves coastal ecosystems.

Management Challenges

Parallel to these environmental challenges, and in many cases, standing in the way of addressing those challenges effectively, is a suite of management challenges recognized by MassBays as barriers to realizing our vision. The Management Committee, RCs, and LGCs identified three primary challenges to be considered and countered in implementing the CCMP:

- ***Limited cross-agency and cross-discipline communication and collaboration.*** MassBays’ focus on convening and coordination has resulted in excellent results with regard to collaboration among the “usual suspects.” In many cases, MassBays is the only entity willing or able to convene the myriad stakeholders and their interests for constructive discussion, planning, and action. The challenge continues to exist, however, because cross-discipline and cross-agency collaboration are more difficult than traditional approaches, in which academia, municipal staff, and state-level decision makers are able to remain in their silos, often only talking to their own colleagues even when brought to the same table. This isolation of ideas thwarts generations of creative solutions to environmental challenges.

¹⁰⁶ Sustainable Solutions Lab/University of Massachusetts Boston. 2018. *Feasibility of Harbor-wide Barrier Systems: Preliminary Analysis for Boston Harbor*. https://www.umb.edu/editor_uploads/images/centers_institutes/sustainable_solutions_lab/umb_rpt_BosHarbor_5.18_15-optimized.pdf

¹⁰⁷ U.S. Climate Change Research Program. 2018. Fourth National Climate Assessment. <https://www.globalchange.gov/nca4>

¹⁰⁸ Office of Coastal Zone Management, Rapid Assessment Surveys of Marine Invasive Species, <https://www.mass.gov/service-details/rapid-assessment-surveys-of-marine-invasive-species>

- ***Lack of information to support decision making*** prevents forward momentum in responding to multiple environmental challenges. Investment in environmental monitoring has fallen off since MassBays' early years when millions were made available for baseline assessments in Boston Harbor. While MWRA continues to support monitoring in Cape Cod Bay and the lower reaches of the Mystic, Neponset, and Charles Rivers, their scope is still confined to Boston Harbor and the 9-mile outfall.¹⁰⁹ Localized data are critical to local planning that takes natural resources into account, and MassBays seeks opportunities and partnerships to address these gaps. For example, in 2015 MassBays led the National Coastal Condition Assessment (NCCA) across the coast of Massachusetts in collaboration with EPA's NARS program. Following the success of that project, MassBays has been contracted by the Department of Environmental Protection (DEP) to run the four-year long Massachusetts Coastal Condition Assessment (MCCA) which includes sampling of 90 stations between 2020-2023. The results will be shared with stakeholders and decisionmakers and MassBays will seek opportunities to continue this type of monitoring beyond 2023. In this way MassBays has and will continue to play a key role in making new information available to decision makers.
- ***Inconsistent public input, especially from environmental justice communities*** is another management challenge that prevents realization of MassBays' vision. Landowners must see the value in restoring hydrologic systems, residents must take responsibility for their own impacts on water quality, taxpayers must be willing to support climate adaptation measures that protect their neighbors as well as their own properties, and the impacts of invasive species and fragmentation on longer-term health of coastal systems must come into the realm of public awareness. MassBays' efforts to address this challenge will include demystifying decision-making processes and facilitating access to staff responsible for decision making at the federal, state, and local level. Only with investment and buy-in from land- and homeowners, taxpayers, and residents of all stripes will we see wholesale changes in how municipalities respond to the environmental challenges of coastal habitat degradation and loss of biodiversity.

These environmental and management challenges are inextricably linked. Complex challenges like climate change require cross-discipline collaboration and sharing of tools and ideas across sectors. Encouraging public input, and then taking it seriously, are critical components of identifying feasible solutions for any challenge affecting our commonwealth. Lack of data, a management challenge, could just as easily be categorized as an environmental challenge, to the extent that scarcity of data limits our ability to define the challenges that we face.

Outcomes

Over the next 10 years, and with this CCMP, the Management Committee expects MassBays to achieve specific environmental and programmatic accomplishments, outcomes that can be traced back to both our own actions, and MassBays' support of others' actions. Contrary to past CCMPs, which listed multiple "lead agencies" responsible for the planned lists of actions, this CCMP sets out programs and projects on which MassBays will take the lead, as well as responsibility for their completion. The Management Committee holds that this is a more responsible approach, and more likely to result in concrete results tied directly to the desired outcomes: sustainable and resilient

¹⁰⁹ Massachusetts Water Resources Authority Water Quality Monitoring, <http://www.mwra.com/harbor/html/bhmonitoring.htm>

environmental and organizational systems. Our progress will be documented with specific measures described in Section VI.

Organizational Outcomes

Why does MassBays exist as an organization? Why should anyone care if this organization carries out its mission? The Programmatic outcomes of this CCMP will be the result of projects and programs initiated and carried out by MassBays – specific outcomes that only MassBays has taken up through our mission. While we will rely on funders and partners to assist us in this work, MassBays is taking ownership and responsibility for serving as a broad convener across the MassBays region and communities and for completion of programs that will deliver the following:

- **Information about habitat extent and conditions across the Bays will be documented and disseminated via a targeted communications strategy.** State of the Bays reporting is a requirement of §320, and a focus of MassBays’ outreach and communication efforts. This overarching reporting is in the context of ongoing outreach to highlight MassBays’ and the larger National Estuary Program’s contributions to improving conditions over time.
- **Assist MassBays municipalities in implementing habitat protection and restoration practices, informed by diverse stakeholders, including EJ communities.** MassBays’ RCs provide technical support, conduct outreach to residents already impacted by local conditions, and convene stakeholders across sectors, helping municipal decisionmakers implement restoration and protection efforts that are grounded in scientific research and best practices, and that take into account local environmental priorities and concerns.
- **Measurable progress toward target conditions across the MassBays study area.** A central aspect of this outcome is utilization of specific target conditions for habitats in the Bays. A means for documenting trends over time is critical to this outcome, and it is thus tied to the State of the Bays reporting outcome above.

Environmental Outcomes

MassBays’ desired environmental outcomes are relative to existing conditions, which are not, in many cases, specifically known. A suite of targets relative to habitat extent and condition will guide our forward-looking work and provide benchmarks for progress. Progress toward the targets will be measured using both our monitoring framework (Attachment 3) and qualitative assessments by regional partners, then shared with communities to inform local action. We seek to document the following environmental outcomes:

- **Improved habitat continuity and restored hydrology,** assessed through GIS analysis and documented species migration successes.
- **More resilient coastal habitat, including implementation of nature-based coastal protection measures.** Tracking site-specific projects to expand coastal habitat will form the basis to evaluate this outcome.
- **Restored natural communities,** as evidenced by increased spatial extent of specific coastal habitats documented in MassBays’ Ecohealth Tracking Tool (ETT).
- **Improved water quality,** documented as reductions in harmful algal blooms, fewer beach closures – and healthier habitats.

Our primary means for measuring progress toward these outcomes rests on a target-setting method developed by EPA called the Biological Condition Gradient (BCG).¹¹⁰ Our BCG process and

¹¹⁰ Cicchetti, G., et al. 2017. Implementing the Biological Condition Gradient Framework for Management of Estuaries and Coasts. US EPA Office of Research and Development, Washington, DC, EPA/600/R-15/287. <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100SN3Y.txt>

the resulting habitat targets are described in Appendix A. Continuation of these efforts are included under Goal 3.

Management Outcomes

Finally, as a result of our work to respond to management challenges, MassBays anticipates the following:

- **Robust interagency and interdisciplinary collaboration and partnerships.** The Management Committee has determined that convening working groups, committees, and partnerships across agencies, disciplines, and sectors is one of MassBays' primary roles. While the Management Committee itself already serves as a forum for interagency collaboration, across and within state and federal agencies, more can be done.
- **Well-informed, multisector input to decision making, including contributions from EJ communities.** MassBays' outreach efforts are focused on fostering not only basic understanding of the science of estuaries, but to build capacity among local community members to ask their own questions and prompt new actions on the part of decision makers. This outcome aligns with the tenets of environmental justice and overlaps with Programmatic Outcome 2 above: input from all sectors of society including underserved communities, will result in better-informed and more effective actions at the municipal and other levels of decision making. Already, MassBays has conducted stakeholder workshops¹¹¹ and piloted processes for eliciting local priorities for ecosystem benefits with marginalized communities, both described in Appendix B. Our new home as a Center at UMass Boston will enable and broaden this effort.

MassBays will not be able to claim sole credit for progress toward these outcomes, even if we complete all tasks described in this CCMP. We do anticipate, however, that MassBays' work to delineate and compile data about individual embayments in the Bays with the EDA positions us to lead a data-driven effort to monitor and report on improved conditions across the Bays. Our unique combination of regional connections and expertise, a non-regulatory focus on coastal habitats, and ability to convene decision makers, scientists, NGOs, and the public without bias will be key to our success – as they are for all NEPs.

¹¹¹ Lyon-Mackie, J., Vella, P., DiBona, P., Shehab-Sehovic, N., Roche, S., Kreiley, A.I., and Mavrommati, G. *In Review*. Exploring stakeholders' ecosystem services perceptions across Massachusetts Bays using deliberative valuation. ns

V. The New CCMP

MassBays’ Management Committee has identified two sets of complementary goals, Organizational Goals and Programmatic Goals (Figure 24). MassBays anticipates that, with these goals achieved, we will see specific outcomes corresponding to the environmental and management challenges, as described above. These two sets of goals are related to each other, in that MassBays must have organizational capacity to meet the programmatic goals and produce genuine environmental outcomes. The new operational framework provided in this CCMP will enable us and our partners to generate and point to real and substantial improvements in the MassBays ecosystems as laid out in the previous section, and specifically described here:

- Observed improvements in habitat continuity and hydrological connectivity at the local level.
- Local investment in and long-term maintenance of natural systems to improve coastal resilience.
- Documented expansion of natural communities.
- Ambient water quality that supports biodiversity.

MassBays’ Organizational CCMP goals respond to the questions, “Why should MassBays take the lead on responding to these challenges? What position should MassBays occupy in the network of organizations already working in the coastal zone?” These are internally focused goals that will sustain MassBays as an entity and build upon the National Estuary Program’s presence in the Bays.

Organizational Goals	+ Programmatic Goals	→ Environmental Outcomes
MassBays is a primary source for information about conditions and trends in Ipswich Bay, Massachusetts Bay, and Cape Cod Bay.	MassBays provides new resources to support research and management in the Bays.	Locally significant habitats and ecosystems assessed and prioritized for research, assessment, and implementation actions.
MassBays is an important influence on local decision making that recognizes the roles, functions, and values of healthy habitats in the Bays.	MassBays reaches all study-area municipalities with actionable information about coastal habitats.	Ambient water quality supports biodiversity; observed improvements in habitat continuity and hydrological connectivity at the local level.
MassBays is a model program for management and planning that addresses diversity among estuaries.	MassBays provides regular and locally informed State of the Bays reporting that reflects the unique characteristics of MassBays assessment areas, and documents progress toward target conditions.	Locally relevant improvements in water quality, habitat, biodiversity, and resilience.

Figure 24. Relationship of CCMP Organizational and Programmatic Goals to Environmental Outcomes.

Programmatic CCMP goals address the programming, or external services, that MassBays will provide to stakeholders both within the study area, and the larger NEP and coastal habitat management community. They answer the question, “What will MassBays accomplish?”

Pursuant to each goal, MassBays has developed a proactive set of strategies to be applied, and actions to be undertaken to produce the outcomes we’ve identified as critical for the Bays. These

strategies incorporate adaptive monitoring and management, and the actions incorporate stakeholder input collected over the course of the CCMP development. They rest on the suite of habitat-based targets developed using the BCG.

History Informing the Future: MassBays’ Habitat Targets

To produce a suite of habitat targets for this CCMP, MassBays undertook a multi-year process to devise target extent and conditions for saltmarsh, eelgrass, and tidal flats for each embayment ecotype (see Section II above). (Additional target-setting for diadromous fish habitat and benthic communities will continue under Goal 3.) The BCG process facilitated by EPA for MassBays included (1) compiling historical habitat data, (2) determining ecotypes with ground-truthing of embayment-specific characterizations by MassBays’ RCs, (3) consultation with habitat experts to define “Level 1,” or best possible conditions, (4) development of target acreage for each habitat by the year 2050 for review by STAC, and (5) final endorsement by the MC in 2021.¹¹² The process is described beginning on page 30 of this document, and in detail in Appendix A.

The resulting targets are visualized as “habitat goals” in MassBays’ *Ecohealth Tracking Tool (ETT)*, a web-based State of the Bays reporting platform launched in 2022. The targets (see table below) are described in terms of “healthy acres” of each habitat and are based primarily on the suitability for the habitat offered by geophysical conditions (exposure, coastal geology, and shallow-water habitat area) and not influenced by anthropogenic factors. As we look forward (see Goal 3), we will develop additional information about support for habitat expansion and health in terms of water quality. We will thus be able to track progress toward our environmental outcomes: expanded coastal habitat, improved habitat continuity and hydrology, restored natural communities, and improved water quality through implementation of our monitoring framework (Attachment 3).

Ecotype	Habitat	Goal by 2050	Acres to restore/maintain	Associated ecosystem benefits
Green	Eelgrass	Increase acres, improve quality	2,040	<ul style="list-style-type: none"> Habitat for fish, birds, invertebrates Improved water quality Nitrogen uptake Carbon sequestration Shoreline protection & erosion control Aesthetics Shellfish production Food sources Recreational opportunities
	Salt Marsh	Maintain acreage, improve quality	2,800	
	Tidal flats	Maintain acreage, improve quality	4,060	
Yellow	Eelgrass	Increase acres, improve quality	4,560	
	Salt Marsh	Maintain acreage, improve quality	27,170	
	Tidal flats	Maintain acreage, improve quality	11,720	
Orange	Eelgrass	Increase acres, improve quality	10	
	Salt Marsh	Maintain acres, improve quality	1,730	
	Tidal flats	Maintain acres, improve quality	3,270	
Blue	Eelgrass	Maintain acreage, improve quality	2	
	Salt Marsh	Maintain acreage, improve quality	0	
	Tidal flats	Maintain acreage, improve quality	4	

¹¹² Cicchetti, G., et al. 2017. Implementing the Biological Condition Gradient Framework for Management of Estuaries and Coasts. US EPA Office of Research and Development, Washington, DC, EPA/600/R-15/287. <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100SN3Y.txt>

VI. Goals, Strategies, and Actions: 2023 through 2033

The following sections describe the goals, strategies, actions, and activities to be undertaken by MassBays' MC, Central Staff, and RSPs, with reference to the environmental and management outcomes expected as a result of each action (Figure 23 is a map of the relationships between the components). Year-by-year implementation of activities will be detailed in MassBays' annual workplans, with tasks described in terms of specific funding sources and amounts, partners and their roles, and timeframes. This structure supports flexibility in sequencing those activities, supporting staff and regional coordinators' ability to take advantage of opportunities in political readiness and funding available at the local level. MassBays' yearly workplans will list and describe activities with the highest likelihood of success given funding, local support (as indicated by the LGCs), and concurrent projects by other entities that provide opportunities that provide leverage for MassBays-initiated actions to advance CCMP implementation. A sample workplan, developed for FFY2022, is included here as Appendix M to illustrate the tight connection between the CCMP and yearly activities.

In this section, three sets of Organizational and Programmatic Goals provide the context for Strategies to be employed, with Actions and Activities identified through the CCMP development process, presented in the following layout:

*Description of **Organizational Goal***

*Description of associated **Programmatic Goal***

*Description of **Strategy [1]***

*Description of **Action [1.1]***

*List of **Activities***

*Description of **Environmental Outcomes expected***

*Estimate of **Resources Required**, both staff time (FTE) and funding on a scale:*

\$ Less funding required, primarily to support implementation from Boston

\$\$ Moderate funding required for planning and/or implementation, perhaps with a consultant

\$\$\$ Significant funding required, for example to roll out region-wide implementation of a program

*List of **Outputs***

*List of **Measures***

*Estimated **Timeline***

*List of anticipated **Partners and their [Roles]***

All Strategies described in this section will be taken up and led by MassBays, in the role of convener of the partners listed. In this way, MassBays can report on and measure outcomes and outputs carried out by our own initiative rather than relying on (and hoping for) actions to be taken by other entities.

Goal 1

Organizational: MassBays is a primary source for information about conditions and trends in Ipswich Bay, Massachusetts Bay, and Cape Cod Bay.

Programmatic: MassBays provides new resources to support research and management in the Bays.

These programmatic and organizational goals respond to the management challenge, “Lack of information to support decision making.” Support of both applied research and monitoring are critical to meeting this challenge. While some areas within the MassBays study area have been well assessed and monitored over the previous 30 years (see Section II), most of the delineated assessment areas have not been the subject of long-term monitoring, either for water quality or habitat conditions. Only with data in hand can we select and promote suitable management actions, assess progress over time, and determine research priorities. MassBays will draw from existing data portals administered by partners -- EPA, MassGIS, NERACOOS, DEP, and DMF – rather than duplicate these resources with our own data banks. MassBays is well-situated to meet these goals with the help of STAC and extensive network of partners in Massachusetts and beyond. The Strategies and Actions below are a framework for taking advantage of these resources.

Strategy 1.1 Make new data available, especially to address specific gaps in knowledge.

MassBays began development of this CCMP with a list of gaps identified by the MC, RCs, STAC, LGCs, and others in 2013, updated in subsequent reassessments through 2022. We have already realized success in addressing several of those gaps, for example, MassBays has:

- Designed and coordinated the Massachusetts Coastal Condition Assessment (MCCA) with DEP, using probabilistic survey methods to collect water quality and sediment condition data and benthic community statistics.
- Facilitated statewide implementation of the 2015 National Coastal Condition Assessment (NCCA), working to expand the number of near-shore monitoring locations to make the results more useful for resource management.
- Provided training and technical support to local watershed groups for expansion of their own monitoring efforts through a new Monitoring Coordinators’ Network.
- Conducted an inventory of tide gates in Massachusetts,¹¹³ generating a list of 137 sites with data about up- and down-stream habitat conditions, physical condition, and permit status.

Under this Strategy, MassBays will continue to prompt funders, researchers, students, nonprofits organizations, and government agencies to support and conduct new baseline assessment and other data-gathering to increase our ability to take informed steps to improve environmental conditions.

Action 1.1.a Identify gaps in data sets.

Description

A recurring theme of stakeholders’ input to the CCMP is the lack of data available to decision makers, across a range of topics. In our effort to be a primary source for information to support

¹¹³ Geosyntec Consultants, 2017. Tide Gate Inventory and Data Evaluation Gateway. [Final Report](#). [GIS datalayer](#). [TIDEGateway Tool](#).

action, it only makes sense for MassBays to identify and compile data needs as a recurring step. This action provides the basis for Action 1.1.b.

Activities

- Compile data needs for measuring progress toward targets, and to support State of the Bays reporting.
- Maintain an existing master list of data gaps (previously generated by MassBays) with input from stakeholders and where applicable, develop a GIS spatial analysis.
- Align data gaps identified with EPA EJ Screen and Commonwealth EJ designations.
- Establish a web-based tool for soliciting data needs from partners and community members.
- Convene a meeting of stakeholders in a particular watershed to discuss ongoing work, future opportunities for collaboration and funding, implement monitoring plans, and share data and actionable results (e.g., in 2021 and 2022 MassBays has worked with MVPC and MRWC to convene monitoring program managers for roundtable discussions, to be done annually)

Environmental outcomes

This Action addresses all desired environmental outcomes, as it serves to guide action and facilitates tracking successes.

Resources required

\$

Annual update of the master list and GIS analysis of spatial data gaps will require minimal funds.

0.03FTE per year

Boston staff will compile the master list annually, with input from partners listed.

Outputs

By 2023, post a master list of data gaps, to be posted on the MassBays website and provided as supporting materials for the Healthy Estuaries Grant Program

By 2024, establish a web-based tool for soliciting data needs from partners and community members

Measures

MassBays provides evidence that data needs drive funding decisions for mini-grants awarded, actions included in annual workplans, and prioritization for State of the Bays documentation

Timeline

Ongoing

Partners

MC/STAC, LGCs

Action 1.1.b Prioritize addressing gaps per need, completeness and reliability of new and existing data, relevance to underserved/underrepresented communities, application to State of the Bays reporting, and potential policy applications.

Description

Addressing the entire current list of data gaps is significantly beyond the existing capacity of MassBays and agency partners. Therefore this action prioritizes the data needed and research gaps. They include:

QA/QC status. In some cases, there are data relevant to the stated need by the MC, RCs, STAC, LGCs, but their reliability for decision making is unknown. Boston staff will refer to MassBays' Monitoring Framework (Attachment 3) to assess data sets based on the minimum acceptable QA/QC parameters required by STAC and EPA.

Benefit to EJ communities. The existing master list of data needs has for the most part been generated based on input from individuals and organizations not representative of underserved and underrepresented communities. MassBays has developed processes to solicit input from those communities, and to assist them in addressing their own needs where they prefer autonomy.

Relevance to State of the Bays reporting. MassBays' regional and Bays-wide conditions and trends reporting on any specific parameter requires a baseline data set. Data gaps hinder MassBays' ability to include a broad suite of parameters in the State of the Bays reporting scheme.

Application to coastal policy. Not all data are directly relevant to policy making. DEP, for example, prioritizes parameters included in 314 CMR 4, Massachusetts' water quality standards. Action by policy makers that will improve local water quality and coastal habitats are a priority for MassBays, so any data specifically requested for that purpose will rise to the top of the prioritized list.

Activities

- Target 314 CMR 4 (Mass water quality standards) in prioritization.
- Determine minimum dataset (number of years, sites, etc.) required to address specific needs.
- Host a biennial joint meeting of STAC, RCs/LGC representatives, and MC to prioritize data (and research, per Strategy 2.1) gaps relevant to meeting CCMP targets and objectives, especially as detailed in the Monitoring Plan.
- Incorporate emerging concerns (e.g., re: climate change, coastal acidification, emerging contaminants, aquaculture, and coastal impacts of offshore wind development).

Environmental outcomes

Factors that contribute to prioritization, and the final prioritized list of data gaps, should prompt new efforts to collect missing data, thus informing protective policy and restoration efforts.

Resources required

\$ per year

Convening stakeholders will require minimal funding; outreach and solicitation of priority data needs among underserved and underrepresented communities will require travel expenditures.

0.05FTE per year

RCs will be trained in methods to elicit priorities from local communities; Boston staff will facilitate overall prioritization effort.

Outputs

Biannual meeting dedicated to prioritization of data needs.
List of priority data gaps included in each Healthy Estuaries Grant Solicitation and EDA update.
Workplan tasks targeted to respond to priority data needs.

Measures

Priorities of diverse stakeholders are documented, assessed by STAC, and explicitly incorporated into MassBays' workplan to address data gaps.

Timeline

Ongoing

Partners

STAC, RCs, MC, LGCs, stakeholders (EJ communities, policy makers)

Action 1.1.c Maintain the Ecosystem Delineation and Assessment (EDA) as a record of current data availability.

Description

The EDA (see page 15) has proven to be an essential component of MassBays' efforts to assess the state of knowledge about the Bays and provides critical grounding for target-setting using the BCG. EDA 2.1 fulfilled steps 3 through 5 in the BCG process, which include:

1. Determining the biological attributes, measures, and stressors most relevant to management objectives.
2. Delineating and classifying the waterbody and watershed of interest.
3. Organizing and analyzing existing data for the identified measures, collecting new data if needed.

Continued expansion of the scope of the EDA and periodic updates will be taken up under this Action.

Activities

- Inventory near-shore and estuarine, infrastructure, and social science-based data sets available for the Bays.
- Incorporate social-science metrics and EJ delineations into the EDA.
- Identify additional data sets relevant to meeting habitat targets
- Maintain and update an online ArcGIS Story map, to provide public access to the information included there.

Environmental outcomes

Consistently updated compilation of a wide range of data available to inform planning and restoration efforts, and to measure progress toward targets.

Resources required

\$\$ per update

Funds on the order of \$30,000 to \$40,000 will be required for a consultant to carry out each scheduled update.

0.1FTE per update

Boston staff will manage the updates.

Outputs

EDA 3.0 (2023), EDA 4.0 (2026), EDA 5.0 (2029)

For each update, an up-to-date online ArcGIS Story Map providing georeferenced, interactive access to EDA data by assessment unit

EDA 3.0 will document environmental justice data layers

Measures

By 2025, MassBays compiles case studies for a study area? demonstrating how researchers and others utilize the EDA for their work in the Bays.

Timeline

Updates scheduled for 2023, 2026, 2029

Partners

Consultant (data compilation, story map, update, and analysis)

Monitoring and research community (audience)

Strategy 1.2 Support valid (QA/QC) data collection and application.

A major challenge meeting subsequent CCMP Goals is the lack of a coordinated data collection system across the Bays. This is mainly due to financial and personnel constraints. Although there are several monitoring programs in the Bays, each is designed to answer questions unique to the needs of location. This makes it challenging to reach MassBays’ goal of compiling a comprehensive State of the Bays report on conditions and trends in the Bays. MassBays’ Monitoring Framework (Attachment 3) inventories the geographic coverage and parameters measured by past and ongoing monitoring efforts. In some cases, baseline data sets already exist for many embayments, but data have not been collected using EPA- or DEP-reviewed Quality Assurance Project Plans (QAPPs) or other stringent QA/QC procedures. As an EPA-funded program, MassBays’ reporting must draw from quality-assured data sets.

Strategy 1.2 reflects MassBays’ need for access to consistent and valid data to meet our reporting requirements under the CWA, as well as our commitment to supporting the groups we depend upon for those data. Work under this Strategy includes generating, supporting collection of, and identifying existing quality-assured data sets useable not only for MassBays’ reporting, but acceptable to regulatory agencies for decision making and resource management.

Action 1.2.a Implement a MassBays-wide monitoring framework that incorporates long-term monitoring program data and makes data and findings available to the public

Description

MassBays is fortunate to have an engaged and expert STAC. The group worked with MassBays’ Staff Scientist to develop a Monitoring Framework (Attachment 3) which describes MassBays’ need for quality data sets and the criteria for evaluating data for inclusion in MassBays’ work, whether for the EDA, State of the Bays reporting, informing resource management agencies, or highlighting potential environmental problems. The Plan requires MassBays to utilize only data generated using an EPA- or DEP-approved QAPP for the purpose of State of the Bays reporting. Other data can be used to justify further study or investment on the part of MassBays. Under this Action, staff will

apply the criteria to evaluate existing and new data sets for application in MassBays' workplans and deliverables. Part of this implementation action is to share the criteria with those collecting data or initiating programs to ensure their data outputs support desired uses.

Activities

- Apply monitoring framework for evaluation of continuous and discrete data including water quality, sediment characterization, and evaluation of data sets.
- Access/download data for analysis and other uses.
- Invest in continuous monitoring systems tied to priorities set in Strategy 1.1, especially using Bipartisan Infrastructure Law (BIL) funding (2023-2026), collaborating with partners such as NERACOOS and Gulf of Marine Research Institute (GMRI) to stream and share data e.g., from ocean acidification monitoring.
- Bring data to decisionmakers (e.g., MassDEP, DMF, EPA, local municipalities) in useable format and encourage its use to inform habitat protection and improvements

Environmental outcomes

Identification and generation of quality-assured data will support policies and restoration efforts, and to measure progress toward targets.

Resources required

\$\$

MassBays staff and STAC will update the Monitoring Plan to incorporate the availability of BIL funding and provide guidance to monitoring partners with regard to data usage. BIL funding will be applied to meet the need for long-term data sets.

0.1FTE per year

Boston staff will administer a small-grant (currently under our "Healthy Estuaries Grant Program") and monitoring programs and maintain contact with monitoring groups and access and analyze data to support Goal 2.

Outputs

Updated inventory of monitoring programs in the Bays relevant for conditions and trends analysis. New data uploaded to EPA's Water Quality Portal.

Measures

Beginning in 2022, at least biennial documentation of baseline conditions and trends through the ETT.

Timeline

Ongoing

Partners

DEP, EPA, DMF, academia, NGOs (data generation); Northeast Ocean Data Portal, EPA, DEP, NERACOOS (data sharing & access)

1.2.b Convene and partner with citizen monitoring coordinators, researchers, QA/QC agency staff, others to support and improve monitoring outputs.

Description

While MassBays has limited capacity and relies on others – from state agencies to local nonprofits – to conduct monitoring, long-term, high-quality data are lacking in many parameters. Investigations in 2015 to present have revealed that only a subset of citizen-generated data sets are available or suitable for State of the Bays reporting or inclusion in the EDA, for example. A 2014 survey focused on Cape Cod nonprofits (n=25) conducted by APCC revealed that while some organizations have QAPPs, others use protocols handed down in a manner similar to oral history. Data are stored in filing cabinets, or in spreadsheets on home computers. Some groups have never conducted statistical analyses of their data alongside a trained scientist or with an accredited institution.

In 2016, MassBays asked 24 groups “What are the skills your organization would need to take your monitoring program to the next level?” The responses revealed needs in three areas: program design, planning, and reporting; data management and analysis; and interpretation and dissemination of results (Figure 25). These findings are consistent with subsequent investigations by the Massachusetts Rivers Alliance and the Northeast Interstate Water Pollution Control Commission (NEIWPCC).

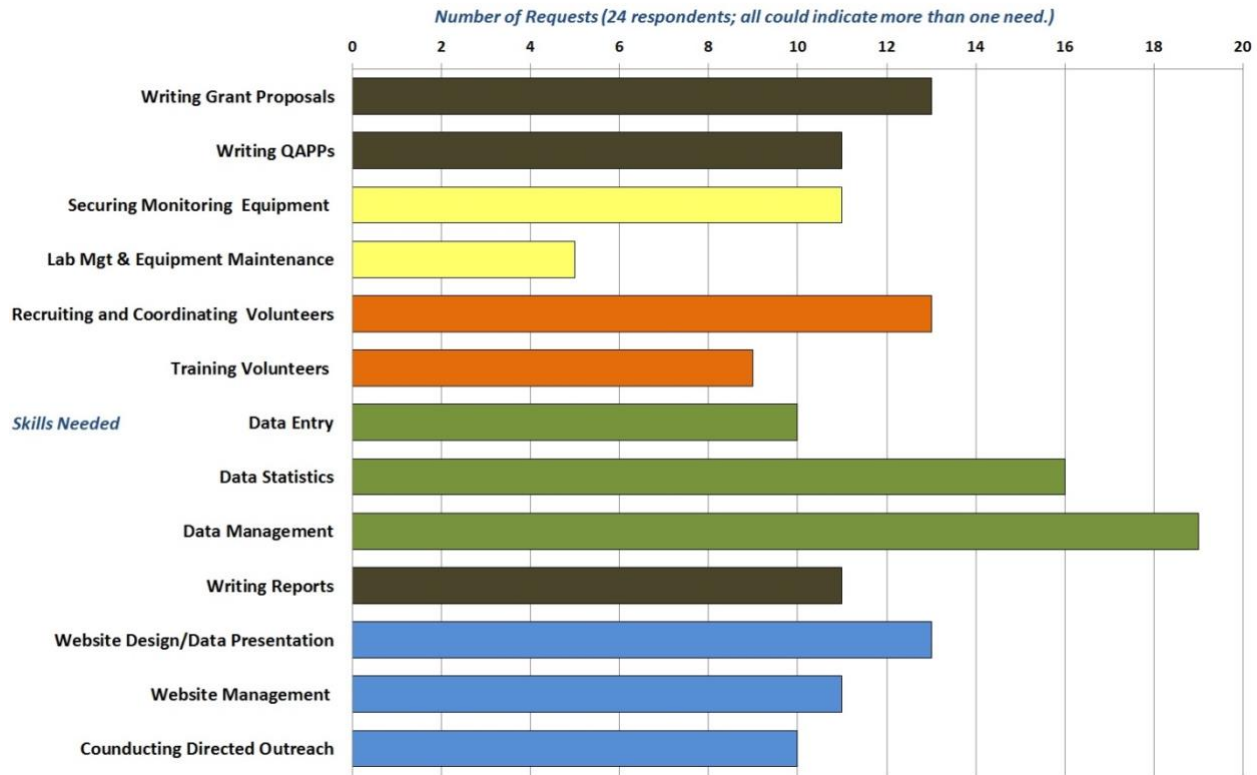


Figure 25. Citizen Monitoring Coordinators’ needs assessment survey results, 2016.

Funding from EPA’s Exchange Network Grant Program and DEP from 2018 through 2024 has and continues to support MassBays’ efforts to build capacity among community-based monitoring groups. We have been a leader in these efforts, sharing outputs with national (through the NEP) and international (through the Citizen Science Association) partners. We have:

- Established the **Monitoring Coordinators' Network** focused on building capacity among groups already monitoring or seeking to monitor conditions in the Bays.
- Provided **professional development**, one-on-one technical assistance, and a forum for ideas exchange.
- Developed **new tools for data management**: *AquaQAPP*, a web-based “wizard” that leads users through a step-by-step process to develop a QAPP formatted according to EPA and DEP standards; *MassWateR*, a suite of R-based tools that can be used to conduct data QA/QC, analyze data sets, and produce a QA report for submission to DEP; and the *ETT*, which provides partners with a means for map-based data visualization and trends reporting. Figure 26 illustrates how these tools aid engagement in the data management cycle set out by DataOne, an international effort to improve data quality and effective use of metadata.

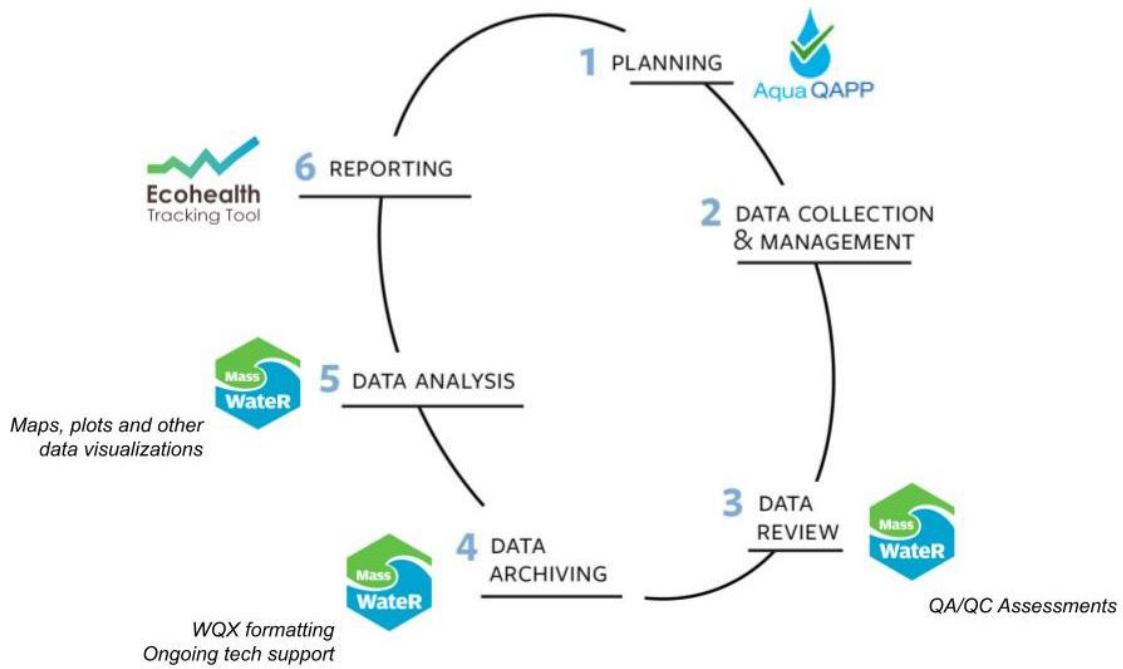


Figure 26. Tools (represented by their logos) produced by MassBays, in the context of the data management cycle.

Activities

- Support underserved communities to advance their engagement in monitoring and data use for decision making to address water quality and habitat degradation.
- Promote continued use of – and continue to improve and develop – tools to support local engagement in the data cycle.
- Re-survey coastal monitoring groups regarding needs and develop a long-term plan for supporting the Monitoring Coordinators' Network.
- Conduct watershed-specific assistance for monitoring coordination and analysis.
- Continue to engage with national and international networks on data quality issues around community-generated data sets.

Environmental outcomes

Locally generated, locally desired data sets that capture local environmental conditions and reveal research and policy questions.

Resources required

\$\$

MassBays will continue to seek supplemental funding to improve existing and build new tools to support local efforts.

0.3FTE per year

Boston staff will support the MassBays-wide Monitoring Coordinators’ Network with one-on-one assistance for statistical analysis, volunteer training, etc., and implement new projects as funds become available.

Outputs

- Documented use of MassBays tools
- Updates to AquaQAPP and ETT to improve outputs for partner monitoring groups
- Regular Monitoring Coordinators’ Network meetings
- Regular participation in national citizen science data quality evaluation networks

Measures

A robust Citizen Monitoring Coordinators’ Network provides quality data to MassBays and others MassBays presents at regional and national conferences regarding our efforts to increase utilization of citizen science outputs

Timeline

Ongoing

Partners

DEP, EPA (funding)
RCs (tech support)
ANEP, Citizen Science Association (external connections)
River Herring Network, Monitoring Coordinators’ Network,
Massachusetts Rivers Alliance (convening partners)

Action 1.2.c Provide information about data needs for entities funding and conducting monitoring and restoration.

Description

Data that are useful for resource management and local action require funding over the long term. MassBays will disseminate prioritized lists of data gaps to those interested in contributing treasure and/or talent to the effort of documenting baseline conditions, including academic researchers, students, state and federal agencies, local and regional nonprofits and associations, and funders’ consortia. At the same time, we will encourage continued monitoring as a critical component of science-based, adaptive resource management.

With reference to our strategic communications plan and finance plan, MassBays will approach potential funders to articulate the importance of having this information, with the goal of increasing funding for MassBays and partners carrying out the monitoring efforts (watershed associations, e.g.). Case studies that connect specific data sets with positive environmental outcomes will be useful to this effort.

For our own part, MassBays- administered small grants will be directed in part to new studies or monitoring efforts that address data gaps. As an example, the 2022 Healthy Estuaries Grant Program Request for Proposals is included here as Appendix N.

Activities

- Disseminate list of data gaps to researchers and monitoring groups.
- Prompt and maintain focus on management outcomes of data analysis and research.
- Identify funders, undertake education to promote investments in baseline data sets.
- Support graduate and undergraduate student research and monitoring programs.
- Support and undertake new studies or monitoring efforts to address gaps.

Environmental outcomes

New data will support environmental condition assessments, status reports, and information about trends to inform policy and restoration.

Resources required

\$\$

Funds under the Healthy Estuaries Grant program will be directed toward this Action. Some travel expenditures are expected, especially to attend regional conferences.

0.08FTE per year

Boston staff will develop materials and attend meetings and events to disseminate prioritized data needs, prepare grant applications, and manage Healthy Estuary Grant projects that address this Action.

Outputs

- DEP-funded probabilistic coastal monitoring program (EPA CWA §106) completed by MassBays
- Each year, address at least one data gap per year via research, management, or monitoring through the Healthy Estuaries Grant Program (or other)
- Case studies illustrating the connections between data availability and environmental improvement

Measures

All MassBays grantees document their projects' connection to policy and/or resource management. MassBays is successful in obtaining grants and other funds to support data generation.

Timeline

Ongoing

Partners

NERACOOS, EPA, DEP, NOAA, MET, AGM (funding); Monitoring Coordinators' Network, universities and colleges, watershed associations and other NGOs, RPAs, MACC, MOTN, NERACOOS (monitoring and audiences)

Strategy 1.3 Analyze and present existing data in multiple formats to document baselines and trends.

This Strategy focuses on State of the Bays reporting; more general outreach, education, and training are encompassed in Strategy 2.2. Both are built around the ETT and grounded in the EDA, with the objective of making data accessible and understandable to communities that are interested in knowing more about their local coastal ecosystems, and empowering them to ask questions about conditions and trends.

If MassBays is to be a primary source for information about the Bays, the information we provide must be presented in a way that is useful to multiple audiences. Data modeling, statistical analysis, interpretation, and visualization will be utilized to bring new and existing data into use by local, state, and federal decisionmakers. Our State of the Bays reporting will be presented online, accessible to communities interested in knowing more about their local coastal ecosystems. MassBays will not host the data itself but will be able to direct those interested to existing data portals administered by partners -- EPA, MassGIS, NERACOOS, DEP, and DMF -- rather than duplicate these resources with our own data banks. for further analysis.

Action 1.3.a Analyze connections among datasets and trends to inform reporting, actions, and policies

Description

The Management Committee has identified provision of data and data interpretation as a key role for MassBays. We will do this by hosting forums, conferences, and meetings to share information about trends with local, state, and federal agencies. We will describe trends we observe in the context of resource management and management policies, both existing and proposed. For example, MassBays will develop Habitat Potential Index scores (HPIs), a means for interpreting water quality conditions in relation to a given habitat. This approach not only makes it easier for the audience to understand how and whether local conditions are adequate to sustain healthy eelgrass beds, for example, it also acknowledges the complexity and interdependence of chemical and physical conditions, even though they are usually measured and reported individually.

Activities

- Assess new data sets brought to the EDA for inclusion in the ETT (e.g., social metrics and data generated in response to community requests).
- Incorporate additional habitats and means for data interpretation (e.g., Habitat Potential Indices) into the ETT.
- Disseminate findings to local, state, and federal agencies with direct reference to policy implications, especially with regard to proposed projects and policies (see parallel activity under Action 2.1.a regarding dissemination of research findings).

Environmental outcomes

New understanding of the interactions between data sets and trends over time will support data-based decision making that supports improvement of coastal habitats.

Resources required

\$\$

Funding to support partners' participation, develop HPIs, and build-out of the ETT

0.3FTE per year

Boston staff will lead development of HPis and ETT build-out, develop outreach materials and presentations, and submit comments on regionally significant projects and statewide policies that impact the goals of the CCMP.

Outputs

- Habitat Potential Indices
- Targets for diadromous fish and benthic habitats, rocky shores, and dunes and beaches incorporated into the ETT
- Presentations and formal input to agencies and other resource managers

Measures

- By 2023, specific parameters are identified for cross-comparisons and reporting via State of the Bays and revisited as additional data sets become available.
- By 2025, Habitat Potential Indices are included in ETT to facilitate interpretation of water quality data.
- By 2025, MassBays is a regular contributor to policy decisions and project review, bringing new information to bear on decision making.

Timeline

Ongoing

Partners

STAC, EPA ORD, consultant on ETT updates

Action 1.3.b Provide State of the Bays reporting at multiple scales

Description

All NEPs are required under CWA §320 to document and report on conditions and trends in their study areas in the form of State of the Bays reporting. MassBays is particularly hindered in its efforts to construct a narrative about conditions and trends across the Bays, due to the geographic extent of the study area, the diversity of habitats, a wide range of physical and biological characteristics not easily generalized, and a paucity of adequate data for such generalizations.

The Management Committee holds that localized State of the Bays reporting is key to both generating and sustaining interest in the health of local habitats among coastal communities. This Action includes reporting at several scales: across the entire study area, by MassBays region, and at the local embayment level. Standardized metadata, and a reporting cycle that highlights individual regions between the required 5-year State of the Bays reports will enable us to identify common issues across the Bays to be addressed through other Actions.

Concurrent with development of this CCMP, MassBays has established practices and developed tools that allow data analysis and visualization from the very local level (e.g., individual embayments) to region-wide (i.e., from Salisbury to Provincetown). Between these two scales, the RSPs need to address issues from stormwater management to climate change vulnerability and adaptation at their own regional level. Tools and approaches already in place include:

- **Data Exploration Tool (DET).** Developed for MassBays by EPA ORD, this data dashboard brings all of the data used in the BCG process and the EDA into one place, for day-to-day use by the RCs and Central Staff. Information about everything from tidal residence times to shorebird nesting sites can be extracted for communication with local audiences.

- **Ecohealth Tracking Tool (ETT).** As described in Section V, this tool is a means for partners, local stakeholders, and others to track progress toward the BCG goals for habitat extent (and eventually habitat condition, Strategy 3.1), at both embayment and region-wide scales.
- **State of the Bays Symposium.** Last presented in 2015 (prevented in 2020 by the COVID pandemic), MassBays is committing with this CCMP to host future Symposia in 2025 and 2030. This event looks at progress in the Bays writ large, while highlighting concerns and opportunities for improvement.
- **Regional conferences and roundtables.** Each of the RSPs hosts or co-hosts events on coastal issues specific to their area. Those are scheduled at the regional level as needed; to date they have included the State of the Sound (Lower North Shore region), the Great Marsh Symposium (Upper North Shore), the Cape Cod Conference, Boston Harbor and Islands Science Symposium, and the South Shore Climate Change and Sea Level Rise Symposium.

Activities

- Maintain the DET based on future BCG efforts (see Action 3.1.a) and EDA updates.
- Present "Living" State of the Bays reporting via the ETT.
- Present Bays-wide State of the Bays reporting in 2025 and 2030.
- Host/participate in international, national, Bays-wide, regional, and local forums, conferences, and meetings to share results, to include multi-sector input and engagement.
- Support RSPs' efforts to highlight regional issues and identify common concerns and potential responses across the Bays.

Environmental outcomes

Greater awareness of environmental conditions at various scales will prompt action at scales commensurate with the need, making success more likely.

Resources required

\$ per year

Funding to host a Bays-wide Symposium and support regional conferences,

0.25FTE

Central staff will maintain and update the DET and ETT, host Symposia, provide support for regional events, and present findings in public venues.

Outputs

- Regular updates of the DET and ETT to incorporate new data sets
- Slide decks, posters, and other presentation materials regarding status and trends
- State of the Bays Symposia (2023, 2025, 2030) include both cross-region and region-specific information and needs
- Regional events addressing topical and contemporary issues

Measures

- MassBays' DET and ETT incorporate new quality-assured data sets with each update.
- Partners report on utility of the DET and ETT for informing community members.
- By 2023, MassBays is providing data analysis and reporting not available elsewhere.

Timeline

Ongoing

Partners

Resource managers, regulatory agencies
NGOs, municipal officials (target audiences)

Goal 2

Organizational: MassBays is an important influence on decision making that recognizes the roles, functions, and values of healthy habitats in the Bays.

Programmatic: MassBays reaches all study-area municipalities with actionable information about coastal habitats.

Work under Goal 2 moves beyond data about conditions and trends to ask questions about ecosystem functions, and the value of those functions to MassBays communities and beyond. Actions under this Goal will advance our understanding of the impacts of climate change, examine alternative management options for adaptation, and promote responses that sustain coastal habitats and maintain their critical functions.

MassBays will work with partners to disseminate this information to target audiences that can and should take action in response: local, state, and federal agencies, regional planning agencies, land and resource managers, and coastal residents. When MassBays *reaches all planning-area municipalities with actionable information about coastal habitats*, we will also encourage them to take up habitat protection and restoration.

Along with Goal 1, Goal 2 incorporates concerns about environmental justice, as we seek input to decision making from under-represented and underserved communities both through our own organizational structure and by facilitating access to decisionmakers and decision-making processes for communities otherwise overlooked or side-lined in planning and restoration activities.

Strategy 2.1 Support, conduct, and disseminate research regarding ecosystem conditions and functions to inform state policy and local action.

MassBays' Healthy Estuaries Grant Program, the successor to the MassBays Research and Planning Grant Program, was established to provide catalytic funding for pilot projects, proof-of-concept investigations, and small-scale research efforts. Our objective is to bolster grantees' ideas with information and best practices they can incorporate into subsequent proposals to larger funders. Actions under this strategy are focused on making sure the limited funds available for this small-grant program address gaps in understanding to inform policy, future research, and MassBays' own actions.

Action 2.1.a Identify, evaluate, support, implement, and apply research regarding effectiveness of conservation & restoration activities.

Description

The existing Healthy Estuaries Grant-making process itself is a way for MassBays to learn about research questions, data collection needs, and the players working in the study area. A sample call for the 2022 grant is included as Appendix N. Each of the following steps open possibilities for synergies, innovative approaches, and new knowledge that can advance MassBays' own goals:

- **Broad distribution of the RFP** through multiple outlets increases the chances that we will identify many previously sidetracked projects.

- The requirement for a **Letter of Interest** or pre-proposal allows potential applicants to test out their idea and make their case for its relevance without an inordinate amount of effort. This lower bar for initial application brings new ideas forward and allows MassBays to provide feedback regarding potential synergies with existing efforts and/or other partners.
- The **full proposals** themselves must address several components that demonstrate connections between the work and the CCMP, and the proposal *evaluation process* includes review by at least one member of the MC, a past grantee, and STAC member. Discussions about the proposals are rich and informative.
- **Announcing selected proposals** provides an opportunity for MassBays to share its mission and purpose with the larger community, attract new applicants, and acknowledge EPA's and Congress' investment in the NEP.

Activities

- Fund, and disseminate findings of, Healthy Estuaries Grant Program.
- Maintain practical, applied-research orientation.
- Disseminate findings to local, state, and federal agencies with direct reference to policy implications, especially with regard to proposed projects and policies (see parallel activity under Action 1.3.a regarding dissemination of data findings). This activity will include establishing a subcommittee of the MC to assist with identifying opportunities to influence decisions

Environmental outcomes

New and potentially more effective approaches are deemed suitable for implementation.

Resources required

\$\$

MassBays will make a call for Letters of Interest once we have \$100,0000 to distribute. An 18-month project period not only gives applicants two sampling seasons for research but allows us to set aside funds each year from our operating budget for application to this purpose.

0.3FTE

Boston staff draft the RFP, solicit contributions, organize review, announce awards, prepare scope of work, and track progress. Taken together with published research, findings will be applied to evaluate and comment on regionally significant projects and statewide policies that impact the goals of the CCMP.

Outputs

- At least 5% of MassBays budget is set aside to support the Healthy Estuaries Grant program
- Web pages dedicated to each grant project on MassBays' website

Measures

- Web pages for each funded project describe their policy and/or resource management implication(s)
- Each funding cycle, there is an increase in the number of high-quality and relevant Letters of Interest.

Timeline

Ongoing; grants will be solicited biennially (2023, 2025, 2027, 2029)

Partners

MC, STAC (announcements & outreach)

Action 2.1.b Test and implement innovative monitoring and restoration approaches

Description

The RSPs are forward-thinking, creative partners in MassBays' efforts. This Action encompasses their work in the regions, as well as Healthy Estuaries Grant-awarded projects, and Boston-based staff's cross-region work to gain even more insight into and improvements in the conditions in the Bays. We are especially interested in developing rapid field assessments and other screening methods that can be utilized by community-based organizations to flag potential problems and confirm suspected issues. One example is the rapid assessment protocol¹¹⁴ MassBays and DMF developed for field assessment of eelgrass coverage and condition, especially for use by volunteers, to fill a gap in mapping data.

Activities

- Provide opportunities for partnerships on program pilots and demonstrations
- Support research and development of monitoring methods for emergent contaminants
- Evaluate suitability of approaches used elsewhere for MassBays study areas
- Participate in and host participatory data collection efforts (e.g., rapid assessment surveys) and data challenges

Environmental outcomes

- New and potentially more effective approaches are deemed suitable for implementation.
- Local environmental conditions improve over time.

Resources required

\$\$\$

RSP grants are the primary expense under this Action, along with hosting and maintenance costs for web-based tools and maintaining and replacing field equipment

0.2 FTE

Boston staff will initiate and support collaborations, and track RSP activities according to yearly workplans.

Outputs

- Annual reporting including highlights describing work under this Action
- Quarterly reports from RSPs on activities under this Action

Measures

- MassBays continues to build out a suite of tools available to partners via our website for environmental assessments
- Existing tools are well-maintained and users continue to receive support for their application.

Timeline

Ongoing

Partners

State & federal agency scientists, academic & research institutions, citizen scientists, NGOs, marine tech business and consultants (collaborators)

¹¹⁴Standard Operating Procedure for Citizen Scientist Eelgrass Monitoring
<https://www.iseagrass.com/static/protocol.pdf>

Action 2.1.c Support cross-sector information sharing

Description

When MassBays hosted meetings and symposia, a consistent post-event evaluation asked for more frequent gatherings to facilitate networking among people working on habitat issues in the Bays. Separately, STAC has suggested that we bring the Healthy Estuaries Grant awardees together to share their research and findings. These types of gatherings represent important forums for information exchange, and opportunities to identify data and research gaps.

MassBays also has an important role to play in the region as an information hub (as described under Goal 1) and convener with regard to region-specific and timely topics. This role can come about as a component of funded projects (e.g., determining the carbon sequestration potential of eelgrass in Massachusetts waters), sparked by policy change (e.g., examining interactions between shellfish aquaculture siting and potential impacts on eelgrass), or by request from regulatory agencies. For example, in 2022 MassBays assisted the MWRA Outfall Monitoring Science Advisory Panel (OMSAP) by inviting researchers and regulatory agencies to an exploratory Forum¹¹⁵ to examine potential causes of recurring hypoxia events in Cape Cod Bay.

Activities

- Disseminate and promote successes, share challenges, and promote transferability of MassBays' programs and approaches through regular roundtables, forums, and symposia.
- Identify needs for, and take advantage of opportunities to convene multi-sector meetings and investigatory discussions to facilitate progress.

Environmental outcomes

Well-vetted and thoroughly considered policies and actions to promote habitat protection and environmental improvements.

Resources required

\$

Outreach and meeting expenses

0.1 FTE

Boston staff will organize regular meetings of researchers and grantees, and design and facilitate topic-specific, cross-sector meetings as needs arise.

Outputs

- Meetings of researchers working in MassBays (e.g., Healthy Estuaries recipients) to alternate with the State of the Bays Symposia.
- Regional meetings or forums convened by RCs.
- Topic-specific and timely meetings as needed.

Measures

- State of the Bays Symposia and alternating "Research in the Bays" meetings are well-attended by target audiences.
- MassBays continues to be sought out as a trusted convener for cross-sector discussion.

¹¹⁵ Investigating and Responding to Hypoxia in Cape Cod Bay. October 21, 2021. Recording (<https://bit.ly/3Y6lmxD>); Summary <https://www.mwra.com/monthly/wac/presentations/2022/010722-omsap.pdf>

Timeline

Outreach about research in the Bays will be conducted on an ongoing basis, researchers et al. will be convened in 2023, 2026, and 2028

Partners

Healthy Estuaries grantees, STAC, RARGOM, MOTN, NERACOOS, GOMC, state agencies (audience-participants)

Strategy 2.2 Provide education, training, and technical support; provide access to, and increase influence on decision making by EJ communities.

This Strategy acknowledges the significant opportunity and expertise that MassBays has – through the RSPs and Central Staff – to share information about coastal systems and climate change impacts, build capacity among partners, and guide effective action for environmental improvements. This strategy also includes a call for dedicated efforts on the part of RCs and Central Staff to bring new voices to decision makers from among EJ communities, as well as investment to increase MassBays Central Staff's ability to conduct more general communications and outreach efforts.

Action 2.2.a Revise and disseminate existing effective education and outreach materials, and develop new materials and outreach efforts, providing context and integrating multiple sources, especially with regard to climate change risks and vulnerabilities.**Description**

This Action acknowledges the breadth of education and outreach materials already accessible, as well as the fact that MassBays' needs are unique and will require some reworking of those materials. Conducting needs surveys, presenting case studies, convening stakeholder meetings and professional networking groups, and building a useful and robust website are the groundwork for a successful education and outreach program. MassBays' existing capacity (primarily with the RSPs) should be augmented with additional staffing in the Boston office to make their efforts the most efficient. For example, the MassBays Communications Plan (Attachment 2) should include climate change as a specific topic. Genuine engagement with EJ and other community stakeholders are critical to success under this Strategy.

Activities

- Determine target audiences for education and outreach products
- Compile case studies, challenges, and solutions for use by municipal staff
- Identify existing and potential networks in each region for reciprocal communications
- Present findings at conferences, etc.
- Include outreach materials on website, etc. per communications plan
- Frame messages with references to benefits -- ecosystem services, etc.
- Emphasize the connection of habitat to natural/wild places, biodiversity
- Engage in blue economy efforts, e.g., workforce development
- Connect directly with resilientma.mass.gov and other topical clearinghouses

Environmental outcomes

More informed and effective responses to climate change, water resource management, habitat protection, and other local issues that result in ecosystem improvements.

Resources required

\$\$

This is the only Action in the CCMP that cannot be covered by existing levels of \$320 funding, but is critical to realizing our goals. MassBays will pursue supplemental funding to hire staff to carry out this Action.

1.1 FTE

This would be a new hire for MassBays (1.0FTE) and requires time for planning to be carried out and/or reviewed by Boston staff.

Outputs

Effective education and outreach materials specific to MassBays’ and municipalities’ needs

Measures

- By 2026, increase MassBays' capacity for communications and outreach by 0.5FTE/y, and 1.0FTE/y by 2030
- By 2028, establish an estuary-focused subgroup within NEOSEC.
- Each year, audiences in at least 30 of the 50 towns in MassBays’ planning area will be significantly engaged by MassBays

Timeline

Ongoing

Partners

municipal staff, residents (audiences); watershed associations, MEMA, MIT Sea Grant and EPA social scientists (content resources) NEOSEC, CZM, DMF, DER, NGOs (partners for dissemination)

Action 2.2.b Engage with municipal decision makers and residents for habitat protection and restoration to mitigate climate impacts – more intense precipitation events, sea level rise, and storm surges – including promotion of nature-based approaches.

Description

This Action, a direct response to the impacts of climate change, encompasses the work of MassBays’ RSPs at the local level. Massachusetts agencies, including EEA, CZM, and DER, provide funding to municipalities to respond to climate change impacts; MassBays’ role has been to provide technical support, convene regional meetings, and assist with grant proposals to make local progress on adaptation and mitigation. With this revised CCMP MassBays commits to making sure that EJ communities are engaged in these efforts as well, especially as retreat and coastal structures are considered (see Strategy 2.3). In a pending update to our Financial Planning Framework (Attachment 2), MassBays will also include dedicating resources to identify grant opportunities and apply for funding to address our own priority issues related to climate change impacts. In addition, MassBays’ Communications Plan (Attachment 1) will be revised to include climate change as a specific topic, and include efforts to highlight green infrastructure activities happening around the Bays and beyond for local consideration.

Activities

- Convene regional meetings; support regional approaches.

- Assist with grant proposals for local resilience and municipal vulnerability assessments, bringing ecosystem concerns to the table.
- Identify resources for mitigation, especially where co-benefits are possible.
- Collaborate with and provide technical assistance to neighborhoods, municipal staff, boards, and commissions.
- Provide direct support to underserved/underrepresented communities to lessen EJ impacts.
- Provide direct technical support re: tide gates, and EEA MVP action plans and implementation grants.

Environmental outcomes

Responses to climate change that address EJ issues while accommodating and augmenting natural systems – dams removed, tide gates retrofitted, habitat restored.

Resources required

\$\$\$

RSP subawards and spending under BIL are included under this Action

0.15 FTE

Central staff will support regional approaches, solicit funding, and administer grants to RSPs and BIL subawardees.

Outputs

Documented RSP assistance on at least two local funding proposals per year (e.g., Letter of Support, proposal review).

Each year, document four cases in which MassBays has influenced local decision-making (e.g., serving on an advisory group or other decision-making body, submitting comment letters).

Annual list of engaged communities and community groups, and projects initiated and completed.

Measures

MassBays RSPs are recognized by municipal staff as important partners in responding to climate change, as evidenced by letters of support for their MassBays RSP proposals.

Each year, four cases will be documented in which MassBays has influenced local decision making (e.g., serving on an advisory group or other decision-making body, submitting comment letters).

Investments of BIL funds meet the standards of Justice 40.

Timeline

Ongoing

Partners

CZM, DER, EPA (science content)

TNC, MLTC, TTOR, Mass Audubon (education content & sites)

Local NGOs (engagement efforts)

Strategy 2.3 Increase and maintain input from new and diverse partners for CCMP implementation and updates, through MassBays’ organizational structure and operations.

Traditional environmental conservation organizations have been struggling for years to respond to inequities in exposure to pollution and access to green space among communities of color, immigrant communities, and low-income neighborhoods. MassBays is committed to picking up these issues in our study area, and contributing our technical expertise, network, and other resources to assist groups already working toward more equitable conditions in Massachusetts. We

will not impose our own solutions but will listen for opportunities and respond to requests to support those groups where our objectives align.

Action 2.3.a Review and adjust Management Committee composition to ensure diverse, representative input to MassBays' planning.

Description

According to historical program documents, MassBays' Management Committee included 48 members in 1993, and 31 in 1998. Around 2009, the current composition of MassBays' Management Committee was established to designate seats for partner and stakeholder groups, and the LGCs were more clearly tasked with setting priorities at the regional level. Representation on the Management Committee deserves revisiting at this point, to make sure that any gaps in the roster – including missing sectors and EJ communities – are addressed.

Activities

- Revisit MassBays' 2013 Structure and Operating Procedures to assess Management Committee roster.
- Based on social metrics and EJ-related data layers included in the EDA, identify gaps in representation and solicit new members.
- Ensure representation of diversity in the MC and Subcommittees.

Environmental outcomes

On-the-ground actions and environmental improvements that reflect concerns of a diversity of stakeholders

Resources required

\$

This will be a short-term effort; minimal funds will be needed to implement this Action

0.05 FTE

The Director will commit time to reviewing the Committee's SOPs and solicit review and comment on proposed changes from the Committee members.

Outputs

By 2024, Management Committee SOPs reviewed and revised as needed.

Measures

By 2024, Subcommittee membership is diversified, with active engagement of new representatives from public health, business, technology, formal and informal education, and other sectors as identified by the MC.

Timeline

2023 through 2024

Partners

MC Nominating and Governance Subcommittee, EEA, EPA EJ and Urban Waters offices (advisors)

Action 2.3.b Engage partners who work with EJ communities in MassBays' regions.

Description

This Action is similar to 2.3.a but focused on the regional level. RSPs will evaluate their own LGCs' representation of multiple sectors and interest groups, including underserved and under-represented communities. In 2022, with funding from EPA's Urban Waters Program, the Mystic River Ambassador conducted an analysis and produced region-specific EJ reports for each RC. Combining layers from EPA's national EJ Screening Tool and EEA's EJ Map, the report pinpoints communities that RCs will connect with to identify concerns. The RCs will facilitate direct access to decision makers at the local, state, and federal level where appropriate, to break down barriers between impacted communities' policymaking.

Activities

- Evaluate representation of underserved/underrepresented groups on LGCs
- Ensure that events are accessible to underserved/underrepresented community members
- Offer and support direct access to local? decisionmakers
- Facilitate cross-Bays sharing of tools and contacts for engagement

Environmental outcomes

Environmental improvements that incorporate EJ considerations

Resources required

\$

RCs will dedicate time to recruiting representation and input from diverse stakeholders, especially regarding their yearly workplans.

0.1 FTE

Boston staff will provide advice and support as requested.

Outputs

Each year, RCs will document measures taken to support diverse community access to meetings, events, and decisionmakers.

Measures

- Each year, MassBays attributes action on at least one initiative to requests, or programs identified or selected for action, by underserved communities.
- Each year, representatives of groups based in underserved communities regularly engage in activities at the regional level.
- In 2023 and 2028, representatives of underserved/ underrepresented communities will report on MassBays' engagement as part of the EPA PE.

Timeline

ongoing

Partners

EPA EJ & Urban Waters programs, local EJ organizations (evaluation)
RPAs, MMA, RSPs (connections to decisionmakers)

Goal 3

Organizational: MassBays is a model program for management and planning that addresses ecosystem diversity.

Programmatic: MassBays provides regular and locally informed State of the Bays reporting that reflects the unique characteristics of MassBays assessment units (embayments, rocky shore, barrier beach), and documents progress toward target conditions.

Goal 3 demonstrates MassBays' willingness to step forward and provide testing grounds for new approaches to coastal habitat assessment and management. The diversity and geologic and geographic breadth of our study area, as described in Section II, precludes one-size-fits-all responses to ecosystem change. Instead, with assistance from EPA researchers, regional research associations, and Massachusetts-based experts, MassBays has assessed and categorized 44 embayments according to a suite of physical characteristics, and demonstrated application of the BCG assessment to set habitat targets based on current conditions and future potential for improvement. Action 3.1.b will incorporate descriptions of associated ecosystem services.

Another aspect of this Goal is to sustain MassBays' efforts into the future which means, the MC recognizes, that we must maintain our status as an Estuary of National Significance under §320 of the Clean Water Act. As we prepared this CCMP, it was written with the assumption that MassBays would be restricted to reliance on §320 funding, which would be adequate to meet the goals set out here. We are certain that additional funds will allow MassBays to expand these actions from pilot programs to ones that would be widely implemented, from region-specific efforts to Bays-wide efforts, and from single-sector initiatives to multi-sector programs. The Finance Subcommittee developed, and the Management Committee approved, a Finance Plan and recommendations for fiscal sustainability both of MassBays and efforts under the CCMP. A priority under this Goal will be to update the plan to incorporate two critical factors:

- ***Passage of the Infrastructure Investment and Jobs Act*** (referred to as the *Bipartisan Infrastructure Law, or BIL*) in late 2021. Congress has appropriated funds under BIL to be directed to the NEP, a total of \$909,800 per year to each NEP for 5 years (FFY2022-2026). EPA released BIL funding guidance in July 2022,¹¹⁶ and MassBays immediately submitted a workplan that focuses on implementation projects in the Mystic and Merrimack River watersheds, along with supplemental funding to the RSPs. This funding is a significant boost to MassBays' ability to implement the CCMP, opening up opportunities for us to fund implementation as well as planning efforts.
- ***Transfer of MassBays' hosting to UMass Boston's School for the Environment (SFE)***. MassBays' ability to diversify its funding sources has been restricted while under the purview of the Commonwealth's Executive Branch. In spite of the NEPs' nonregulatory charge, being situated in EEA prevented MassBays from being able to request in-kind services, donations, or funding from private entities – including Federal grant administrators like Restore America's Estuaries or the National Fish and Wildlife Foundation. As a Center in SFE, we have new opportunities not only to apply for and seek new funding, but the ability to distribute MassBays-branded press releases and communication to the press, legislators, and members of Congress describing our work and calling attention to our successes.

¹¹⁶ NEP Funding implementation memo: https://www.epa.gov/system/files/documents/2022-07/NEP%20BIL%20Implementation%20Memo%20FY22-26_July%202022_signed.pdf

Strategy 3.1 Establish target (improved) water quality and habitat conditions tied to desired uses and ecosystem services.

Action 3.1.a Identify indicators and metrics to describe diversity and similarities among embayments, diadromous fish habitat, rocky shores, beaches, and dunes across MassBays' study area.

Description

Action 3.1 is central to MassBays' approach to gaining improvement in the Bays using habitat targets as detailed in Appendix A. As we move ahead under this CCMP, we will use the same process to determine similarities and differences among the 65 delineated assessment units (i.e., PCA of EDA metrics) for diadromous fish migration and spawning, beaches, rocky shores, and dunes of the Bays' shoreline, setting out targets for their future extent and condition. Activities under this Action include applying data gathered via EDA updates to bring new considerations to existing and *de novo* assessments.

Activities

- Consider new data sets, emerging issues & contaminants, and social science/economic valuation measures for EDA updates. Incorporate climate change metrics and indicators.
- Refine BCG analyses for estuarine embayments where EDA updates indicate a need.
- Apply BCG to develop targets for diadromous fish and rocky shore habitats, beaches, and dunes.

Environmental outcomes

Improved coastal habitats

Resources required

\$

EPA ORD is providing in-kind support to..., and MassBays will invest funds to collect and analyze new data sets. Funds to populate the ETT with new habitats will be needed.

0.1 FTE

Central staff time will be expended primarily on coordinating various contributors to the effort and providing a big-picture view of the effort.

Outputs

- Public document and journal publications describing the processes used to categorize embayments and set targets
- New BCGs for additional habitat types
- Input to ecosystem services assessments

Measures

- BCG targets for additional habitat types are set.
- New habitat targets are added to the ETT.

Timeline

Through 2026

Partners

EPA ORD and OST, Northeastern University, STAC (methodology and guidance)
DER, DMF, Mass Audubon, other habitat experts (input to metrics, target-setting)

Action 3.1.b Identify local priorities for ecosystem services to guide management and restoration decisions.

Description

Coastal habitats have intrinsic value and should be protected and restored on their own merit. Influencing decisions about investments in protection and restoration often requires some description of the habitat's value to humans, however, which we can do in terms of ecosystem services, or the benefits derived by humans from intact and healthy natural systems. Appendix A describes investigations MassBays has undertaken with partners to define the ecosystem services provided by coastal habitats, and work with stakeholders to understand their willingness to invest in habitat restoration to protect and enhance those services. This Action includes undertaking an Ecosystem Services Gradient (ESG) assessment. ESG can help to identify measurable outcomes, define relationships between biological conditions and ecosystem services, and communicate about and monitor corresponding social and economic impacts of actions. Two recent projects provide a starting place for work under this Action:

- **Document analysis.** EPA ORD examined the relative frequency of mentions of specific ecosystem services in more than 1400 community-generated planning documents.¹¹⁷
- **Deliberative valuation workshops.** In partnership with researchers at UMass Boston, MassBays convened stakeholders representing each embayment category to observe and document their individual and collective priorities for habitat restoration in terms of ecosystem services.¹¹⁸

Activities

- Establish relationships between BCG targets and ESG for each habitat type.
- Share and apply findings from document analysis and stakeholder workshops to inform and develop effective, tailored education and outreach to coastal communities.

Environmental outcomes

Local investments in improved coastal habitats

Resources required

\$\$

EPA ORD is providing in-kind support to develop ESG protocol, and MassBays will invest funds to identify local priorities around additional habitats' ecosystem services. Funding for staff time or consulting services to produce outreach materials will be needed.

0.15 FTE

Central staff will coordinate among the various contributors to the effort and produce all-important outreach materials with input from RCs.

Outputs

- Public documents and journal publications describing the processes used to prioritize ecosystem services
- ESGs for all habitat types including eelgrass, salt marsh, tidal flats, diadromous fish habitat, beaches and dunes, rocky intertidal, and benthic communities
- Findings from stakeholder prioritization processes

¹¹⁷ Yee et al., in review

¹¹⁸ Lyon-Mackie, Vella, DiBona, Shehab-Sehovic, Roche, Kreiley, and Mavrommati. *In review*. Exploring stakeholders' ecosystem services perceptions across Massachusetts Bays using deliberative valuation.

Measures

By 2026, ESGs associated with all BCG targets are determined.

Timeline

Through 2026

Partners

EPA ORD and OST, UMass Boston (methodology and guidance)
DER, DMF, Mass Audubon, STAC, other habitat experts (input to ESG-BCG relationship)

Strategy 3.2 Guide local action to expand habitat and improve water quality according to community-prioritized targets.

This Strategy is where work under Goals 1 and 2 come together to help MassBays make real progress in our Estuary of National Significance. Its implementation relies on the local connections and established partnerships of MassBays’ RCs, as they share with decisionmakers and planners the targets and priorities identified by stakeholders through Strategy 3.1. We are fortunate to have new funding under BIL to apply to specific projects; Central Staff will develop a plan for these funds that will leverage other infrastructure investments under the Act to build capacity among municipalities and partner organizations and realize successes. With the targets as guideposts and employing specific measures of progress (presented in the ETT and State of the Bays) to evaluate habitat status and the Monitoring Framework to identify suitable data sets, MassBays will utilize adaptive management to shift resources, justify investments, and encourage persistent efforts to improve local conditions.

Action 3.2.a Devise, adapt, and/or augment local plans to address targets.

Description

MassBays’ RSPs will draw from results of Action 3.1 to initiate discussions with municipal staff, local organizations, and other stakeholders as they scope out their yearly workplans. This Action calls on the RSPs to bring our Bays-wide vision to the local level, where plans for specific activities – wastewater management, stormwater infrastructure retrofits and LID, habitat restoration, and updated resource protection practices, for example – should improve environmental conditions, as implemented under Action 3.2.b and measured under Action 3.2.c.

Activities

- Evaluate feasibility of proposed actions to meet target conditions, including funding and support from local, state, and federal decisionmakers.
- Provide input and habitat-oriented guidance to local initiatives.
- Prioritize habitat conservation and restoration projects for inclusion MassBays’ annual workplan based on regional needs assessments.

Environmental outcomes

Local investments in improved coastal habitats

Resources required

\$\$

This work is incorporated into RSP subawards

0.1 FTE

Central Staff will compile regional workplans into a MassBays-wide annual workplan, and pursue supplemental funding for RSPs’ efforts and to increase municipal capacity for project planning.

Outputs

- Action on local priority projects which reflect MassBays’ goals for habitat protection and restoration and water quality
- Annual MassBays workplan describes region-based tasks that contribute to this Action
- Green infrastructure/BMPs (BIL)
- Acres or miles of habitat protected and restored

Measures

RSPs’ annual scopes of work include contributing to local plans for coastal ecosystems, which in turn are based on progress toward target conditions.

Timeline

Ongoing

Partners

RSPs, LGCs, MC

Action 3.2.b Implement and evaluate activities to improve and protect habitat values and resources.

Description

Working alongside state, federal, and local partners, the RSPs will support local implementation efforts that follow from or align with outcomes of Action 3.2.a.

Activities

- Contribute to project implementation efforts, for example through grant writing, serving on advisory panels, and participating in public outreach and education.
- Evaluate and report project outcomes.
- Encourage and support post-restoration monitoring for at least five years.
- Disseminate case studies across MassBays communities, and share successes and challenges among RCs.
- Implement habitat protection and restoration projects in MassBays’ annual workplan.

Environmental outcomes

Local projects that improve coastal habitats

Resources required

\$\$

This work is incorporated into RSPs subawards

0.15 FTE

Central Staff will compile regional workplans into a MassBays-wide annual workplan and pursue supplemental funding for RSPs’ efforts and to increase municipal capacity for project implementation and evaluation.

Outputs

Quarterly reports on activities provided to MC

Measures

Restoration efforts are based on regional prioritization for action

Timeline

Ongoing

Partners

NOAA, DER, DMF (restoration funding and implementation)
municipal officials and staff, local organizations, others
(priority-setting)

Action 3.2.c Measure and report on progress toward targets.

Description

With targets set (Action 3.2.a) and activities implemented that are focused on meeting those targets (Action 3.2.b), MassBays should begin to see improved environmental conditions. This Action includes implementing MassBays’ monitoring framework, submitting annual reports on restored habitat to EPA via NEPORT (Online Reporting Tool), and providing stakeholders with an interactive way to track local progress via the ETT. This tracking will further support adaptive monitoring and management, as we assess correspondence between actions and outcomes.

Activities

- Implement monitoring framework (see Goal 1 strategies above)
- Submit NEPORT data to EPA
- Maintain ETT to reflect up-to-date water quality, and habitat condition and extent

Environmental outcomes

Feedback on progress toward ecosystem targets will inform subsequent work to realize continued or new environmental improvements

Resources required

\$

This Action requires funding to maintain the ETT.

0.1 FTE

Central Staff will focus on reporting and dissemination of information via the ETT.

Outputs

- Up-to-date ETT
- Documentation of habitat restoration submitted to EPA
- Monitoring plan implementation; list of data gaps remaining

Measures

- Beginning in 2023, at least biennial updates to ETT content will document progress toward targets.
- Adaptive management and monitoring are carried out; i.e., MassBays’ monitoring framework and RSPs’ workplans are informed by biennial assessments.

Timeline

2023 and ongoing

Partners

DEP, DMF, EPA, MWRA, non-governmental monitoring groups (data)
CEI, Inc. (ETT)

Strategy 3.3 Meet National Estuary Program requirements

EPA sets out multiple and significant requirements for maintaining NEP status. Yearly progress reports and workplans, annual meetings with EPA staff in Washington DC, regular comprehensive program evaluations (PEs), financial reporting, and impact reports (habitat restoration and leveraged resources) are prerequisites to funding under CWA S.320. This strategy requires close attention not only to EPA's guidance and mandates, but Congressional support for the National Estuary Program itself. MassBays will continue its efforts to prove the value of federal investment in the Bays.

Action 3.3.a Conduct evaluation of organizational and programmatic impact.

Description

The primary tools for evaluation of MassBays' progress under the CCMP include the annual report (bundled with the annual workplan) provided to EPA (Action 3.2.a), and the PE conducted every five years. The process includes documenting actions over the previous 5-year period and submitting narrative describing the structure and practices of the NEP to EPA Region 1 and EPA Headquarters staff. MassBays has consistently received a "Pass" on PEs. (This highest possible score, indicating compliance with EPA guidance and suitable progress on the CCMP).

Also included in this Action is external evaluation of MassBays' communications impact, per the recommendations listed in the report included here as Attachment 1.

Activities

- Develop, implement, and evaluate impact of communications activities based on the Strategic Communications Assessment and Recommendations
- Host EPA performance evaluation(s)
- Determine and communicate program impact, e.g., via partners' survey, network analysis, other methods
- Regularly evaluate host situation

Environmental outcomes

MassBays contributes to environmental improvements in efficient and effective ways.

Resources required

\$/years 2023 and 2028

Funding for transportation to site visits, materials, etc.

\$/years 2025 and 2029

Communications evaluation consultant

0.5 FTE in years 2023 and 2027

Compiling documentation and hosting site visits for the PE requires considerable time on the part of Boston staff and RCs in the year leading up to the delivery date.

Outputs

- Each year, document local support of MassBays programming and initiatives from agency, nonprofit, individual, and research community in each region.
- Each year, S.320 funding granted to MassBays equal to other NEPs' base funding allocation.
- Biennial evaluation reports regarding MassBays' communications impact.

Measures

MassBays receives highest category awarded from EPA through the PE process. MassBays documents impact of communications efforts to target audiences.

Timeline

PEs 2023, 2028
Communications evaluations 2025, 2027, 2029

Partners

grantees, RSPs (reporting)
Communications Subcommittee (advice)

Action 3.3.b Establish and support collaborative efforts that increase opportunities to leverage new resources.

Description

EPA tracks leveraged resources – funding and in-kind support – that augment their own investment in the NEPs’ efforts. MassBays’ leveraged expenditures on programs and projects across the study area are presented in Figures 27 and 28. This Action commits MassBays to continuing to increase resources that are brought forward for implementation of the CCMP. Activities include tracking potential and existing partners’ contributions, engaging with regional (e.g., Gulf of Maine and Massachusetts’ South Shore) partnerships, strengthening connections to the business and technology communities, and facilitating new partnerships for joint funding proposals.

Activities

- Create and maintain topic-specific partner lists
- Support region-specific partnerships with academic and business/technology communities
- Coordinate grant proposals and meetings among diverse and nontraditional partners, within and across regions
- Expand opportunities for collaboration extending from UMass Boston School for the Environment
- Address data gaps identified under Action 1.1.a coinciding with EPA EJ Screen and Commonwealth EJ designations

Environmental outcomes

MassBays invests and leverages new funding for additional and larger environmental restoration and mitigation projects.

Resources required

\$
Free online tracking systems should be utilized

0.3FTE

Boston staff currently spend time on annual reporting to EPA through NEPORT. Implementation of this Action will require some input from a Communications staff person, not yet funded. Communications staff would spend at least 0.2FTE per year cultivating partnerships.

Outputs

Each year, prepare at least one multi-partner proposal for funding from entities other than EPA.

Each year, set and meet targets for engagement with the business/technology sector at the regional level.

Measures

Between 2019 and 2023, document (and report via NEPORT) 25% increase in average leveraged resources; between 2024 and 2028 document 50% increase in average leveraged resources, compared to 2012-2017 5-year average of \$6 leveraged per \$320 dollar.¹¹⁹

Timeline

Ongoing

Partners

Any and all potential and existing partners

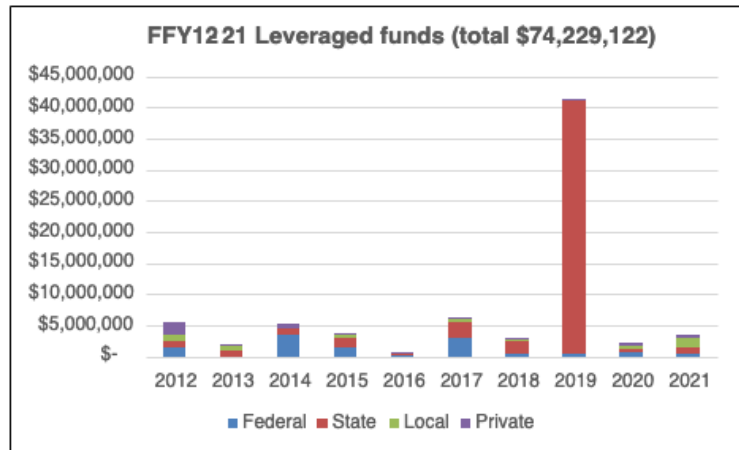


Figure 27. Cash and in-kind investment leveraged (actual dollars) with \$320 funds per federal fiscal year from FFY 2012 to FFY2021. Leverage types are defined as “Federal,” “State,” “Local,” and “Private” according to EPA reporting definitions.

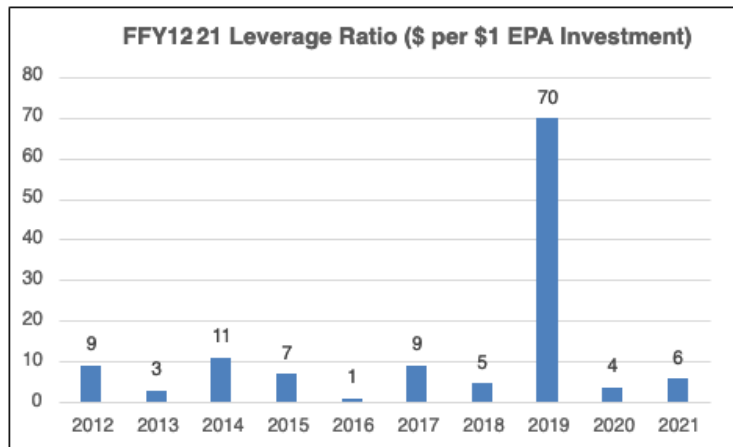


Figure 28. Cash and in-kind investment leveraged per dollar of \$320 funds invested per federal fiscal year from FFY 2012 to FFY2021. Leverage includes “primary,” “significant,” and “support” according to EPA reporting definitions.

¹¹⁹ Per EPA’s website, “Leveraged dollars are defined as the dollar value (cash or in-kind equivalent) of resources dedicated to implementing an NEP CCMP above and beyond the funding provided to the NEP under Section 320, including earmark funding. “Primary” leveraging indicates that the NEP Director and staff, rather than NEP partners, played the central or leadership role in obtaining the additional resources. “ <https://www.epa.gov/nep/financing-strategies-used-national-estuary-program>

VII. Conclusion

MassBays is pleased to share this CCMP, the product of multiple years of effort, extensive stakeholder input, and application of innovative methods for ecosystem-based, active management. We are sure that new areas for work – responding to climate change and bringing new voices to decision making – and new opportunities represented by our new host setting and infusion of Federal infrastructure funds will help MassBays meet the ambitious goals set out here.

Figure 29 presents an “at-a-glance” summary of the Strategies and Actions included here. Each year, activities and tasks under those actions will be implemented via our annual workplan, according to priorities vetted with local partners. We look forward to sharing our successes with those partners, and more broadly through the NEP.

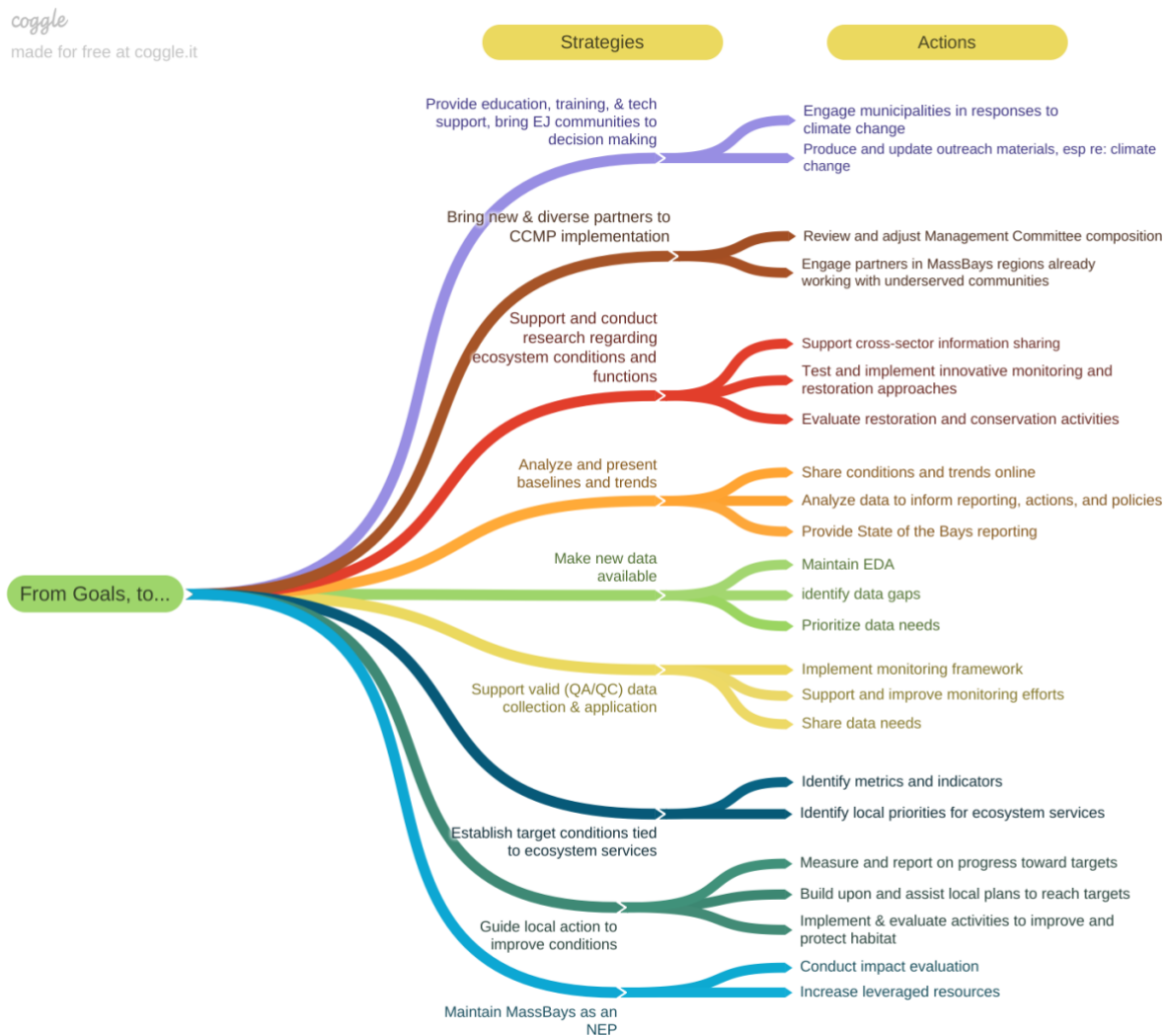


Figure 29. Compilation of the MassBays CCMP Strategies and Actions planned through 2033.

Appendix A. A Framework for Developing Long-term Habitat Targets for MassBays

A Framework for Setting Long-term Environmental Targets for MassBays National Estuary Partnership

Appendix to the
MassBays Comprehensive Conservation and Management Plan

October 2022

Massachusetts Bays National Estuary Partnership

Acknowledgements

The work described in this document was made possible by Grants from U.S. EPA Washington, DC, and by experts and collaborators from:

U.S. EPA Office of Research and Development

U.S. EPA Office of Science and Technology

U.S. EPA Region 1

E&C Enviroscope

Geosyntec, Inc.

Northeastern University Marine Science Center

University of Massachusetts Boston

MassBays Science and Technical Advisory Subcommittee

MassBays Regional Service Providers

This document is an appendix to the MassBays National Estuary Partnership 2022
Comprehensive Conservation and Management Plan

Contents

1.0 Introduction	4
1.1 Purpose of the Project	4
1.2 Goals and objectives	5
1.3 The Study Area	6
2.0 Estuary Delineation and Assessment	7
3.0 Developing a Biological Condition Gradient for Estuarine Embayments	10
3.1 Developing estuarine embayment eco-types.....	11
3.2 Developing historic maps for estuarine habitats to inform Level 1 definitions	13
3.3 Developing BCGs for each eco-type	19
3.4 Setting long-term targets for habitat restoration	23
4.0 Developing embayment resource-stressor clusters	25
5.0 Ecosystem services of estuarine habitats.....	30
5.1 Applications of Ecosystem Service Gradient (ESG) to evaluate restoration benefits	31
5.2 Exploring stakeholders' ecosystem services perceptions across MassBays region using a deliberative valuation approach	35
6.0 Communication strategies	37
6.1 Tracking progress: The Ecohealth Tracking Tool	38
7.0 Next steps.....	39
References	41

1.0 Introduction

Section 320 of the Clean Water Act requires all 28 National Estuary Programs to develop a Comprehensive Conservation and Management Plan (CCMP) to guide habitat protection and restoration of water quality and ecological integrity of estuaries of national significance. MassBays has recently concluded a revision of its CCMP, including the setting of habitat targets and a long-term framework strategy to monitor progress towards these targets. This document (an appendix to the CCMP) serves to describe the approach used to develop the long-term habitat targets based on local priorities, to restore estuarine ecosystem health in the MassBays area.

Mass Bays is dedicated to protecting, restoring, and enhancing living estuarine resources, including approximately 34,000 acres of salt marsh, 14,000 acres of tidal flats, 10,000 acres of seagrass, 700 acres of rocky intertidal shorelines, 11,000 acres of dunes and sand beaches, 155 miles of herring runs or fishways, and 69,000 acres of benthic shellfish habitat (Yee et al., In Review). To achieve this goal, MassBays worked with many partners and stakeholders over several years. Over numerous meetings and discussions, local expert input was provided and integrated with scientists' advice in order to develop a robust set of achievable and sustainable goals to improve conditions in the estuaries. This project was managed by MassBays collaborating with the Regional Service Providers (through Regional Coordinators (RCs)), the MassBays Science and Technical Advisory Subcommittee (STAC) and the MassBays Management Committee.

1.1 Purpose of the Project

Estuaries provide key ecosystem functions and services. They support critical habitats such as eelgrass, salt marsh, and oyster reefs that provide nursery and foraging grounds for fish, cycle and remove excess nutrients, play a key role in carbon cycling, and stabilize shoreline sediments (Beck et al, 2001; Jackson et al., 2001; in Hanley et al., 2021). However, they are also highly vulnerable to degradation which is the result of human development and activities (Halpern et al, 2008). In many regions there is limited understanding of environmental conditions and stressor levels in these complex ecosystems. Developing a clear understanding of existing levels of habitat and anthropogenic stressors through the collection of critical baseline data and information is important to enhance conservation and restoration efforts (Hanley et al., 2021).

MassBays planning area has a diverse and complex geomorphology, creating embayments with diverse ecological and socioeconomic characteristics which in turn result in specific management needs to address specific conditions (Hanley et al., 2021). Estuarine resources in many parts of the MassBays region have given rise to concerns over deteriorating conditions (e.g., almost 60% eelgrass loss from Duxbury-Kingston-Plymouth embayments since 1995). MassBays' mission includes providing support to local communities as they address their management priorities within their estuaries.

With the revision of the MassBays Comprehensive Conservation and Management Plan (CCMP), MassBays is focusing on priority needs of its communities and the changing ecosystem conditions at the embayment level. To support locally targeted efforts, MassBays applied a multistep approach that started by delineating its estuarine coast, defining landward and seaward boundaries as well as characterizing estuarine embayments. A suite of resource and stressor attributes were selected based on a set of criteria including availability and quality of data across the whole region and at the embayment scale.

Using the embayment-level data, MassBays then partnered with Northeastern University's Marine Science Center where a team of researchers conducted a series of analyses to: (1) characterize and develop clusters of MassBays embayments with similar resource, environmental, and stressor attribute levels, and (2) identify the stressor attribute(s) that were the strongest predictors of resource attribute levels within each embayment. At the same time, MassBays worked closely with EPA Office of Research and Development (ORD) and Office of Science and Technology (OST) to apply the Biological Condition Gradient (BCG) tool to establish long-term habitat targets that MassBays planned to reach by 2050. Importantly, this effort is informed by our knowledge that climate change already affects the trajectory of our most critical habitats; the understanding of our underlying physical systems gained throughout the process will enable us to work with partners to establish credible targets over time.

In this project we introduced a new concept – a combined approach of biological conditions and the ecosystem services that estuarine habitats provide (Ecosystem Services Gradient, ESG). The BCG/ESG approach can help managers better understand how an estuary (or group of estuaries) has changed over time, help establish a vision of a desired future for that estuary and develop targets to achieve the vision.

The BCG tells us the rate and extent of loss of nature relative to an undisturbed condition and allows us to compare nature among different scales, places and over time. This allows us to visualize nature in a desired future. The ESG incorporates the benefits that nature provides to people and allows us to visualize our lives in a desired future. Together, the BCG and ESG can inspire a vision of a desired future that resonates broadly with managers and the public.

The BCG approach has been successfully used (without ESG) to motivate people to create a vision of a desired future, set targets, and take actions to achieve that vision. But looking at the bigger picture, the goal of protecting and restoring the environment depends on the political will of the people, particularly decisionmakers and those who influence them. MassBays communities are empowered to make decisions that affect their local areas, and a motivated public is a powerful force in environmental protection. But “the public” includes a diversity of people that bring with them a range of beliefs and priorities. Expanding political will involves motivating people who are less engaged in protecting nature for its own sake. Communicating nature through things that a broad spectrum of people cares about get better results in protecting the environment.

Describing the benefits nature provides to people as an ecosystem services approach combined with BCG will in almost every case lead to stronger public support and political will for setting and achieving environmental goals. In this project, BCG - a mathematical quantification of the rate and extent of loss of nature – is applied as a starting point and to serve as a foundation for communicating ecosystem services that further resonate with a broad audience in support of environmental protection.

1.2 Goals and objectives

The main goal of this study is to establish long-term habitat target conditions that would guide and inform management actions towards improving the overall ecosystem condition of estuaries.

Objectives:

- Pick scale and area of interest (embayments)
- Assemble historic and modern data for estuarine habitats at embayment scale

- Assemble the Biological Condition Gradients (BCGs)
- Add ecosystem services
- Develop a strategy to engage with stakeholders, decisionmakers, and other audiences
- Establish credible long-term targets

The general approach involved several steps and the use of different tools (Figure 1). It was divided into three parts: data gathering, data synthesis, and outputs. The data gathering step included:

- (1) Developing the Estuary Delineation and Assessment (EDA) (Section 2.1) that resulted in the identification of 65 assessment areas and data on current estuarine habitat conditions
- (2) Using the EDA to develop Resource-Stressor clusters and using R statistical software to identify the main drivers affecting estuarine resources in each cluster.
- (3) Conducting a tidal residence time assessment¹ to measure the influence of tidal flux from the ocean versus freshwater.
- (4) Assembling habitat data to establish a historical “reference point” for the BCG.
- (5) Conducting a deliberative multicriteria decision analysis that generated information to add to the Estuarine Condition Gradient (ESG) tool.
- (6) Connecting the BCG and ESG models to develop long-term targets in the context of local priorities

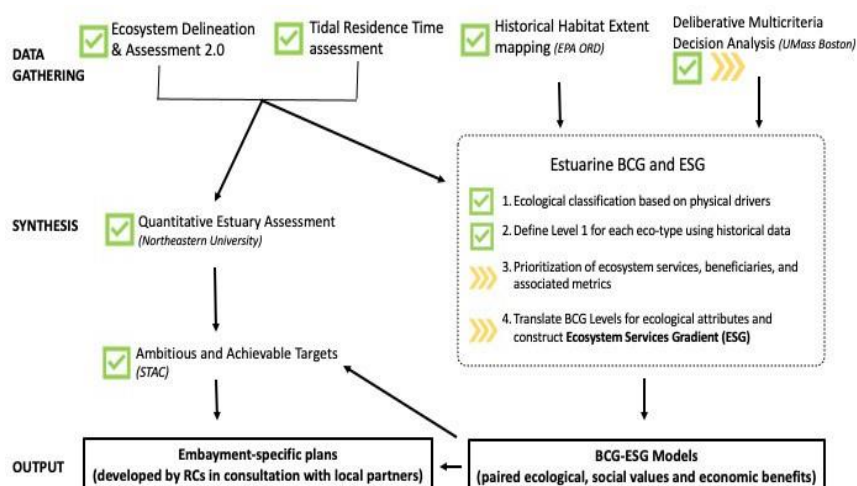


Figure 1. Model of the process used to develop ecosystem targets for the MassBays CCMP

1.3 The Study Area

MassBays’ planning area encompasses an offshore area of about 1,650 square miles with an inland watershed covering over 7,000 square miles. From coastal wetlands, it stretches offshore to Stellwagen Bank, 25 miles east of Boston. Its 1100-mile coastline from Salisbury to Provincetown is characterized by a diverse and complex geomorphology that has shaped unique estuaries where some of the harshest environmental challenges take place. By the very nature of their location and hydrography, these estuaries are rich in natural resources (including salt marsh, tidal flats, eelgrass beds, and diadromous fish habitat), attracting plenty of commercial and recreational uses.

¹ Description of this project is outside the scope of this document, but the report is available upon request. Woods Hole Group 2019.

The MassBays planning area is home to 1.7 million people living year-round in 50 communities along the coast of Ipswich Bay, Massachusetts Bay, and Cape Cod Bay. Each year between June and September, the area receives a heavy influx of tourists drawn to its vibrant coastline, its natural resources, and the many recreational and commercial opportunities it offers. Commercial and recreational uses in Massachusetts include coastal development (both urban and industrial), fishing, aquaculture, boating, and whale watching, maritime transportation, and more recently development of infrastructure to support offshore wind energy development. Although initially located south of Nantucket and Martha's Vineyard, over the next decade offshore wind energy development will be expanding to the Gulf of Maine, bringing with it a new set of challenges for which we need to be prepared.

The layout of shoreline habitats in the Bays is determined by geology, slope and orientation, and exposure to waves, as well as adjacent land use and freshwater flow from inland. In general, there is a habitat gradient north to south from Ipswich Bay, where salt marshes dominate, to the southern coast of Massachusetts Bay where rocky intertidal habitat mingles with marshes, and finally to Cape Cod Bay, which is dominated by sand beaches, dunes, and tidal flats. The average depth of the MassBays planning area is 30m (120ft) and the area is subject to a daily mean high tide of 9-12 ft. Currents flowing south in the Gulf of Maine vary seasonally, with cold water flowing through Ipswich and Massachusetts Bays south to Cape Cod Bay. This flow is influenced by riverine inputs, especially during Spring. Several rivers, including the Charles, Mystic, Neponset, Saugus, Parker, Ipswich, Rowley, and Essex rivers, as well as the Merrimack River, which discharges the largest volume of fresh water into the Bays, carry nutrients and pollutants from the upper watershed to coastal wetlands and into the bays.

MassBays' estuaries vary in size and condition – some estuaries (e.g., Boston Harbor which receives water from three major urban rivers), are densely populated and characterized by high impervious surface, tidal restrictions, habitat loss and fragmentation (including the impacts of multiple dams), and legacy and emerging pollutants, and where the impacts of climate change such as increased storms and floods are most felt. This is especially true for vulnerable communities. Estuaries in more rural areas provide critical support to vulnerable habitats such as salt marshes and sand dunes (e.g., Rowley, Ipswich and Parker Rivers which drain into Plum Island Sound), but also face their own set of challenges. Massachusetts Bay also receives discharge from the wastewater treatment plant on Deer Island from which about 300 MGD of secondary treated water are discharged through the outfall 9 miles from shore.

Cape Cod Bay is also a dynamic environment with its own hydrologic "regime" that influences observed differences in nutrient cycling and productivity patterns between open coastal waters and shallow embayments. Cape Cod Bay receives most freshwater input from groundwater inflow. Because Cape Cod residents rely primarily on septic systems, the groundwater that seeps into the Bay often carries more nutrients into coastal waters than the coastal rivers. Monitoring data suggest an overall decline in environmental conditions nearshore in Cape Cod Bay. Since 2019, an annual decline in DO in southern Cape Cod, often coinciding with a chlorophyll peak at the pycnocline and increased volume of HABs, Bay has also given rise to concerns about benthic organisms including lobster and scallops that inhabit the area.

2.0 Estuary Delineation and Assessment

The MassBays planning area is diverse and complex, characterized by freshwater/brackish and marine habitats. MassBays' mission includes providing support to local communities as they address their management priorities within their estuaries. With the revision of the MassBays Comprehensive Conservation and Management Plan (CCMP), MassBays is focusing on priority needs and changing

ecosystem conditions at the embayment level.

This project included several steps and the use of different tools. The EDA developed in 2017 can serve as a tool for assessing and tracking trends and changing conditions of estuarine and inter- estuarine habitats at the embayment level; with its expansive inventory of attributes and indicators it can provide actionable information for use by resource managers and decision-makers to improve ecosystem health and alleviate the impacts of stressors on estuarine ecosystems as well as the wellbeing of communities that depend on them.

MassBays delineated its coastal planning area, defining a landward boundary and a seaward boundary. The boundaries were depicted using topography and indicators of tidal influence², as well as existing USGS and MassGIS watershed boundary lines. At the sub watershed level, 65 assessment areas were identified. The first delineation was conducted in 2013, with a revision in 2017 to update the existing data and include additional attributes that highlighted similarities and differences among the assessment areas (EDA 2.0).



Given the variety of embayment characteristics across the estuaries, the process used to delineate the estuarine watershed boundaries sometimes varied on a case-by-case basis. For assessment areas that do not have a major freshwater tributary on which to establish a landward boundary, their watersheds were delineated simply by determining the proximal area contributing to the embayment using topography. Assessment areas located on Cape Cod are influenced by groundwater contribution rather than by a typical watershed defined by surficial topography; to address this and other special circumstances, the process developed a deviation from the general delineation process, using best professional judgment to determine how the most informative and useful “estuarine watershed” would be delineated.

Figure 2: MassBays planning area with 65 assessment areas

Method

The 65 assessment areas include 44 embayments and 21 “inter-estuarine” areas that include nearshore stretches of beach, straight rocky shore, and headlands that exist between estuaries. In order to define and delineate these inter-estuarine assessment areas the MassGIS “Drainage Sub-basins” data layer was intersected with the embayment assessment areas. The resulting coastal subbasins and subbasin segments that did not overlap with embayment assessment areas were selected as the basis for the inter-estuarine assessment units. After completing this process, the draft delineations were reviewed by the MassBays Regional Coordinators who provided local expertise. Subject matter experts also weighed in on

² The extent of Chapter 91 Jurisdiction was determined by overlaying the MassGIS “Tidelands Jurisdiction Datalayer” on the assessment areas. Chapter 91 Jurisdiction was used to indicate the landward extent of tidal influence.

various components.

Unlike estuarine areas which often have a specific waterbody to use as the basis for the seaward boundary, assessment areas located along barrier beaches, linear coastlines, and other inter-estuarine areas directly border the ocean and have no obvious seaward boundary that could be dictated by geography or features. To establish the seaward boundary, the 10-meter isobath was selected as a suitable basis for the new seaward boundaries. This depth was chosen because it encompasses the photic zone, which generally includes many of the near-shore marine ecological resources of interest. In some cases, seaward boundaries were expanded outward from the 10-meter isobath in order to include any marine ecological resources that existed at greater depths within the vicinity of the assessment area.

For estuaries with one or more significant freshwater tributaries, the furthest extent of tidal influence was used to determine the location of the landward boundary. The two primary data sources used to interpret this location included: (1) maps of salt marsh locations; and (2) Massachusetts General Law Chapter 91 Tidelands Jurisdiction maps. Salt marshes were mapped using the MassDEP Wetlands data layer (2005). Details of how the landward and seaward boundaries were determined are described in the Estuary Delineation and Assessment 2.0 (Geosyntec Consultants, 2017).

Each assessment area was characterized using datalayers for several indicators or attributes that included 7 estuarine resources, 15 anthropogenic stressors, and 8 socioeconomic indicators (Table 1).

Table 1. Estuarine resources, anthropogenic stressors and socioeconomic attributes included in the assessment area characterization (2017)

Estuarine Resources	Eelgrass, salt marsh, tidal flats, rocky intertidal, sandy beaches and dunes, shellfish habitat, shorebird habitat, shorebird nesting sites, anadromous fish runs
Stressors	High-intensity land use, annual stormwater discharge impervious area, population density, wastewater discharge to surface water, wastewater discharge to groundwater, % population using septic systems, 303(d) impairments estuaries (bacteria & nutrients), 303(d) impairments tributaries (bacteria & nutrients), designated shellfish growing area classification, # impoundments causing fish passage barriers, #stream crossings, # road crossings in tidal areas.
Socioeconomic	Beach closure days, marinas, mooring fields, dredging projects, seawalls and related infrastructure, boating access, public/semi-public beach length, beach access

Attributes were analyzed using spatial analysis to determine areal extent within each watershed. Data for spatial extent for each attribute was normalized: aquatic attributes (such as shellfish habitat, eelgrass extent) were normalized to the area of open water within the estuarine watershed boundary; land attributes (land use, impervious area, population density, etc.) were normalized to the area of land within the estuarine watershed boundary; attributes that existed in both open water and on land, or in transitional areas, were normalized to the entire area within the estuarine watershed boundary (such as salt marsh, tidal flat, shorebird habitat). Wastewater was quantified in MGD to allow for intercomparison.

The results include a series of GIS maps that were compiled into the Estuary Delineation and Assessment

(EDA) and used to: (1) create a story map³ to showcase the assessment areas and allow users to access datalayers in their area of interest for management decisions, and (2) develop tools to track changes in conditions, to establish long-term environmental targets and to measure progress towards reaching those targets. All the attributes, methods and analyses are described in detail in Geosyntec Consultants, 2017.

3.0 Developing a Biological Condition Gradient for Estuarine Embayments

MassBays' goal is to establish long-term targets of habitat conditions based on underlying physical and biological characteristics and to develop a framework to measure progress towards these targets over time. MassBays worked with the Management Committee (which includes numerous stakeholders) and with its five Regional Coordinators (representing their respective local communities) to better understand what we want the NEP to look like by 2050. To answer this question, MassBays needed to look at what the estuaries looked like historically, look closely at current conditions, and use this information to help develop a future vision for what we want the NEP to look like. /This process could be quite complicated given the limited availability of historical data, the changes in habitat conditions over decades of development and land use change, and the uncertainty of the future regarding climate change impacts.

The tool that best addressed these needs is the Biological Condition Gradient (BCG), a scientific framework developed by USEPA that can be used to interpret biological responses from the cumulative effects of stressors for different types of water bodies. The BCG helps managers and practitioners more precisely define and interpret baseline biological conditions, help evaluate potential for improvement in degraded waters, and measure and document incremental changes in condition along a gradient of anthropogenic stress (Davies and Jackson, 2006; USEPA, 2016). As depicted in Figure 3, the BCG starts by describing the biological condition in natural or minimal disturbed habitats and the expected changes in biological conditions along a stressor gradient caused by human-induced environmental changes. The gradient extends from undisturbed (Level 1) to very degraded (Level 6). Not all levels need to be applied for all areas under study. As the stressor increases (x-axis), the biological condition becomes more degraded (y-axis). In Figure 3, the Y-axis depicts changes in taxonomic make-up and integrity.

USEPA and MassBays piloted the BCG tool in estuarine ecosystems to establish long-term future targets for selected habitats in each embayment. Based on expert input and local priorities, the BCG was applied to four key estuarine habitats: eelgrass, salt marsh, tidal flats, and diadromous fish habitat. For MassBays, natural conditions (Level 1) or minimally disturbed (level 2) were equated to conditions before settlement or to the oldest recorded data, representing when population was low and pre-industrial conditions. The metric used is percent area remaining for each habitat.

The x-axis known as the Generalized Stress Index (GSI) conceptually describes the range of anthropogenic stress that may adversely affect estuarine resources in a particular embayment or group of embayments. For the MassBays BCG framework, the GSA was made to represent changes over time (1770's to the present day), assuming that stressors were increasing over time. MassBays aimed to develop a well-defined GSI to possibly serve as a nexus between biological and causal assessments, thereby linking management goals and selection of management actions for protection or restoration (USEPA, 2016).

³ [MassBays Assessment Areas \(arcgis.com\)](https://arcgis.com)

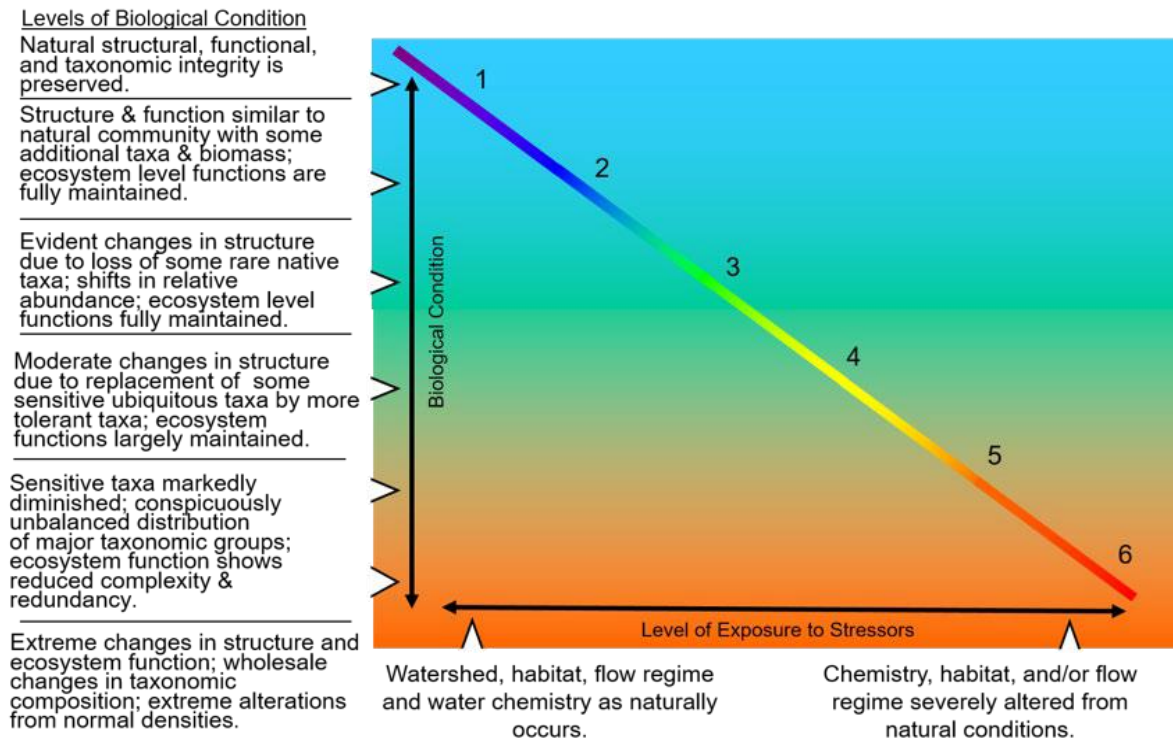


Figure 3. Biological Condition Gradient showing levels of degradation with exposure to stressors.

In 2021 BCGs and habitat targets were developed for three of the four habitats selected. Work to develop a target for diadromous fish habitat is currently underway. Details of this approach are described in the sections below. The first step in developing a BCG for estuarine embayments was to look at the physical and geomorphological features of embayments without any human impact. This “site suitability assessment” would serve as an indicator for the area’s (embayment’s) ability to support specific habitat based on natural conditions only. The analysis results in a classification of the embayments into ecotypes. The next step was to examine historical data and/or maps that could show the historic location and/or extent of eelgrass, salt marsh and tidal flat habitat. We are currently working on similar steps for diadromous fish habitat.

3.1 Developing estuarine embayment eco-types

To develop credible long-term targets for MassBays, it is important to understand the physical and geomorphological suitability of each embayment to support a specific habitat or mosaic of habitats. Assessing the planning areas through this lens resulted in the development of specific ecotypes. Ecotypes represent the biological potential of an area (embayment) to support a habitat or mosaic of habitats under conditions of no human impact. Defining these ecotypes not influenced by anthropogenic factors provides the ability to truly track the impact of changing levels of stressors over time. Each of the 44 embayments was categorized into one of four ecotypes (Figure 4) based on three criteria: exposure, amount of sediment available, and water depth.

Method

Eco-types⁴ were first generated using two datasets: tidal flux⁵ and the 10m-resolution CZM/USGS (Andrews et al., 2019) defined as percent of seaward area less than 2m deep. This combination of layers resulted in four proposed eco-types: fewer shallow habitats with higher tidal flux; fewer shallow habitats with lower tidal flux; more shallow habitats with higher tidal flux; and more shallow habitats with lower tidal flux. In reviewing the draft eco-types, the MassBays Science and Technical Advisory Committee (STAC) and the RCs provided input and suggestions on additional data to refine the initial eco-types.

Results

The MassBays eco-type classification was revised based on input on shallow water habitat area, energy regime, and exposure. Information about coastal geology and morphology was also compiled and incorporated into the classification. By combining the information about modern sediment, energy regime, and exposure, the MassBays embayments fell into the following groups:

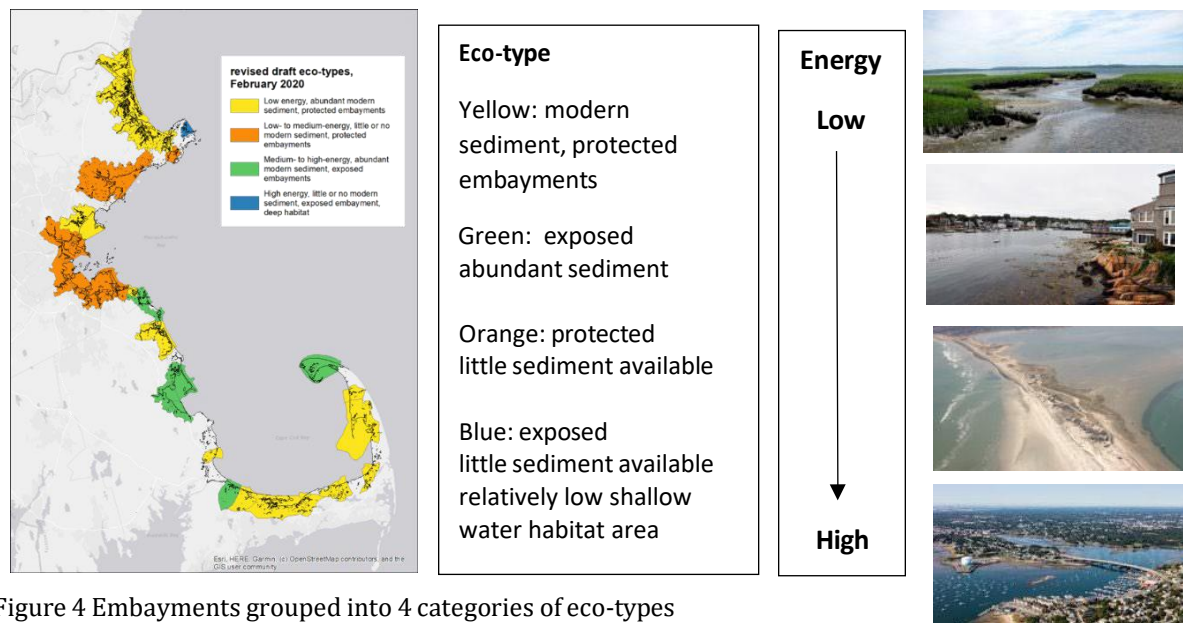


Figure 4 Embayments grouped into 4 categories of eco-types

Yellow ecotype includes protected embayments with abundant sediment. These are usually low energy embayments with abundant salt marsh. For example, areas on the north shore where the Great Marsh is located and areas around Cape Cod Bay which are characterized by sandy beaches as well as salt marshes.

Orange ecotype embayments are also protected and low energy but with little sediment available. These embayments tend to form natural harbors and are usually urbanized. E.g., Boston area and Salem Sound.

Embayments in the green ecotype are more exposed and subject to moderate energy waves. They have abundant sediment and despite greater exposure tend to support extensive eelgrass and areas with tidal flats e.g., Duxbury-Kingston-Plymouth Bays and Provincetown Harbor.

The blue ecotype is highly exposed with high energy waves and therefore with very little sediment. Such areas have rocky shores and are characterized with rockweed and kelp. Only one embayment, Rockport,

⁴ Generated by E&C Enviroscope

⁵ WHG tidal flushing study

which has a rocky intertidal shore, fell into this category.

3.2 Developing historic maps for estuarine habitats to inform Level 1 definitions

A BCG approach for MassBays requires an understanding of eelgrass habitat “as naturally occurs” or “minimally disturbed” habitat. The BCG tool can help managers better understand how an estuary (or group of estuaries) has changed over time, help establish a vision of a desired future for that estuary and inform the development of targets to achieve the vision (Figure 5). On the right of present time (2021) Figure 7 shows three possible future scenarios resulting from different levels of conservation and restoration. Using historic and present data, the BCG provides a comparison between past conditions and the present and provide the framework to craft a future vision that is based both on desired natural conditions and ecosystem benefits for communities whose wellbeing depend on them.

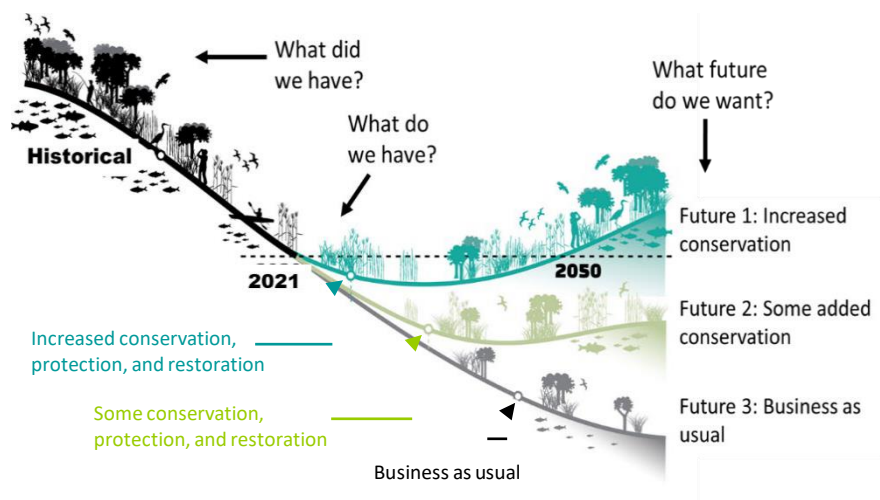


Figure 5. Diagram shows nature in the historic past (left, in black) degrading through the present time (2021). This models the BCG. Vector symbols in diagram courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science. ian.umces.edu/symbols/.

Recent maps and data on areal extent and habitat condition of eelgrass, salt marsh and tidal flats show that significant amounts of eelgrass and salt marsh have been lost from various embayments around MassBays because of changes in land use and land cover, increase in development and impervious surface, as well as changes in agricultural practices and impacts of climate change over time. The BCG tool shows what can be attained over time going forward under different scenarios: increased conservation and restoration, some conservation, or business as usual. Ultimately this depends on the capacity available and how invested communities are in a brighter future.

Method

Developing a Level 1 estimate for salt marsh and tidal flats in estuarine embayments

Historical data and maps were used to establish natural/minimally disturbed (Level 1) conditions which would then be compared to current conditions in each embayment. For MassBays, it was decided to use percent remaining habitat as the BCG metric (y-axis) against which to measure progress towards future targets. Scientists from USEPA ORD and OST examined numerous historic maps and documents, and conducted a rigorous process to compile historic data, interpret maps and navigational charts, and ultimately develop GIS shapefiles that depict the historic areal distribution of salt marsh and tidal flats across the MassBays region. Where there was no quantitative information, qualitative or descriptive analysis was used to describe Level 1 conditions.

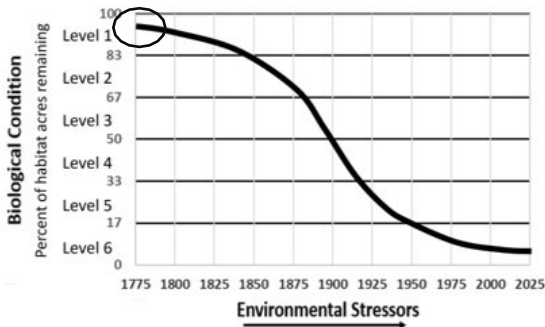


Figure 6. Draft Level 1 narratives for each eco- type based on biological potential and physical drivers (Figure above). Supplemented by historical ecological data (resources and stressors). An example Level 1 information from historical ecology research (Figure on the right).

“Cod, bass, mackerel, skate, herring, tomcod, eels and smelt were abundant. Resident Indians caught bass and other species with spears and arrows.” - A study of the marine resources of Plymouth, Kingston, and Duxbury Bay, MassDMF

“Prior to arrival of English colonists on the Lynn shores, Indians fished from canoes with bone fish hooks and hemp lines...At night, pine torches were carried to attract fish...Salmon were often speared from the rivers, and primitive nets of sticks tied together with strips of animal skins were used to catch salmon or trout... Early colonists in the Lynn area gathered mussels and clams as a source of food.” – A study of the marine resources of Lynn-Saugus Harbor, MassDMF

The oldest maps for the Boston area dated back to 1776 showing salt marsh, beaches, and flats. Sources of maps included Library of Congress, Boston Public Library, NOAA Historical Maps, and USGS Historical Topomaps. Larger scale Revolutionary War era maps were used for consistency among embayments, but quality declined with distance from Boston. Small scale Revolutionary War era maps for better mapping quality across Massachusetts were patched in. This resulted in better maps. However, Cape Cod was poorly mapped at the time, so 1877 U.S. Coastal Survey maps were patched in to include Cape Cod Bay. Revolutionary War era coastal maps cut off inland area for many marshes, so data on inland spatial extent of marshes are missing. Finally, a patchwork of spatial and temporal maps with acceptable map detail were used to best represent BCG Level 1 for salt marsh and tidal flats. These maps from 1775 served as a historical “reference point” where minimally disturbed conditions could be considered as the Level 1 for these habitats.

Not all the data from historical sources could be used as the mapping methods changed over the years and were subject to interpretation. In addition, substantial changes had taken place in certain areas and embayments, enough to render some of the data unusable. For example, most of the area around Boston Harbor that used to be tidal marsh was filled around the 1850s, so that the original marsh extent cannot be recovered. However, there were enough data to generate historic layers for salt marsh and tidal flats across most of MassBays area. In the case of eelgrass, however, comparable maps could not be generated.

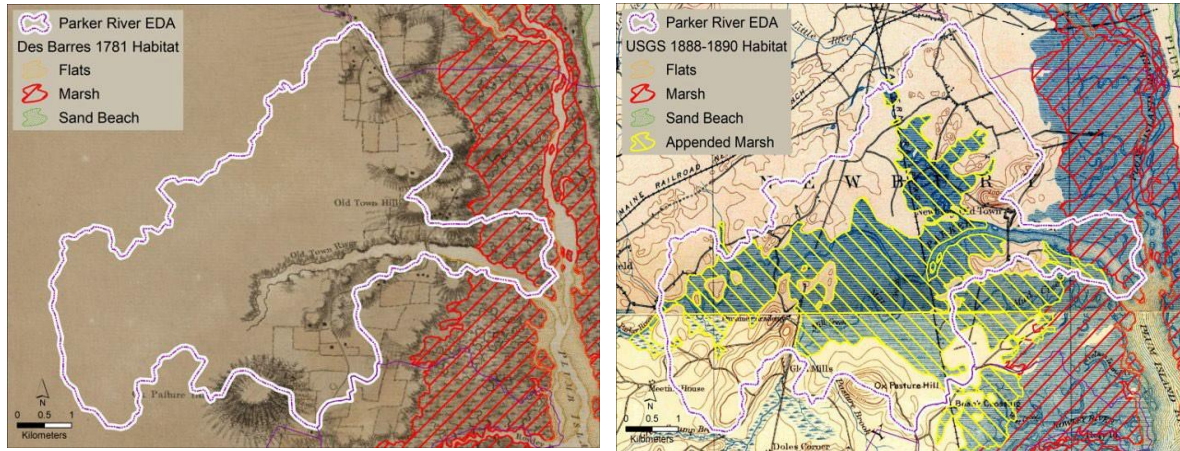


Figure 7. Revolutionary War era maps cut off inland area of many marshes (Left). Using maps from different eras resulted in a patchwork of maps over space and time.

The historical data were used to support Level 1 estimates for MassBays habitats which could represent the habitat “as naturally occurs” or “minimally disturbed”. Estimating habitat extent in MassBays prior to extensive anthropogenic influence was used to represent BCG “Level 1” and generate a more complete time series of habitat changes in MassBays to create context for further condition assessment and target-setting. Attaining a Level 1 may not be possible for many estuarine embayments within MassBays due to the substantial changes that have taken place over decades and centuries of development. Although estimating Level 1 conditions for the three habitats (salt marsh, tidal flats, and eelgrass) is essential to guide viable restoration efforts, long-term habitat restoration targets will not be set to Level 1 conditions (1775 levels for salt marsh and tidal flats) due to irreversible changes over time.

Developing a Level 1 estimate for eelgrass in estuarine embayments

As for salt marshes and tide flats, the BCG approach for MassBays requires an understanding of eelgrass habitat “as naturally occurs” or “minimally disturbed” habitat. The consensus among eelgrass scientists is that there are no existing eelgrass beds in MassBays that reflect these conditions. Over the years several attempts to estimate historical eelgrass extent and condition in Massachusetts to understand trends in loss and select potential restoration sites have not been successful (Colarusso et al., 2006). The oldest comprehensive, quantitative, survey-quality dataset characterizing eelgrass in Massachusetts is from 1995. An additional eelgrass coverage estimate exists from 1950s aerial photographs interpreted by the Massachusetts Department of Environmental Protection (MassDEP), but the data are not comparable to current survey-quality data although they may be useful for understanding eelgrass trends broadly. Nevertheless, estimating eelgrass extent in MassBays prior to extensive anthropogenic influence to represent “Level 1” for BCG is necessary to create a more complete time series that will provide context for further assessment and target-setting.

To develop a Level 1 estimate of eelgrass in MassBays, a habitat suitability approach was applied. Using available data representing current physical habitat conditions, expert judgment of eelgrass habitat requirements was applied to develop a model of eelgrass extent assuming little to no anthropogenic

disturbance. Key assumptions included: (1) current physical habitat conditions generally reflect Level 1 physical habitat conditions, and (2) eelgrass habitat requirements have not changed since historical times.

Table 4. Physical habitat variables and values used to model Level 1 eelgrass extent in MassBays.

Physical habitat data	Source	Range of suitable values	Notes
Depth	Continuous Bathymetry and Elevation Models of the Massachusetts Coastal Zone and Continental Shelf (ver. 3.0, December 2019)	Depth ranges by eco-type: <ul style="list-style-type: none"> • Yellow (low energy, abundant modern sediment, protected): 1.5 – 5.0m • Green (medium to high energy, abundant modern sediment, exposed): 1.5 – 5.0m • Orange (low to medium energy, little or no modern sediment, protected): 1.5 - 7.5m • Blue (high energy, little/no modern sediment, exposed): 1.5 - 7.5m 	MassBays STAC ²⁸ members advised that eelgrass would exist at different depths depending on the ecotype due to the influence of energy regime, sediment availability, and exposure on turbidity and light limitation.
Sediment type	Massachusetts CZM Surficial Sediment data 2020	All values suitable EXCEPT: <ul style="list-style-type: none"> • Very high confidence mud • Very high confidence rock 	Criteria used by MA Division of Marine Fisheries to develop an eelgrass restoration suitability model.
Exposure/fetch	Calculated aspect from: Continuous Bathymetry and Elevation Models of the MA Coastal Zone and Continental Shelf (ver. 3.0, Dec 2019)	All values suitable EXCEPT: <ul style="list-style-type: none"> • Areas with predominant (90th percentile within 100m moving window) northeast exposure • Areas with northeast exposure in Salisbury, Hull, Scituate to Plymouth 	Following guidance from STAC, areas with northeast exposure were eliminated from consideration as suitable habitat.

Results

Results showed that the habitat suitability model alone representing potential eelgrass habitat without anthropogenic influence (and before merging the 1950s and 1995 layers) predicted 37,338 acres of eelgrass across the estuarine embayments of MassBays. The model alone, moreover, was able to correctly predict the location and extent of 77-78% of eelgrass meadows from the 1950s and 1995 datasets. As expected, the model predicted far more eelgrass in places where none existed in either the 1950s or 1995 datasets, meaning that there was likely much more eelgrass in previous decades. When the habitat suitability model was merged with the 1950s and 1995 eelgrass layers to ensure that all existing and historical eelgrass meadows were included in the final Level 1 estimate, the total eelgrass area for historical MassBays was estimated at 41,218 acres. As is the case today, some of the largest beds were predicted to occur in Wellfleet Harbor, Provincetown Harbor, and the Kingston-Plymouth-Duxbury Bays complex.

Table 5. Comparison of habitat suitability model predictions with historical eelgrass datasets.

Layer	Acres correctly predicted	Acres missed	Excess acres predicted
1950s DEP	8,738 (77% of total)	2,565	26,035
1995 DEP	8,138 (78% of total)	2,289	26,910


Can eco-types predict historical habitat?

Historic data prior to settlement are very limited and therefore the oldest data from pre-industrial times are used in this study as a Level 1. Additionally, since there is not enough information on habitat extent to inform future suitability of an embayment to support a specific habitat(s), eco-types were developed to portray basic physical conditions that could potentially support estuarine habitats in embayments. The in-depth study of historical resources, including maps and literature, historical coastal habitat conditions were suitable to support the “natural” biotic communities that existed prior to human settlement and development in the 1600s. From this it can be deduced that:

- A mosaic of coastal habitats including saltmarsh, eelgrass, and tidal flats provided breeding and nursery habitat for a variety of fish, shellfish, birds, and other fauna.
- Coastal habitats existed under diverse physical environments (i.e., sediment, energy, and exposure regimes) such that as a whole they were resilient and adaptable to disturbance events such as storms.
- Coastal habitats had natural hydrology and connectedness with each other and with upland areas that also allowed for the migration and spawning of abundant anadromous fish populations.
- Water quality was unaffected by chemical contaminants, domestic animal waste, human waste, or urban and agricultural runoff.

Eco-type evaluation

Table 6. Acreage of habitat in each ecotype representing loss over time

	Eco-type	Marsh acres/km shoreline	Tidal flats acres/km shoreline	Length of shoreline (km)
	Yellow: low-energy, abundant modern sediment, protected	19.0 HIGH MARSH ACRE	5.6 LOW FLATS ACRES	1675
	Green: Medium- high-energy, abundant modern sediment, exposed	13.1 LOW MARSH ACRES	17.7 HIGH FLATS ACRES	404
	Orange: Low- to medium-energy, little/no modern sediment, protected	14.7 MID- ABUNDANCE OF MARSH AND FLATS ACRES	13.3	496
	All embayments	17.3	9.0	2575

Evidence shows that eco-types can accurately predict historic habitat acres. As can be seen from Table 6, eco-types can associate with distinct and explicable distribution of estuarine habitat.

Table 7. Key components specific to salt marsh habitats:

<p>MassBays (all ecotypes)</p>	<ul style="list-style-type: none"> • Natural hydrology and connectedness <ul style="list-style-type: none"> ○ No ditching or berms (microtopographic alterations) ○ No tidal restrictions (e.g., road and railroad crossings, no tide gates) ○ Natural pool/panne ratios ○ No stormwater/point/nonpoint source inputs (e.g., associated with road and railroad crossings) • Maintenance of high marsh habitat vegetation and natural vegetated/unvegetated ratio • No invasive species (e.g., Phragmites, purple loosestrife, etc.) • Natural undeveloped upland buffer • Ability to migrate upland – adaptation zones • Provides habitat <ul style="list-style-type: none"> ○ for breeding fauna (e.g., silversides, salt marsh sparrow, horseshoe crabs) ○ for species expanding ranges (this is more related to target-setting) ○ Nursery (e.g., winter flounder, horseshoe crab larvae, smelt, tomcod) • Presence of multi-host parasites • Robust macroinvertebrate community • Provides carbon storage • Buffers inland habitats against storm damage • Soil properties and organic content as naturally occurs • Intact marsh banks • Sediment source is present • Elevation capital • Connectivity with other habitats such as barrier beaches (which in-turn offer marsh protection)
<p>Yellow - Low-energy, abundant modern sediment, protected</p>	<p>Marshes are broad; extensive back barrier marshes and tidal creeks present</p>
<p>Orange - Low-to-medium-energy, little or no modern sediment, protected</p>	<p>Combination of broad and fringing marsh</p>
<p>Green - Medium- to-high-energy, abundant modern sediment, exposed</p>	<p>Marshes are fringing</p>
<p>Blue - High-energy, little, or no modern sediment, exposed embayments (with rel. low shallow water habitat area)</p>	<p>Marshes are fringing and may not be present</p>

Table 8. Key components specific to eelgrass habitats:

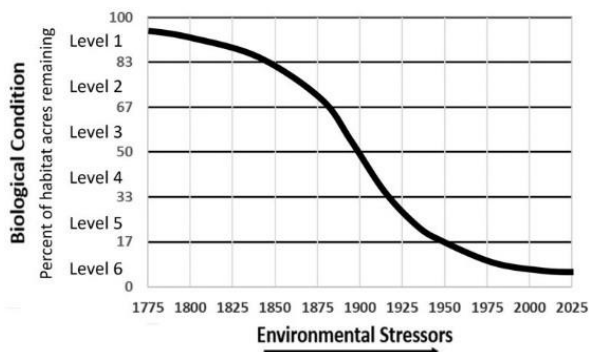
<p>MassBays (all ecotypes)</p>	<ul style="list-style-type: none"> • Shoot densities at or above 1000/m² • Eelgrass present in deeper (25-30'), clear water • Few epiphytes • Lush meadow • Continuous meadows in protected sites; patchy meadows in more exposed sites • Provide habitat for fish and other fauna
--------------------------------	---

Yellow - Low-energy, abundant modern sediment, protected	Eelgrass limited to shallows; more continuous meadows
Orange - Low-to-medium-energy, little or no modern sediment, protected	Eelgrass exists in deeper water; meadows are patchier
Green - Medium- to-high-energy, abundant modern sediment, exposed	Eelgrass meadows are patchier
Blue - High-energy, little or no modern sediment, exposed embayments (rel. low shallow water habitat area)	Eelgrass can exist in deeper water but may not be present

Table 9. Key components specific to tidal flat habitats:

MassBays (all ecotypes)	<ul style="list-style-type: none"> • Abundant shellfish • Diverse benthic faunal communities • Provide foraging area for migratory and resident birds • Habitat for fish • Natural water circulation and water depth (i.e., no dredging, extraction, and natural levels of erosion) • Sediments uncontaminated by metals, PCBs, and other toxic compounds • No invasive epifauna/flora • No adjacent or overhead structures such as docks, piers, aquaculture gear, derelict fishing gear • No bottom disturbance from fishing gears
Yellow - Low-energy, abundant modern sediment, protected	
Orange - Low-to-medium-energy, little or no modern sediment, protected	
Green - Medium- to-high-energy, abundant modern sediment, exposed	
Blue - High-energy, little or no modern sediment, exposed embayments (with relatively low shallow water habitat area)	

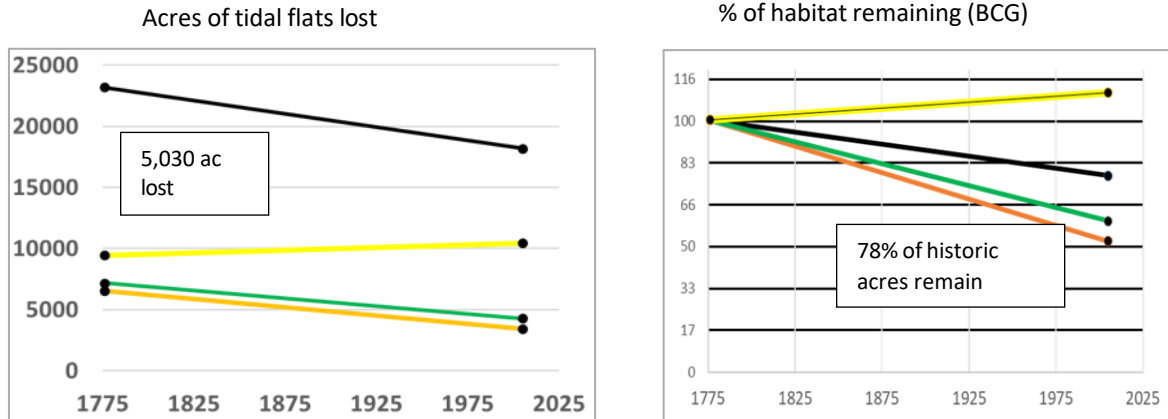
3.3 Developing BCGs for each eco-type



Using historic and current information of areal extent of salt marsh, eelgrass, and tidal flats, BCGs were developed for each habitat within each of the four eco-types. These preliminary results are shown graphically in Figures 9 and 10.

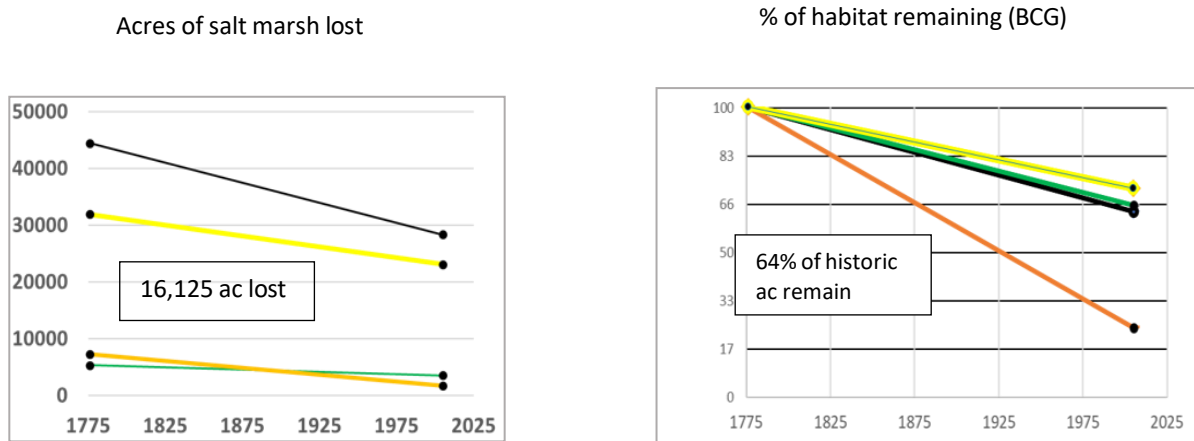
Figure 8. BCG levels as percent of acres remaining from level 1 undisturbed condition

Figure 9. Draft BCGs for Tidal Flats in each embayment eco-type



Shoreline % anthropogenic	Historic acres	Eco-types
5%	9500	Yellow-low energy, abundant modern sediment, protected
14%	7200	Green – medium-high energy, abundant modern sediment exposed
38%	6600	Orange – low-medium energy, little or no modern sediment
12%	23200	Black – All embayments

Figure 10. Draft BCGs for Salt marsh in each embayment eco-type



Shoreline % anthropogenic	Historic acres	Eco-types
5%	31900	Yellow-low energy, abundant modern sediment, protected
14%	5300	Green – medium-high energy, abundant modern sediment exposed
38%	7300	Orange – low-medium energy, little or no modern sediment
12%	44400	Black – All embayments

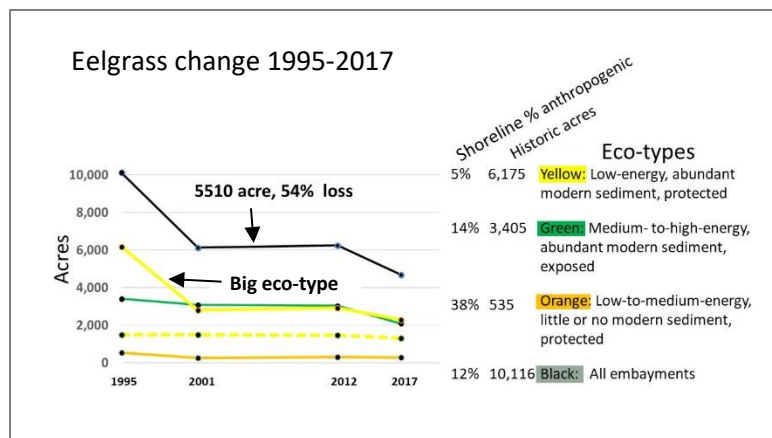


Figure 11. Eelgrass change from 1995-2017. Earlier “historic” data are not available across all MassBays, and a Level 1 definition was difficult to develop.

prolific in nearshore waters and estuaries. Between 1995-2017 it is estimated that over 54% of eelgrass was lost from all embayments taken together, and that estimate may be conservative based on the limitations of fixed-wing aerial surveys. The biggest losses occurred from the yellow eco-type embayments but the reasons why well protected embayments have suffered the biggest losses are still being investigated, although the amount of modern sediment and associated shoaling could play a role.

On the other hand, it was noted that the embayment that lost most eelgrass was Wellfleet Harbor, for a variety of reasons including nutrient discharge from septic systems. If the losses in Wellfleet Harbor were excluded from the calculations for all embayments, a different picture emerges. In this case, eelgrass loss across all embayments would make up 11% from 1995-2012, followed by a 23% loss after 2012-2017. It is also noted that between 1995-2017, the eelgrass stayed quite stable in embayments in the yellow eco-type. Wellfleet Harbor is a yellow eco-type embayment, which explains the big eelgrass loss from yellow eco-type embayments which actually offer the best conditions to support this habitat.

It is not all bad news however, as embayments within the Boston area as well as Provincetown Harbor gained substantial amounts of eelgrass over the past 25 years. In 1993 Provincetown became sewerred and since then it has gained 94 ac of eelgrass. Nearby, Pamet River gained 69 acres over the same period. Boston Harbor gained 34 acres, partly as a result of the relocation of the sewage outfall from the harbor out into Massachusetts Bays.

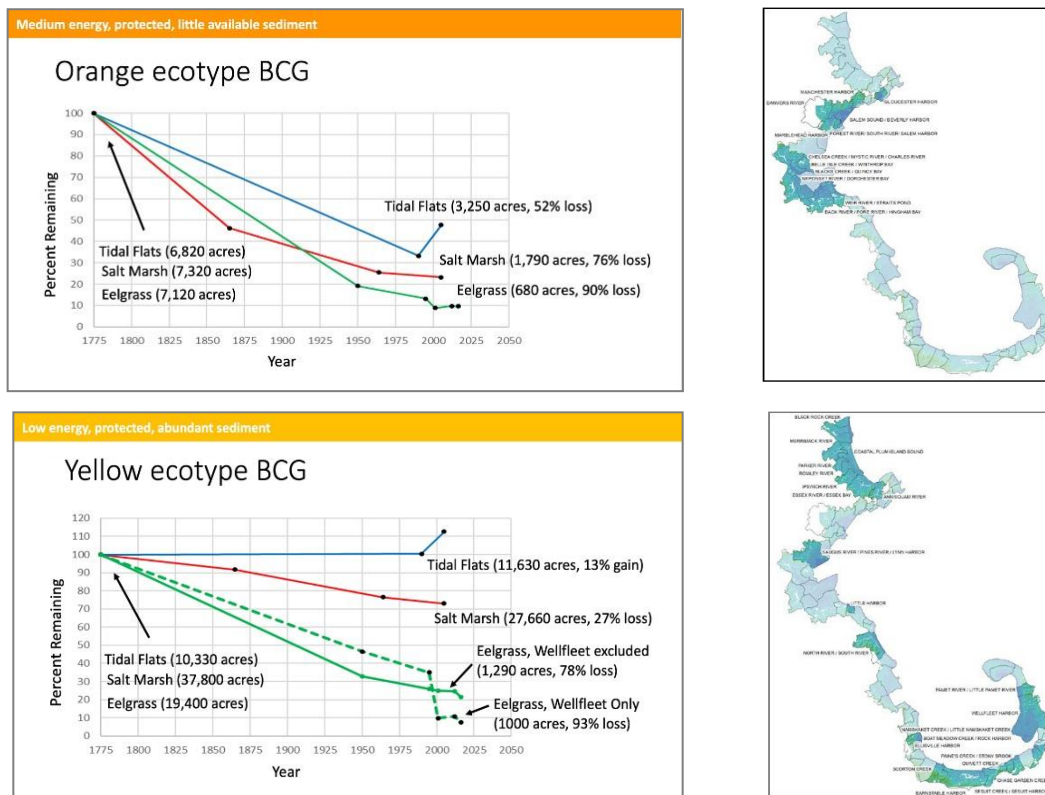
Table 10. Summary of habitat results and associated BCGs. MassBays lost significant acres of habitat.

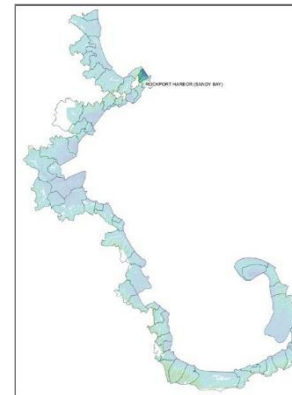
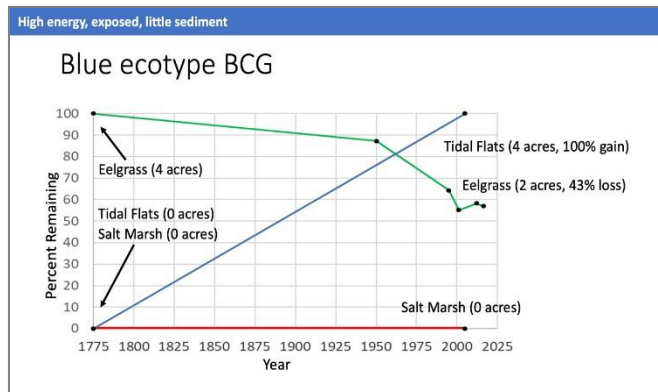
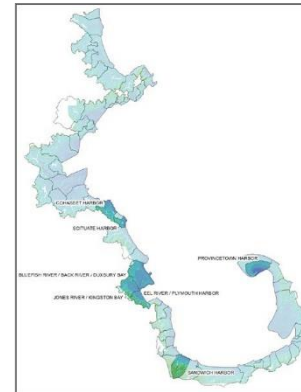
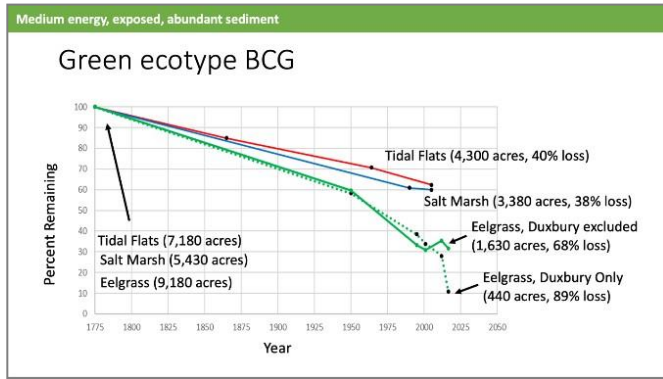
	Acres lost	% Lost	Data quality	
Salt marsh 1700s-2005	16125	36	Good	Significant losses will have occurred after 2005 with increasing stressors including Sea Level Rise, population density, nutrient pollution; new surveys are needed.
Tidal flats 1700s-2005	5030	22	Fair	
Eelgrass 1995-2017	5510	46	Excellent	Reflects huge seagrass loss in Wellfleet Harbor
Eelgrass 1995-2017 (Wellfleet excluded)	1827	33	Excellent	MassBays lost 33% of eelgrass over 22 yrs The rate of eelgrass loss from 2012 to 2017 was twice that of the previous 17 years.

As can be seen in Figure 12, a BCG was developed for the embayments within each eco-type. Despite the minimal historical information, it provided enough data points to generate BCGs that reflect conditions reviewed and confirmed by subject matter experts as well as by local stakeholders. From historical records, a “reference point” in 1775 was used for all three habitats. The maps and literature had more details about tidal flats and salt marshes. The most recent data points for these two habitats are from 2005 wetland maps (MassDEP). Although lots of work has been done on these habitats, especially on salt marshes, since that time, the MassDEP maps have not yet been updated. Therefore the “present” data point for these two habitats is 2005. In the case of eelgrass, the most reliable complete data set started in 1995. MassDEP also have converted 1950s data into maps. However, it was decided to use 1995 as the “reference point” and then scale back to 1775. On the other hand, in the case of eelgrass, data are still being regularly collected by various entities. The longest-term official datasets are the ones collected via MassDEP’s aerial surveys which take place about every 3 years.

Figure 12 served as the basis to start looking into the future based on historic and present rates of changes. The BCGs provide values for habitat loss, as well as present values and these numbers provide us with the opportunity to establish long-term future targets and based on the stressors lay the road for actions that need to be done to reach the targets. The next big step was to develop a target for each of the habitats (salt marsh, eelgrass, and tidal flats) for each of the four ecotypes.

Figure 12 a-d BCGs developed for each eco-type





3.4 Setting long-term targets for habitat restoration

The BCG tool uses the data input to help inform the establishment of potential long-term targets for each habitat type. Rather than set targets by embayment, it was decided to identify long-term targets for each habitat type by ecotype. Because embayments within each ecotype are similarly suited for supporting a specific habitat or habitats, an assumption was made that a specific habitat has the potential of being conserved, expanded and/or restored.

The habitat targets metrics are associated with either areal extent, or with condition of each habitat, or both. These are informed by the results of the BCGs using historical and current resource data as well as the stressors driving resource conditions. Targets also had to be ambitious but attainable, informed by the suitability of an embayment to support restoration (natural or manmade), the primary stressors, (including projected impacts of climate change), and the support of the community for improved future estuarine conditions. An understanding of the ecosystem benefits that these habitats provide and on which their livelihood depends will gain the support of local communities.

Each habitat type was assigned a long-term target (2050). The reason for establishing long-term targets is to allow for definition of a stressor through monitoring (e.g., stormwater runoff), preparation of design and management plans, obtaining funding needed to address the stressor/s, and importantly, allow adequate time for the ecosystem to respond following implementation. Because these targets are long-term, associated water quality, sediment, and biological metrics are selected to track progress through monitoring programs. MassBays CCMP is itself a long-term effort by design, acknowledging that achieving its goals will require flexible implementation and adaptive management over time, even while keeping to the goals of ecosystem health and human well-being.

Draft target numbers were identified using the results from historical assessment, current data, and resource-stressor clusters. The process of target setting was conducted with oversight from the STAC and input from various subject matter experts. During multiple meetings, STAC provided input on the proposed approach to develop target conditions, to discuss proposed targets, and to provide advice on studies and products that helped advance our thinking. MassBays and STAC established three subgroups, one each for eelgrass, salt marsh, and tidal flats, with subject matter experts to focus on and discuss specific including methods used, the data used to establish the targets and how the results were interpreted to develop targets. There was much discussion over whether targets could or should be established and what is the appropriate “reference point”, what constitutes an ideal eelgrass bed or healthy salt marsh, and how to take into consideration climate change impacts that may entail additional actions over the coming years.

The process of target setting was developed with local expert input. Regional coordinators provided expert guidance on how to apply the BCG framework and incorporate the concept of ecosystem services to communicate about targets in their communities. They also provided key information through their in-depth knowledge of the embayments within their region that helped provide a better understanding of the uniqueness of each embayment and helped refine the targets to address these differences.

Table 12 shows that for eelgrass, targets were selected to restore areal extent of eelgrass beds to the 1995 levels (the most historic year where we have statewide data in which we are confident). If there is no longer enough space to expand, focusing on improving the health of a habitat is also an important target. For example, saltmarsh surrounded by impervious surface may no longer have room to expand or migrate landward in the event of sea level rise. However, efforts can be dedicated to eliminating *Phragmites*, for example, by removing tidal restrictions, or transplanting to restore denser coverage, thereby improving the hydrology, and enhancing growth of native saltmarsh species. In this case, the target would be a “hold the line” approach for areal extent and improve condition in terms of health.

Table 12. 2050 estuarine habitat goal by eco-type

Ecotype	Habitat	Goal by 2050	Acres to restore/maintain	Associated ecosystem benefits
Green	Eelgrass	Increase acres, improve quality	2,040	<ul style="list-style-type: none"> Habitat for fish, birds, invertebrates Improved water quality Nitrogen uptake Carbon sequestration Shoreline protection & erosion control Aesthetics Shellfish production Food sources Recreational opportunities
	Salt Marsh	Maintain acreage, improve quality	2,800	
	Tidal flats	Maintain acreage, improve quality	4,060	
Yellow	Eelgrass	Increase acres, improve quality	4,560	
	Salt Marsh	Maintain acreage, improve quality	27,170	
	Tidal flats	Maintain acreage, improve quality	11,720	
Orange	Eelgrass	Increase acres, improve quality	10	
	Salt Marsh	Maintain acres, improve quality	1,730	
	Tidal flats	Maintain acres, improve quality	3,270	
Blue	Eelgrass	Maintain acreage, improve quality	2	
	Salt Marsh	Maintain acreage, improve quality	0	
	Tidal flats	Maintain acreage, improve quality	4	

Because habitat improvement is often a slow process, a set of associated metrics was developed by MassBays and OST to help track progress over the short term as management actions are put in place and implemented. For example, restoring eelgrass in an embayment may require the reduction of stormwater discharge. Planning, designing, and constructing stormwater BMPs may take several years (if funding is available), and post construction it may take some time for water clarity to be restored and for eelgrass to come back. Therefore, over time water quality improvements will be monitored by measuring this and other key metrics to keep track of progress towards the long-term targets.

4.0 Developing embayment resource-stressor clusters

Although the MassBays planning area has a diverse geomorphology, many embayments share similar resources and stressors. As such, management efforts may benefit from clustering embayments with similar attributes to achieve set targets (Hanley et al., 2021). For example, urban embayments tend to share similar stressors and natural resource conditions but may be very different from embayments in rural areas. However, it is important to note that even in embayments that have similar attributes, it may be easier to improve certain conditions (e.g., reduce stormwater) than others (e.g., reduce population density). Ultimately, it is the nature of the embayment system and the conditions of estuarine resources as well as the levels of specific anthropogenic stressors that enables the choice of restoration tools by resource managers to conserve and restore critical coastal embayments and the ecosystem benefits they provide.

This section describes how data from the EDA were used to identify similar clusters of embayments and subsequently try to identify the primary driving stressors impacting estuarine resources. The results will ultimately be used by managers in making decisions on which conservation or restoration actions to implement to address the stressor, improve conditions, and restore estuarine habitats.

Method

Embayment suitability for multivariate analysis

Using the 44 embayment assessment areas and a suite of embayment-level data, a series of analyses was conducted to: (1) characterize and develop clusters of embayments with similar estuarine resource conditions and stressor attribute levels, and (2) identify the stressor attribute(s) that are the strongest predictors of estuarine resource levels within each embayment.

This analysis was only applied to the 44 embayment assessment areas (Phase 1) but not to the inter-estuarine areas⁶. Additionally, not all the stressor and resource attributes initially used to characterize estuarine embayments were used in the analysis. Some attributes were excluded for specific reasons such as being dependent variables, while others were modified to fit into the analyses (Table 13). A detailed account of the rationale behind the decisions to make these adjustments is outside the scope of this document and is described in detail in the final report (Hanley et al., 2021).

⁶ Phase 2 will include analysis of all 65 assessment areas, including both embayment and inter-estuarine areas.

Table 13. Estuarine resources and anthropogenic stressors included in the statistical analysis (2020)

Estuarine Resources	Eelgrass, salt marsh (% shoreline length), salt marsh (areal extent), tidal flats, rocky intertidal (natural unhardenable shoreline), tidal flushing
Stressors	High-intensity land use, annual stormwater discharge, population density, % population using septic systems, 303(d) impairments estuaries (bacteria & nutrients), septic system use; CAPS tidal restrictions, shoreline hardened

The following method was applied by the Northeastern University team and is described in Hanley et al., 2021.

Using multivariate analyses, stressor and natural resource attributes for each embayment were aggregated into a single dataset. Principle component analysis (PCA) was used to analyze the data after it was transformed using Hellinger transformation R statistical analysis software⁷ (Oksanen et al., 2013). This transformation divides each value in a data matrix by the square root of its marginal sum of squares. A partitioning around medoids (PAM)⁸ approach was then applied using R⁹ to determine the appropriate number of clusters based on optimum average silhouette width (Hennig, 2013, in Hanley et al., 2021). PCA results were extracted and visualized graphically with clusters differentiated by color (Figure 13). The appropriate number of components to include was determined by visually inspecting the screen plot (e.g., the percentage of variance explained by each component) for a drop-off in explained variance (Hanley et al., 2021). This analysis resulted in four resource-stressor categories (R-S Categories) of embayments to inform MassBays and communities when applying different management strategies to improve habitat conditions (Figure 14).

Similarity percentages (SIMPER) analysis was implemented to determine the contribution of each variable (attribute) to the observed dissimilarity between clusters. A Bray-Curtis method was used on Hellinger transformed data. The results were used to propose potential target stressor and resource levels for each estuarine embayment.

Identify stressors that drive resource conditions for each embayment cluster

Regression tree analysis was used to determine which continuous stressor attributes are the most powerful predictors of select resource attributes. This univariate analysis explains variation in a response variable (resource attributes) using a select suite of explanatory variables (stressor attributes) by repeatedly partitioning data into increasingly homogeneous groups and maximizing homogeneity within and heterogeneity between the resulting subgroups (De'ath & Fabricius, 2000). The effect of the nine stressor attributes used in the PCA (hardened shoreline, high intensity land use, population density, annual stormwater discharge, % population using septic systems, septic system use, impairment for nutrients, impairment for bacteria, and CAPS tidal restriction) were applied to the five resource attributes (salt marsh shoreline, salt marsh areal extent, seagrass beds, tidal flats, and rocky intertidal shoreline). Details of the advantages of using regression trees and how these are interpreted are described in detail

⁷ Using the decostand procedure from the vegan package (R v. 3.4.3, R Core Team, 2016)

⁸ A mediod is defined as a cluster and the surrounding space with minimal average dissimilarity to all objects in the cluster.

⁹ Using pamk procedure from the fpc package (R v. 3.4.3, R Core Team, 2016)

in Hanley et al., 2021. *The full method is described in Hanley et al., 2021.*

Regression trees provide threshold values of the stressor attributes that are most powerful in predicting each resource attribute; the results, coupled with the PCA (and Bray Curtis) cluster results which defines ranges for each attribute for each cluster, provide the basis for threshold recommendations. Depending on the specific resource attribute (e.g., eelgrass extent), the regression tree results and accompanying cluster tables can be used to: 1) set realistic targets for habitat coverage (i.e., within the range of its cluster), 2) determine the stressors that are driving the health of the resource, and 3) define optimal or target stressor levels that correspond with greater resource extent or condition.

Results

The PCA and PAM analyses (Figure 13) described above identified four clusters of embayments. While the cluster analysis revealed that groups that include embayments that are proximal to each other are more likely to be in the same cluster, geography alone was a poor predictor of similarity in embayment characteristics. Although cluster 4, for instance, primarily included embayments in the metro Boston area – an unsurprising result given that region’s high population density and correspondingly higher levels of anthropogenic stressors – the other three clusters included embayments from across the entire MassBays region. Municipalities often tend to compare themselves to neighboring municipalities, but the multivariate method reveals that this approach may be misleading. Instead, by comparing embayments/ municipalities that cluster together based on quantitative stressor and resource attributes, local regulators can compare the characteristics of their embayments with those in the same category and apply the same management strategies to address stressors (Hanley et al., 2021). These results support the use of stressor and resource attributes rather than geography alone to compare and set realistic and achievable targets among similar embayments.

Table 14. Means and ranges of the four clusters of stressor and resource attributes.

	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Hardened Shoreline	62.41	(36.58-92.43)	9.93	(0.00-37.59)	9.75	(0.00-55.15)	51.55	(30.44-92.64)
High Intensity Land Use	44.32	(18.26-56.78)	23.75	(4.23-47.86)	28.83	(0.11-56.17)	65.33	(38.08-91.09)
Annual Stormwater Discharge	2.43	(0.19-8.43)	1.09	(0.16-2.10)	1.52	0.21-4.47)	1.42	(0.28-3.05)
Population Density	3.11	(0.80-5.91)	0.63	(0.27-0.98)	1.08	(0.20-2.53)	10.58	(2.00-19.48)
% Population Using Septic	50.68	(50.08-51.17)	82.87	(52.03-104.07)	58.97	(0.50-100.16)	1.12	(0.00-8.94)
Septic System Use	1.57	(0.41-2.96)	0.54	(0.23-1.02)	0.58	(0.07-1.26)	0.02	(0.00-0.18)
Nutrient Impairment 303(d)	0.00	(0.00-0.00)	2.18	(0.00-15.26)	1.90	(0.00-24.92)	0.00	(0.00-0.00)
Bacterial Impairment 303(d)	98.74	(96.75-99.76)	7.33	(0.00-12.84)	95.62	(65.44-100.00)	99.74	(98.12-100.00)
CAPS Tidal Restriction	0.00	(0.00-0.00)	10.74	(0.00-48.36)	25.81	(0.00-84.41)	48.83	(9.53-96.52)
Salt Marsh Shoreline	32.73	(0.00-59.79)	71.35	(38.03-100.00)	83.38	(51.85-100.00)	72.01	(40.29-95.20)
Salt Marsh Extent	19.03	(0.00-44.14)	46.15	(22.10-81.01)	32.14	(12.29-97.36)	18.08	(8.82-32.89)
Eelgrass	13.39	(0.77-27.44)	4.87	(0.00-15.14)	3.73	(0.00-27.54)	3.23	(0.00-11.19)
Tidal Flats	2.38	(0.00-8.92)	19.39	(0.00-42.90)	14.36	(0.12-49.43)	11.96	(0.00-33.07)
Unhardenable	19.77	(0.00-52.18)	10.76	(0.00-35.43)	9.03	(0.00-46.11)	6.02	(0.00-18.31)
Tidal Flushing	37.95	(10.2-70.5)	4.77	(1.40-11.30)	6.79	(2.90-15.00)	21.04	(9.00-38.10)

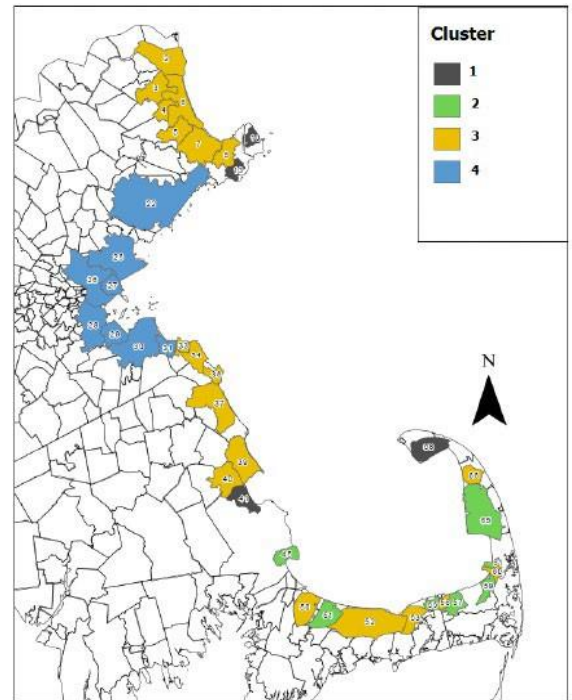
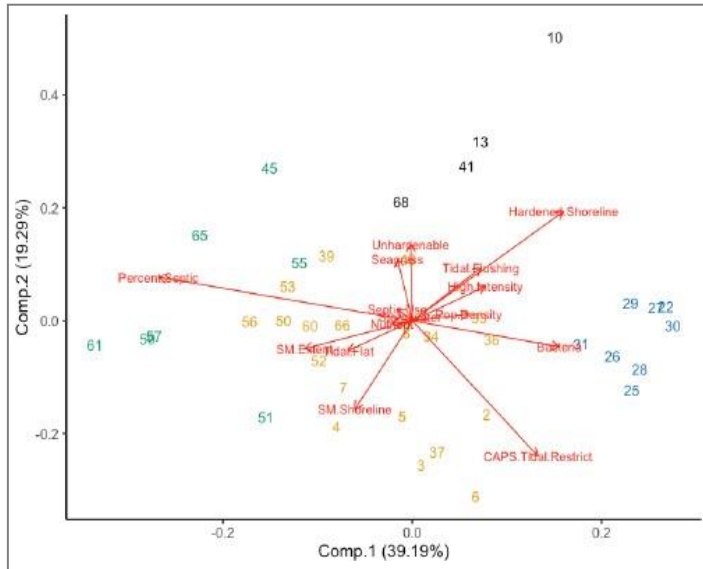


Figure 13. PCA splitting the embayments into 4 clusters based on combined stressor and resource attributed data. Numbers correspond to embayments (see Tables 4 & 5 in Hanley et al., 2021.) and colors correspond to clusters

Table 15. Main stressor drivers for each cluster

Cluster 1 – Salt marsh extent and tidal flat area	Cluster 2 – Hardened shoreline and seagrass extent	Cluster 3 – Salt marsh shoreline and impairment for nutrients	Cluster 4 – High intensity land use, mean pop. density, CAPS tidal restriction
High % population using septic systems and septic system use	Highest mean shoreline hardened	Highest impairment for nutrients (not significant)	High mean shoreline hardened
Low impairment for bacteria	High mean population density	High % of population using septic systems and septic system use	Highest mean high intensity land use
Low mean CAPS tidal restriction	High impairment for bacteria	High impairment for bacteria	Highest mean population density
Highest mean salt marsh extent	No impairment for nutrients	High mean CAPS tidal restriction	Low % of population using septic systems
High mean salt marsh shoreline	Low mean CAPS tidal restriction	Highest salt marsh shoreline	High impairment for bacteria
Highest mean tidal flat area	Lowest mean salt marsh shoreline	High saltmarsh extent	No impairment for nutrients
	Low salt marsh extent		Highest mean CAPS
	Highest mean eelgrass Lowest mean tidal flat		Low salt marsh extent

SIMPER analysis indicated that differences between cluster means were most often driven by a suite of stressor and resource attributes (Hanley et al., 2021). Highlights of results from analysis include:

- Mean shoreline hardened was significantly higher for embayments in Clusters 1 and 4 than in

Clusters 2 and 3 ($p < 0.05$ for all pairwise comparisons).

- Mean high intensity land use was highest for embayments in Cluster 4 but only Cluster 3 significantly differed from Cluster 4.
- In general, annual stormwater discharge differed relatively little between clusters, though this stressor attribute did differ between Clusters 1 and 2 ($p = 0.049$), and between Cluster 1 and 3 ($p = 0.049$).
- Mean population density was significantly higher for embayments in Cluster 4 than in Clusters 2 or 3, but not for Cluster 1.
- Both metrics of septic system use were significantly lower for embayments in Cluster 4 than embayments in the other clusters.
- No significant differences in mean impairment for nutrients were detected among clusters. Mean impairment for bacteria was universally high for Clusters 1, 3 and 4, all of which had significantly higher mean impairment for bacteria than Cluster 2.
- Mean CAPS tidal restriction was greatest for embayments in Cluster 4, which differed significantly from Clusters 1 and 2, but Cluster 3 did not.
- Mean salt marsh shoreline was significantly lower for embayments in Cluster 1 than in Clusters 2 and 3 but Cluster 4 did not differ significantly from the others. Salt marsh extent was significantly higher for embayments in Cluster 2 than in Clusters 1 and 4. However, Cluster 3, which has the second highest mean salt marsh extent, was not significantly different from the other clusters for this resource attribute.
- Mean seagrass (acres seagrass per acres open water < 10 m) was greater for Cluster 1.
- Mean tidal flat area (area tidal flats per acres open water < 5 m) was significantly greater for embayments in Cluster 2 than embayments in all other clusters.
- The proportion of natural, unhardenable shoreline (i.e., rocky intertidal, vertical escarpments, etc.) differed less among clusters than other resource attributes, with no significant differences among clusters ($p < 0.05$).
- Tidal flushing, differed among a subset of clusters, with embayments in Clusters 1 and 4 having generally higher rates of tidal flushing. Cluster 1 differed significantly from Clusters 2 and 3, but Cluster 4 did not.

As described in Hanley et al., 2021, the results provide insight into targets for the lower bounds of stressors and upper bounds of resources that might be achievable for embayments within a specific cluster. However, reducing levels to the lower bound within a cluster may be unrealistic given the range of competing demands within an embayment, and therefore using the mean or median for a stressor to be reduced may be a more realistic target. The analyses also provided insight into which major stressor levels impacted which resources most. For example, results indicated that salt marsh habitat is vulnerable to a variety of stressors, a primary predictor being population density, with higher densities (≥ 1.23 persons per acre) corresponding to lower salt marsh extent. In areas with lower population densities, CAPS tidal restriction was an important predictor of salt marsh extent: embayments with $< 0.73\%$ tidally restricted salt marsh had on average 28 more acres of salt marsh per km salt marsh shoreline than embayments with $\geq 0.73\%$ tidally restricted salt marsh. These results indicate the stressors that are most likely responsible for degradation of salt marsh habitat and suggest critical stressor thresholds for embayments experiencing higher levels of these stressors. These same considerations are true for setting targets for resource attributes (i.e., whether to aim for the upper bound vs. the mean or median). Given that several stressors may individually and cumulatively be contributing to declines in a resource attribute, achieving targets for

resource metrics may be even more challenging (Hanley et al., 2021).

Regression tree analysis was used to examine each resource attribute to determine the most predictive stressor attributes and their thresholds. Regression tree analyses of the potential drivers of differences in tidal flat, seagrass, and rocky intertidal habitat levels did not reveal any stressors that were strong predictors. The failure of regression tree analysis to identify critical thresholds of potential predictors could be a consequence of several factors discussed below. As mentioned above, results of multivariate analysis provided potential levels (e.g., lower bound, mean, or median) that could also be used to set targets for stressor attributes (Hanley et al., 2021).

General conclusions:

- geography alone is a poor predictor of stressor and resource levels in the MassBays region.
- results provide a potential realistic target for the lower bounds of stressors and upper bounds of resources that might be achievable for embayments within a given cluster.
- range of methods to set target: the lower bound of the range is the current lowest level within a cluster, and likely is the minimum level achievable for each stressor attribute. Because reducing levels to the lower bound within a cluster may be unrealistic given the range of competing demands within an embayment, the mean or median may be a more realistic target. These same considerations are true for setting targets for resource attributes
- 20% of shoreline hardened appears to be a critical threshold, above which both salt marsh shoreline and salt marsh extent decline precipitously
- in areas with low levels of shoreline hardening, septic system use was an important predictor of salt marsh shoreline loss
- realistic targets for habitat coverage = within the present range of its cluster.¹⁰

5.0 Ecosystem services of estuarine habitats

Improving habitat conditions is an exciting goal but getting the required buy-in and support from stakeholders often poses many challenges. Each of the three habitats (eelgrass, salt marsh and tidal flats) provides a suite of ecosystem attributes that sustain organisms within the ecosystem. These attributes also provide services that benefit the communities which depend on these habitats for their wellbeing. Therefore, communicating to local communities and stakeholders the ecosystem services and benefits provided by each habitat, and emphasizing that improved habitat conditions result in better ecosystem benefits is important to garner support from local communities for the protection, conservation, and restoration of vulnerable habitats. For example, ecosystem services provided by saltmarshes include clean water, food (shellfish and fish), recreational opportunities (birding, kayaking), economic benefits, and shoreline protection (buffering against waves).

This project went the next step to align consideration of benefits with ecosystem condition by developing a parallel Ecosystem Services Gradient (ESG) to: (1) identify priority ecosystem services associated with each habitat type, and (2) understand that ecosystem services improve with improved habitat conditions. The elements to this process are described in the following subsections: (1) applications of ESG to evaluate benefits of restoration (using an embayment in MassBays as an example), (2) assessment of how local stakeholders will prioritize restoration efforts based on ecosystem benefits they value most, (3) identifying beneficiaries and ecosystem services, and (4) linking the BCG and ESG as applied to MassBays estuarine

habitat targets. (1) and (2) will be briefly described in this document since they are both parts of ongoing projects and the details will be fully described through separate publications.

5.1 Applications of Ecosystem Service Gradient (ESG) to evaluate restoration benefits

As stated in the beginning of this document, the MassBays CCMP update includes setting restoration targets for coastal habitats that support sustainable ecosystem services for communities dependent on them. MassBays' vision includes sustainable ecosystems that support life and the communities dependent on them. As such, target setting will address not only "What kind of ecological future do we want?" but also "What kind of socio-economic future do we want?". An understanding of potential natural resource benefits of ecosystem restoration can help to communicate potential benefits of restoration in ways that motivate local support for implementation and provide a means toward measuring progress in ways that take into account local concerns (Yee et al., In press).

MassBays and EPA¹¹ collaborated to identify the top ecosystem services associated with the main habitats (eelgrass, salt marsh, tidal flats, and soon diadromous fish habitat) and that are related most closely to ecological conditions and socioeconomic interests in MassBays. The goal was to develop an approach to describe and quantify the delivery of critical ecosystem functions and services associated with desired beneficial uses and how they shift with ecological condition. ESG is a science-based descriptive model of ecosystem services production that measures response to changing environmental conditions and human beneficiary populations. Therefore, ESG is a tool that can help in identifying meaningful measures, defining reference points, communicating, and monitoring the relevant social and economic impacts of actions, and evaluating tradeoffs across multi-sector objectives.

The conceptual foundation for an ESG follows that of the BCG. As described previously, the BCG leverages expert knowledge and biomonitoring data to describe ecological condition along a gradient from undisturbed reference conditions to severely altered. Similarly, the ESG framework aims to create a framework, based on measurable ecologically important attributes, that can be used to describe the complete range of condition, provide a rational and consistent means for setting targets and actions to achieve them, and to communicate how delivery of ecosystem services varies either as the consequences of different management choices or along some other continuum, such as distance from the site. In this way, BCG and ESG are closely linked, and this link will be used in the development of habitat targets that are informed not only by the biology of the estuarine embayment and its ecosystem functions, but also by the ecosystem benefits that communities prioritize.

The ESG leverages a number of practical strategies for integrating ecosystem services into decision-making, including: prioritizing information and analysis to what is most important for a given area or decision, using the concept of final ecosystem goods and services (FEGS) to identify metrics that are unambiguous and directly relevant to human beneficiaries, applying ecosystem services production functions (EPFs) to link changing condition to changes in ecosystem services, understanding the range of potential outcomes, and considering tradeoffs across multiple objectives (Yee et al.,2020).

¹¹ Gulf Ecosystem Measurement and Modeling Division, Center for Environmental Measurement and Modeling, USEPA

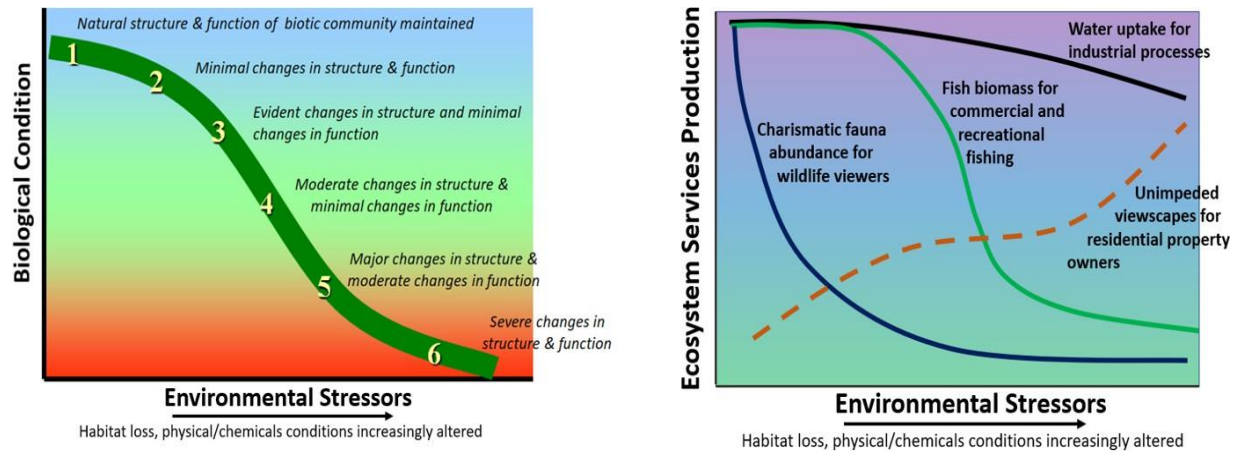


Figure 14. Figures showing relationship between BCG and ESG.

The ESG approach will help decision-makers to: 1) identify priority ecosystem services most relevant to local stakeholder needs, 2) understand current levels of ecosystem services provisioning by the habitat e.g., salt marsh, in comparison to potential or desired provisioning, 3) understand what levels of restored condition are needed to achieve desired levels of ecosystem services, and 4) compare potential benefits (or tradeoffs) across priority ecosystem services to facilitate choosing among alternative restoration options.

The goal for MassBays was to develop an ESG that can be integrated into decision-making for comparing restoration options (i.e., setting restoration targets, setting budget priorities, identifying metrics for monitoring to track restoration success). It is important to identify the ecosystem services associated with a particular habitat and at the same time identify the beneficiaries and stakeholder priorities. Once a set of prioritized ecosystem services are selected, development of the ESG can begin. Developing an ESG involves seven steps that are summarized in Table 16 and are currently being tested in the Belle Isle – Rumney Marsh – Chelsea complex.

Table 16

Ecosystem Services Gradient Steps	Process
1. What ecosystem goods & services (FEGS) are relevant?	Identify and prioritize FEGS with stakeholders.
2. How will we measure them?	Identify FEGS metrics and indicators, and the biophysical attributes that provide them.
3. What FEGS could we have?	Establish potential availability under a range of bio-physical conditions using historic data, reference sites, or ecological production function (EPF) models.
4. What FEGS do we have now?	Establish current availability using monitoring data, spatial maps, or EPF models.
5. What FEGS do we want?	Evaluate potential co-occurring benefits and tradeoffs at varying levels of restored condition or alternative restoration options
6. How do we get there?	Identify restoration activities such as habitat creation or stressor reduction to achieve desired levels of restored condition.
7. What are the social and economic consequences?	Conduct and communicate an optional benefits assessment using ecological benefit functions (EBFs) to translate ecosystem services supply into socio-economic, monetary, or human health and well-being benefits.

An essential first step is identifying key stakeholders and understanding what benefits are important to them. In evaluating variability in beneficial uses of estuarine habitats across coastal communities in MassBays, the final ecosystem goods and services (FEGS)¹² classification framework and related prioritization tool to identify users, or beneficiaries, of natural resources and the ecosystem services they care about, based on the relative frequency of mentions in over 1400 community planning documents (Yee et al., In Review).

This approach provided insight into the groups of people or stakeholders directly using or indirectly benefitting from the three estuarine habitats (eelgrass, salt marsh, and tidal flats), and allows for analysis of individual embayment communities to help support local restoration decisions, as well as those for estuarine embayments across the MassBays region.

Top beneficiaries included residents, viewers, property owners, educators and students, and commercial and recreational fishing. Top ecosystem services they care about included naturalness, fish and shellfish, water movement and navigability, water quality and quantity, viewsheds, availability of land for development, flood mitigation, and birds. Community-level priorities were primarily related to regional differences, the local job industry, and whether the community was predominantly a high minority urban area or retirement community. Priority ecosystem services identified from community planning documents provide a starting point for setting locally relevant restoration goals and targets, designing and implementing projects that reflect what stakeholders care about, and implementing post-restoration monitoring in terms of accruing benefits to local communities (Yee et al., In Review). A follow-up to these variables will include the EJ metrics that are becoming a priority in some MassBays communities.

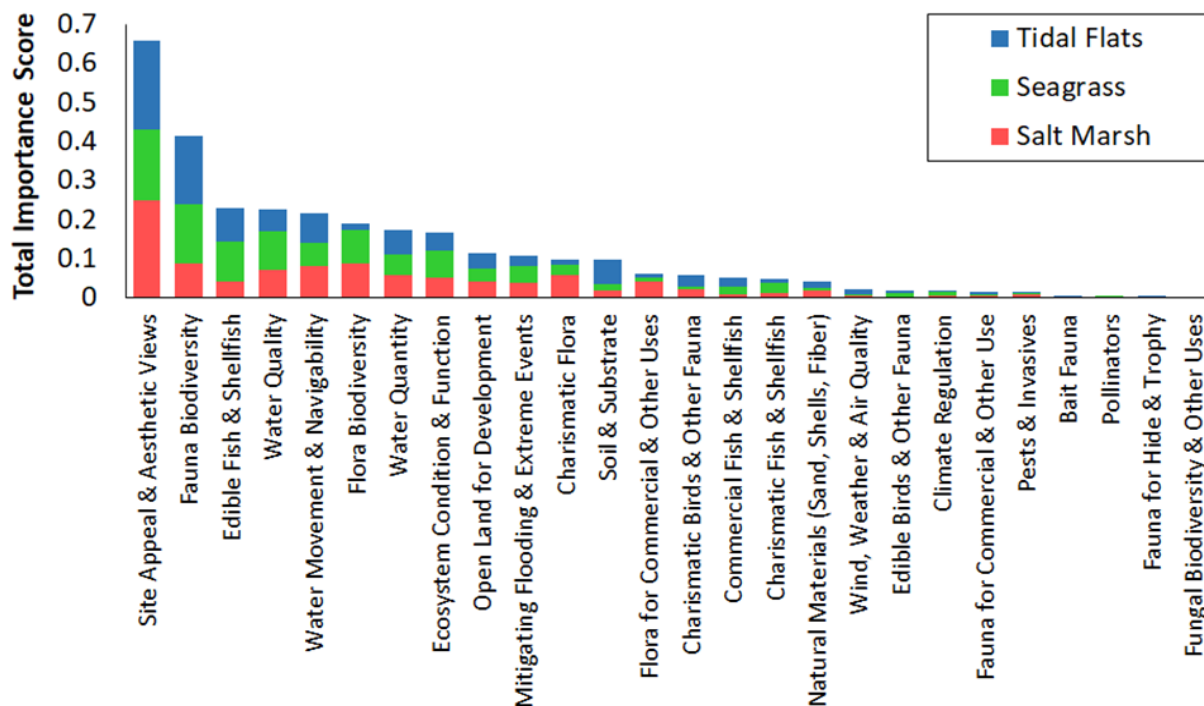
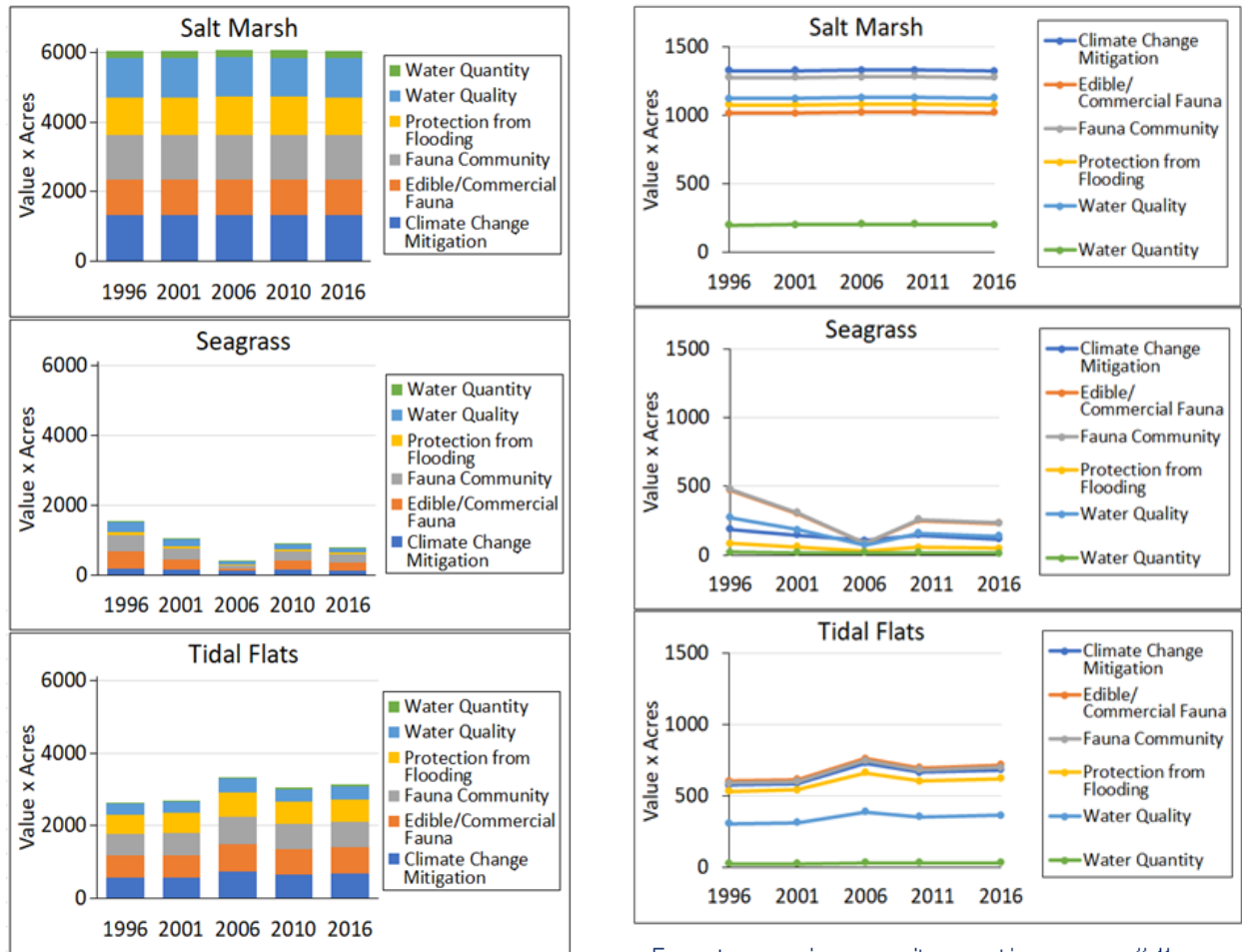


Figure 15. Document analysis provided the relative frequency with which beneficial uses and ecosystem service attributes were mentioned

¹² <https://www.epa.gov/eco-research/national-ecosystem-services-classification-system-nescs-plus>



Ecosystem services capacity over time across all Mass Bays embayments for the three focal ecosystems.

Ecosystem services capacity over time across all Mass Bays embayments for the three focal ecosystems.

Figure 16. Variation of ecosystem services capacity over time across 44 embayments for salt marsh, eelgrass, and tidal flats.

Overall, in the MassBays region salt marsh was the habitat making the most substantial and consistent contribution to ecosystem service capacity, particularly for climate change mitigation and fauna biodiversity. Over the last 20 years, eelgrass ecosystem service capacity showed the most significant declines, with edible fauna and fauna biodiversity being hardest hit (Yee et al., In Review).

This body of work supports productive discussions exploring historic losses, current potential, and the desired future that is critical for setting restoration targets for MassBays. As the work continues, the focus is shifting to identification and validation of metrics for monitoring restoration progress and applying the ESG process at local scales to prioritize restoration projects, support specific management decisions and to communicate and track the potential benefits of restoration to motivate projects and/or sustain long-term community and policymaker investment and support.

5.2 Exploring stakeholders' ecosystem services perceptions across MassBays region using a deliberative valuation approach

A key priority of this project was to gather information on ecosystem services that resonate with stakeholders that live around, work in, recreate or utilize MassBays estuaries. The project was designed and implemented in collaboration between MassBays and the University of Massachusetts Boston School for the Environment, to inform future outreach efforts. MassBays' question was: Do stakeholder prioritization of coastal ecosystem services vary with physical and demographic characteristics of the local ecosystem? (Lyon-Mackie et al., In review).

In December 2020 a unique series of workshops were held to identify priority ecosystem services associated with the three critical habitats based on local expert input. In this case, "stakeholders" were defined as representatives of sectors within the community that MassBays anticipates communicating with to promote project implementation – municipal staff, homeowners and real estate professionals, local environmental groups and stewards, and business associations. Four workshops were held, one for each of the four-embayment resource-stressor clusters described in Section 2.1 (Figure 4). A deliberative multicriteria evaluation approach was used: (1) to assess community-based values of four coastal ecosystem services, and (2) to explore spatial variability of group values along the MassBays coastline.

Four ecosystem services were selected that apply to eelgrass and salt marsh habitats. These included biodiversity (fish abundance), food availability and security (shellfish landings), coastal resilience (blue carbon), and clean water (water quality). Quantitative data came from individual survey results and group preferences, while qualitative data were derived through analysis of video recordings and transcripts of deliberations (LyonMackie et al., In Review). Stakeholders voiced their preferences for these ecosystem services based on a series of tradeoff analysis

The clusters of embayments used in the deliberative analysis take into account natural estuarine as well as anthropogenic similarities and differences across the embayments within their clusters. Knowing the anthropogenic stressors driving habitat conditions in these embayments will help practitioners and communities prioritize and meet their goals by guiding change and supporting work at the local level.

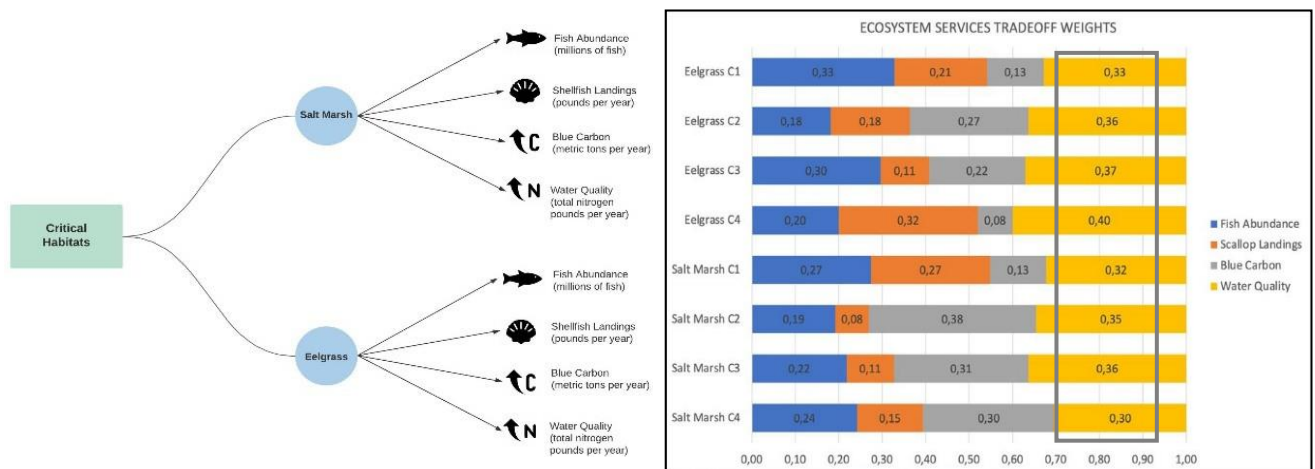
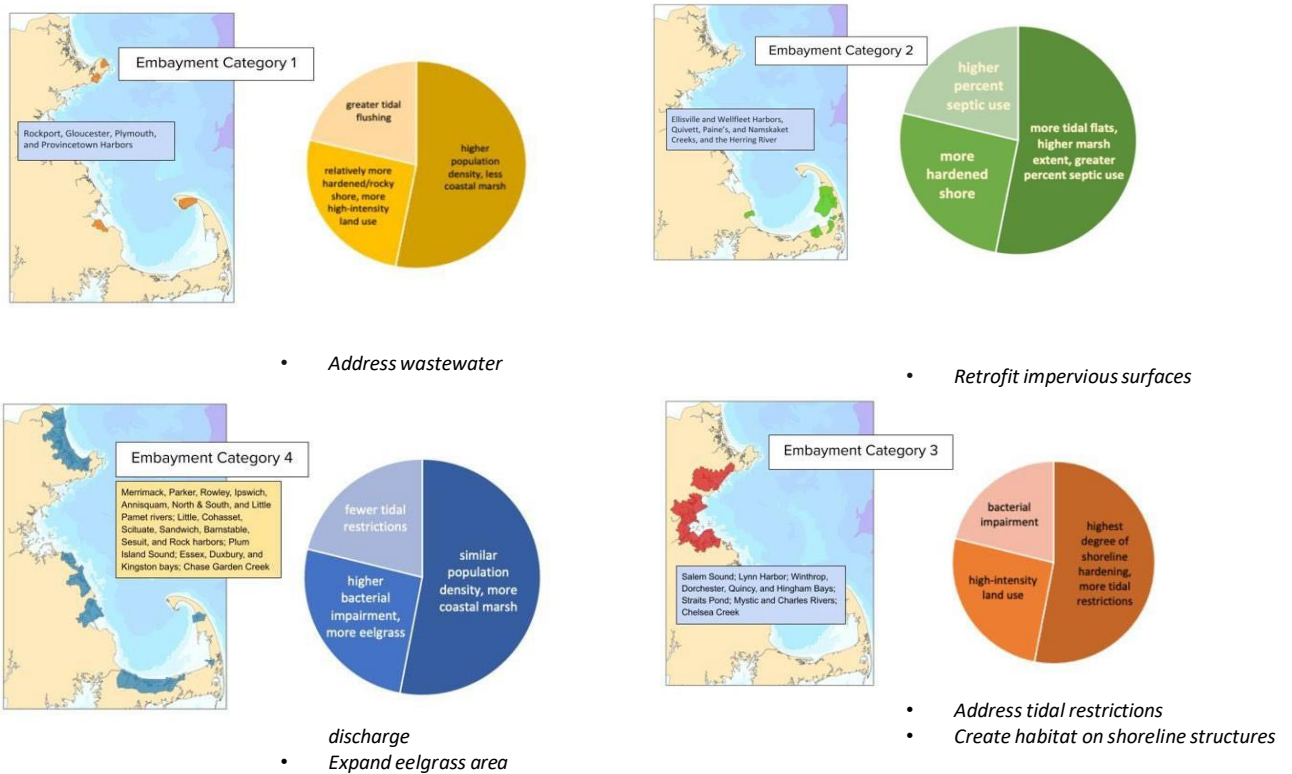


Figure 17: ecosystem services for critical habitats (Lyon-Mackie et al. *In review*)

Preliminary results

In this exercise, coastal stakeholders placed a particular emphasis on the need for access to clean water and services that provide direct economic benefits. Isolating the differences in the quantitative and qualitative results of these deliberative tasks between groups provided insight into the need for localized policymaking to complement and inform regional or statewide management. Policymakers and environmental managers will use these observations to address local values and priorities as we implement habitat restoration efforts (LyonMackie et al., In review).

Figure 18 Ecosystem services driving embayment categories



Similar local actions and strategies can be used in different embayments in a resource-stressor category. This will help facilitate management decisions and actions. For example, embayments in category four are characterized by extensive saltmarsh, varying eelgrass extent that is vulnerable to changing conditions, and fewer tidal restrictions. At the same time, habitat conditions are driven by higher bacterial impairments (e.g., due to septic systems). Local action to improve conditions would include addressing wastewater discharge, protecting marsh buffers, and working to expand eelgrass areas and restore eelgrass where it has been lost. In another example, embayments in category 3 are characterized by high bacteria impairment, high intensity land use and urbanization, higher degree of shoreline hardening and more tidal restrictions. Local action to be undertaken in these embayments includes retrofitting impervious surfaces, addressing tidal restrictions, and creating habitat on shoreline structures.

6.0 Communication strategies

The BCG-ESG process has been innovative and highly collaborative and has enabled MassBays to establish credible long-term habitat targets - by 2050, eelgrass must come back to 1995 levels while salt marsh and tidal flats will hold the line. A similar target will be established for diadromous fish habitat. In the interim years there is lots of work to be done, including prioritizing embayments and habitats and making decisions on what management actions need to be taken to improve water quality and ecosystem conditions and functions to progress towards these goals.

A key aspect is to develop a communication strategy that resonates with key stakeholders, documents the presence and value of the ecosystem services that these habitats offer, and builds their support to act. When communicating about the different options on how to improve our estuaries there are various strategies that can be used. For example:

- Restore the Balance (restore habitats to historic proportions)
- Bring Back What We Had (a time the public remembers as good)
- Hold the Line (no more loss, e.g., for salt marsh and tidal flats)
- Bring Back Our Benefits (prioritize ESG)
- Save Our Salt Marsh (prioritize a habitat)
- Restore Duxbury Bay (prioritize a place)

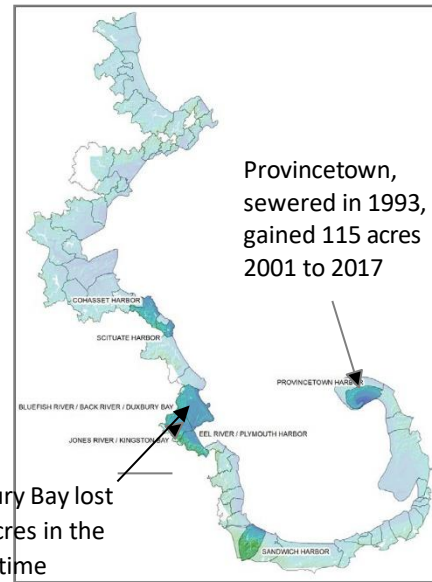
In the case of the long-term targets for MassBays, as described above, a consensus was reached to restore eelgrass to 1995 levels and to hold the line for salt marsh and tidal flats. Here are examples of what that may look like. Figure 20 is an example of prioritizing a place (Duxbury) and prioritizing a habitat (eelgrass). The strategy would focus on local actions at the embayment level by engaging the public and encouraging habitat protection or restoration by comparing Duxbury's status to a successful embayment (Provincetown).

Figure 19. Prioritize a place [Green Ecotype Strategy: Restore Duxbury Bay Eelgrass]

Eelgrass trends from 1995 (green) to 2016 (orange)



Duxbury eelgrass from 1995 to 2016:
 Lost 1120 ac (72%) in 21 yrs
 700 acres (38% of that) lost in last 4 years (2012-2016)
 Duxbury = 87% of green ecotype losses
 5 of 8 Green embayments lost < 10 acres or gained acres



Duxbury Bay lost 929 acres in the same time

Provincetown, sewered in 1993, gained 115 acres 2001 to 2017

The long-term targets are ambitious, and communities may feel overcome when thinking of all the money and work that needs to be done to restore eelgrass in an embayment, or even keeping an existing habitat such as salt marsh from losing more acreage or deteriorating in condition. In order to measure progress over the short- and medium term, MassBays intends to implement a monitoring program to measure interim progress towards the ultimate goal. As management actions are taking place to address issues such as discharge from land or sewerage, regular monitoring will capture step-by-step improvements necessary to achieve the ecosystem outcome and will encourage communities to maintain their support of the actions being taken at the community level.

MassBays has a monitoring framework that is intended to support and possibly enhance ongoing monitoring programs and help others start as needed. Importantly, MassBays has been working side by side with various groups to train them on QA/QC of their data and to upload their data to USEPA’s WQX where they may be shared by others. MassBays has also been working with citizen scientists by providing tech support for their monitoring programs and to seek funding, developing tools such as AquaQAPP (to develop QAPPs), the Ecohealth Tracking Tool (a data portal) and MassWaterR (to enhance their data to share with their audience, forthcoming), and developing initiatives such as the annual Eelgrass Blitz in Duxbury-Kingston-Plymouth bays to monitor eelgrass. All these tools are transferable and can be used by the 50 communities within MassBays

6.1 Tracking progress: The Ecohealth Tracking Tool

Because habitat improvement is often a slow process, associated metrics were identified to track progress over the short term as management actions are implemented. For example, restoring eelgrass in an embayment may require the reduction of stormwater discharge. Planning, designing, and constructing stormwater BMPs may take several years (once funding is available) and after construction it will take some time for water clarity to be restored and for eelgrass to come back. Therefore, a water quality

monitoring plan should be in place before the project starts and should be continued during and after the project is complete to measure progress towards long-term targets.

There are several monitoring programs that survey different embayments and that will provide much needed information to policymakers and environmental managers and practitioners to use to address local priorities as habitat restoration efforts are implemented. However, these datasets are not in one place.

To address this gap, in August 2022, MassBays launched a new interactive tool to track estuary health. The Ecohealth Tracking Tool¹³ provides a portal for the public, scientists, and policy makers to access coastal habitat and water quality data across the MassBays region. Users can check the status and trends of salt marshes, eelgrass meadows, tidal flats, and diadromous fish habitats (coming soon). Within each embayment, users can track progress toward MassBays goals for each habitat type. In addition, water quality data are available from hundreds of sampling stations, allowing users to access data (including bacteria, nutrients, temperature, and other parameters) from estuaries across the region. Water quality stations can be selected to view a time series of the data and to see if measurements are within healthy thresholds. The water quality data used in the tool are downloaded from USEPA's WQP.

It is important to mention that the tool will be adapted to incorporate new ecosystem services data and metrics, and this will be the next phase of the implementation. MassBays is exploring the possibility of using the tool to develop potential habitat indices which will serve to inform management decisions in restoration projects.

7.0 Next steps

There are many products that have emerged from the process of using the BCG to establish long-term habitat targets. Some products are complete and ready to be shared, some are still in process and will be forthcoming. Here is a list of products we have so far:

[MassBays National Estuary Partnership Data Exploration Tool](#) is a dashboard that provides access to multiple products that have been produced since the start of this work. This includes interactive dashboards where users can access different eco-types, habitats, resource-stressor clusters, and eventually the ecosystem services tool as well. The data exploration tool is mostly for use by MassBays, its regional coordinators to help in decision making in their regions, and by STAC.

[Ecohealth Tracking Tool](#) was released in August 2022 and presents water quality and habitat data where users can interact and access the data in their embayment of interest. It allows the user to look at progress towards targets as well as access water quality data. The ETT tool only shows data that have been uploaded to the WQP and is working with organizations to help them upload their data so that it can be used and included. This tool is available to the public.

[MassBays Assessment Areas](#) is a story map that shares resource and stressor datasets for all 65 assessment areas. This tool is available to the public.

The BCG process is an evolving process that will be updated and made adaptable to incorporate ecosystem services as well as update the resources and stressor datasets to keep managers informed with current data as management actions are implemented. Therefore, the following next steps will be

¹³ [MassBays Ecohealth Tracking Tool](#)

implemented over the next several months:

- 1) Develop a BCG for diadromous fish habitat
- 2) Expand the Ecohealth Tracking Tool to incorporate ecosystem services as part of the communication strategies.
- 3) Develop a Habitat Potential Index that will evaluate the “suitability” of a site, based on a set of criteria, for restoration of a habitat. This will help ensure that efforts are implemented where there is most need and more potential for success.
- 4) Implement the monitoring framework to track changes in water quality resulting from management actions, to track progress towards the long-term habitat targets.

References

- Andrews, B.D., Baldwin, W.E., Sampson, D.W., and Schwab, W.C. (2018) Continuous bathymetry and elevation models of the Massachusetts coastal zone and continental shelf (ver. 3.0, December 2019): U.S. Geological Survey data release. ([LINK](#))
- Beck, M.W., Brumbaugh, R.D., Airoidi, L., Carranza, A., Coen, L.D., Crawford, C., Defeo, O., Edgar, G., Hancock, B., Kay, M., Lenihan, H., Luckenbach, M., Toropova, C. & Zhang G. (2011) Oyster reefs at risk and recommendations for conservation, restoration and management. *BioScience*, 61, 107-116.
- Chandler, M., P. Colarusso and R. Buchsbaum (1996) A study of eelgrass beds in Boston Harbor and northern Massachusetts Bays. Report to the U.S. Environmental Protection Agency. 50pp.
- Davies, Susan P.; Jackson, Susan K. (2016): *The Biological Condition Gradient: A Descriptive Model for Interpreting Change In Aquatic Ecosystems*. Wiley. Collection.
<https://doi.org/10.6084/M9.Figshare.C.3293492.V1>
- De'ath, G. & Fabricius, K.E. (2000) Classification and regression trees: a powerful yet simple technique for ecological data analysis. *Ecology*, 81, 3178-3192.
- Geosyntec, 2017. Estuary Delineation and Assessment 2.0. Report to the MassBays National Estuary Partnership.
- Hanley, T. C., Baillie, C., Donelan, S., O'Donnell, K., Trussell, G., Villanueva, N., and Grabowski, J.H. (2021). [Estuary Delineation and Assessment 2.1](#). Report to the MassBays National Estuary Partnership.
- Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M.P., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R. & Watson, R. (2008) A global map of human impact on marine ecosystems. *Science*, 319, 948-952.
- Hennig, C. (2013) fpc: Flexible procedures for clustering. R package version 2.1-5.
- Jackson, J.B.C., Kirby, M.X., Berger, W.H., Bjorndal, K.A., Botsford, L.W., Bourque, B.J., Bradbury, R.H., Cooke, R., Erlandson, J., Estes, J.A., Hughes, T.P., Kidwell, S., Lange, C.B., Lenihan, H.S., Pandolfi, J.M., Peterson, C.H., Steneck, R.S., Tegner, M.J. & Warner, R.R. (2001) Historical overfishing and the recent collapse of coastal ecosystems. *Science*, 293, 629-638.
- Lyon-Mackie, J., Vella, P., DiBona, P., Shehab-Sehovic, N., Roche, S., Kreiley, A.I., and Mavrommati, G. In Review. Exploring stakeholders' ecosystem services perceptions across Massachusetts Bays using deliberative valuation.
- Oksanen, J., Blanchet, F.G., Kindt, R., Legendre, P., Minchin, P.R., O'Hara, R., Simpson, G.L. Solymos, P., Stevens, M.H.H. & Wagner, H. (2013) Package 'vegan'. Community ecology package, version 2.
- Sharpe, L.M., C.L. Hernandez, C.A. Jackson. 2020. Prioritizing stakeholders, beneficiaries, and environmental attributes: A tool for ecosystem-based management. In. T.G. O'Higgins, M. Lago, T.H. DeWitt (Eds.) *Ecosystem-Based Management, Ecosystem Services, and Aquatic Biodiversity*. Springer,

Switzerland.

Sharpe, L.M. (2021) FEGS Scoping Tool User Manual. U.S. Environmental Protection Agency, Gulf Breeze, FL, EPA/600/X-21/104.

Sharpe, L.M. In Review. Applications of the Final Ecosystem Goods and Services Community Scoping Tool for environmental decision making.

USEPA, 2016. [A Practitioner's Guide to the Biological Condition gradient: A Framework to Describe Incremental Change in Aquatic Ecosystems](#). EPA-842-R-16-001. U.S. Environmental Protection Agency, Washington, DC.

Yee, S., G. Cicchetti, T.H. DeWitt, M.C. Harwell, S.K. Jackson, M. Pryor, K. Rocha, D.L. Santavy, L. Sharpe, E. Shumchenia. (2020). The Ecosystem Services Gradient: A Descriptive Model for Identifying Levels of Meaningful Change. Chapter 15 In: O'Higgins T, Lago M, DeWitt T (eds) Ecosystem-Based Management, Ecosystem Services and Aquatic Biodiversity. Springer, Cham. https://doi.org/10.1007/978-3-030-45843-0_15

Yee, S., Sharpe, L., Branoff, B., Jackson, C., Cicchetti, G., Jackson, S., Pryor, M. and Shumchenia, E. In Review. Beneficial Uses of National Estuary Program Habitats for Communities along the Massachusetts Coast, USA.

Appendix B. 2003 CCMP Action Items

1. Protecting Public Health

- 1.1. Establish a central clearinghouse program for all beach testing and closure information generated for Massachusetts' coastal public beaches

2. Protecting and Enhancing Shellfish Resources

- 2.1. Conduct three Sanitary Survey Training Sessions annually -- one each on the North Shore, Metro Boston/South Shore, and Cape Cod -- to educate local shellfish constables and health officers on the proper techniques for identifying and evaluating pathogen inputs into shellfish harvesting areas
- 2.2. Develop and administer a local Shellfish Management Grants Program to help communities finance the development and implementation of effective local shellfish management plans
- 2.3. Continue and expand the Shellfish Bed Restoration Program to restore and protect shellfish beds impacted by nonpoint source pollution
- 2.4. Through the Shellfish Clean Water Initiative (SCWI), complete an Interagency Agreement to define agency roles and contributions to protect shellfish resources from pollution sources

3. Protecting and Enhancing Coastal Habitat

- 3.1. Prepare and implement an EOEA - approved Open Space Plan to preserve and protect key wetlands, floodplains, fish and wildlife habitat, and other ecologically- and recreationally-important natural resource areas
- 3.2. Adopt and implement a local Riverfront District Bylaw to maintain river water quality, preserve fish and wildlife habitat, and protect downstream nursery and shellfish resources
- 3.3. Work cooperatively with neighboring communities, EOEA agencies, and other interested parties to develop proactive, long-term ACEC Management Plans to preserve and protect these vital resource areas
- 3.4. Adopt and implement a local Wetlands Protection Bylaw to supplement the state Wetlands Protection Act Regulations
- 3.5. Prepare and implement ecosystem-based Barrier Beach Management Plans to promote responsible use and protection of these critical coastal resources
- 3.6. Employ full-time, professionally trained conservation staff to provide ongoing technical and administrative support to local Conservation Commissions
- 3.7. Continue to develop Resource Management Plans for all DCR-owned coastal properties
- 3.8. Develop and promote the use of river basin planning reports to facilitate responsible water resources planning and management at the local and regional levels
- 3.9. Acquire and restore undeveloped coastal properties that offer outstanding living resources habitat and public recreation opportunities
- 3.10. Complete the statewide inventorying and mapping of coastal and inland wetlands, and provide local Conservation Commissions with 1) accurate base maps depicting wetland boundaries, and 2) instruction on proper wetland map interpretation and use

- 3.11. In collaboration with the Riverways Program, prepare an up-to-date inventory of anadromous fish runs in the Massachusetts Bays region and develop a strategy to prioritize, restore, and maintain these runs
- 3.12. In collaboration with the Riverways Program, develop and implement a citizen based Fishway Stewardship Program to restore and maintain anadromous fish runs along the Massachusetts Bays coast
- 3.13. Continue the Wetlands Restoration Program to restore and protect degraded coastal and inland wetlands
- 3.14. Continue and expand current efforts to support eelgrass habitat protection and restoration in Massachusetts and Cape Cod Bays
- 3.15. Work with CZM to develop scientific methods for assessing the ecological integrity of coastal wetlands and to train volunteers in data collection

4. Reducing and Preventing Stormwater Pollution

- 4.1. Adopt subdivision regulations that require the incorporation of stormwater runoff best management practices (BMPs) into all new development plans
- 4.2. Implement best management practices to mitigate existing stormwater discharges that are causing or contributing to the closure of shellfish harvesting areas and swimming beaches
- 4.3. In collaboration with Regional Planning Agencies, Natural Resources Conservation Service/MassCAP (formerly US Soil Conservation Service), and Massachusetts Coastal Zone Management Office, should: 1) disseminate its Nonpoint Source Management Manual and Urban Best Management Practices for Massachusetts, and 2) sponsor public workshops to educate local officials about best management practices and performance standards for controlling stormwater runoff
- 4.4. Develop a coordinated and streamlined regulatory system within DEP to assure effective implementation of the stormwater components of the Massachusetts Clean Water Act, Wetlands Protection Act, and Federal Stormwater Program (Federal Clean Water Act, Sections 401 and 402)
- 4.5. Reduce stormwater pollution in the Massachusetts Bays watersheds through: (a) technical assistance to communities in developing comprehensive stormwater management programs; and (b) National Pollutant Discharge Elimination System (NPDES) compliance for industrial stormwater dischargers Targeted areas are the lower Charles River for the stormwater management programs and the Neponset River for the industrial stormwater dischargers
- 4.6. Prepare an Environmental Manual to complement the Highway Design Manual and provide for the integration of environmental concerns (including stormwater management) into all phases of highway project planning, design, construction, and maintenance
- 4.7. As part of its forthcoming pollution prevention plan, develop a Stormwater Pollution Mitigation Program to identify, prioritize, and correct existing stormwater pollution problems associated with state highway drainage facilities
- 4.8. Sponsor annual workshops to train local public works personnel on the proper use of stormwater runoff best management practices
- 4.9. Require the use of on-site stormwater best management practices as a precondition to the permitting of private property tie-ins to state drainage facilities
- 4.10. Develop and implement stormwater management plans for compliance with Phase II NPDES regulations

- 4.11. Provide technical assistance for developing and implementing non-structural Best Management Practices, support efforts to create local stormwater utilities, provide grant writing support to municipalities for implementing the stormwater policy, Phase II requirements, and resource protection efforts, and support the efforts of DEP and CZM to revise and update the stormwater policy

5. Reducing and Preventing Toxic Pollution

- 5.1. Adopt and implement the following set of regulations to ensure the safe use, storage, and disposal of toxic and hazardous materials: 1) Toxic and Hazardous Materials Regulation, 2) Underground Storage Tank Regulation, 3) Commercial/Industrial Floor Drain Regulation
- 5.2. Establish Household Hazardous Waste Collection Programs for difficult-to-manage hazardous products to ensure their proper disposal on a regular basis
- 5.3. In collaboration with the Department of Environmental Protection, develop and offer continuing education courses on hazardous materials management to create a pool of trained "HazMat Specialists" at the local level
- 5.4. Form partnerships to facilitate the safe management of hazardous products, emphasizing reduced products use and recycling wherever possible
- 5.5. Reduce and prevent toxic pollution through targeted National Pollutant Discharge Elimination System (NPDES) permitting of significant discharges in the Massachusetts Bays; in particular, oil tank farms on Chelsea Creek and the Island End River
- 5.6. Continue to perform on-site assessments and provide instructional materials to help businesses and industries in the Massachusetts Bays region reduce the use of toxic substances

6. Reducing and Preventing Oil Pollution

- 6.1. Establish and promote the use of Used Motor Oil Collection Facilities to ensure the proper collection and disposal of used motor oil from do-it-yourself oil changes
- 6.2. In collaboration with the US Coast Guard, EPA, and NOAA, implement the Policy on the Use of Oil Spill Chemical Countermeasures (Dispersants) to protect coastal resources from the adverse effects of oil spills
- 6.3. In collaboration with other federal, state, and local agencies, continue to update and implement the Massachusetts coastwide Area Contingency Plans to assure a rapid and effective response to discharges of oil and other hazardous substances into the marine environment

7. Managing Municipal Wastewater

- 7.1. In collaboration with other state and federal agencies, continue to implement the Ocean Sanctuaries Act by closely monitoring all facilities plans which propose increased wastewater treatment plant discharges into an ocean sanctuary
- 7.2. Support the control of combined sewer overflows in the Massachusetts Bays watersheds, especially the lower Charles River, and target National Pollutant Discharge Elimination Systems (NPDES) permitting to implement technology and water quality-based requirements in the Merrimack River watershed
- 7.3. Work collaboratively to develop and implement an effective program for monitoring and enforcing point source discharges from wastewater treatment plants and energy-producing facilities

- 7.4. In cooperation with UMass, EOE, CZM, and MBP, analyze and determine the Total Maximum Daily Loads (TMDLs) of nitrogen for coastal embayments and develop management plans for wastewater treatment facilities to adapt to these new standards
- 7.5. Identify resource areas sensitive to wastewater and develop management plans appropriate to these areas, focusing on the capacities of natural systems to assimilate wastewater
- 7.6. In cooperation with DEP, develop and implement regular inspection and maintenance (I/M) programs for on-site wastewater systems
- 7.7. Employ full-time, professionally trained public health staff to provide ongoing technical and administrative support to the local Boards of Health
- 7.8. Establish a Title 5 and alternative systems technical assistance program directed to local Boards of Health and health agents, systems engineers/ installers, and homeowners
- 7.9. Evaluate and build upon the centralized statewide repository for testing information on alternative technologies, to be established as part of the Buzzards Bay Project's two-year Environmental Technology Initiative Project
- 7.10. Plan for decentralized wastewater management and treatment

8. Managing Boat Wastes and Marine Pollution

- 8.1. Work cooperatively with neighboring communities, private boatyards and marinas, and state agencies (DFG and CZM) to establish, promote, and maintain Boat Pumpout Programs in targeted embayment areas
- 8.2. With assistance from CZM and DEP, require private boatyards and marinas to implement effective stormwater runoff control strategies which include the use of pollution prevention measures and the proper design and maintenance of hull servicing areas

9. Managing Dredging and Dredged Materials Disposal

- 9.1. Continue to monitor dredged material disposal sites in the Massachusetts Bays region and initiate the planning necessary to begin a capping demonstration project at the Massachusetts Bay Disposal Site
- 9.2. Coordinate the development of a comprehensive Dredging and Dredged Materials Disposal Plan to improve and maintain access to the Commonwealth's ports, harbors, and channels, and to minimize adverse impacts to the marine environment

10. Reducing Marine Debris and Marine Floatables

- 10.1. Work cooperatively with the Massachusetts Coastal Zone Management Office (CZM), neighboring communities, and waterfront users to design and implement Beach and Marine Debris Reduction Programs

11. Protecting Nitrogen Sensitive Embayments

- 11.1. Strengthen Massachusetts Water Quality Standards to enhance and protect nitrogen-sensitive coastal embayments
- 11.2. Work collaboratively to expand upon current Massachusetts Bays Program efforts to identify nitrogen-sensitive embayments, determine critical loading rates, and recommend actions to manage nitrogen to prevent or reduce excessive nitrogen loading to coastal waters and groundwater

12. Enhancing Public Access and the Working Waterfront

- 12.1. Develop and implement Municipal Harbor Plans which: 1) promote marine-dependent waterfront uses, 2) enhance public access to the water, and 3) protect habitat of shellfish and other living resources
- 12.2. Enhance the Designated Port Area (DPA) program with new planning and promotional initiatives
- 12.3. Establish a new technical assistance program to accelerate municipal efforts to identify and legally reclaim historic rights-of-way to the sea
- 12.4. In collaboration with the Department of Conservation and Recreation and MassGIS, prepare and distribute a statewide Coastal Access Guide to facilitate public access to the shoreline
- 12.5. In collaboration with coastal municipalities, develop and implement an Access-Via-Trails program to enhance public access along the coast

13. Planning for a Shifting Shoreline

- 13.1. Adopt and implement strict development/ redevelopment standards within FEMA A and V flood hazard zones and other areas subject to coastal flooding, erosion, and relative sea level rise
- 13.2. Continue to assist communities in the development of effective Floodplain Management Regulations

14. Managing Local Land Use and Growth

- 14.1. Develop and implement Local Comprehensive Plans (LSPS) which: 1) direct development into areas in the community capable of absorbing the impacts of growth and its associated facilities, and 2) preserve and protect the community's important natural resources
- 14.2. Adopt local bylaws and ordinances that promote open space preservation and natural resource protection
- 14.3. Work with the Massachusetts Highway Department and other transportation agencies to ensure that facilities and infrastructure do not endanger sensitive resource areas
- 14.4. Work with EOEa and the Massachusetts Bays Program to assist communities in creating Community Development Plans
- 14.5. Work with EOEa to provide local support and expertise to communities on the Community Preservation Act and facilitate regional links and networking among neighboring communities
- 14.6. Provide technical assistance to municipalities to adopt and implement plans and bylaws that promote open space preservation and natural resource protection
- 14.7. Support Conservation Commission Networks (Con Com Networks) in the coastal region by providing technical and management assistance

15. Enhancing Public Education and Participation

- 15.1. In collaboration with the Executive Office of Environmental Affairs, continue to develop and integrate environmental education as an important component of the curriculum in the public schools of the Commonwealth, making broad use of the Benchmarks for Environmental Education developed by the Secretaries' Advisory Group on Education (SAGEE)
- 15.2. Continue to work closely with the Department of Education through the Secretaries' Advisory Group on Environmental Education (SAGEE) in order to develop a strategy for the

implementation of the "Benchmarks for Environmental Education" Further, EOEa should continue to place a priority on the role of environmental education and provide adequate staffing to ensure that appropriate state leadership is maintained

- 15.3. In cooperation with the Department of Education, continue to develop a grant relationship with the National Science Foundation and other funding agencies in order to provide technological outreach aimed at enhancing environmental literacy. The goal is to make resource and curriculum materials widely accessible and to provide ongoing coordination among the various members of the education community. The Massachusetts Bays Program represents an important aspect of the total environmental picture and should play a key role in this effort, helping to establish a unified voice to speak for environmental education concerning the Bays region
- 15.4. Empower exemplary teachers, administrators, and/or schools, who demonstrate the competence, to carry out formal and non-formal environmental education initiatives that complement the Commonwealth's environmental education programs
- 15.5. Continue and expand its current efforts to build a community of educators who can ably teach about and promote the protection of the Massachusetts Bays, their shores, and watersheds
- 15.6. Continue to serve as a vehicle for bringing information to and from the government on environmental issues affecting the Bays, with a particular emphasis on proposed projects or regulatory changes
- 15.7. Continue to provide a public forum for the exchange of information and ideas on CCMP development and implementation among the Bays' business community and resource users
- 15.8. Continue to offer undergraduate marine science and policy courses; and, through the bi-annual Massachusetts Marine Environment Symposium, bring together diverse marine interests to promote a better understanding of marine policy issues
- 15.9. Develop and maintain a clearinghouse of NPS education, information, and technical assistance materials, as well as a database of available state NPS materials and programs
- 15.10. Develop and maintain a matrix, by topic, of NPS education, information, and technical assistance materials produced by state agencies and associated organizations
- 15.11. Expand upon Massachusetts Bays Program efforts and develop a strategy for NPS outreach and technical assistance statewide that would coordinate the development and production of NPS education, information, and technical assistance materials, and provide technical assistance in order to implement NPS pollution controls

16. Preventing Marine Invasive Species

- 16.1. In collaboration with the MBP, work with other state agencies and partners to develop a public education program on marine invasive species
- 16.2. Coordinate with managers and scientists to develop a monitoring strategy for marine invasive species and periodically conduct rapid assessment surveys in coastal resource areas for the presence of marine invasive species
- 16.3. Work with CZM, MIT Sea Grant, and other parties to develop a monitoring and industry education strategy for pathways for marine invasive species

17. Monitoring the Marine Environment

- 17.1. In coordination with the MBP, DMF, DEP, BBP, and university scientists, coordinate on the design and implementation of a marine monitoring plan

- 17.2. Work with the MBP and the BBP to develop and produce a State of the Coast report
- 17.3. Coordinate with the CZM and the MBP on the implementation of the state and federal Beaches Bills

Appendix C. Progress and Accomplishments, 2003 through 2018 [legal-size pages]

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
1.1	Establish a central clearinghouse program for all beach testing and closure information generated for Massachusetts' coastal public beaches	Department of Public Health	substantial	completed	DPH presented results from their database at the 2015 SOTB Symposium.
2.1	Conduct three Sanitary Survey Training Sessions annually -- one each on the North Shore, Metro Boston/South Shore, and Cape Cod -- to educate local shellfish constables and health officers on the proper techniques for identifying and evaluating pathogen inputs into shellfish harvesting areas	Division of Marine Fisheries	full	discontinued/ deemed obsolete	DMF conducts sanitary surveys on each growing area every 12 years. DMF states (https://www.mass.gov/service-details/learn-about-shellfish-sanitation) that "areas also must have an evaluation every three years along with an annual review," but no information about training is provided.
2.2	Develop and administer a local Shellfish Management Grants Program to help communities finance the development and implementation of effective local shellfish management plans	Division of Marine Fisheries	substantial	discontinued/ deemed obsolete	last mention on mass.gov was 1999
2.3	Continue and expand the Shellfish Bed Restoration Program to restore and protect shellfish beds impacted by nonpoint source pollution	MassBays (with DMF, MACD, NRCS)	moderate	discontinued/ deemed obsolete	MassBays 1997 fact sheet states "while most SBRP projects are still in the early...stages" encouraging early successes included: Scituate BOH enforcement order that opened 400ac in Cohasset Harbor; Quincy installed a tide gate at Wollaston Beach and replaced sewer pipes; MassBays trained citizens to collect "reliable shellfish bed pollution data." A SBR Coordinator was hired in 1998; subsequent activities included sewer upgrades in Duxbury. A 2000 report states "There are no cheap, quick fixes to shellfish bed restoration remaining in the [MassBays] area."
2.4	Through the Shellfish Clean Water Initiative (SCWI), complete an Interagency Agreement to define agency roles and contributions to protect shellfish resources from pollution sources	Office of Coastal Zone Management	new		no evidence of this named program online
3.1	Prepare and implement an EOE - approved Open Space Plan to preserve and protect key wetlands, floodplains, fish and wildlife habitat, and other ecologically- and recreationally important natural resource areas	Municipalities	substantial	ongoing	EEA's Division of Conservation Services keeps a status list of Open Space and Recreation Plans, but the website version is dated June 2014
3.2	Adopt and implement a local Riverfront District Bylaw to maintain river water quality, preserve fish and wildlife habitat, and protect downstream nursery and shellfish resources	Municipalities	substantial	completed	implemented statewide via the Rivers Protection Act
3.3	Work cooperatively with neighboring communities, EOE agencies, and other interested parties to develop proactive, long-term Areas of Critical Environmental Concern Management Plans to preserve and protect these vital resource areas	Municipalities	some	ongoing	per ACEC website

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
3.4	Adopt and implement a local Wetlands Protection Bylaw to supplement the state Wetlands Protection Act Regulations	Municipalities	substantial	completed	per MACC, 2006
3.5	Prepare and implement ecosystem-based Barrier Beach Management Plans to promote responsible use and protection of these critical coastal resources	Municipalities	moderate	discontinued/ deemed obsolete	No progress (other than delineation) reported since the publication of Guidelines for Barrier Beach Management in 1994. (http://www.mass.gov/eea/docs/czm/stormsmart/beaches/barrier-beach-guidelines.pdf)
3.6	Employ full-time, professionally trained conservation staff to provide ongoing technical and administrative support to local Conservation Commissions	Municipalities	moderate	ongoing	Over 100 Commissions have permanent full-time employees, many of whom are conservation professionals providing invaluable support to volunteer Commissioners. More than half of Conservation Commissions have some level of staffing.
3.7	Continue to develop Resource Management Plans for all DCR-owned coastal properties	Department of Conservation and Recreation	substantial	ongoing	As of June 2015, 18 sites management plans have been adopted, two of those are coastal properties. Two additional coastal property plans are in development as of 1/16
3.8	Develop and promote the use of river basin planning reports to facilitate responsible water resources planning and management at the local and regional levels	Department of Conservation and Recreation	some	completed	DEP and DCR direct and consult with municipalities to develop comprehensive water resource management plans, required for SRF funding and other state assistance.
3.9	Acquire and restore undeveloped coastal properties that offer outstanding living resources habitat and public recreation opportunities	Department of Conservation and Recreation	some	ongoing	Land trusts and other nonprofits continue to acquire coastal properties; CZM is advising re: facilitating salt marsh migration due to sea level rise.
3.10	Complete the statewide inventorying and mapping of coastal and inland wetlands, and provide local Conservation Commissions with 1) accurate base maps depicting wetland boundaries, and 2) instruction on proper wetland map interpretation and use	Department of Environmental Protection	substantial	completed	http://maps.massgis.state.ma.us/images/dep/omv/wetviewer.htm
3.11	In collaboration with the Riverways Program, prepare an up-to-date inventory of anadromous fish runs in the Massachusetts Bays region and develop a strategy to prioritize, restore, and maintain these runs	Department of Fish and Game	substantial	completed	http://www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/anadromous-fish-restoration.html
3.12	In collaboration with the Riverways Program, develop and implement a citizen based Fishway Stewardship Program to restore and maintain anadromous fish runs along the Massachusetts Bays coast	Department of Fish and Game	substantial	ongoing	Division of Marine Fisheries maintains fish migration data collected by volunteers. MassBays funded the establishment of the River Herring Network (riverherringnetwork.com).
3.13	Continue the Wetlands Restoration Program to restore and protect degraded coastal and inland wetlands	Executive Office of Energy and Environmental Affairs	substantial	ongoing	Corporate Wetlands Restoration Program works primarily with the Division of Ecological Restoration.
3.14	Continue and expand current efforts to support eelgrass habitat protection and restoration in Massachusetts and Cape Cod Bays	U.S. EPA, National Marine Fisheries Service, U.S. Army Corps of Engineers	substantial	ongoing	ongoing, see conservation mooring implementation, 2014 ACOE GP
3.15	Work with CZM to develop scientific methods for assessing the ecological integrity of coastal wetlands and to train volunteers in data collection	MassBays National Estuary Program	new	ongoing	program sits with CZM, MassBays RSPs participate

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
4.1	Adopt subdivision regulations that require the incorporation of stormwater runoff best management practices (BMPs) into all new development plans	Municipalities	some	completed	Nearly all Massachusetts municipalities must document the application of BMPs for stormwater under MS4 permits.
4.2	Implement best management practices to mitigate existing stormwater discharges that are causing or contributing to the closure of shellfish harvesting areas and swimming beaches	Municipalities	moderate	ongoing	some slow-down due to delay in MS4 permitting
4.3	In collaboration with Regional Planning Agencies, Natural Resources Conservation Service/MassCAP (formerly US Soil Conservation Service), and Massachusetts Coastal Zone Management Office, should: 1) disseminate its Nonpoint Source Management Manual and Urban Best Management Practices for Massachusetts, and 2) sponsor public workshops to educate local officials about best management practices and performance standards for controlling stormwater runoff	Department of Environmental Protection	substantial	ongoing	CZM is launching a new initiative with the MS4 permit
4.4	Develop a coordinated and streamlined regulatory system within DEP to assure effective implementation of the stormwater components of the Massachusetts Clean Water Act, Wetlands Protection Act, and Federal Stormwater Program (Federal Clean Water Act, Sections 401 and 402)	Department of Environmental Protection	substantial	unknown	
4.5	Reduce stormwater pollution in the Massachusetts Bays watersheds through: (a) technical assistance to communities in developing comprehensive stormwater management programs; and (b) National Pollutant Discharge Elimination System (NPDES) compliance for industrial stormwater dischargers Targeted areas are the lower Charles River for the stormwater management programs and the Neponset River for the industrial stormwater dischargers	U.S. Environmental Protection Agency	substantial	completed	EPA has shifted its focus to other rivers, e.g., Mystic; industrial discharges are subject to the 2015 Industrial Stormwater Multisector General Permit. (https://www.epa.gov/npdes/final-2015-msgp-documents)
4.6	Prepare an Environmental Manual to complement the Highway Design Manual and provide for the integration of environmental concerns (including stormwater management) into all phases of highway project planning, design, construction, and maintenance	Department of Transportation	some	ongoing	MassDOT Environmental Services Division in place, annual reporting to EPA re: NPDES permit compliance is up-to-date (http://www.massdot.state.ma.us/highway/Departments/EnvironmentalServices/StormwaterManagementUnit/NationalPollutantDischargeEliminationSystem.aspx). 2006 Project Development and Design Guide (http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/ProjectDevelopmentDesignGuide.aspx) includes runoff and drainage aspects (Chapter 8), but do not appear to be applied consistently.
4.7	As part of its forthcoming pollution prevention plan, develop a Stormwater Pollution Mitigation Program to identify, prioritize, and correct existing stormwater pollution problems associated with state highway drainage facilities	Department of Transportation	moderate	completed	sustainability plan published 2006, implemented by MassDOT Environmental Services Division's Environmental Management Systems and Sustainability Unit

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
4.8	Sponsor annual workshops to train local public works personnel on the proper use of stormwater runoff best management practices	Department of Transportation and Department of Conservation and Recreation	substantial	ongoing	via Bay State Roads
4.9	Require the use of on-site stormwater best management practices as a precondition to the permitting of private property tie-ins to state drainage facilities	Department of Transportation	some	completed	http://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/ma/reports/2012/MassDOT12.pdf
4.10	Develop and implement stormwater management plans for compliance with Phase II NPDES regulations	Municipalities	new	ongoing	updated MS4 permit in draft form
4.11	Provide technical assistance for developing and implementing non-structural Best Management Practices, support efforts to create local stormwater utilities, provide grant writing support to municipalities for implementing the stormwater policy, Phase II requirements, and resource protection efforts, and support the efforts of DEP and CZM to revise and update the stormwater policy	MassBays National Estuary Program	new	ongoing	
5.1	Adopt and implement the following set of regulations to ensure the safe use, storage, and disposal of toxic and hazardous materials: 1) Toxic and Hazardous Materials Regulation, 2) Underground Storage Tank Regulation, 3) Commercial/Industrial Floor Drain Regulation	Municipalities	substantial	unknown	
5.2	Establish Household Hazardous Waste Collection Programs for difficult-to-manage hazardous products to ensure their proper disposal on a regular basis	Municipalities	substantial	completed	
5.3	In collaboration with the Department of Environmental Protection, develop and offer continuing education courses on hazardous materials management to create a pool of trained "HazMat Specialists" at the local level	Department of Education	some	ongoing	online resources hosted by DEP
5.4	Form partnerships to facilitate the safe management of hazardous products, emphasizing reduced products use and recycling wherever possible	Executive Office of Environmental Affairs	substantial	ongoing	program funding reduced
5.5	Reduce and prevent toxic pollution through targeted National Pollutant Discharge Elimination System (NPDES) permitting of significant discharges in the Massachusetts Bays; in particular, oil tank farms on Chelsea Creek and the Island End River	U.S. Environmental Protection Agency	full	completed	per http://www.epa.gov/region1/npdes/mass.html
5.6	Continue to perform on-site assessments and provide instructional materials to help businesses and industries in the Massachusetts Bays region reduce the use of toxic substances	Office of Toxics Use Reduction	substantial	ongoing	ongoing

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
6.1	Establish and promote the use of Used Motor Oil Collection Facilities to ensure the proper collection and disposal of used motor oil from do-it-yourself oil changes	Municipalities	substantial	completed	point-of-sale return, municipal drop-off
6.2	In collaboration with the US Coast Guard, EPA, and NOAA, implement the Policy on the Use of Oil Spill Chemical Countermeasures (Dispersants) to protect coastal resources from the adverse effects of oil spills	Department of Environmental Protection	full	completed	SPCC plans required
6.3	In collaboration with other federal, state, and local agencies, continue to update and implement the Massachusetts coastwide Area Contingency Plans to assure a rapid and effective response to discharges of oil and other hazardous substances into the marine environment	U.S. Coast Guard	substantial	completed	uploaded 4/2014 to http://www.mass.gov/eea/agencies/massdep/cleanup/regulations/massachusetts-contingency-plan.html
7.1	In collaboration with other state and federal agencies, continue to implement the Ocean Sanctuaries Act by closely monitoring all facilities plans which propose increased wastewater treatment plant discharges into an ocean sanctuary	Department of Conservation and Recreation	substantial	ongoing	addressed through Ocean Planning
7.2	Support the control of combined sewer overflows in the Massachusetts Bays watersheds, especially the lower Charles River, and target National Pollutant Discharge Elimination Systems (NPDES) permitting to implement technology and water quality-based requirements in the Merrimack River watershed	U.S. Environmental Protection Agency	full	completed	Reduction of CSO in Charles River 1998-present from 1742 million gallons to 13 million gallons. Completion (Dec 2015) of construction under the MWRA's Long-Term Control Plan reduced total CSO discharge volume in a typical rainfall year by approximately 88%. Nearly all (93%) of the remaining discharge volume is treated at MWRA's 4 CSO treatment facilities. See http://www.mwra.com/annual/csoar/2015/2015csoar-r3.pdf
7.3	Work collaboratively to develop and implement an effective program for monitoring and enforcing point source discharges from wastewater treatment plants and energy-producing facilities	U.S. Environmental Protection Agency, Executive Office of Energy and Environmental Affairs, Department of Environmental Protection, and Office of Coastal Zone Management	moderate	ongoing	Monitoring under NPDES permits is consistent.
7.4	In cooperation with UMass, EOEA, CZM, and MassBays, analyze and determine the Total Maximum Daily Loads (TMDLs) of nitrogen for coastal embayments and develop management plans for wastewater treatment facilities to adapt to these new standards	Department of Environmental Protection	new	ongoing	only a few finalized in Mass Bay & Cape Cod Bay

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
7.5	Identify resource areas sensitive to wastewater and develop management plans appropriate to these areas, focusing on the capacities of natural systems to assimilate wastewater	Municipalities	substantial	ongoing	especially Cape Cod 208 plan
7.6	In cooperation with DEP, develop and implement regular inspection and maintenance (I/M) programs for on-site wastewater systems	Municipalities	substantial	revised	Title 5 only addresses issue at change-of-title
7.7	Employ full-time, professionally trained public health staff to provide ongoing technical and administrative support to the local Boards of Health	Municipalities	substantial	ongoing	reduced funding, see 2006 publication: http://www.mphaweb.org/resources/strength_lph_6_06.pdf
7.8	Establish a Title 5 and alternative systems technical assistance program directed to local Boards of Health and health agents, systems engineers/ installers, and homeowners	Regional Planning Agencies	substantial	ongoing	Barnstable County testing facility
7.9	Evaluate and build upon the centralized statewide repository for testing information on alternative technologies, to be established as part of the Buzzards Bay Project's two-year Environmental Technology Initiative Project	Department of Environmental Protection	full	completed	DEP alternatives certification program
7.10	Plan for decentralized wastewater management and treatment	Multiple	full	ongoing	not sure how this is listed as "full" in 1998?
8.1	Work cooperatively with neighboring communities, private boatyards and marinas, and state agencies (DFG and CZM) to establish, promote, and maintain Boat Pumpout Programs in targeted embayment areas	Municipalities	full	completed	No-discharge zones were approved in 2014 for the entire Massachusetts coast, which requires pumpout sites (https://www.mass.gov/service-details/no-discharge-zones-ndzs). EPA issued Vessel General Permit (https://www.epa.gov/npdes/vessels-vgp) in 2013 and Small Vessel General Permit (https://www.epa.gov/npdes/vessels-svvp) in 2014.
8.2	With assistance from CZM and DEP, require private boatyards and marinas to implement effective stormwater runoff control strategies which include the use of pollution prevention measures and the proper design and maintenance of hull servicing areas	Municipalities	some	ongoing	Stormwater pollution (drains) from boatyards is covered by the EPA's industrial stormwater MSGP, (SECTOR R: SHIP AND BOAT BUILDING AND REPAIRING YARDS). Sheet stormwater runoff is not covered. (https://www.epa.gov/npdes/final-2015-msgp-documents) CZM provides technical assistance re: the General Permit and stormwater control best practices.
9.1	Continue to monitor dredged material disposal sites in the Massachusetts Bays region and initiate the planning necessary to begin a capping demonstration project at the Massachusetts Bay Disposal Site	U.S. Army Corps of Engineers	substantial	ongoing	A pilot project (Cohasset Harbor Capping Project) was conducted in 1998 to 2000 with clean sediment to determine whether capping is feasible at this deep-water site. Extensive monitoring has indicated that the capping project was successful in isolating underlying sediment
9.2	Coordinate the development of a comprehensive Dredging and Dredged Materials Disposal Plan to improve and maintain access to the Commonwealth's ports, harbors, and channels, and to minimize adverse impacts to the marine environment	Executive Office of Energy and Environmental Affairs	substantial	completed	completed 2004

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
10.1	Work cooperatively with the Massachusetts Coastal Zone Management Office (CZM), neighboring communities, and waterfront users to design and implement Beach and Marine Debris Reduction Programs	Municipalities	some	ongoing	see: Coastsweep
11.1	Strengthen Massachusetts Water Quality Standards to enhance and protect nitrogen-sensitive coastal embayments	Department of Environmental Protection	some	ongoing	Only one wastewater treatment facility in MassBays (Cohasset) has a permitted limit for Nitrogen; others have "monitor only" requirements.
11.2	Work collaboratively to expand upon current Massachusetts Bays Program efforts to identify nitrogen-sensitive embayments, determine critical loading rates, and recommend actions to manage nitrogen so as to prevent or reduce excessive nitrogen loading to coastal waters and groundwater	Regional Planning Agencies, Department of Environmental Protection, Municipalities	some	ongoing	
12.1	Develop and implement Municipal Harbor Plans which: 1) promote marine-dependent waterfront uses, 2) enhance public access to the water, and 3) protect habitat of shellfish and other living resources	Municipalities	substantial	ongoing	CZM is the lead agency in this effort. (https://www.mass.gov/service-details/czm-port-and-harbor-planning-program-municipal-harbor-plans)
12.2	Enhance the Designated Port Area (DPA) program with new planning and promotional initiatives	Office of Coastal Zone Management	substantial	completed	https://www.mass.gov/service-details/czm-port-and-harbor-planning-program-designated-port-areas
12.3	Establish a new technical assistance program to accelerate municipal efforts to identify and legally reclaim historic rights-of-way to the sea	Office of Coastal Zone Management	full	completed	handbook published 1999
12.4	In collaboration with the Department of Conservation and Recreation and MassGIS, prepare and distribute a statewide Coastal Access Guide to facilitate public access to the shoreline	Office of Coastal Zone Management	some	completed	https://www.mass.gov/service-details/coast-guide-online
12.5	In collaboration with coastal municipalities, develop and implement an Access-Via-Trails program to enhance public access along the coast	Executive Office of Environmental Affairs	some	completed	directory of coastal trails

Task	Description	Lead Agency	Status* as of 1998 (new = 2003 CCMP)	Status as of 2018	Notes/documentation
13.1	Adopt and implement strict development/ redevelopment standards within FEMA A and V flood hazard zones and other areas subject to coastal flooding, erosion, and relative sea level rise	Municipalities	moderate	ongoing	new standards in negotiation among state agencies
13.2	Continue to assist communities in the development of effective Floodplain Management Regulations	Department of Conservation and Recreation	moderate	ongoing	CZM developed and promotes a model bylaw; 13 communities have surpassed those standards
14.1	Develop and implement Local Comprehensive Plans (LSPS) which: 1) direct development into areas in the community capable of absorbing the impacts of growth and its associated facilities, and 2) preserve and protect the community's important natural resources	Municipalities	substantial	ongoing	Municipalities in Massachusetts are required to have comprehensive Open Space plans as a condition for receiving state environmental funding. Further, the state passed enabling legislation, the Community Preservation Act, which incorporates this information for planning.
14.2	Adopt local bylaws and ordinances that promote open space preservation and natural resource protection	Municipalities	new	ongoing	The Community Preservation Act passed in 2000, and has been adopted by 30 of the 50 MassBays coastal municipalities
14.3	Work with the Massachusetts Highway Department and other transportation agencies to ensure that facilities and infrastructure do not endanger sensitive resource areas	Regional Planning Agencies	new	unknown	
14.4	Work with EOEA and the Massachusetts Bays Program to assist communities in creating Community Development Plans	Regional Planning Agencies	new	ongoing	build-out scenarios shared; smart growth initiative established
14.5	Work with EOEA to provide local support and expertise to communities on the Community Preservation Act and facilitate regional links and networking among neighboring communities	MassBays National Estuary Program	new	ongoing	community preservation act passed in a majority of MassBays communities (http://communitypreservation.org/content/map) but no regional links or networking evident
14.6	Provide technical assistance to municipalities to adopt and implement plans and bylaws that promote open space preservation and natural resource protection	MassBays National Estuary Program	new	ongoing	RSPs carry out this effort incidentally to MassBays initiatives
14.7	Support Conservation Commission Networks (Con Com Networks) in the coastal region by providing technical and management assistance	Office of Coastal Zone Management	new	discontinued/ deemed obsolete	This program was discontinued with a staff departure, though some regions continue to be engaged by MassBays.

Appendix D. 2005-2008 Strategic Plan Progress Report

CS: Central Staff, UNS: Upper North Shore, SS: Salem Sound, MB: Metro Boston, SoS: South Shore, CC: Cape Cod

I. Produce significant environmental results in the MBP region.	Regional and Sub-regional Progress to Date						Yearly Goals Achieved	
	CS	U NS	SS	M B	So S	CC	Total Possible	Progress to Date
Goal 1: Protect and Enhance Shellfish Resources (from Action Plan 2)								
1.a. Provide update on shellfish landings indicator in 2009 State of the Bays report								
1.b. Provide assistance as required by the Division of Marine Fisheries to communicate red tide information to the public and partner organizations	X							X
1.b. With MIT Sea Grant, coordinate an HAB regional workshop	X							X
Subtotal	2	0	0	0	0	0	3	2
Goal 2: Protect and Enhance Coastal Habitat (from Action Plan 3)								
2.a. Target five towns each year for technical and grant-writing assistance to complete an Open Space Plan, local Wetlands Bylaw and other habitat protection tools. (O)	X	X	X		X	X		X
2.b. Update the Wetlands Health Assessment Toolbox manual (December 2008). (I)								
2.b. Maintain the number of trained volunteers and local officials each year in the Wetlands Health Assessment Toolbox program; apply for funding to expand WHAT into another sub-region; gather data and contribute to the Gulf of Maine database. (O)	X	X	X			X		X
2.c. Initiate three wetlands restoration priority efforts based on inventory of tidally restricted wetlands. (I)	X	X			X	X		X
2.d. Develop and complete one ACEC Management Plan in Mass. Bays region. (I, C)		X				X		X
2.f. Develop standard procedures for emerging phragmites data gathering and management. (O)		X				X		X
2.f. Initiate an inventory of restoration opportunities of degraded habitat/emerging phragmites in another subregion (Upper North Shore inventory already under way) (O)			X					X
2.g. Initiate five anadromous fish/river restoration and/or monitoring projects. (I)		X	X		X	X		X
2.h. Develop indicators to measure river restoration success. (I)	X							X
2.h. Ensure Massachusetts Gulf of Maine Program grantees with successful implementation of funded projects. (O)	X					X		X
2.j. Continue field testing and verification for bioindicators project.								
Subtotal	5	6	4	0	3	7	11	9

I. Produce significant environmental results in the MBP region.	Regional and Sub-regional Progress to Date						Yearly Goals Achieved	
	CS	UNS	SS	M B	So S	CC	Total Possible	Progress to Date
Goal 3: Reduce and Prevent Stormwater Pollution (from Action Plan 4)								
3.a. Target ten municipalities each year to provide technical assistance and grant writing support for implementing the stormwater policy, Phase II requirements, and resource protection efforts, including ensuring stormwater mitigation in development and redevelopment plans. (O)		X	X		X	X		X
3.b. Provide workshops or other technical assistance to train local officials on the implementation of the DEP Stormwater Policy and on Stormwater Phase II requirements. (O)			X			X		X
3.c. Facilitate feasibility analysis for stormwater utility, create information exchange, and develop a model bylaw. (I)		X				X		X
3.e. Assist in grant writing to fund environmental analyses and stormwater projects. (O)						X		X
3.f. Revise and update the stormwater policy (June 2006). (I)	X							X
3.h. Complete series of stormwater print ads; create a Think Blue website; create a Think Blue pitchkit for funders and partners; develop point-of-purchase displays (POP's). (O)	X	X			X			X
3.i. Initiate a local television weather forecaster partnership to communicate stormwater information and tips to viewers. (I)	X							X
3.i. Organize and hold a Think Blue kickoff event (May 2006); organize local community Think Blue events (to create support for stormwater utilities); and complete a follow-up telephone survey after year one of campaign. (O)	X		X		X	X		X
3.j. Assist two towns with GIS mapping of their storm drain systems.	X							X
3.k. Develop Greenscapes outreach materials, pilot demonstration sites, provide training and workshops, and draft model bylaws. (O)		X	X		X			X
3.l. Expand Greenscapes program to one additional MBP region (C)		X	X					X
Subtotal	5	5	5	0	4	5	11	11

I. Produce significant environmental results in the MBP region.	Regional and Sub-regional Progress to Date						Yearly Goals Achieved	
	CS	UN S	SS	M B	So S	CC	Total Possible	Progress to Date
Goal 4: Manage Municipal Wastewater (from Action Plan 7):								
4.b. Provide technical assistance to local officials toward development of wastewater management plans. (O)						X		X
4.c. Provide workshops and technical assistance to local Boards of Health, health agents, systems engineers/installers, and homeowners regarding on-site wastewater challenges. (O)						X		X
4.e. Designate two No Discharge Zones within the Mass. Bays region.			X		X	X		X
Subtotal	0	0	1	0	1	3	3	3
Goal 5: Manage Local Land Use and Growth (from Action Plan 14):								
5.a. Hold regular workshops and provide networking opportunities to municipalities regarding locally implementable smart growth tools, including bylaws. (O)		X	X		X	X		X
5.c. Hold, attend regular meetings of existing North Shore, Urban, South Shore, and Cape Cod municipal networks (Conservation Commission Networks, DPWs, Boards of Health, CPC). (O)		X	X		X	X		X
Subtotal	0	2	2	0	2	2	2	2
Goal 6: Prevent Marine Invasive Species (from Action Plan 16)								
6.a. Seek funding to develop a monitoring strategy and conduct a rapid assessment in coastal resource areas for the presence of invasive species. (First assessment held in 2003, next in July 2007) (C)	X				X	X		X
6.b. Support a monitoring strategy for new and existing vectors within water-based industries (2003). (O)	X							X
6.c. Develop and distribute public education material on invasive species (completed and ongoing). (O,C)			X			X		X
6.d. Manage data collected by volunteers; maintain number of invasive species monitoring volunteers. (O)	X		X		X	X		X
Subtotal	3	0	2	0	2	3	4	4

I. Produce significant environmental results in the MBP region.	Regional and Sub-regional Progress to Date						Yearly Goals Achieved	
	CS	UN S	SS	M B	So S	CC	Total Possible	Progress to Date
Goal 7: Monitor Marine Waters (from Action Plan 17):								
7.a. Identify and hold gatherings of coastal partners to develop a state marine waters monitoring plan (O)	X					X		X
7.a. Provide a summary of NPDES data – flow and nutrients synthesis report.								
7.b. Review and revise indicator list and publish in a second State of the Bays report (To be completed in 2009) (I)	X					X		X
7.c. Work with EPA, CZM and New England NEPs to conduct research on coastal condition indicators; Produce white papers on research of coastal condition indicators (I)	X							X
7.d. Develop embayment monitoring process and implement in two embayments. (I)	X				X			X
7.e. Submit recommendations to EPA to refine the Coastal Conditions report. (C)	X							X
7.g. Complete a white paper on public health and environmental quality links with assessment and options.								
Subtotal	5	0	0	0	1	2	7	5
Total							40	36

II. Build organizational sustainability for the Massachusetts Bays Program.	Regional and Sub-regional Progress to Date						Yearly Goals Achieved	
	C S	U NS	SS	M B	SoS	CC	Total Possible	Progress to Date
Goal 1: Strengthen the identity and influence of the MBP.								
1.a. Begin preparations for 2009 State of the Bays symposium and report by preparing updates on indicators. (I)	X					X		X
1.b. Explore feasibility and structure of regional coastal protection workshops by 2008.	X							X
1.c. Develop clear, simple "messages" and promote through projects described in an annual Communications and Outreach Plan. (I, O)	X							X
1.d. Continue to develop and distribute a current, appealing portfolio of outreach materials. (O, I)	X	X	X		X	X		X
1.d. Continue to update the MBP constituency mailing list. (O)	X					X		X
1.e. Announce recipient of Stephen Gersh award every two years in appreciation of a local volunteer (2006 and 2008). (O)	X							X
Subtotal	6	1	1	0	1	3	6	6
Goal 2: Identify and pursue alternative funding.								
2.a. Partner with at least two non-EPA funding sources for MBP Strategic Focus and Funding Zone areas annually. (O)	X	X	X	X	X	X		X
2.a. In 2006, work with MBEA in seeking non-EPA sources to maintain funding for MBP Strategic Focus and Funding Zone areas. (O)	X							X
2.c. Develop MBEA strategic plan and MOU with Mass. Bays Program (C)	X							X
Subtotal	3	1	1	1	1	1	3	3
Goal 3: Ensure effectiveness of MBP structure for managing implementation.								
3.a. Restructure to three Management Committee meetings per year (one for regional accomplishments/issues; one for MBEA and annual planning; and one for a pressing Mass. Bays issue). (C)	X							X
3.b. Continue to identify changes needed to move from planning to management of implementation. (O)						X		X
3.b. Continue to develop proposed improvements to structure to strengthen local implementation efforts. (O)	X					X		X
Subtotal	2	0	0	0	0	2	3	3
Total							12	12

Appendix E. Results of Regional Meetings



Massachusetts Bays Program

251 Causeway Street, Suite 800, Boston, MA 02114

(617) 626-1230 / Fax (617) 626-1240

www.massbays.org

Dear Mass Bays Partners:

October 2013

This past June and July, Mass Bays staff and regional coordinators were fortunate to meet with you to hear your priorities and needs for our coastal natural resources. Since then, we've been compiling results of our conversations and drawing parallels and distinctions among the five sub-regions that make up the Massachusetts Bays National Estuary Program. This letter is to summarize what we heard in individual meetings, as well as the take-away messages repeated from meeting to meeting. Skip to the end of this letter to see our next steps, informed by your important comments.

Cross-region themes

- Mass Bays' mission and vision are not specific enough to provide direction to the work. *We have draft vision and mission statements based in part on your input. While our vision is shared with many of you and other coastal organizations, our mission describes how the Mass Bays Program, uniquely, works toward that vision.*

Vision: We envision a network of healthy and resilient estuaries, sustainable ecosystems that support the life and communities dependent upon them.

Mission: The Massachusetts Bays Program is an EPA National Estuary Program dedicated to protecting, restoring, and enhancing the estuarine ecosystems of Massachusetts and Cape Cod Bays. We facilitate partnerships to prompt local, state, and federal action and stewardship, convening stakeholders on the local and regional level, providing scientific basis for management decisions, and educating decisionmakers about problems and solutions.

- Mass Bays' strength lies in convening stakeholders and facilitating partnerships. That work should continue.
- Estuarine natural resources – salt marshes, beaches, sea grass, shellfish beds – are variously and often inconsistently managed on the local level.
- Education and outreach about the role of estuarine resources in resilient coastal systems – their ecosystem values – are still needed for multiple audiences.
- Coastal communities need concrete advice for practical, ready-to-implement adaptations to climate change and sea level rise.

Cross-cutting needs

At each regional network meeting (and in the Cape Cod regional survey), we asked partners and stakeholders to highlight their primary concerns for their region, drawing from a list of past CCMP priorities, everything from expanding coastal monitoring to restoring benthic habitat. The interconnected nature of these issues was evident as stakeholders expressed difficulty in choosing just one topic as their primary concern. Suggestions for action that will have cascading benefits to estuarine systems, applicable across the Mass Bays planning area, include:

- Implement improved stormwater management – especially through municipal utilities and MS4 plans – that will reduce impervious surface and prevent nutrient and bacterial loading at the source. Reduced inputs will enhance and restore marshes, benthic habitat, eelgrass beds, and shellfish beds, and support diadromous and anadromous fish runs.

- Encourage regional collaboration for planning and implementing climate change adaptation responses, for example providing practical guidance and technical support to plan for sea level rise with regard to stormwater infrastructure.
- Encourage cross-agency cooperation and planning for restoration projects, tying individual projects to the larger ecosystem's health and facilitating early input to project plans from local stakeholders.
- Determine/compile the state-of-knowledge of the benefits provided by coastal habitats – e.g., shellfish for nutrient and bacteria removal, salt marshes for flood mitigation – and make the case to local decisionmakers for protecting, restoring, and enhancing those resources.

Habitat-specific actions

Discussions reinforced the fact that while Mass Bays' sub-regions have unique characteristics and needs. However, estuarine habitats across the planning area would benefit from specific actions, for example:

- Remove all traditional moorings from eelgrass beds.
- Restore shellfish beds, taking into consideration the impacts of ocean acidification.
- Encourage beach management plans that consider habitat value.
- Model potential for marsh migration in response to sea level rise.

Each of these actions require groundwork to determine which agencies have existing authority and policies, compile maps, collect and compile monitoring data, and coordinated planning and implementation that take into account the cross-cutting needs identified above. Mass Bays' role going forward will be informed by our mission, with fluid prioritization of efforts that reflect current scientific understanding, political readiness, and availability of resources.

Next steps

Your contributions over this past summer have moved us a good way toward meeting our first two goals. This document is not the end point of our work, and we continue to process your and others' input as we look for opportunities to add to, rather than duplicate, efforts already underway or planned. Meanwhile, our next steps include:

- Soliciting additional input from stakeholders not already at the table, including academia, local elected officials, water-based industry, and region-wide nonprofits.
- Convening partners at the state and regional level to determine how Mass Bays can contribute most effectively to a common vision of resilient coastal ecosystems.
- Identifying ways to measure Mass Bays' impact at multiple scales.
- Drafting a CCMP for stakeholder and EPA review.

Thank you again for your commitment to Massachusetts and Cape Cod Bays. The Mass Bays National Estuary Program is only as strong as your continuing support of our mission. Please be sure to sign up for our e-newsletter (<http://www.mass.gov/eea/agencies/mass-bays-program/whats-new/>), stay in touch with your regional coordinator listed below, and keep your eyes on our website (www.massbays.org) for updates on how you can take part.

Sincerely,

Pam DiBona
Executive Director

Appendix F. Results of Stakeholder Interviews

Memo

To: Pam DiBona & Prassede Vella

From: Joshua Wrigley

Date: May 5, 2014

Re: Stakeholder Scoping Initiative

Purpose & Background

This memo contains the results of the 2014 winter scoping exercise that sought to gather individual perspectives from stakeholders in the five regions of the Massachusetts Bays NEP (MassBays). In preparation for redrafting the Comprehensive Conservation and Management Plan (CCMP), MassBays convened stakeholder meetings during June and July of 2013 on the Upper North Shore, Salem Sound, Metro Boston, and the South Shore. Additionally, feedback from Cape Cod was gathered through a survey. During that time, stakeholders involved in coastal and watershed conservation lent their views regarding a list of top priority concerns that included storm water, wastewater, invasive species, water monitoring, and other associated topics.

Desiring to sift the regions for perspectives that may have been missed in the meetings of already-engaged stakeholders, the 2014 follow-up scoping effort focused on personal interviews with professionals and citizens (“narrators”) otherwise involved in local decision making around coastal natural resources. In many cases, these interviews have bolstered the 2013 findings and have helped in further determining the unique characteristics of individual locations whose issues fall under the broader penumbrae of previously articulated concerns. The findings in this round of outreach included highly specific regional observations that spoke to the uniqueness of given areas and their individual environmental, regulatory, economic, and sometimes geomorphological characteristics. These scoping interviews convey the personal perspectives of each narrator in a manner that identifies their specific concerns and subjective views regarding the state of their coastal resources.

For a complete list of participating agencies and organizations, see Appendix I.

Background

Objective: The current CCMP, revised in 2003, contains seventeen action plans and corresponding Action Items. As MassBays revises the document in 2014, there is a significant need for stakeholder input that accurately reflects the state of the MassBays estuarine environment and the challenges that it faces. The process of revision has been guided by the following Outputs and Short-term Outcomes:

CCMP Revision Process Outputs & Short-term Outcomes

- MassBays vision to inform program and regional priorities
- Identified target audiences for MassBays education and outreach
- In all regions, re-engaged existing partners; new partners recruited
- Specific regional and region-wide priorities
- Up-to-date understanding of Massachusetts Bay, resources, and complementary programs

- CCMP scope focused on priorities, informed by capacity
- Education and outreach to target audiences
- Dynamic, realistic, performance-based guidance re: MassBays issues
- Time-bound (5-8 years), strategic CCMP

In support of these goals, the 2014 scoping interviews have sought to “conduct a...fact-finding mission to identify and compile data on issues of concern that have not already been voiced by currently engaged participants.” In this second phase, one of MassBays’ priorities now is to attain an up-to-date understanding of the Massachusetts Bays region and of its communities. By interviewing community leaders who by extension of their office or personal interest could offer an informed perspective on the coastal environment, the interviews have tried to establish a relationship between place and environmental issue. In addition to the purpose of data collection for the CCMP, this scoping campaign has intended to establish a base of information that may inform future collaborative considerations as MassBays continues to forge partnerships with neighboring agencies, nonprofits, research institutions, and municipalities.

The scoping interviews are especially useful for designing pathways toward process outcomes that are responsive to constituent needs. As a supplement to the outreach work already in progress by MassBays’ Regional Coordinators, this scoping campaign has intended to enlarge the existing base of knowledge by establishing a rich repository of background information useful for gauging the general concerns of future potential partners.

Previous Findings

Results of 2013 Scoping Meetings (Issues Ranked by Priority Highest to Lowest)

North Shore	Salem Sound	Metro Boston	South Shore	Cape Cod
Invasive Species	Monitoring	Storm water	Climate Change	Storm water
Land Use	Storm water	Nutrient Loading	Sea Level Rise	Wastewater
Sea-level Rise	Climate Change/Sea Level Rise	Wastewater	Nutrient Loading	Salt Marshes
Outreach	Outreach	Land Use Planning	Seagrass	SLR/CC
Climate Change	Land Use Planning	Shellfish	Saltmarsh	Storm water
Salt Marshes	Shellfish	Monitoring	Shellfish	Shellfish
Sedimentation	Eelgrass	Salt Marshes	Land Use Planning	Land Use Planning
Nutrient Loading	Wastewater	Benthic	Anadromous Fish	Benthic Monitoring
Storm Water	Salt Marshes	Climate Change/Sea Level Rise	Wastewater	Eelgrass
Holistic Restoration	Reducing Bacteria	Eelgrass	PR	Anadromous Fish
	Anadromous Fish	Anadromous Fish	Storm water	Sediment Budgets
	Invasive Species			
	Nutrient Loading			
	Working with other Organizations			

Methodology

The scoping process followed a stepwise methodology:

- a. Generate questions suggested by the literature review and report produced by the Urban Harbors Institute. E.g., What specific contributions can MassBays offer, and where? In what arenas/topics would MassBays' efforts be most helpful?
- b. Create a list of possible participants and interviewees, prioritize the list by region, schedule in-person and phone meetings, in cooperation with MassBays Regional Service Providers.
- c. Compile existing outreach materials (repackage as necessary) about MassBays' CCMP process to send out to stakeholders who may not know about MassBays and our mission.
- d. Manage discussions with MassBays abilities and priorities in mind to identify areas of potential impact.
- e. Conduct conversations across the region and collect notes in a central spreadsheet.

Through consultation with MassBays' Regional Coordinators, the 2014 scoping initiative began with the establishment of a list of potential contacts that included individuals from town governments, restoration specialists, advocates, business owners, and others who are engaged directly or peripherally with the coastal resources of the MassBays region.

The design of this scoping attempt has relied on the relative nature of personal opinions insofar that they can supply a strong contextual background for consideration of MassBays' own mission and goals. Using a semi-structured approach, the interviewer asked open ended questions that sought to explore themes central to the CCMP revision process. Three elements contributed to the interview structure including (1) the establishment of occupational background, (2) the avoidance of leading inquiries, and (3) the use of follow-up questions to pursue topic areas in greater depth. Additional questions centered around interviewees' current work as well as their present and past priorities. This was necessary to assess individual perspectives on the unique challenges of different offices, perceived drivers of environmental change, and the role that MassBays can play as a facilitator of coordinated action.

Supplementing the results from the 2013 group meetings, these interviews construct a mosaic of testimonies that operate on two levels. As narrative accounts of *local* environmental concerns, they offer specific details applicable to the environmental challenges and regulatory climates of many areas. At the same time, they remain connected to the *regional* priority lists. Such range allows for scalar analysis that embraces unique particulars as well as the commonalities that link regions together. In this way we can maintain continuity between regions, while allowing for broad-based, cross-region approaches to problem solving.

Challenges to Methodology

For an interview-based project reliant on stakeholder perspectives, there are certain challenges to its conception and execution. For one, the Massachusetts Bays coastline, stretching from Salisbury on the North Shore to Provincetown on Cape Cod includes fifty different communities including Boston. To collect testimonies from this diverse geographic and population demographic is to encounter a wide breadth of information concerning vastly different communities. No community is the same in terms of its resources. With such heterogeneity, the details of each location - the individual vagaries of place, occupation, topography, and geomorphology – simultaneously accentuate differences and commonalities. Even two

narrators from the same location may have different perspectives on the condition of their resources and what they perceive to be drivers of change.

Further complicating matters is the difficulty for both the interviewee and interviewer in parsing out relevant from irrelevant information. As was frequently emphasized by respondents, coastal and watershed concerns are not always connected to obvious pollution sources but *are* frequently related to society's physical infrastructure wrought from concrete, asphalt, and steel that was designed to make the coast impervious to the elements. In doing so, these structures - the roads, bridges, and buildings that form the sinews of our modern world - facilitate the movement of organic and inorganic contaminants into coastal environments. Unlike environmental issues with relatively easy explanation (and straightforward responses), coastal health is influenced by wastewater, storm water, invasive species, and climate effects that in many cases are less pronounced to the naked eye and certainly more difficult to communicate via public discussion. Water, as a necessary element of everyday life remains for many a phenomenon that (as one observer noted) begins at the tap and ends at the drain. The challenge of articulating the breadth and urgency of these problems with stakeholders not already engaged in the discussion is particularly daunting.

Other Challenges

The Definitive Perspective:

- One of the first objections voiced by participants was the assumption that the interview must be looking for a "definitive perspective" on a set of issues. To gather good information, the interviewer was compelled to discuss with participants the relative validity of individual perspectives even if the connection between those perspectives and the work that MassBays undertakes is not always readily apparent. This also included validating participants' voices in a manner that allowed them to see their own role in the scoping process as a cumulative effort. Reassuring interviewees about the validity of their empirical testimonies helped them to divulge personal perspectives.

Relevance

- The relevance of the outreach was a challenge to participants who in some cases were disillusioned with the system at large and in other cases had conceptual difficulty envisioning how they fit into the process or what they could contribute to the overall endeavor. Because watershed conservation and restoration work encompass so many different stakeholder communities, articulating the purpose of the outreach program in an inclusive manner proved important.

A Stake in the Outcomes

- Another barrier to gaining the participation of new stakeholders was some individuals' perception that they do not have a stake in the outcomes. Unfortunately, as an interviewee's perception of his or her stake in the outcomes diminishes, the individual's willingness to engage in discussion also decreases. For future scoping attempts, drawing these stakeholders into discussion will require innovative methods of approach that can further solidify the linkage between coastal health and a potential stakeholder's conception of his or her official duties and responsibilities. Close attention to an individual's particular frame of reference may be necessary. One solution may be to activate them by directly appealing to their concerns in language that is familiar to them.

Post-Scoping Findings

The scoping interviews collected input from thirty-three individuals from the Upper North Shore, Salem Sound, Metro Boston, South Shore, and the Cape Cod regions. The views expressed in the interviews included a range of priorities, concerns, needs, ambitions, resource perspectives, ideas of progress, faults in the state system, environmental necessities, limitations of office, reference to area-specific duties, perspectives on constituent/mission conflicts, virtues and limitations of legal and state apparatuses, projections for the future, and overall descriptions of area environmental patterns.

Interviewees provided candid assessments of their areas in terms of environmental health and town efforts to address environmental issues. Views on resource quality tended to differ according to narrator especially if the office concerned was not primarily conservation oriented or there was a specific goal of which they were in pursuit. Some articulated similar modes of improving resource health by acting in collaboration with other towns. They frequently noted the difficulty in doing so.

Knowing the concerns and individual perspectives of diverse stakeholders provides us with an advantage in conceiving of the region as a whole instead of a set of atomized perspectives. This tapestry of viewpoints yields small truths when its component testimonies are considered in relation to one another.

Coastal Issues & Solutions

Key: The format below lists the concerns of each individual as “issue + issue, etc.” In italics are plans or thoughts regarding how those challenges may be addressed.

Example:

1. Issue + Issue + Issue (Participant Name, Office, Affiliation)
 - a. *Strategies for addressing concerns.*

Upper North Shore

1. Sea Level Rise + Climate Change + Stormwater Improvement + Beach Erosion + Identification of High-Risk Locations (Ray Faucher, District Manager, DCR)
 - a. *Work with MassBays on land acquisition, public education initiatives, develop individual management strategies for individual places that take into account their geographic nuances while also maintaining a concept of how they fit into the entire coastal matrix.*
2. Sea Level Rise + Public Health from Mosquito Infestations + *Phragmites* + (Emily Sullivan, District Manager, NEMMC)
 - a. *Smart infrastructural improvements, better community management, stormwater design improvements, public education.*
3. Storm damage + Sea Level Rise + Site Specific Concerns for Road Maintenance & Redevelopment (Gerri Falco, Conservation Administrator, Rockport & Tim Olson, Highway Superintendent, Rockport)
 - a. *Improving stone revetments, and hard coastal infrastructure, increased coordination between MassBays and town ConsComms that gives the CCMP greater visibility*
4. Water Quality from Merrimack River Sewage Discharge + Invasive Green Crabs (Paul Hogg, Shellfish Constable & Harbormaster, Newburyport)

- a. *Conversations between municipalities about sewage treatment, coalition-based efforts to combat green crabs, MassBays should emphasize oyster restoration in its North Shore work*
- 5. Invasive Green Crabs prey on shellfish beds + Shellfish Seeding Efforts + Climate Effects (John Gundstrom, Shellfish Constable, Rowley)
 - a. *Cooperation by North Shore towns to address crab issue by locating markets*
- 6. Invasive Green Crabs preying on softshell clam population + Law Enforcement Issues + Climate Change + Warming Patterns (Scott LaPreste, Shellfish Constable, Ipswich)
 - a. *Working with state legislators to find market solutions to crab issue, considering the crab's ecological effect on other inshore species including eelgrass,*
- 7. *Phragmites* + Beach Erosion + Sea Level Rise + Climate Change + Water Quality + Dam Removal + Septic Remediation (Doug Packer, Conservation Agent, Newbury)
 - a. *Cooperating with MVPC on coastal initiatives, MassBays could act as convener for inter-regional stakeholder conversations regarding wastewater/storm water solutions.*

Salem Sound

- 1. *Phragmites* Infestation + Marsh Drainage + Community Investment + Wetland Use (Geoff Lubbock, Goldthwait Marsh Trustee, Marblehead)
 - a. *Phragmites eradication by spraying, cooperation between town ConsComm and NE Mosquito Control, maintain drainage trenches in marsh, community education regarding proper marsh uses and care*
- 2. Public Safety + Law Enforcement + Potential Effect of Power Plant Construction on Harbor + Environmentally Friendly Moorings + Channel Dredging + Waterfront Development (Dan McPherson, Harbormaster, Beverly)
 - a. *Continuing to pursue partnerships with local and state agencies to secure funding, in terms of environmental conservation focusing on public willingness to respect impact on the environment if incentivized properly*
- 3. Impervious Surfaces + Urban Development + Limitation of ConsComm Authority + Redevelopment of Pre-Existing Infrastructure + Renovation of LNG Power Plant + Sea Level Rise & Overall Effects of Climate Change (Tom Devine, Conservation Agent, Salem)
 - a. *Maintain Salem's strong network of stakeholder bodies and the flow of information between them, land acquisition, focus on climate change and development concerns*
- 4. Storm Water + Wastewater Discharges (Devon Winkler, Aquatic Biologist, Salem)
 - a. *Grassroots activism, identification of community concerns, translation of concern into political priority for the state, change public mentalities that see environmental declension as unalterable, maintain awareness of individual stakeholder perspectives on resources, maintenance of physical infrastructure*
- 5. Building Yacht Club Business + Regulatory Compliance + Customer Retention (Dan Delorenzo, Yacht Club owner, Danversport)
 - a. *Diversifying services, improving customer care, promoting eco-friendly boat practices for receptive clientele, more dissemination of practical information*

Metro Boston

- 1. Teacher Training + Professional Development + Education for the Under Served + Empowering Individuals Through Knowledge + Catalyzing Action & Investment from Knowledge (Carole McCauley, Outreach Coordinator, Northeastern Marine Science Center)

- a. *Networking with science-based institutions to solidify institutional support, employ innovative strategies for bridging gaps between regulatory and scientific communities, increase education beyond technical assistance, tailoring education to specific audience frames of reference, establish reciprocity between academic research and government*
2. Maintaining herring runs + Eutrophication of Herring Spawning Ponds + Invasive Plant Species + Dredging Herring Pools + Public Water Supply Withdrawal + Flood Control Barriers + Salt marsh Restoration + Tidal Restriction Work + Seawall Reconstruction + Beach Nourishment (Mary Ellen Schloss, Conservation Administrator, Weymouth)
 - a. *State technical assistance, increased services and resources from MassBays*
3. Water Quality Improvement + Storm Water Outflow Control + CSOs + Contaminated Sediments + Phosphorus Inputs + Invasive Plant Species + Developing Green Corridor Along River + Public River Access + Herring Runs + Nurturing Holistic Vision of River Ecology and Management (Ek Ong Kar Singh Khalsa, Mystic River Watershed Association, Arlington)
 - a. *Aid from MassBays in articulating the river's problems as products of an urban/natural interface responsive to human/nature systems, CCMP as educational tool that impresses upon readers the link between land-based processes and riverine impacts, effective communication that tells the river's story in a manner that fosters public investment and understanding, use of education to activate a public will*
4. Water Quality + Monitoring Efforts + Invasive Plant Species + Fore River Access + River Cleanups + Fishway Restoration + Storm Water Runoff + Impermeable Surfaces + Climate Change + Impediments to Restoration Efforts (Kelly Phelan, Conservation Planner, Braintree)
 - a. *More public support and volunteer strength, a central repository of regulatory information, collaborative support for environmental efforts*
5. ConsComm Limitations + Plover Conservation + Dune Erosion + Beach Nourishment + Flood Map Designations + Shoreside Structural Improvements + Lack of Funding & Maintenance + Storm Water Permitting + Short Timeframes for Sewer Repair (Andrew DeSantis, Revere Conservation Commission & Chelsea DPW, Revere & Chelsea)
 - a. *Dune grass restoration, control of public access to ecologically vulnerable areas, nonprofit partnerships for green infrastructure, storm water education and outreach*
6. State Mentalities Toward Restoration Work + Intellectual and Methodological Divides Between Academic and Applied Science + Maintaining Stakeholder Engagement on an Issue Basis + Public Antipathy Towards Shorebird Conservation (Susannah Corona, National Park Service, Boston Harbor Islands)
 - a. *Reconsidering approaches to restoration work and definitions of success, restoration work should be conducted in a manner that allows for consideration of both the limitations and flexibility of an ecosystem, which is often not the case.*
7. Climate Change + Sea Level Rise + Storm Damage + Coastal Erosion + Flood Damage + Beach Management (Anne Herbst, Conservation Administrator, Hull)
 - a. *Educate and plan for effects of sea level rise, ConsComm is becoming more active as a vehicle for outreach and public education, improve coastal infrastructure so that it is more resilient*
8. Invasive Plant Species + Climate Change Effects + Public Knowledge of Invasive Species Eradication Techniques (Lou Wagner, Regional Scientist, MassAudubon)
 - a. *Community outreach to ConsComms, relaying accurate information about current environmental threats to municipal offices, public/technical education regarding eradication efforts*

South Shore

1. Water Quality Control + Beach Management + Sewer Renovation + Tide Gate Scheduling + Harbor Dredging + Phragmites + Pond Drainage + Culvert Widening/Fishway Restoration + Funding Shortages +

Improving Green Infrastructure + Finishing Sewer Repairs + Nutrient Loading + Storm Water (Paul Shea, Conservation Agent, Cohasset)

- a. *Ongoing sewer work and rain gardens that have improved water quality of Little Harbor, consideration of Cohasset's geology in storm water planning, continuation of storm water mitigation projects, MassBays outreach and education on projects*
2. Public Safety + Proper Resource Use + Marking Navigational Hazards + Marsh Erosion + Educating Recreational Boaters (Ron Mott, Harbormaster, Norwell)
 - a. *Outreach and education to harbormasters, topical seminars*
3. Estuary Sodium Chloride Levels + Water Withdrawal + Impervious Surface Impacts on Groundwater Recharging + Private Well Regulation + Nonpoint Source Pollution + Evaluating Impacts of Impervious Surfaces (Peter Dillon, Water Commission, Norwell)
 - a. *Addressing storm water mitigation on a watershed basis, MassBays can help implement/communicate a vision of the South Shore's issues on a watershed/holistic basis, organize educational forums, shift focus away from water supply and withdrawal toward impervious surface mitigation*
4. Public Safety + Proper Marsh Use + License and Code Enforcement + Silt Accretion (Dennis Carvalho, Harbormaster & Shellfish Constable, Kingston)
 - a. *Continued care for shellfish resources & river channel dredging proposal*
5. Anadromous Fish Passage Restoration + Shellfish + Post-Restoration Monitoring + Sewer Outfall + Barrier Beach Protection + Wastewater + Sea Level Rise (David Gould, Director of Marine Affairs, Plymouth)
 - a. *Town/academic partnerships for monitoring and restoration work, wastewater improvement projects, MassBays stakeholder coordination for wastewater management issues, comprehensive data collection for municipal use*
6. Beach Nourishment + Conservation Land Management Plans for Protected Species + Shorebird Nesting + Climate Change + Storm Effects (Jorge Ayub, Coastal Ecologist, DCR)
 - a. *Dune reinforcement projects, indigenous plant restoration, habitat restoration for shorebird nesting*

Cape Cod

1. Adapting to Climate Change + Shellfish Aquaculture + Dune Restoration/Natural Resilience + Cranberry Bogs Abutting Wetlands + High Turnover Rates for Homeownership that Impede Social/Environmental Investment + Benthic Communities in Upper Cape Ponds + Storm Water + Dredging + Nitrogen Loading (Coastal Resources Committee, Barnstable)
 - a. *Public education regarding storm and wastewater, outreach efforts about shellfish that counteract sensational media representations, acquiring federal/grant funding to pursue projects*
2. Progress on Fishway Restoration Projects + Expanding Herring Monitoring Efforts + Water Quality for Shellfish and Herring + Funding Constraints + Private Land Owner Conflicts + *Vibrio* + Continuing Data Collection + Municipal Shellfish Propagation Program + Collection of Northeast Specific Nitrogen Data + Storm Water + Wastewater + Potential Opening of Herring Rivers to Harvest + Expanding Offshore Aquaculture (Abigail Franklin & Diane Murphy, Cape Cod Cooperative Extension, Barnstable)
 - a. *MassBays support to DMF for ongoing work qualifying rivers as sustainable, grant money for projects, continued research efforts and environmental monitoring*
3. Property Acquisition + Habitat Restoration Efforts on Sandy Neck + Protecting Coastal Infrastructure + Storm Damage + Sea Level Rise + Beach Erosion + Sand Retention + (Rob Gatewood, Conservation Administrator, Barnstable)
 - a. *Use of coconut envelopes to prevent erosion, advancing land acquisition goals and ongoing restoration efforts, finding ways to reinforce current infrastructure*
4. Erosion + Coastal Protection + Beach Nourishment + (Jim Gallagher, Conservation Agent, Brewster)

- a. *Continued use of drift fence and identification of better erosion solutions without use of hard structures, use of coconut envelopes*
- 5. Update to Section 208 Water Quality Plan + Storm Water Mitigation + Continued Development + Nitrogen Loading (Heather McElroy, Cape Cod Commission, Barnstable)
 - a. *Watershed-scale solutions to wastewater and storm water, constructed wetlands, fertigation wells, eco-toilets, rain gardens, bioremediation, storm water filtration mechanisms, vulnerability analysis for expansion of salt marsh restoration efforts, closer coordination with Americorps, MassBays could bring stakeholders up to speed on available resources and best practices, continue to foster conversations between stakeholders*
- 6. Coastal Erosion + Permitting for Home Development + Dune Restoration + Sea Level Rise + Difficult Issues to Articulate to Public (Pat Pajaron, Conservation Agent, Truro)
 - a. *Public education regarding home improvements and permitting process, limitations on development by Wetlands Protection Act, how to make property repairs in a lawful manner, MassBays initiation of public outreach program on sea level rise effects and property rights/wetland protection*

Table of 2014 Scoping Issues (Issues Ranked by Frequency Highest to Lowest)

Key: Purple=5, Red=4, Blue=3, Green=2, Black=1

North Shore	Salem Sound	Metro Boston	South Shore	Cape Cod
Climate Change	Power Plant Construction	Invasive Species	Beach Erosion	Beach Erosion
Invasive Species	Invasive Species	Storm Water	Wastewater	Climate Change
Shellfish	Climate Change	Education	Harbor Dredging	Storm Water
Beach Erosion	Community Investment	Herring	Herring	Shellfish
Water Quality	Wetland Use	Beach Erosion	Public Safety	Nitrogen Loading
Identification of High-Risk Locations	Public Safety	Climate Change	Proper Resource Use	Wastewater
Public Health	Law Enforcement	Flood Control	Climate Change	Protecting Coastal Infrastructure
Storm Damage	Environmentally Friendly Moorings	Water Quality	Water Quality	Education
Stormwater	Channel Dredging	Public Access to Rivers	Tide Gates	Permitting for Home Development
Law Enforcement	Waterfront Development	Shorebird Conservation	Invasive Species	Storm Damage
Dam Removal	Impervious Surfaces	Shoreside Structural Improvements	Pond Drainage	Habitat Restoration
Septic Remediation	Urban Development	Flood Maps	Green Infrastructure	Property Acquisition
	Limitation of ConsComm Authority	Limitations of ConsComm Authority	Nutrient Loading	Expanding Offshore Aquaculture
	Redevelopment of Existing Infrastructure	River Cleanups	Storm Water	Land Owner Conflicts
	Storm Water	Monitoring	Marking Navigational Hazards	Data Collection
	Wastewater	Holistic Vision	Marsh Erosion	Water Quality
	Maintaining Business Profits	Developing Riverine Green Corridors	Education	Herring
	Regulatory Compliance	Phosphorus	Sodium Chloride Loading	Dredging
	Customer Retention	Contaminated Sediments	Water Withdrawal	Benthic Communities

		Wastewater	Impervious Surface Impacts on Groundwater	High Homeowner Turnover
		Seawall Reconstruction	Private Well Regulation	Cranberry Bogs Abutting Wetlands
		Tidal Restrictions	Nonpoint Source Pollution	
		Marsh Restoration	Law Enforcement	
		Water Supply Withdrawal	Shellfish	
		Storm Damage	Monitoring	
			Conservation Land Management	
			Shorebird Conservation	

Thematic Elements

Several broader themes offer cohesion to the site-specific concerns that interviewees expressed during the scoping. These themes in some cases reflect continuity between the previous scoping efforts and in other cases prompt new consideration of the relationship between communities and their coastal environments.

Knowledge & Action: For many individuals, coastal issues can be difficult to conceptualize due to the often systemic nature of those problems. Knowledge of coastal environments and ecology can provide the educational base necessary for public engagement with environmental issues. However, education is only the first step toward action and investment. Activating meaningful public engagement around environmental concerns remains a challenge.

Advancing a Watershed Perspective: Coastal watersheds encompass vast areas that frequently cross town, county, and state boundaries. To visualize watershed areas as zones of connectivity requires an engagement with hydrologic and policy perspectives in relation to their socio-political boundaries. One narrator expressed appreciation for the City of Portland, Maine’s active embrace of problem-solving strategies on a watershed basis. Another emphasized the importance of recognizing the relationship between urban and natural environments in the development of a watershed perspective.

Coastal Adaptation: As climate change effects force towns to adapt, coastal managers are rethinking the nature of coastal infrastructure. Emphasis on coastal resilience is evolving to embrace innovative methods for protecting existing structures and habitats. One of the greatest challenges for planners is using natural systems to create dynamic and responsive contingencies for coastal events while maintaining habitable community spaces.

Outreach & Education: Interviewees articulated a general acknowledgement that public engagement rests upon effective communication of environmental issues. Stakeholders discussed education as an issue in both technical/regulatory settings and general outreach. Interviewees suggest that outreach on general coastal issues must resonate with citizens’ everyday lives and local concerns. As general outreach takes place, discussion may also help identify commonalities that stimulate coordination among towns.

Scoping Results 2013—2014: Cross-Cutting Needs & Habitat Action Matching

Many of the views solicited during the secondary scoping campaign aligned with the issues that dominated the previous season’s discussions. Below are the scoping conclusions from those meetings paired with their corresponding inputs from the second round of interviews.

Cross-Cutting Needs

2013 Scoping Results	2014 Scoping Results
Implementation of Improved Storm Water Management	<i>Storm water management remains a high priority consideration for towns interested in compliance with the MS4 storm water permits. Shifts in regulatory regimes between the North Shore and Cape Cod demonstrate different approaches to mitigating a universal problem. Organizations on the Cape are considering bioremediation and other methods of improving filtration.</i>
Encourage regional collaboration for planning and implementing climate change adaptation responses	<i>Climate Change concerns loom for towns that are threatened with beach loss and residential impacts from rising water levels. Solutions range from short-term measures that replace sand and bolster soft infrastructure to state land acquisition efforts. Recognition of climate change has been manifested by landowner challenges to flood maps, locating markets for undesirable marine species, adaptation to rising sea levels, and continued efforts to eradicate invasive species.</i>
Encourage cross-agency cooperation and planning for restoration projects	<i>Restoration work by the DER, NRCS, and DMF currently pertains to storm water, marsh restoration, and fishway/shellfish restoration. Concerted effort between nonprofits, towns, and the state remains essential to progress and legal compliance.</i>
Determine/compile the state-of-knowledge of the benefits provided by coastal habitats	<i>Ecosystem services along the MassBays coast are of great value to industries such as tourism and fishing. As evidenced by the Urban Harbors Institute’s recent survey of academic and grey literature pertaining to the state’s coastal environment, the base of knowledge is increasing. Especially as climate change concerns continue to drive conservation perspectives, this will continue. There is a significant need to bridge gaps between scientific/academic and regulatory/policy communities to facilitate the transfer of knowledge. Challenges include gaps in monitoring and the changing nature of coastal ecosystem inputs and outputs.</i>

Habitat Specific Actions

2013 Scoping Results	2014 Scoping Results
<p>Remove all traditional moorings from eelgrass beds</p>	<p><i>Several respondents noted that the public is often ready to learn and respond to conservation initiatives regarding areas of recreational concern. Accessible information is important for the continued education of pleasure boaters. The introduction of eco-friendly moorings can be prohibitively expensive. There may be a challenge in broaching this topic with harbor masters who have placed their faith in traditional moorings and who view their office as primarily oriented toward public safety. Harbor outreach may be useful in establishing a connection between public safety and environmental health. Also, to note, green crabs have been blamed for degrading eelgrass habitat as well.</i></p>
<p>Restore shellfish beds, taking into consideration the impacts of ocean acidification</p>	<p><i>The challenges facing shellfish populations vary widely across the regions and are highly site-specific owing to their sedentary nature. Factors affecting shellfish health include municipal wastewater systems, downstream impacts from sewage and nonpoint source pollution, invasive species such as green crabs, land use conflicts, and Vibrio. Because shellfish fall under multiple regulatory jurisdictions, an open dialogue between the state, towns, and growers may facilitate ease of propagation.</i></p>
<p>Encourage beach management plans that consider habitat value</p>	<p><i>Beach management challenges include the balance between habitat enhancement and public access. Plover populations in several areas have drawn public ire for the space that is devoted to their conservation. A significant aspect of habitat-based beach management may be outreach related in order to communicate the fragility of that balance. Conventional measures for dune erosion are not working which has prompted some progressive individuals to look at the issue not as a matter of keeping sand in one place but of improving the natural absorbency of coastal habitats.</i></p>
<p>Model potential for marsh migration in response to sea level rise</p>	<p><i>Sea level rise impacts are broad. Newly inundated areas may be more susceptible to mosquito and Phragmites infestation as salinity levels change. GIS modeling similar to MVPC efforts on the Great Marsh and MassAudubon's public school mapping lessons may provide guidance for mitigating marsh habitat variability.</i></p>

Conclusions & Recommendations

During this scoping campaign, thirty-three stakeholders with backgrounds including those of municipal officials, restoration specialists, business owners, state officials, harbor masters, shellfish constables, and academics lent their input. The thoughts that they expressed reflected their highly individual perspectives on the challenges facing their regions and even more importantly on the nature of their relationships with their coastal resources. They communicated an intimate familiarity with communities and coastal ecosystems. Gathered through a suite of open-ended questions, these perspectives sought not to lead participants but instead allow them to express their thoughts on various coastal concerns. Most importantly, the opinions expressed in these interviews reflect the nature of the tripartite relationship between individual, office, and resource.

The views that they expressed are not uniform. In this manner, they are a truthful representation of the breadth of concern that presently exists within the Massachusetts Bays watershed area. We have at hand the reality that issues are perceived differently according to location because each town's resources, needs, and priorities are uniquely their own. Encapsulated within this are themes that do speak to the commonalities linking towns and regions together. What emerges is a matrix of information that accurately reflects the current conditions of coastal areas from the Upper North Shore to the Outer Cape.

This sampling of perspectives is not an exhaustive study in that it only reached those who were most willing to take part in the process. Missing from these perspectives are the voices of municipal officials who perhaps had difficulty envisioning their stake in the outcomes of MassBays' work. Helping to facilitate that connection will be a challenge for future outreach endeavors that hope to engage those stakeholders.

In general, the findings of this scoping attempt are closely aligned with the results of last year's stakeholder meetings. Like last year, a persistent concern for climate change effects and sea level rise seemed to drive many secondary priorities such as beach erosion and flood control. Along with that, individuals reiterated that MassBays can work well as a facilitator and convener of partners. Education and outreach also remain important for the continuation of restoration work and especially for introducing homeowners to the nature of sea level rise.

In conclusion, the information gained from this scoping campaign is useful on a broad level. It supplements the concerns stated during the initial scoping efforts in 2013 and it may act as a reservoir of useful information as MassBays presses ahead in the building of coalitions and collaborative partnerships.

FINAL RECOMMENDATIONS BASED ON SCOPING PERSPECTIVES

- Continue grant program
- Increase outreach efforts with emphasis on roles guiding, advising, educating, and connecting, particularly to towns whose ConsComms lack resources
- Emphasize technical and community education
- Consider expanding name recognition and branding
- Continue facilitating local/state conversations and use leverage as state organization to bring stakeholders into collaborative discussion
- Emphasize adaptive responses to climate change and sea level rise
- Facilitate bridging between academic and regulatory communities
- Behave as resource coordinator for coastal Conservation Commissions interested in informational resources
- Support DMF in its evaluation of herring

Appendix G. Agenda and Results of Interagency Information-sharing Sessions



Massachusetts Bays National Estuary Program Information Exchange Session

100 Cambridge Street
9th floor legal conference room

October 2, 2014 Participants

Sam Cleaves/MAPC, Tim Dexter/DOT, Hunt Durey/DER, Kathryn Ford/DMF,
Heather McElroy/Cape Cod Commission, Regina Lyons/EPA

October 8, 2014 Participants

Michael Celona/DPH, Joe Cosgrove/MVPC, Lealdon Langley/DEP, Regina Lyons/EPA,
Robbin Peach/MassPort, Vandana Rao/EEA, Betsy Reilly/MWRA, Brad Washburn/CZM

Meeting Objective

Exchange information about programs and activities underway and planned by state agencies and RPAs in Massachusetts Bay and Cape Cod Bay, to identify opportunities for MassBays contributions.

Agenda

10am Gather, introductions

10:10 Background:
Comprehensive Conservation and Management Planning
Goals and Strategies
Proposed action items, and an example

10:20 Existing and planned agency programs and initiatives
Consider the following:

- In what areas (geographically and topically) can MassBays complement your agency's work?
- What specific information is needed to advance habitat protection and restoration in Massachusetts Bay and Cape Cod Bay? What data gaps can we help fill?
- How can MassBays magnify and augment your agency's impact?

11:30 Opportunities for collaboration
Compile topics and activities for potential collaboration among agencies, both with MassBays and others.
Identify potential funding sources or cost-sharing opportunities for collaboration on specific projects.

12pm Adjourn

Re: Strategy 1a. Make data available, attendees suggested that MassBays:

- * Document impact of “green” approaches.
- * Conduct rainfall-water quality modeling.
- * Support eelgrass delineation and mapping.
- * Support citizen monitoring and management efforts.
- * Delineate mean high water in salt marshes.
- * Identify and address knowledge gaps.
- * Review studies of climate change impact on restoration and management activities.

Re Strategy 2a, Conduct outreach and training regarding the value of estuaries, attendees suggested that MassBays:

- * Promote timely implementation of living shorelines for long-term habitat protection.
- * Address perception of eelgrass as a nuisance species.
- * Address Rivers Protection Act implementation in the coastal zone.
- * Promote model restorations and practices that have proven successful.

Re: Strategy 2b, Prompt local decisionmaking based on research findings and trends data, attendees suggested that MassBays:

- * Make the wealth of climate change information useful for municipal planning.
- * Use tide gate inventory outputs to prompt adoption of sound management practices.
- * Provide guidance to communities re: responding to harmful algal blooms.
- * Share information about economic tools for habitat protection and restoration.

Re: Strategy 3a, Establish embayment-specific targets for improvement, attendees suggested that MassBays:

- * Identify indicators and metrics for multiple embayment “types.”
- * Establish a methodology for comparisons across embayments in similar settings.
- * Tie municipal-level MS4 permit compliance to embayment-specific water quality targets.
- * Utilize Gulf of Maine sentinel monitoring recommendations to detect climate change impacts.
- * Examine the potential to bring stormwater treatment component to DOT Complete Streets program.

Appendix H. Roadmap to a Revised CCMP for MassBays

EPA Guidance	MassBays proposed response, 7/17/17
<p>Scope of CCMPs – All CCMP action plans must be consistent with and tie back to CWA Section 320. Action plans must identify the needed resources and sources of resources expected to be secured. It is especially important to distinguish between actions funded under Section 320 and those to be implemented with other sources.</p>	<p><i>MassBays' CCMP will include explicit reference to the provisions of CWA Section 320. The CCMP will include actions anticipated to be funded by §320 funds; where supplemental funding is needed it will be clearly noted.</i></p>
<p>CCMP Revisions versus Updates – The Funding Guidance describes when a CCMP Revision or an Update would apply. Revisions involve a significant change. For example, a CCMP Revision could be driven by: 1) new CCMP goals, as directed by the Management Conference, 2) new information obtained through monitoring that would require revisiting and changing the actions in a CCMP; or 3) an expansion of the study area. A Revision would also be necessary in cases where original CCMPs have not yet been revised. Minor changes to action plans or insertion of a few new actions would be considered an Update. Reformatting, streamlining or reorganizing core actions to reflect new ways of accomplishing original CCMP goals would also be considered an Update.</p>	<p><i>MassBays is preparing a CCMP Revision, with a 10-year timeline. The revision is driven by the following: 1) the Management Committee identified new programmatic and organizational goals in 2015; 2) the current CCMP was published in 1996, and many conditions have changed in the interceding 20 years.</i></p>

EPA Guidance	MassBays proposed response, 7/17/17
<p>Review Process – The Region is in the lead with respect to CCMP Revisions and Updates. The Region will work in concert with HQ, using the CCMP Content Checklist and the NEP Funding Guidance as a basis for engaging in the concurrence process. Regional Coordinators will work with the NEP Director and Management Conference to follow the checklist so that the set of content requirements are reflected in the final CCMP and associated documents. ¶ To ensure a common understanding and level of support for the final CCMP, this process assumes that the HQ and Regional Coordinators are regularly communicating and collaborating as needed throughout the process. The Regional Coordinator is responsible for timely communication and for managing the overall review schedule. EPA expects that the NEP will make the changes necessary to the CCMP and associated documents to reflect the Content Checklist. HQ Coordinators will need to honor the CCMP review schedule, while Regional Coordinators need to share documents to allow adequate time for review.</p>	<p><i>MassBays has worked closely with our EPA Regional Coordinator to scope out this roadmap for completing the CCMP revision. We are committed to working with EPA Region 1 and Headquarters to finalize a CCMP that both reflects the Management Committee’s goals and meets EPA’s needs under this guidance.</i></p>
<p>Program Evaluations – To ensure the seamless integration among key NEP products, EPA expects that the Program Evaluations will consider the need, if any, for revisions or updates to the CCMP. EPA also expects that State of the Bay Reports will inform any CCMP Revisions and Updates.</p>	<p><i>MassBays’ Revised CCMP will include a section on plans and methods for incorporating State of the Bays into CCMP implementation and performance measurement. MassBays will prepare two versions of the revised CCMP:</i></p> <ol style="list-style-type: none"> <i>1) A web-based, official version, which will be assembled on a webpage dedicated to the CCMP with links, maps, and graphics. The webpage will include official, dated statements of approval from the Management Committee and EPA. This format will allow us to provide ready access to background materials and cut down on physical resources needed to share the document with stakeholders and partners. All will be offered in alternative formats for universal accessibility.</i> <i>2) A printed summary suitable for sharing with multiple audiences at public venues and meetings which includes prompts for accessing the online documentation.</i>

EPA Guidance	MassBays proposed response, 7/17/17
<p>Identify clearly if there are any changes between the existing and draft CCMP so that reviewers and the public can easily determine what has changed and why. These changes include program priorities and goals; any new information that suggests more promising approaches or currently unaddressed issues, etc.</p>	<p><i>MassBays will include a background section describing the requirements under §320 to prepare a CCMP, and the need for a revision for our planning area. While the content and approach of the 1996 CCMP makes it difficult to definitively document that specific actions have been “completed,” we will provide reporting on status for each 1996 action, e.g. obsolete—revised—reassigned—ongoing. This will be a simple spreadsheet report-out included in the background section.</i></p>
<p>Describe how the NEP has contributed to or supported activities that helped develop new information, if applicable, when highlighting major changes due to new information. Major changes could be informed by Status and Trends or State of the Estuary Reports, Indicator Reports, and associated monitoring programs where adequate monitoring data are available. This is where a discussion of climate change assessments and adaptation strategies should appear.</p>	<p><i>MassBays' investments in research and monitoring have been instrumental in the improvements observed since 1996, in Boston Harbor in particular. The Revised CCMP will highlight those investments. Beyond Boston Harbor, however, there is much to be done, and MassBays' CCMP will address new challenges and impacts posed by climate change, including acidification, more frequent and more intense storms, and expansion of invasive species.</i></p>
<p>Include a map of the study area. If there are any boundary changes, provide the reasons for those changes. Any NEP study area boundary changes should be based on sound science with the support and approval of the NEP's Management Conference in a transparent and open process.</p>	<p><i>We are not proposing any boundary changes. A map will be included on the CCMP landing page and prominently in the hard-copy materials.</i></p>

EPA Guidance	MassBays proposed response, 7/17/17
Describe the NEP's Management Conference and membership with any proposed changes and explain how the structure will support the NEP's ability to oversee and promote CCMP implementation. This would include a discussion about the NEP's approach to achieving financial sustainability and for involving the public and stakeholders in its programs.	<i>MassBays' unusual organizational structure will be described via an organizational chart, as well as a decision tree that illustrates how yearly workplans are developed in alignment with the CCMP.</i>
Discuss changes to existing CCMP action plans, and new action plans, including their relationship to previously stated goals and priority problems; the probable causes and sources they address; and measurable objectives, where appropriate, to attain the goal. Each CCMP Action must identify the key activities expected to be implemented to address the priority problem. It would be very helpful to include a table comparing the old completed or deemed obsolete actions, and new, revised, or on-going actions in the CCMP. This could appear upfront in the document, or within each chapter.	<i>A table compiling the status of the 1996 CCMP activities will be provided as described above. As this first revised CCMP is being developed in a significantly changed environment, few of the specific activities will be carried forward. We expect that this checklist item in the guidance will be more relevant in future revisions, if only for the fact that they should be prepared more frequently (every 10 years instead of 20). In this revised CCMP, we will provide the following:</i>
CCMP Actions encompass environmental goals, metrics, and milestones that the NEP strives to achieve over time as implemented through annual workplans. They need to be clear, understandable, and plainly link to CWA § 320 (See 4 th bullet under Purpose of Conference). They should:	<i>Goals will be described with specific reference to their importance to meeting CWA goals.</i>
a) describe each action and what is proposed;	<i>Programmatic and organizationally oriented Actions will be introduced, with context regarding need and expected outcomes.</i>
b) identify key activities to implement the action, including affected habitat types, or resource(s) if appropriate; some activities may take place system-wide or involve policy changes rather than in-the-ground projects.	<i>Activities/Strategies for executing proposed actions will be described. These will form the basis for future tasks in MassBays' yearly workplans.</i>
c) identify proposed action plan responsibilities, including likely lead parties if known, along with any implementing partners;	<i>Only Activities to be led by MassBays are to be included in the CCMP; anticipated partners will be listed.</i>

EPA Guidance	MassBays proposed response, 7/17/17
d) include a timeframe, and where appropriate, key milestones for completion (or indicate on-going);	<i>A 10-year timeline will be described, with milestones for each Activity.</i>
e) estimate the range of potential costs of the overall action and identify the possible sources of funding; and	<i>Beyond the S.320 funds required to maintain MassBays' work, expected contributions of cash and in-kind support from partners will be estimated for each Activity.</i>
f) include performance measures (quantitative measures and intended environmental results wherever possible).	<i>MassBays is committed to providing quantitative performance measures for each Activity. These will feed directly into our monitoring program and STATE OF THE BAYS reporting.</i>
Those CCMP Actions eligible for CWA §320 funding (and as stated in your EPA Assistance Agreement) will be spelled out and included in the NEP workplan submitted to EPA. CCMP Actions not funded by Section 320 should be clearly identified along with the other potential funding source.	<i>Only activities to be funded at least in part by S.320 funds will be included in the CCMP.</i>

EPA Guidance	MassBays proposed response, 7/17/17
<p>CCMPs are living documents and as such should be re-examined and revised on a regular basis. EPA recognizes that CCMPs are also critical components of the NEP model of adaptive management as it facilitates a continual process of integrating new data and results. EPA expects that revised CCMPs will discuss the relevance and applicability of the: 1) monitoring, 2) habitat, 3) finance, and 4) outreach component strategies, including any needed substantive changes. If such changes are not discussed in the revised CCMP as language within a chapter or as a separate Action Plan, they should be described in a separate document and completed within 3 years of the final Revised CCMP.</p>	<p><i>The revised CCMP will have a habitat focus. It will include a Monitoring Framework and Financial Strategy as attachments. A Communications Plan, developed once the CCMP is complete, will be tied directly to the final CCMP and its goals.</i></p>
<p>Include a Monitoring approach to track and detect changes and/or improvements within the study area (so change in environmental indicators can be detected over time), and effectiveness of CCMP Actions. This can be described in a separate, brief, higher level document, or chapter or action in the CCMP. The Monitoring approach should identify: a) objectives, b) data the NEP and partners are collecting for which parameters; c) the party/parties responsible for collecting the data; d) frequency of collecting and reporting the monitoring data; e) how the data are shared, reported, and used; f) data gaps; and g) additional funding needed for monitoring activities and filling data gaps. This section should explain how monitoring has/will change as a result of new/modified actions and priorities, and any new environmental indicators. Monitoring should be tied to the State of the Bay Report which has similar components. Please note: A Quality Management Plan or Quality Assurance Project Plan can supplement the Monitoring Plan, but does not in and of itself meet this requirement.</p>	<p><i>A monitoring framework developed by MassBays' Science and Technology Advisory Subcommittee and endorsed by the Management Committee will be included as an attachment.</i></p>

EPA Guidance	MassBays proposed response, 7/17/17
<p>Include a Finance strategy that will establish long-term financial sustainability to implement the CCMP through diverse resources and partners. The strategy can be a separate document or chapter or action in the CCMP. The strategy should discuss: a) priorities for funding; b) current funding and other support such as staff assignments, or in-kind partnering; c) short- and long-term resource needs; and d) proposed actions or strategies to maintain or garner new resources for CCMP implementation and their timeframe.</p>	<p><i>A financial framework developed by MassBays' Finance Subcommittee will be included as an attachment.</i></p>
<p>Include a Habitat Protection/Restoration strategy. The strategy should clearly tie back to habitat or ecosystem issues addressed in the CCMP, including those habitats and species prioritized for protection and or restoration efforts. Strategies can be addressed in a separate document or as an action in the CCMP and should discuss: a) relevant habitat types and key species in the study area; b) goals and measurable objectives to address them; and c) actions that reflect a climate change vulnerability assessment. The Strategy can make it easier for NEPs to plan and report on their habitat protection results under GPRA.</p>	<p><i>MassBays' revised CCMP as a whole is focused on habitat protection and restoration. All components listed here will be addressed in the core of the document.</i></p>
<p>Include a Communication/Outreach Strategy to ensure community involvement and ownership in CCMP implementation that can be represented as a stand-alone document, chapter, or a series of actions in the CCMP that includes: a) guiding principles, or goals and objectives; b) a target audience(s); c) a narrative description of activities, including any tool used such as branding and messaging, behavior change campaigns, or social media; d) implementers for those activities; e) any key deliverables, and f) a budget and timeframe for implementing the activities.</p>	<p><i>A Communications Strategy will be submitted as an Attachment; an implementation plan will be finalized within three years of CCMP submission.</i></p>
<p>NOTE: Make sure to include a public review process that extends beyond the Management Conference members. Responses to comments should be summarized and be made publicly available.</p>	<p><i>MassBays had previously published a Public Review Draft of a revised CCMP, announced at a MassBays-wide event. All comments garnered from that public release have been incorporated into the proposed Activities. This final revised CCMP will be reviewed by MassBays' regional Local Governance Committees and the Management Committee. Following this vetting, a second round of public comment will be solicited prior to final Management Committee endorsement.</i></p>

Appendix I. Results of Public Outreach, November 2018

Sources:

Boston Harbor Ecosystem Network meeting

South Shore Municipal Partners meeting

Management Committee meeting and survey

Online survey – Cape Cod responses

Online survey

Data gaps:

- Dock & pier coverage of marsh platform
- Dredged areas/dredge extent (UHI attempted to compile this)
- Historical data retrieval, including pre- and post-restoration monitoring
- Statistics re: seawall permits over time
- Consensus flood maps and other data needed for long-term planning and design
- Shellfish monitoring (DMF)
- Ecosystem dynamics, cranberry bog inputs
- integration of watershed data with regulatory work
- Routine and frequent nutrient monitoring in small embayments.
- salt marsh hydrology, status of species,
- specific populations and needs
- Water Quality
- QAPP templates.
- Analysis of all past restoration project data across the region to show overall success.
- Monitoring post-restoration beyond first year or two.
- Many anadromous fish run population estimates need more people collecting count data.
- Not using updated precipitation or flood and surge maps
- Aquatic invasive species in freshwater river herring spawning ponds
- Standardization of collected data across the estuaries, and a lack of focus on Boston Harbor.
- Presence & extent of hazardous waste contamination
- More comprehensive and timely seagrass monitoring
- Basic water quality parameters
- Outfall monitoring in all MassBays communities. Most of the North Shore communities require improved stormwater management practices to help improve water quality. Public education is key.
- Water quality, fishing quality, swimming quality, habitat quality
- Additional stormwater outfall monitoring is needed - some will be required under NPDES permit but more frequent monitoring would be more useful for analysis
- land use/local regulation assessment
- lack of an integrated one-stop-shopping compendium of WQ information.
- guidance for municipalities to evaluate and choose among adaptation measures.
- public understanding of climate change risks

Research needs:

- Document invasives species' impact on ecosystem services, as opposed to impact on native spp.
- When a neighborhood raises its elevation to prevent flooding, what happens to nearby neighbors and neighborhoods that do not?
- Response of marshes to sea level rise, adaptation that protects marsh habitat into the future
- Cape Cod Bay fisheries study
- Application of herbicides in spawning ponds for the control of AIS and how this might affect larval and juvenile river herring Exploring ways to reduce pollutants impacting habitat sustainability
- relating climate change; eutrophication and toxic chemicals to the "productive capacity" of Essential Fish Habitat
- The effects of altered hydrology, e.g., dredging, tide restrictions, on embayment water quality
- Long-term effects of pollution in estuarine environments that are changing due to climate change
- restoration models that take SLR into account
- Changes in predator-prey interactions due to climate change
- Damage & Conditions resulting from rising seas and superstorms.
- addressing migration of fish species from the Mid Atlantic into southern New England waters
- Coastal vulnerability from storms and impacts on evacuation and infrastructure
- I'd like to see more social science and evaluation research carried out so that we all have a better understanding of WHY a certain approach is working, or why specifically an approach did not work
- Impact of accelerating, intensified development
- Habitat resiliency
- Stormwater, sea level rise, coastal resiliency.
- impact of climate change on Bays community and recommended actions towns, cities, and state should take to mitigate/adapt

Education & Outreach needs:

- Visuals – especially video – to illustrate storm surge, storm damage
- Materials that highlight problems and issues – and case studies with solutions – for municipal officials. MassBays & municipal staff can use these materials to convince decisionmakers that they are not isolated in their challenges and won't be the first to take up a given response. Relevant for MS4, dam removal, resilience actions, investing Ch.90 funds for stormwater/flooding mitigation.
- Compilation of resources (links, applications) in one place online.

Management needs:

- While MVP structure is good (service providers id'd means less contract mgt), projects need to bring ecosystem concerns to the table, and there should be a route to implementation of plans.
- Regional approach (with MassDOT) to Route 3 corridor stormwater and flood management
- Cross-agency assistance to towns for storm response
- Funding for long-range infrastructure planning
- Operational support to towns hit by storms to help with ongoing response and recovery re: rebuilding above elevation, retreating, etc.

Appendix J. CCMP Development Logic Model

[11x17" layout follows, 1 page]

Inputs

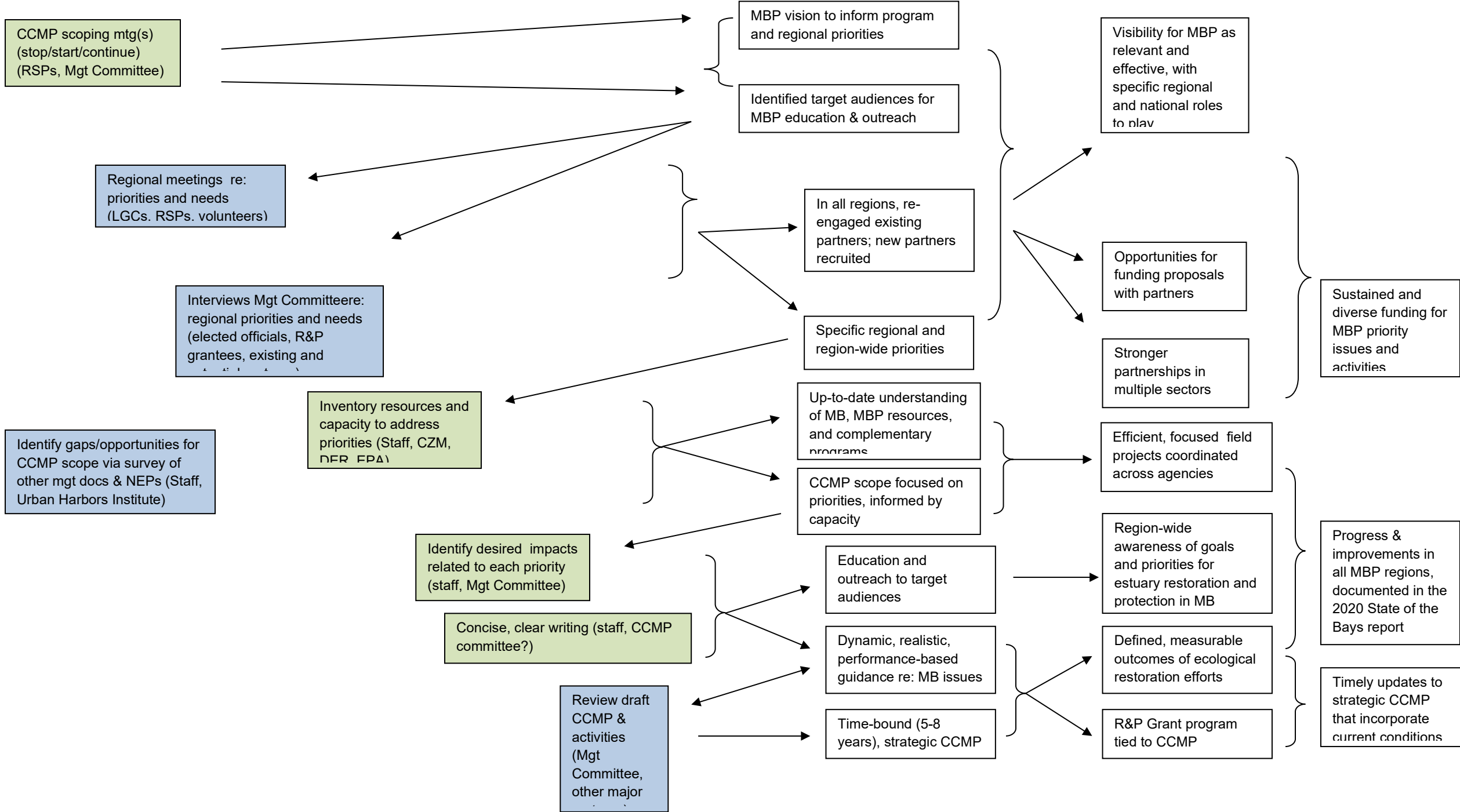
Activities (Participants) *internal*

Activities (Participants) *external*

Outputs & Short-term Outcomes

Longer-term Outcomes

- Communications tools**
- Websites & listservs
 - Comm'n networks
 - Compelling issues, both good & bad
- Content resources**
- 1996 CCMP
 - 2003 CCMP Update
 - Delineation Report
 - MBP Strategic Plans
 - State of the Bays report
 - R&P grant products
 - Complementary resource mgt plans
 - Knowledge of ecosystems
 - Desired natural resource conditions
 - Regional Service Providers
 - Local Governance Committees
 - Other NEPs
 - Previous CCMP update efforts
 - CZM
 - EPA
- Human resources**
- MBP Central Staff
 - Regional Coordinators
 - Mgt Committee



Appendix K. EPA/State Management Conference Agreement, 1990

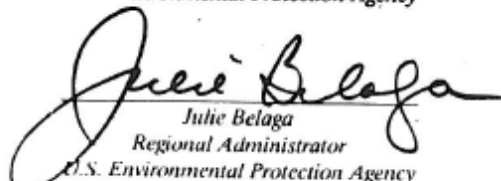
**MASSACHUSETTS BAYS
MANAGEMENT CONFERENCE AGREEMENT
FOR THE NATIONAL ESTUARY PROGRAM
UNDER THE WATER QUALITY ACT OF 1987**

WE recognize the need for a Management Conference for Massachusetts and Cape Cod Bays to better define the environmental concerns in the ecosystem; to address the extent, complexity and sources of pollutants; and to develop a comprehensive conservation and management plan for action. We further recognize that regional and local governments as well as the Executive Office of Environmental Affairs and the Environmental Protection Agency share the responsibility for management decisions and planning for the future of the Bays.

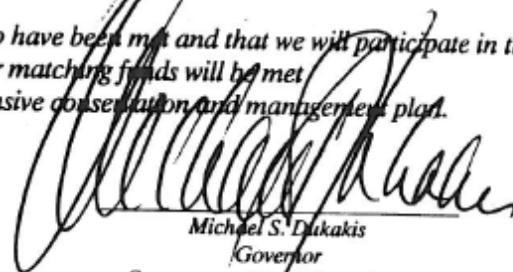
IN signing this agreement, we are committing to products and schedules in the Conference's five-year workplan to: assess trends in water quality, natural resources and uses; identify the causes of environmental problems through data collection, characterization, and analysis; evaluate point and non-point loadings and relate them to observed trends; write a comprehensive conservation and management plan which includes recommendations for priority actions; develop plans to coordinate implementation of a comprehensive plan with federal, state and local agencies; monitor the effectiveness of the management actions; and review federal financial assistance programs and federal development projects for consistency.


WE also agree that the statutory requirements for Management Conference membership have been met and that we will participate in that conference. Further, we commit that the statutory requirements for matching funds will be met to complete the characterization of priority problems and develop the comprehensive conservation and management plan.


Juana S. Wilcher
Assistant Administrator for Water
U.S. Environmental Protection Agency


Julie Belaga
Regional Administrator
U.S. Environmental Protection Agency
Region 1




Michael S. Dukakis
Governor
Commonwealth of Massachusetts


John P. DeVillars
Secretary
Massachusetts Executive
Office of Environmental Affairs

Dated this 13th day of November, 1990

Appendix L. Management Committee Membership, 2013 to 2022

Members, 2013-2015	Organization	Member Category
Julia Blatt	Massachusetts Rivers Alliance	Statewide nonprofit
Robert Buchsbaum/Rebecca Dupont-Coutu	Salem Sound Coastwatch	Regional nonprofit
Bruce Carlisle/Brad Washburn/Lisa Berry Engler	Massachusetts Office of Coastal Zone Management	Standing
Sam Cleaves/Mark Fine	Metropolitan Area Planning Council	Standing
Mel Cote/Regina Lyons	Environmental Protection Agency	Standing
Ed DeWitt/Andrew Gottlieb	Association to Preserve Cape Cod	Regional nonprofit
Tim Dexter/David Goldstein	Massachusetts Department of Transportation	Standing
Harlan Doliner/Morgan McCarthy	Marine & Oceanographic Technology Network	Industry/business
Kathryn Ford/Mark Rousseau	Division of Marine Fisheries	Standing
Jon Kachmar/Steve Kirk	The Nature Conservancy	Statewide nonprofit
Beth Lambert/Tim Purinton/Georgeann Keer	Massachusetts Department of Fish and Game	Standing
Wendy Leo/Ken Keay/Denise Ellis-Hibbett	Massachusetts Water Resources Authority	Standing
Alan Macintosh/Joe Cosgrove/Jen Hughes/Cece Gersternbacher	Merrimack Valley Planning Commission	Standing
Rebecca Newhall	NOAA Coastal Program	Federal government
Judith Pederson/Juliet Simpson	MIT Sea Grant	Research and academic
Jane Peirce/Cathy Vakalopoulos/Steve McCurdy/Lealdon Langley	Massachusetts Department of Environmental Protection	Standing
Vandana Rao	Executive Office of Energy and Environmental Affairs	Standing
Maureen Thomas	Town of Kingston	Local government
Geoff Trussell/Jon Grabowski	Northeastern University Marine Science Center	Research and academic
Jack Wiggin/Kristin Uiterwyk	Urban Harbors Institute	Research and academic
Colin Van Dyke	Anderson Krieger	Industry/business
Samantha Woods	North and South Rivers Watershed Association	Regional nonprofit

Appendix N Sample Healthy Estuaries Grant Request for Proposals



Margherita Pryor
U.S. Environmental Protection Agency, Region 1
5 Post Office Square
Boston MA 02109

July 25, 2022

Dear Margherita:

We are pleased to submit Massachusetts Bays National Estuary Partnership (MassBays') application for funding to implement our Federal Fiscal Year 2022 Section 320 Workplan. MassBays staff and regional coordinators have significant accomplishments to report from this past year. As of June 30, we have:

- ☑ Identified target extent and conditions for saltmarsh, eelgrass, and tidal mud flats in our 47 embayments.
- ☑ Completed our new online Ecohealth Tracking Tool, which will serve as our web-based State of the Bays reporting system.
- ☑ Coordinated a session at the Massachusetts Association of Conservation Commissions' Annual Meeting, with presentations from all RCs making the case for long-term monitoring of habitat restoration projects.
- ☑ Engaged volunteers across the region in herring counts, eelgrass monitoring, water sampling and beach monitoring, restoration projects, and invasive species management.
- ☑ Developed revised Risk Categories for both interpreting cyanobacteria data for the public and reporting results to health agents, which was accepted by health agents and Massachusetts DPH for the 2022 monitoring/reporting season. (Cape Cod RSP)
- ☑ Conducted in-depth monitoring in Salem Sound and Salem Harbor to inform resource management and investment in new water infrastructure. (Lower North Shore RSP)
- ☑ Served in a leadership role to develop EJ/DEI resources for the NEPs (Metro Boston RSP), and worked with the Mystic River Ambassador to identify impacted and exposed target audiences.
- ☑ In the Great Marsh, completed impact assessments of chemical treatment of Phragmites and extent of microplastics. (Upper North Shore RSP)
- ☑ Presented interim results of a long-term study to document marsh migration, thanks to the participation of private dock owners along the North and South Rivers who have been recording changes in the adjacent marsh for five years. (South Shore RSP)

MassBays' Management Committee reviewed and approved this application, and endorsed the tasks included as important steps toward implementing our CCMP. Please do not hesitate to contact us if you have any comments, suggestions, or concerns regarding the workplan.

Sincerely,

A handwritten signature in black ink that reads "Pamela DiBona".

Pam DiBona
Executive Director
Massachusetts Bays National Estuary Partnership
pamela.dibona@mass.gov
339-368-0608 (cell)

A handwritten signature in black ink that reads "Juliet Simpson".

Juliet Simpson
Management Committee Chair

cc: Bob Chen, Interim Dean, UMass Boston School for the Environment

Contents

Acronyms and Abbreviations	Page 3
A. Summary	Page 5
<i>2021-2022 Progress and Accomplishments</i>	
<i>2022-2023 Proposed Work + Staffing and Management + Budget Overview</i>	
B. Completed major projects and activities	Page 10
<i>Listed by CCMP Strategy</i>	
C. New and ongoing projects and activities	Page 30
<i>Listed by CCMP Strategy</i>	
D. Budget	Page 60
<i>Budget Narrative</i>	
<i>Proposed Budget</i>	
<i>Travel Detail</i>	
<i>Direct and Project Match</i>	
<i>Regional Service Provider and Urban Waters Budget detail</i>	
Attachments <i>to be provided under separate cover</i>	

Acronyms and Abbreviations

ANEP	Association of National Estuary Programs
APCC	Association to Preserve Cape Cod
BCG	Biological Condition Gradient
BHEN	Boston Harbor Ecosystem Network
BU	Boston University
CC	Cape Cod (MassBays Region)
CCC	Cape Cod Commission
CCCD	Cape Cod Conservation District
CCMP	Comprehensive Conservation and Management Plan
CCS	Center for Coastal Studies
CCWRRP	Cape Cod Water Resources Restoration Project
CPR	Coastal Pollution Remediation (CZM Grant Program)
CS	Central Staff (MassBays Boston Office)
CSA	Citizen Science Association
CSO	Coastal States Organization <i>or</i> Combined Sewer Overflow
CWA	Federal Clean Water Act
NEPCWG	National Estuary Program Coastal Watershed Grant Program
CZM	MA Office of Coastal Zone Management
DCR	MA Department of Conservation and Recreation
DEP	MA Department of Environmental Protection
DER	MA Department of Fish and Game, Division of Ecological Restoration
DMF	MA Department of Fish and Game, Division of Marine Fisheries
DPW	Department of Public Works
ED	Executive Director, MassBays
EDA	Estuary Delineation and Assessment
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ENHC	Essex Natural Heritage Commission
ESG	Ecosystem Services Gradient
ETT	Ecohealth Tracking Tool
FTE	Full-time Equivalent
GOMC	Gulf of Maine Council on the Marine Environment
IRWA	Ipswich River Watershed Association
ISA	Interagency Service Agreement
LGC	Local Governance Committee
LID	Low Impact Development
LNS	Lower North Shore (MassBays Region)
LOE	Level of Effort
MC	Management Committee
Mass Audubon	Massachusetts Audubon Society
MassBays	Massachusetts Bays National Estuary Partnership
MassDOT	MA Department of Transportation
MassDPH	MA Department of Public Health
MB	Metro Boston (MassBays Region)
MBL	Marine Biological Laboratory
MCCA	Massachusetts Coastal Condition Assessment
MET	Massachusetts Environmental Trust
MIT Sea Grant	MIT Sea Grant College Program
MMC	Massachusetts Marine Collective
MOP	Massachusetts Oyster Project
MOTN	Marine & Oceanographic Technology Network
MME	Massachusetts Marine Educators

Acronyms and Abbreviations, continued

MPG	Multipurpose Program Grant
MS4	Municipal Separate Storm Sewer Systems
MVP	Municipal Vulnerability Preparedness
MVPC	Merrimack Valley Planning Council
MWRA	Massachusetts Water Resources Authority
MRWC	Merrimack River Watershed Council
MyRWA	Mystic River Watershed Association
NECC	Northern Essex Community College
NEP	National Estuary Program
NEPORT	NEP On-line Reporting Tool
NERACOOS	Northeast Regional Association of Coastal and Ocean Observing Systems
NHDES	New Hampshire Department of Environmental Services
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NS	North Shore (LNS + UNS MassBays regions)
NSRWA	North and South Rivers Watershed Association
NU	Northeastern University
NUMSC	Northeastern University Marine Science Center
NWF	National Wildlife Federation
NWR	National Wildlife Refuge
O&M	Operations and Management Plan
ORD	Office of Research and Development, EPA
OST	Office of Science and Technology, EPA Headquarters
PFAS	Per- and PolyFluoroAlkyl Substances
PIE-Rivers	Parker-Ipswich-Essex Rivers Restoration Partnership
PRNWR	Parker River National Wildlife Refuge
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RC	Regional Coordinator
RCC	Restoration Coordination Center (Cape Cod)
RPA	Regional Planning Agency
RSP	Regional Service Provider
SLL	Stone Living Lab
SLR	Sea Level Rise
SS	Staff Scientist, MassBays OR South Shore (MassBays Region)
SSCW	Salem Sound Coastwatch
SSL	Sustainable Solutions Lab
SSU	Salem State University
STAC	Science and Technical Advisory Subcommittee, MassBays
TNC	The Nature Conservancy
TTOR	The Trustees of Reservations
UHI	Urban Harbors Institute
UMB	University of Massachusetts Boston
UNH	University of New Hampshire
UNS	Upper North Shore (MassBays Region)
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAA	Watershed Action Alliance
WBNERR	Waquoit Bay National Estuarine Research Reserve
WHOI	Woods Hole Oceanographic Institution
WWTP	Wastewater Treatment Plant

A. Summary

2021-2022 Progress and Accomplishments

In our annual **NEPORT reporting** to EPA for October 2020 through September 2021, MassBays submitted documentation of 154 acres of habitat restored, as well as more than 3 miles of fish runs, and leveraged funding of more than \$2million during the NEPORT reporting period of October 1, 2020 through September 30, 2021. This translates to \$4 cash and in-kind support secured for every \$1 invested by EPA. Leveraged funds are in addition to the 1:1 non-federal resources put forward as direct match to EPA's funding under CWA §320.

Restoration targets for coastal habitat extent and condition have been finalized for eelgrass, salt marsh, and tidal flats, and are being incorporated into MassBays' Comprehensive Conservation and Management Plan (CCMP), with work underway to develop targets for diadromous fish habitat. We acknowledge the significant assistance received from EPA's Office of Research and Development (ORD) and Office of Water/Office of Science and Technology (OW) to implement the Biological Condition Gradient for this purpose.

With help from EPA OW, MassBays now has a **Data Exploration Tool**, which provides MassBays' RCs and Boston staff ready access to data compiled in the EDA, as well as the historic data sets and categorization of embayments that were prepared for the BCG process. Then, with EPA Exchange Network Grant funding (2018 award, Grant No. OS-83941701-1), this June MassBays completed a public-facing interactive data mapping tool, the **Ecohealth Tracking Tool (ETT)** available at www.MassBaysEcohealth.org.

Completed an internal program review process which resulted in identification of a new host entity for MassBays. We submit this proposed workplan as a Center within the University of Massachusetts Boston's School for the Environment, the result of a thorough and thoughtful process initiated and carried out by MassBays' MC and based on a vote of Committee members. Consideration of the transition process to date has encompassed everything from transfer of funds and projects to repositioning of staff as Research Staff at the University.

"Exploring stakeholders' ecosystem services perceptions across Massachusetts Bays using deliberative valuation" was submitted in April 2022 for publication in Environmental Management by UMass Boston researchers with MassBays staff as co-authors. This report documents the process and results MassBays used to identify ecosystem benefits provided by eelgrass, salt marshes, and tidal flats that are important to local community members.

New connections to environmental justice communities were established when MassBays became a partner on an NSF planning grant, and the ED facilitated four workshops with members of underserved communities in Plymouth and Falmouth (Herring Pond Wampanoag and Cape Verdean communities, respectively). With assistance from the Mystic River Urban Waters Ambassador, MassBays Regional Coordinators now have new tools for identifying and reaching out to local EJ communities

In Salem, the RSP assisted in expanding the urban forest through meetings with neighborhood associations, a Facebook page and introductory video, and volunteers – in the first season they planted more than 400 trees in Environmental Justice (EJ) neighborhoods. This effort, in collaboration with DCR, is a "Greening Gateway Cities" project.

Healthy Estuaries Grant Program projects were completed, including a relaunch of the Merrimack River Watershed Council's water quality and bacteria monitoring on the lower portion of the river; research to develop design standards for docks and piers in the vicinity of eelgrass, an inventory of Belle Isle Marsh, Boston's last remaining salt marsh; and monitoring in Cape Cod Bay to characterize the extent and impacts of coastal acidification.

MassBays made two successful applications for additional funding: 1) a NOAA Project of Special Merit to improve reliability and support more up-to-date mapping of eelgrass in Massachusetts waters, and 2) an EPA Exchange Network project to develop tools to help local monitoring groups improve data management practices, as well as analyze and share their data with multiple audiences. Both projects are underway.

See **Section B, Completed Major Projects**, for more detail on these and other accomplishments.

2022-2023 Proposed Work

Highlights of proposed new work for the coming year include:

- **Submitting MassBays' CCMP.** While developing the habitat targets for the final CCMP, MassBays has already implemented many actions included in the plan submitted in 2019. We will submit the final document to EPA in the first quarter of our grant award period, including updates to all sections and actions as needed, as well as planned spending under the Bipartisan Infrastructure Law (BIL, the Infrastructure Investment and Jobs Act of 2021).
- **Establishing a new Center at University of Massachusetts Boston.** Within its new host entity, MassBays will become a Center within the School for the Environment (SFE) on the Boston Harbor campus, and MassBays will become research staff at the institution. Along with this shift, MassBays will **develop an updated Finance Plan** to accompany the CCMP to incorporate new funding opportunities and partnerships enabled by our new host arrangement.
- **Final reporting on a project to increase agency confidence in eelgrass maps used for project review and ocean planning.** MassBays is leading this Project of Special Merit with funding from NOAA, and in collaboration with CZM. The goal is to facilitate comparison across remote sensing methods for eelgrass mapping.
- **Investigate aquaculture-eelgrass interactions to inform policy.** With MIT Sea Grant, MassBays will convene workshops to identify and discuss interactions between aquaculture and eelgrass.
- **Launch MassWateR.** With funding from EPA's Exchange Network Grant Program, MassBays will publish an R package which monitoring partners can use to carry out QA/QC data analysis according to DEP and EPA standards.
- **Expanding support to underserved and environmental justice communities.** All RSPs, along with Central Staff, will use information provided by the Mystic River Urban Waters Ambassador to offer direct assistance and capacity-building to facilitate community input into decision making.
- **Monitoring and restoring blue mussels at the mouth of the North and South Rivers.** The South Shore RSP will launch a multi-year shellfish restoration project in the near-subtidal and low-intertidal zones to benefit migratory shorebirds and restore a crucial hard-bottom species.
- **Monitoring for sea brook trout in Manchester-by-the-Sea.** The Lower North Shore RSP will begin a citizen monitoring program to record temperatures in Sawmill Brook and Cat Brooks and sample environmental DNA for sea brook trout, herring and rainbow smelt.
- **Incorporating socioeconomic variables into restoration planning.** The Metro Boston RSP will identify and compile data for socio-economic variables to assess relationships among stressor, resource, and socio-economic factors to inform priorities for restoration efforts in environmental justice areas.
- **Reviewing bylaws for climate resiliency.** In cooperation with Greenscapes and with funding from EEA, the Upper North Shore RSP will review and provide model bylaws for municipalities across the North Shore, encompassing stormwater, zoning, wetlands, and subdivision bylaws.

Specific proposed MassBays-wide and regional tasks are described in **Section C, New and Ongoing Projects**.

Staffing and Management

MassBays' Management Committee sets priorities for the program, and fosters partnerships for diverse engagement in our work. Committee members for the period July 1, 2021 through June 30, 2022 are listed in Attachment A.

With this workplan, MassBays begins work with a new host entity, the *University of Massachusetts Boston School for the Environment (SFE)*. This host decision is the result of a process initiated and carried out by MassBays' MC to evaluate hosting alternatives for MassBays in 2021 at the recommendation of an *ad hoc* Program Evaluation Subcommittee. The Subcommittee cited language in MassBays' Structure and Operating Procedures stating that such an evaluation would take place "periodically;" in addition, EPA's findings from previous Program Evaluations pointed out that MassBays should seek opportunities for more independent communications and diverse funding opportunities. A separate Evaluation Team led by the MC Chair was delegated by the MC to solicit Statements of Interest from potential host institutions. The seven-member team included MC representatives from business, nonprofit organizations, academia, and a state agency. Evaluation criteria were vetted by the MC, then used to carry out a transparent and objective Analytical Hierarchy Process through which those criteria were weighted in terms of importance to MassBays' operations and sustainability. EPA Region 1 provided critical input regarding considerations of host capacities, timelines, and lessons learned from similar evaluations undertaken by other NEPs. A final vote by the MC determined that MassBays should pursue hosting by UMass Boston contingent on satisfactory responses to final questions regarding program and communication autonomy, adequate office space, confirmed return on indirect, and equivalent salaries and benefits for staff.

Final terms of the agreement reached between the MC and UMass Boston include a transition to the new host to be completed by October 1, 2022 with the following confirmed and in place:

- MassBays will be a Center within SFE. As a Center, the Director has the authority to hire, evaluate, and with due process remove staff in accordance with HR procedures.
- MassBays personnel will be Professional Staff Union-represented research staff at the University, with authority as principal investigators to seek diverse funding initiate and implement funded programs.
- UMass Boston will provide the following:
 - In-kind technical, communications and outreach, and development assistance.
 - Office space for up to five staff, and meeting space.
 - Fiscal management, IT, and HR services.
 - Photocopiers and printers, computers and software, and internet and phone services.
- MassBays will apply UMass Boston's federally negotiated indirect rate (currently 52.5%) to the following line items: salaries, fringe, contracts, pieces of equipment less than \$5000, travel, and the initial \$25,000 of subawards in the first year of any multi-year agreements.
- SFE will provide 30% return on indirect costs incurred on MassBays funds to MassBays at the close of the fiscal year; these funds will be used by the program to implement the MassBays CCMP as endorsed by the MC in the annual workplans.

Executive Director Pam DiBona is responsible for the overall management of the program, including reports to EPA and other funders; staff supervision, including oversight of Regional Service Providers in line with contracts. She works closely with the Management Committee Chair to guide organizational development, including strategic planning and communications, and securing supplemental funding to implement the CCMP.

Staff Scientist Prassede Vella is MassBays' lead for all MassBays monitoring and technical reporting efforts. She coordinates the Healthy Estuaries Grant Program, staffs the Science and Technical Advisory Subcommittee to our Management Committee, and collaborates with institutional partners to generate data critical to MassBays CCMP implementation.

Coastal Data Scientist Jill Carr is a 0.8FTE staff person funded by supplemental grant awards external to the S.320 cooperative agreement for FFY22. In addition to providing technical assistance to community-based monitoring groups across the MassBays planning area with training and new tools to make more quality data available, she leads MassBays’ habitat monitoring and mapping efforts. Both are important inputs to meeting our CCMP goals.

Regional Service Providers (RSPs) connect MassBays with planning area communities organized under five regions: Upper North Shore, Lower North Shore, Metro Boston, South Shore, and Cape Cod. Under cooperative grants from MassBays, each RSP designates a Regional Coordinator, in turn responsible for identifying regional priorities consistent with the outcomes articulated in the CCMP, and implementing an annual workplan at the local level. For FFY2022, the following organizations will serve in this capacity:

- Merrimack Valley Planning Commission (MVPC)/MassBays Upper North Shore Region
- Salem Sound Coastwatch (SSCW)/MassBays Lower North Shore Region
- Northeastern University Marine Science Center (NUMSC)/MassBays Metro Boston Region
- North and South Rivers Watershed Association (NSRWA)/MassBays South Shore Region
- Association to Preserve Cape Cod (APCC)/MassBays Cape Cod Region

Finally, MassBays will administer the Urban Waters grant to Mystic River Watershed Association through a subaward pending incremental allotments from EPA.

FFY2022 Budget Overview

A detailed budget request and narrative are included in **Section D**; a summary is included here:

Salary & fringe	\$ 232,501
Travel	\$ 6,042
Contractual	\$ 300
Other Direct Costs	\$ 410,139
Indirect	\$ 191,018
Total Request	\$ 840,000
Non-Federal Match	\$ 846,266

B. Completed Major Projects and Activities (July 1, 2021 to June 30, 2022)

MassBays' Workplan for FFY2021 was guided by the Goals and Strategies of our Interim CCMP:

Goal 1. MassBays provides new resources to support research and management in the Bays.

Strategy 1.1 Make new data available, especially to address gaps in knowledge

Strategy 1.2 Support valid (QA/QC) data collection and use

Strategy 1.3. Analyze and present existing data in multiple formats to document baselines and trends

Goal 2. MassBays reaches all planning-area municipalities with actionable information about coastal habitats

Strategy 2.1 Support and conduct research to address gaps in knowledge and inform policy and actions regarding ecosystem conditions and functions

Strategy 2.2 Provide education, training, and technical support; share case studies (successful and not); and support collaboration and cooperation on specific topics

Strategy 2.3 Facilitate access to decision making forums, and increase influence on decision making by underserved communities

Goal 3. MassBays provides regular and locally informed State of the Bays reporting that reflects the unique characteristics of MassBays assessment units (embayments, rocky shore, barrier beach), and documents progress to inform local action and progress toward target conditions.

Strategy 3.1 Establish target (improved) water quality and habitat conditions tied to desired uses and ecosystem services, and document progress toward those targets.

Strategy 3.2 Guide local action to expand habitat and improve water quality according to targets

Strategy 3.3 Maintain MassBays' National Estuary Program status

Our work is closely aligned with the Clean Water Act Core Programs, which are:

- (1) establishing water quality standards
- (2) identifying polluted waters and developing plans to restore them (total maximum daily loads)
- (3) permitting discharges of pollutants from point sources (National Pollutant Discharge Elimination System permits)
- (4) addressing diffuse, nonpoint sources of pollution
- (5) protecting wetlands
- (6) protecting coastal waters through the National Estuary Program
- (7) protecting Large Aquatic Ecosystems.

The following list of accomplishments is organized according to the CCMP Strategies included in our 2019 Interim CCMP completed by June 30, 2021. Each project description includes the following:

Title

CWA core program: Per list (1-7) above

Objective: project-specific objective

Partners: Collaborators not directly funded by MassBays/\$320 funds

Status: as of June 2022

Accomplishments and Deliverables: completed products

Strategy 1.1 Make new data available, especially to address gaps in knowledge

Title	Implement MassBays Monitoring Plan (Central Staff)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Compile data sets for MassBays' delineated embayments, toward the goal of comprehensive and specific State of the Bays reporting.
Partners	STAC, DEP, SSCW, SSU, CCS, CZM, ACASAK Technologies
Status	Year 2 pilot completed; contract renewed for the second monitoring year: 25 sites in the near-shore region from Cohasset to Provincetown, as well as the outer Cape Cod coast around Provincetown to the National Seashore.
Accomplishments and deliverables	
Implemented Year 2 of the MA Coastal Conditions Assessment (Year 2021)	Coordinated fieldwork including monthly survey (June-August) of Region A (Salisbury to Boston Harbor) to assess coastal conditions. During Year 2, work included water quality monitoring, sediment quality monitoring and identification of benthic macroinvertebrates from 25 sites across Massachusetts. Data have all been analyzed. Benthic infauna analysis was funded by the Massachusetts Ocean Trust Fund. Planning for Year 3 (25 sites, Region B) was initiated in the Spring in preparation for the field season.
Investigate nutrients in Salem Sound	Conducted monitoring according to approved QAPP in Danvers River and Salem Sound between July and September 2020. This built on the monitoring conducted in 2019. Gathered new baseline data for nutrients, sediment characterization, and benthic community structure in Salem Sound. A report of findings and recommendations for next steps was developed and submitted to EPA in May 2022. Results presented at Underwater Salem Series (May 18, 2022).
Title	Investigate microplastics in Ipswich Bay beach sand and water column (Upper North Shore)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Estimate the reach and degree of microplastic pollution.
Partners	BU, UNH, NECC, SSS
Status	Developed new protocols for beach sand microplastic collection and processing. The new protocols were based on "lessons learned" from last year's effort, including for example sampling sand and wrack at the king tide wrack line.
Accomplishments and deliverables	
Recorded baseline conditions in Great Marsh beaches.	The RC sampled three of the six beach site locations (Plum Island Lot1, Plum Island North Point, and Salisbury Beach) after the fall king tide and submitted to NECC for processing as part of student thesis work.
Recorded baseline conditions in Ipswich Bay waters.	Water column microplastic samples collected in the Little River, Parker River, Rowley River, Ipswich River, and the Plum Island Sound through May 2022. Established a new partnership Triple Ring Technologies (a tech incubator) to help alpha test their prototype microplastic water column sampler.

Title	Monitor Cyanobacteria blooms (Cape Cod)
CWA Core Program	Protecting coastal waters through the National Estuary Program; Identifying polluted waters and developing plans to restore them
Objective	Collect actionable information on harmful cyanobacteria blooms for the public and decisionmakers.
Partners	EPA, towns of Brewster, Chatham, Barnstable, Dennis, Yarmouth, MA Department of Public Health, MA DEP, MET
Status	Outreach efforts have increased visibility of the problem that exists in many CC ponds as documented by volunteer monitoring.
Accomplishments and deliverables	
Revised Risk Categories accepted by local health agents and MassDPH	APCC revised Risk Categories for interpreting and reporting results to health agents and the public, to include DPH criteria and toxin testing if warranted - this was accepted by health agents and MassDPH for 2022, a major achievement - see updated webpage at https://apcc.org/our-work/science/community-science/cyanobacteria/ represents a major step forward in this program to raise public awareness of the health and ecological threats posed by cyanobacteria blooms.
Report on transport of cyanobacteria and cyanotoxins via herring	Pilot study "Pond-to-Sea" cyanobacteria-herring project and status of herring found cyanotoxins were present in juvenile herring and in stream water and pond water along two herring runs in Brewster and Mashpee.

Title	Monitor Diadromous Fish Runs (South Shore, Cape Cod)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Provide local, state, and federal fisheries managers with population estimates of river herring at monitored runs to inform protection, restoration and management efforts. Monitoring by volunteers also supports citizen stewardship of runs.
Partners	DMF, NOAA Fisheries, Herring River Network, citizen volunteers
Status	Data submitted for 2021 runs; 2022 counting efforts were taken up by volunteers once again this year.
Accomplishments and deliverables	
2021 Herring run results reported (SS, CC)	Data submitted to DMF.
Trends report for Cape Cod runs from 2007 to 2021 completed	Plots of herring run size estimates over time indicate that for most if not all runs, the highest numbers occurred in past years (i.e., runs have not really recovered despite the ban on fishing). Some runs have declined significantly over time, while others have oscillated up and down within limits. Most runs number in the 10,000s, a few runs number in the 100,000s, and a few runs number less than 1000.
2022 counts carried out	Eight groups of volunteers were trained for CC monitoring at 16 sites; Six SS sites were monitored by trained volunteers. The South River run was also monitored using a camera system.

Title	Long-term Monitoring of Salt Marsh Vegetation Change (South Shore)
CWA Core Program	Protecting wetlands
Objective	Work with volunteers to monitor salt marsh vegetation changes through the Salt Marsh Sentinels program.
Partners	Private dock owners, volunteers
Status	2021 data and 5-year trends shared with multiple audiences
Accomplishments and deliverables	
Year 5 training, monitoring, and reporting completed	Program expanded to Cohasset, results presented to multiple audiences, including volunteers, Massachusetts' Salt Marsh Working Group, and CERF biennial meeting.

Title	Mapping Sea Level Rise-induced Marsh Platform Die-off Areas (Upper North Shore)
CWA Core Program	Protecting wetlands
Objective	Document impounded water and die-off using drone imagery and field surveys.
Partners	UNH, BU, 8TGM
Status	2021 data collected and mapped
Accomplishments and deliverables	
Previously mapped die-off areas confirmed	Marsh die-off sites were ground-truthed by drone at previously flown sites in Salisbury, Newbury, and Rowley; flight schedule determined for 2022.

Title	Marine Invasive Species Monitoring (Upper North Shore, Lower North Shore)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Monitor established field sites for non-native species in cooperation with CZM
Partners	CZM, volunteers
Status	Monthly monitoring conducted June-October, 2021; data submitted to CZM
Accomplishments and deliverables	
Monitoring sites across MassBays' planning area	All monitoring carried out as planned, including volunteer training, and photo-documentation of the Beverly Pier settle plates. LNS trained a new volunteer coordinator to lead this effort for their region.

Title	Horseshoe Crab Spawning Surveys (South Shore)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Conduct horseshoe crab spawning surveys in Duxbury Bay to assess the population
Partners	DMF, volunteers
Status	2021 data were submitted, 2022 surveys were conducted and data summary is in process.
Accomplishments and deliverables	
Reporting up-to-date	Data for the 2021 season were submitted to DMF.

Title	Water quality monitoring (South Shore, Lower North Shore)
CWA Core Program	Protecting coastal waters through the National Estuary Program; Identifying polluted waters and developing plans to restore them
Objective	Lead citizen monitoring in coastal waters to identify potential for remediation and source control.
Partners	EPA, MassDEP, municipalities
Status	2021 monitoring completed; plans for 2022 sampling season are in place.
Accomplishments and deliverables	
Riverwatch monitoring (SS)	Eight sampling events held over the course of the 2021 field season; sampling at 10 sites for the 2022 season began in June 2022. With SS support, the Town of Hanover received a DEP Water Quality Monitoring Grant to engage the RSP in conducting bacterial source tracking in the headwaters of the North River.
Clean Beaches & Streams and tributary monitoring (LNS)	Water samples collected biweekly from June through August 2021 at up to 18 outfalls and streams for bacterial analysis following an approved 2020 QAPP; results published on SSCW website at https://www.salemsound.org/CB&S.html . Remediation efforts taken up by municipalities in response to the findings include a new project in Sawmill Brook (Manchester), new sewer lining in Salem along Loring Ave prompted by LNS reports of algae in the Forest River, and sewer replacement along Forest River in Salem.

Title	Assess Coastal Acidification in Massachusetts (Central Staff, South Shore)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Assess coastal acidification conditions in Duxbury Bay.
Partners	EPA, UMB, Town of Duxbury
Status	MassBays' coastal acidification monitoring system is deployed and collecting continuous data. Central Staff and RCs continue engagement with state and regional entities investigating potential impacts and responses.
Accomplishments and deliverables	
Ocean acidification monitoring system developed and deployed in Duxbury Harbor	Following testing of the system and some final troubleshooting in 2020, the system was deployed in Duxbury Harbor for the second time in July 2021. After 4 weeks of data gathering the system was flooded during a storm and had to be recovered. The system sustained extensive damage and is currently being repaired. The data gathered in 2021 provided a brief insight into pH variation across tidal cycles. However more data are needed to be able to establish causality of observed low pH data of short-time duration. A third and final attempt at deployment of the prototype was initiated in May 2022 and the system is still operating well as of June 2022.

Strategy 1.2 Support valid (QA/QC) data collection and use

Title	Support for Citizen Science Monitoring Efforts (Central Staff)
CWA Core Program	Identifying polluted waters and developing plans to restore them
Objective	Increase the value and use of citizen monitoring data for decision making across the region.
Partners	Monitoring Coordinators Network, CSA Data Quality and Metadata Working Group, MassRivers Alliance, DEP, EPA EN, EPA Region 1, Eastern Research Group, UMCES-IAN
Status	One-on-one assistance to groups continues via Zoom and in person, as well as engagement with regional and national efforts. Training, outreach and technical support continues to promote use of AquaQAPP (launched in Fall 2021) and submission of data to WQX.
Accomplishments and deliverables	
AquaQAPP outreach	Presented at local, regional and national-scale venues to demonstrate AquaQAPP and promoting its use in developing Quality Assurance Project Plans. Several NEPs and state agencies across the country have requested one-on-one demonstrations and discussions about how to use and/or adapt the tool to their area. Dozens of watershed groups in Massachusetts have interacted with the tool, and several have already used it to generate QAPPs for review by EPA and DEP in support of water quality monitoring grants.
One-on-one tech support provided	Provided technical support to 13 watershed monitoring programs, including developing appropriate monitoring methods for salt marsh and eelgrass studies, developing research goals of a new water monitoring program in Swampscott, assisting in developing a QAPP for D.O. monitoring in the Parker River, serving on a monitoring steering committee, providing custom WQX training, assisting with data formatting for import to WQX, developing a process by which to submit data from a regional database into WQX, helping strategize new citizen science opportunities, and providing connections to assist in setting up new lab equipment.
Launch of new seagrass monitoring tool	Officially launched a citizen science eelgrass monitoring app, iSeaGrass (www.iseagrass.com), which was developed in collaboration with DMF. Presentations given to various local and national audiences on its use to promote open seagrass data.
WQX custom data import configurations	In process of developing custom import configurations for three organizations (Center for Coastal Studies, MWRA, Cape Cod Commission) to help facilitate their data sharing via WQX. Once finalized, this will make the groups' data findable to the public and will allow incorporation into other data products like MassBays' ETT.
Secured EPA Exchange Network funding	In November 2021, kicked off new Exchange Network grant project, Building Technical Capacity for Data Analysis & Visualization. Project will develop a suite of R-based packages for streamlining and standardizing data QA/QC, analysis and visualizations; host beta testing and training sessions; and develop and Community of Practice. Monitoring Groups gain expanded capacity for data analysis and reporting, and more data are contributed to WQX.

Strategy 2.1 Support and conduct research to address gaps in knowledge and inform policy and actions regarding ecosystem conditions and functions

Title	2020-2021 Healthy Estuaries Grant Program
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Improve understanding and extent of data available across MassBays' planning area.
Partners	EPA, SSCW, CCS, MyRWA, MRWC
Status	All projects completed.
Accomplishments and deliverables	
Project summaries are posted on the MassBays website	MassBays administered the 3rd round of the grant (2020-2021). Technical support was provided as needed by the Regional Service Providers for projects in the respective regions. The four funded projects covered a wide variety of topics and geographic areas. All projects have been wrapped up and results are available at https://www.mass.gov/service-details/projects-funded-by-massbays-grant-programs (projects dated 2020).

Title	Increasing agency confidence in eelgrass maps used for project review and ocean planning
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Investigate eelgrass remote sensing techniques to quantify mapping and edge detection accuracy.
Partners	Massachusetts Office of Coastal Zone Management (co-PI), Massachusetts Department of Environmental Protection, Massachusetts Division of Marine Fisheries, NSRWA, SSCW, MIT Sea Grant, Northeastern University
Status	Won grant in Fall 2021 and kicked off project by convening Advisory and Steering Committees. QAPP approved. Field surveys to be completed June 2022 and analysis and reporting to be completed by April 2023.
Accomplishments and deliverables	
Project planning	Advisory Committee made up of local experts was convened on two occasions to get feedback on proposed sites, field survey methods, and analytical processes. Steering Committee comprised of project partners met to establish roles, schedules and equipment needs.
QAPP development	QAPP finalized, signed by EPA QA Officer and distributed to partners.
Data acquisition	Field surveys completed in June 2022 following protocols described in the QAPP.

Title	Assess Impacts of <i>Phragmites</i> Management Practices in the Great Marsh (Upper North Shore)
CWA Core Program	Protecting wetlands
Objective	Determine progress regarding <i>Phragmites</i> removal in the Great Marsh and investigate potential adverse impacts of repeated herbicide application.
Partners	BU
Status	Interim report completed and results presented at the February 2022 quarterly meeting of the MassBays MC
Accomplishments and deliverables	
Interim findings presented	<ul style="list-style-type: none"> • Three years of monitoring appears to be sufficient to evaluate the success of <i>Phragmites</i> die-off and native plant recovery. • Plant assemblages may continue to change as conditions stabilize and/or as sea level rises. • Maintenance treatments will most likely need to be performed every other year to fully control <i>Phragmites</i> invasion into the open, high marsh. • Rising seas flooding the marsh with higher-salinity water to a depth and with a frequency undesirable to <i>Phragmites</i> will help keep open marsh <i>Phragmites</i> colonization at bay. • <i>Phragmites</i> may be more tolerant or more adaptable to SLR than many other high marsh vegetation.
Compared treated to untreated sites	Presence/absence of <i>Phragmites</i> and status of native marsh vegetation and benthic conditions assessed at nine Presence/Absence sites and six Marsh Vegetation Recovery sites.

Title	Seagrass Seed Restoration Pilot Study (Metro Boston)
CWA Core Program	Protecting Large Aquatic Ecosystems.
Objective	Pilot a seed-based eelgrass restoration effort in areas around Boston Harbor and evaluate its effectiveness
Partners	EPA, BU, BHEN, Girls Inc.
Status	Seedlings observed in April 2022; program evaluation underway
Accomplishments and deliverables	
Seeds collected, transplanted, and monitored	In collaboration with scientists at NUMSC, EPA, and BU and engaging girls in the Beach Sisters program at Girls, Inc., seagrass seeds were planted at two sites in Winthrop MA in late September/early October using three methods. Monitoring for germination in November, and again in April; seagrass seedlings observed at both sites in April 2022.
Letter of Interest submitted under the NEP Coastal Watershed Grant Program	Proposed project submitted in September 2021, “Restoring eelgrass habitat by seed using community science in MassBays NEP” was not selected for funding.

Title	Dam Removal Implementation and Monitoring: Peterson Pond, Veterans Memorial Park, Temple Street Dams (South Shore)
CWA Core Programs	Protecting coastal waters through the National Estuary Program
Objective	Work with regional communities and other partners to assess feasibility and seek funding for removal of dams and other barriers and collect ecological data pre- and post-restoration
Partners	NOAA Fisheries, DER, Towns of Marshfield and Duxbury: dam removal project technical assistance and management
Status	Peterson Pond dam removed; progress continues on others
Accomplishments and deliverables	
Peterson Pond Dam post-removal monitoring	Progress reports provided to funding agency
Temple Street Dam (Marshfield & Duxbury) removal assessed	Permitting underway
Luddams Ford Dam (Hanover & Pembroke)	Natural Resources Damages Grant secured for feasibility study

Strategy 2.2 Provide education, training, and technical support; share case studies (successful and not); and support collaboration and cooperation on specific topics

Title	MassBays Science Walk (All regions)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	To share information with diverse learners about research, monitoring, and restoration in the Bays, and the importance of estuaries
Partners	MIT Sea Grant, MyRWA, CCS, DMF, MOP, MRWC
Status	Seventeen vinyl banners were presented at public spaces throughout the region from June to November 2021 and shared on MassBays' website. Installation locations included Martin's Park near the Boston Children's Museum (Boston), the Cape Cod Museum of Natural History (Brewster), Rock Harbor (Orleans), the Ipswich Mills Dam (Ipswich) and along Fishermans Beach (Swampscott). (https://www.mass.gov/info-details/massbays-science-walk-2021)
Accomplishments and deliverables	
Expanded reach	Family-friendly banners presented in well-travelled public sites. Each poster included QR codes to facilitate more in-depth exploration.
Built capacity among partners	Consultant provided training and one-on-one support to leads on poster preparation, improving ability to communicate with public audiences.
Documented MassBays' contributions to work in the estuaries	The range of projects supported by MassBays was well-represented by the posters, and included two posters to bracket the walk describing MassBays and the importance of estuaries.

Title	City Nature Challenge – Boston Area (Central Staff)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	To engage diverse learners in watershed and increase awareness of beaches as coastal habitat
Partners	Brandeis University, Zoo New England, Earthwise Aware, National Park Service, Suffolk University, UMB
Status	International annual Challenge completed May 2021. MassBays' iNaturalist project, #MassWrack, was featured in outreach materials.
Accomplishments and deliverables	
Expanded reach	MassBays' logo was included in all materials, including Boston's project page on the international City Nature Challenge website (https://www.inaturalist.org/projects/city-nature-challenge-2022-boston-area)
Supported partnerships	ED served on the steering committee, and secured outreach via REI's new retail location in North Point, Boston.
#MassWrack observations analyzed through June 2021	UMB graduate intern Shannon Hogan analyzed #MassWrack observations collected through June 2021 to catalog species utilizing this coastal habitat. She presented "What's in the wrack – and why we should protect it" to the MC September 2021. Her recommendations were to: 1) encourage communities to include wrack in their beach management plans; 2) study whether beach characteristics affect the type and variety of organisms in the wrack, 3) conduct a survey to determine the public's perception of wrack and inform outreach efforts, and 4) explore the use of less-destructive grooming techniques.

Title	Support municipal and regional actions that promote resilient coastal habitats and communities through the use of nature-based solutions (All regions)
CWA Core Programs	All
Objective	Work with partners and communities to encourage planning for climate change including stormwater management and adoption of adaptation measures that promote resilient coastal habitats, especially via nature-based solutions.
Partners	TTOR, Tufts, UNH, BU, Pew Foundation, MassAudubon, Northeast Coastal Coalition, LGCs, CCC, NOAA Restoration Center, WBNERR, CZM
Status	MassBays continues to be a key player in communication and outreach efforts, planning initiatives, and implementation of nature-based coastal management.
Accomplishments and deliverables <i>Climate resilience</i>	
Regional meetings, workshops, and lectures (All regions)	All RCs and Central Staff hosted and/or participated in events describing the impacts of climate change, especially regarding sea level rise and more frequent and severe storms. For example, the Metro Boston RC collaborated with UMass Boston's Stone Living Lab to produce a conference for more than 150 people on October 26, 2021, with a theme of Resilient Boston Harbor, featuring lightning talks and research posters by presenters from 15 institutions, agencies, and organizations around Boston, including breakout groups for discussion and networking.
Contributed to regional planning (All regions)	All RCs and Central Staff contributed to regional plans, including The Trustees' coastal strategy, North Shore Drought Management Committee, PIE-Rivers Steering Committee, the South Shore Climate Group, Cape Cod Conservation Agents network, etc. In October 2021 Central Staff convened a Forum on Hypoxia in Cape Cod Bay to investigate potential causes (including climate change) of low-DO events at the request of EPA Region 1. https://youtu.be/dotclCC-ypE
Implemented coastal resilience grants (LNS)	RC was a team member on an MVP project to develop a Peabody/Salem North River multi-use path, and Salem's CZM Coastal Resilience Grant titled "Climate Deep Dive" in an EJ community.
Facilitated planting of 409 trees in Salem (LNS)	SSCW served as outreach partner for Salem's Greening Gateway City program, which has a goal of planting 2400 trees in EJ neighborhoods. Produced a video, attended and presented at neighborhood association meetings, collaborated with Tree Commission and DCR forester. https://www.facebook.com/GGCSalem/
Conducted beach profiling (SS)	Monthly beach profiles conducted in Duxbury Beach Reservation, in collaboration with UMB.
Assisted with grant project scoping and applications (All regions)	All RSPs provided input and technical support to municipalities applying to climate change-focused grant programs, including EEA MVP, CZM Coastal Resilience, and SNEP

Title	Support municipal and regional actions that promote resilient coastal habitats and communities through the use of nature-based solutions (All regions) <i>continued</i>
Accomplishments and deliverables <i>Stormwater management</i>	
Inventory of stormwater improvement opportunities at public boat ramps completed (CC)	RSP hired an engineering firm to assess and provide conceptual stormwater BMPs for 20 public boat ramp sites, which will be used to prioritize 5 sites for 75% plans. Eleven towns are participating, including several in the Cape Cod region who have public boat ramps in the MassBays area.
Reviewed and advised on municipal bylaws for LID (LNS)	With funding from DEP's Municipal Assistance Grant Program, provided ordinance and bylaw review for LID advancement to 7 municipalities.
Completed Spanish-language LID maintenance videos (LNS)	Produced Spanish versions of six training videos previously developed by SSCW for DPW workers charged with maintenance of green infrastructure for stormwater management. Topics include rain gardens, high-performance biofiltration systems, catch basin inserts, and bioswales.
Supported municipal stormwater management actions (UNS, LNS)	LNS and UNS RSPs carried out work through the Greenscapes program, which included 24 North Shore communities this year. Completed work includes: "Keeping Water Clean" school-based program, a public program for 150 people held at the Beverly Cabot Theater, and an online LID toolkit (https://greenscapes.org/lid-toolkit/).
Accomplishments and deliverables <i>Habitat Restoration</i>	
Advised on a new living shoreline project (LNS)	Based on their experience with the Collins Cove (Salem) Living Shoreline project (final project information shared at http://salemsound.org/livingShoreline.html), the RC joined site walks and made recommendations for a new living shoreline project at Forest River Park in Salem. Shared lessons learned with MassAudubon staff, and through a public lecture to 98 participants (available at https://vimeo.com/675015566).
Runnels implemented in Essex Bay salt marshes (UNS)	Potential sites on properties owned by the Town of Essex, the Trustees, and other private property were assessed, permits obtained, and runnels implemented and mapped. Monitoring of the sites is underway.
Restoration funding secured (CC)	In April 2022 NRCS announced that the Cape Cod Water Resources Restoration Project will receive FY22 funding of \$42.5 million for 21 restoration projects on Cape Cod, including 13 on the Cape Cod Bay side. The list of funded projects was developed with assistance from APCC, and the RC which met with towns to identify their priorities for restoration, which was used to develop a comprehensive inventory of potential restoration projects.
Joint presentation to Massachusetts Conservation Commissioners (CS, All Regions)	"Successful habitat restoration requires follow-through: coastal case studies and recommendations", presented by Central Staff and all RCs to the Massachusetts Association of Conservation Commissions during their fall virtual conference on 10/20/21. https://youtu.be/zahFqdqkhMY

Title	Mystic River Urban Waters Activities (MyRWA)
CWA Core Programs	Improved water quality
Objective	Coordinate federal, regional, and local contributions and activities in the Mystic River Watershed, providing communications and outreach support to Merrimack River communities, and assisting MassBays with EJ program development.
Partners	EPA, FEMA, USGS, HUD, Dept of Homeland Security, DEP, MRWC, MassBays RSPs, municipalities
Status	Mystic River Ambassador hired and established as a key point person in the network connecting Urban Waters activities in the watershed and beyond.
Accomplishments and deliverables	
Maintained operations of the Mystic River Urban Waters Federal Partnership	Drafted agendas, meeting minutes for planning meetings of the Steering Committee, met with individual Committee members to gain insights into the perceived value of its work, produced and distributed regular email updates and alerts; maintained regular check-ins with EPA Program Officer.
Coordinated Federal input to Mystic River initiatives	Conducted fact-finding interviews with other Urban Waters sites, met with federal partners to learn about case studies and regional efforts, while sharing ideas for collaboration at the state level.
Implemented local actions related to the “Trash Free Mystic” project	Organized cleanups, published data for the Virtual Trash Free Assessment (https://mysticriver.org/news/2022/3/31/visual-trash-assessments), produced awareness videos (https://fb.watch/clqUJ1MwEZ/), installed a trash boom and developed operations and maintenance plan under a NFWF grant.
Assisted with river stewardship events	Contributed to a suite of programs for Earth Month (https://mysticriver.org/news/earth-month-2022-invest-in-our-planet , including a 100+ person clean up at DCR’s Tolbert McDonald park; investigated potential microplastics monitoring program; provided support to the Mystic River Science Forum planning team.

Title	Presentations & Publications
CWA Core Programs	All
Objective	Share MassBays' findings, projects, and expertise with multiple audiences
Partners	multiple
Status	In spite of COVID, MassBays reached multiple audiences; because of the online nature of COVID-era conferences, we shared our work with international and national audiences previously out of reach.
Accomplishments and deliverables <i>Climate resilience</i>	
Joint output	<p><i>Presentation:</i> “Successful habitat restoration requires follow-through: Coastal case studies,” a MassBays panel and recommendations for restoration pre- and post-monitoring presented at the MACC Fall Conference (10/20/21) https://youtu.be/zahFqdqkhMY</p>
Central Staff outputs	<p><i>Presentations:</i> Panelist for “Meaningful Watershed Educational Experience” hosted by the Scituate High School to provide students with an introduction to the various local organizations, experts and citizen scientists who are currently involved in research and abatement of local impacts of global climate change (5/26/22) “Setting the Baseline for Water Quality and Benthic Communities' in Salem Sound” presented at the Underwater in Salem Sound 2022 Lecture Series (5/18/22) “Connecting environmental science & policy in Massachusetts” presented by SS and ED to an undergraduate lecture class at UMB (4/2022) “It can be done! Increasing the quality, usability and distribution of community science data” presented at the Association of National Estuary Programs (ANEP) - BASIS7 technical transfer meeting (3/1/22) “A Framework for Setting Long-term Targets for MassBays” presented at the Association of National Estuary Programs (ANEP) - BASIS7 technical transfer meeting (3/1/22) “New approaches in seagrass mapping: engaging community scientists and assessing remote sensing accuracy” presented at the Association of National Estuary Programs (ANEP) - BASIS7 technical transfer meeting (3/4/22) Presenter and panelist for “Make Your Citizen Science Project Count: Strategies to Produce Quality Data”, hosted by EPA and APHL (9/15/21) “The Connection Between Mapping Seagrass and Art Inspiration” interview with Boston artist Nedret Andre (2/22/22). “R Tools for Water Quality Data Analysis” presentation to watershed groups from across MA introducing R and new tools under development (2/22/22) “Art and Science talk with artist Nedret Andre and marine scientist Jill Carr” presentation to the Turkish Arts Festival (12/4/21) Panelist for “Water Quality in the Merrimack: A 2021 Review.” a public meeting hosted by the Merrimack River Watershed Association (3/14/22). Peer review of Estuaries and Coasts paper titled: “Stakeholder perspectives on the roles of science and citizen science in Chesapeake Bay environmental management”</p>

	<p>“Considering the Past and Future of Boston Harbor” presented to incoming graduate students in UMass Boston’s School for the Environment. (9/2021)</p> <p><i>Publications:</i> Monitoring Coordinators’ Network email newsletter published 7/2021 and 12/2021; MassBays regular e-newsletter published 7/2021, 12/2021, and 5/2022. https://www.mass.gov/service-details/massbays-newsletter</p>
Upper North Shore outputs	<p><i>Presentations:</i> “Phragmites Control and Monitoring in the Great Marsh”, ECAN, 10/29/2022 “Phragmites Monitoring Activities in the Great Marsh” to the MassBays MC, 2/16/2022 “Great Marsh Proposed Restoration Activities and Projects” to the Great Marsh legislative delegation, 3/25/2022 “Invasive Species of the Great Marsh”, podcast for Manchester Cricket, 5/20/2022 “Great Marsh Coastal Restoration”, the Afternoon Buzz radio show, WHMP, 6/23/2022</p>
Lower North Shore outputs	<p><i>Presentations:</i> “Climate Change on a Local Level” presentation at the <i>Keeping History Above Water: Preservation in a Changing Climate</i> conference hosted by SSCW (9/12 - 9/13/21) “Salem’s Industrial Heritage along a Changing Shoreline” and “Salem’s Colonial Maritime Sites and Rising Tides,” public walking tours (9/13/21) “Marblehead Municipal Light Department and Hammond Park Coastal Resilience Project” presented to the Municipal Light Department Commissioners (11/30/21) “Saving our Shoreline: Building Resilience across Salem Sound Communities” presented as part of <i>Underwater in Salem Sound</i> lecture series (1/19/22) “Marblehead Municipal Light Department and Adjoining Public Lands” presented as a series of public forums (2/7, 3/28, 6/11/22)</p>

Metro Boston outputs	<p><i>Presentations:</i> “Adventures of a (non-swimming) aquatic ecologist - From freshwater to saltwater...” presented to Girls Inc. members, Lynn MA (10/19/21) and HS students in Greenfield MA (1/20/22) “Implications of trait divergence and local advantage within seagrass meadows for conservation and restoration,” presented at CERF 2021 (11/2/21) “Not all grasses look alike: Genetic diversity in salt marshes,” presented at NUMSC to Newton MA HS students and teachers (11/10/21) “EDA 2.1: Summary of Results and Conclusions,” presented to the MassBays MC, (2/16/22)</p> <p><i>Publications:</i> DA von Staats, TC Hanley, et al. 2021. “Intra-meadow variation in seagrass flowering phenology across depths.” <i>Estuaries and Coasts</i> https://doi.org/10.1007/s12237-020-00814-0 CG Hays, TC Hanley et al. 2021. “Linking Spatial Patterns of Adult and Seed Diversity Across the Depth Gradient in the Seagrass <i>Zostera marina</i> L.” <i>Estuaries and Coasts</i> https://doi.org/10.1007/s12237-020-00813-1 “Promoting inclusive metrics of success and impact to dismantle a discriminatory reward system in science.” 2021. <i>PLOS Biology</i> https://doi.org/10.1371/journal.pbio.3001282 CG Hays, TC Hanley et al. 2021. “Local adaptation in marine foundation species at microgeographic scales.” <i>The Biological Bulletin</i> https://doi.org/10.1086/714821 TC Hanley et al. 2021. “Short-and long-term effects of nutrient enrichment on salt marsh plant production and microbial community structure.” <i>Journal of Ecology</i> https://doi.org/10.1111/1365-2745.13756 “Repeated genetic and adaptive phenotypic divergence across tidal elevation in a foundation plant species.” 2021. <i>American Naturalist</i> https://doi.org/10.1086/716512</p>
South Shore outputs	<p><i>Presentations:</i> “Salt Marsh Sentinels” presented to volunteers (10/28, 11/4/21), Massachusetts Salt Marsh Working Group (10/29/21), and CERF biennial meeting (11/2/21) “Jacobs Pond Loosestrife” presented to Norwell CPC (1/20/21) “Salt Marshes of the South Shore” presented with USFWS to participants in the NSRWA Winter Nature Challenge (2/9/21) “Population Dynamics of Horseshoe Crabs on Cape Cod” presented to the Massachusetts Horseshoe Crab Science Committee (4/1/22) “Successes and Challenges in Managing Municipal and Ecological Water Demand in a Small Coastal Watershed” presented at JASM meeting (5/20/22) “Estuarine Gradient” podcast numbers 5-8, available at https://www.nsrwa.org/news/podcasts/</p>
Cape Cod outputs	<p><i>Presentations:</i> “Climate Change and Resilience in West Barnstable: What’s happening, what will happen, and what can we do about it?” presented at Wheldon Memorial Library, West Barnstable (11/15/21)</p>

Strategy 2.3 Facilitate access to decision making forums, and increase influence on decision making by underserved communities

Title	Increasing awareness of environmental justice issues
CWA Core Program	Protecting coastal waters through the National Estuary Program
Description/Objective	Highlighting local examples of inequitable distribution of adverse and beneficial environmental impacts for multiple audiences
Partners	WAA, NOAA, Mashpee Wampanoag tribe, UMB, SSL, Wellesley College
Status	New resources produced by the Mystic River Ambassador will scaffold new initiatives in the coming year(s).
Accomplishments and deliverables	
Region-specific EJ materials produced (MyRWA)	Mystic River Ambassador worked closely with MassBays ED to develop a format and content for a series of EJ reports to inform RSP plans for community engagement. The reports combine EJ Screen, EEA EJ Maps, and demographic information, along with lists of organizations already working in the area on similar issues.
Talking Trash for Clean Oceans Teen Program (LNS)	Four high school interns to be funded by NOAA for projects focused on sustainable practices for restaurants (“CoastSmart Restaurants”), home composting (“Composting 101”), and promoting proper disposal of cigarette butts (“Butt Bins”).
Produced materials for the Diversity Committee of the <i>Evolution in Changing Seas Research Coordination Network</i> (MB)	Network-generated deliverables include: 1) Virtual Lab Meeting Training Program, which pairs mentees from historically marginalized groups with mentors in the field; 2) profiles of junior and senior members to facilitate networking and collaborations among academic and non-academic partners; 3) creating educational activities and career development pages, with the goal of having a comprehensive list of resources for educators and students; 4) organizing/facilitating discussion of diversity, equity, and inclusion in evolution and marine science for Summer 2022 Integration and Training Workshop for students and early career scientists
Engaged in national- and state-level planning and assessment of DEI/EJ efforts (MB, Central Staff)	NUMSC participated in an NEP-EPA working group for mutual support and information exchange about effective approaches and tools for increasing DEI (and EJ awareness) within NEP structures and programming. Presented options for tools and assistance to the NEPs in February 2022, including use of EPA’s EJ Screen.

Strategy 3.1 Establish target (improved) water quality and habitat conditions tied to desired uses and ecosystem services

Title	Development of a Biological Condition Gradient Framework for Estuaries in MassBays. (Central Staff)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	Use the BCG framework to set and measure progress towards targets for improvement in estuarine ecosystem conditions.
Partners	STAC, EPA Region 1, EPA ORD, EPA OST
Status	Habitat-based targets identified and endorsed by the MC, metrics proposed for tracking progress toward the targets.
Accomplishments and deliverables	
Resource-stressor categories	Following the finalization of ecotypes and long-term habitat targets, MassBays developed a list of key indicators to measure progress towards targets over time. These indicators were partly informed by the resource-stressor categories developed by the Northeastern University team in August 2021. The MassBays Monitoring Plan is being revised and updated to incorporate these tools.
Target habitat extent and conditions (“habitat goals”) shared publicly	BCG-derived targets for salt marsh, eelgrass, and tidal flats were endorsed by the MC in June 2021 and included as a specific layer with a description of the process in the ETT, completed in June 2022.

Strategy 3.2 Guide local action to expand habitat and improve water quality according to targets

Title	Application of the Ecosystem Services Gradient for MassBays CCMP implementation (Central Staff)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	MassBays employs an ESG framework to communicate about and encourage local action towards targets for improvement in estuarine ecosystem conditions.
Partners	STAC, EPA Region 1, EPA ORD, EPA OST, UMB, Woods Hole Institute
Status	ESG components were identified by EPA and MassBays staff, and vetted by the RCs; results of stakeholder (local expert) workshops conducted by UMB are in preparation. The outcomes will inform education and outreach regarding targets devised using the BCG framework.

Accomplishments and deliverables

Facilitated workshops to determine local priorities in EJ communities	MassBays’ Director served as co-PI on a successful planning grant proposal to NSF, “Connecting Coastal Communities” under the Smart and Connected Communities program. She facilitated four workshops with two underserved communities (Herring Pond Wampanoag tribal community (Plymouth), Cape Verdean community (Falmouth) to identify priority concerns and restoration opportunities related to their local environment. This work will inform continuing efforts in those and other underserved communities.
Incorporated ESG into CCMP implementation planning	EPA continued to work with MassBays staff and RCs to identify the suite of ecosystems services that eelgrass, salt marsh, tidal flats, and diadromous fish habitat provide in MassBays’ planning area, along with associated metrics. MassBays is helping EPA identify a pilot study area for development and testing the application of the ESG to help a local NGO prioritize restoration actions in Belle Isle Marsh, Boston, MA.

Title	Development of an Ecohealth Tracking Tool (ETT) for State of the Bays reporting (Central Staff)
CWA Core Program	Protecting coastal waters through the National Estuary Program
Objective	MassBays provides web-based access to water quality data as well as information about habitats relative to CCMP targets
Partners	Comprehensive Environmental, Inc. (consultant)
Status	Soft launch of the ETT on June 30, 2022 (www.MassBaysEcohealth.org)

Accomplishments and deliverables

Supporting materials produced	“Learn about” buttons lead to modal windows describing habitat goals, habitat benefits and threats, relevant water quality parameters, and access to data sources.
WQ data and habitat data presented for multiple audiences	Behind-the-scenes coding imports quality-assured data from EPA’s Water Quality Portal, and shape files produced for MassBays as part of the EDA, as well as agency-generated habitat map layers are displayed. Salt marsh, eelgrass, and tidal flat extent (area) for 44 embayments is presented relative to the BCG targets; WQ data are compared to habitat-supportive thresholds.

C. New and Ongoing Projects and Activities (July 1, 2022 to June 30, 2023)

Strategies and Outcomes

MassBays' work over the coming year will implement components of our Interim CCMP and contribute to the following Outcomes:

- A. Sustainable NEP
- B. Improved habitat continuity and restored hydrology
- C. Improved water quality
- D. Resilient coastal habitat, including nature-based coastal protection
- E. Restored natural communities
- F. Robust interagency and interdisciplinary collaboration and partnerships
- G. Well-informed, multisector input to decision making which includes underserved communities

Our proposed work with funding under Federal Fiscal Year 2022 is aligned with and driven by the following Goals and Strategies described in the CCMP:

Goal 1. MassBays provides new resources to support research and management in the Bays.

Strategy 1.1 Address data gaps

Strategy 1.2 Support valid (QA/QC) data collection and use

Goal 2. MassBays reaches all planning-area municipalities with actionable information about coastal habitats

Strategy 2.1 Support research to inform policy and actions

Strategy 2.2 Technical support and communications

Strategy 2.3 Increase influence of underserved communities on decision making

Goal 3. MassBays provides regular and locally informed State of the Bays reporting that reflects the unique characteristics of MassBays assessment units (embayments, rocky shore, barrier beach), to document progress and inform local action and progress toward target conditions.

Strategy 3.1 Establish target (improved) water quality and habitat conditions tied to desired uses and ecosystem services, and document progress toward those targets

Strategy 3.2 Guide local action for expanded habitat and improved water quality

Strategy 3.3 Maintain MassBays' National Estuary Program status

Our proposed tasks are also closely related to the Clean Water Act Core Programs, which are:

- (1) establishing water quality standards
- (2) identifying polluted waters and developing plans to restore them (total maximum daily loads)
- (3) permitting discharges of pollutants from point sources (National Pollutant Discharge Elimination System permits)
- (4) addressing diffuse, nonpoint sources of pollution
- (5) protecting wetlands
- (6) protecting coastal waters through the National Estuary Program
- (7) protecting Large Aquatic Ecosystems.

The figures below depict estimates of the Level of Effort (LOE) to be expended toward each Strategy. The division of labor between the Boston office (Central Staff) and regional partners (RSPs) is evident when the two are compared. During the coming year, Central Staff (see Figure 2) will focus on bolstering support for implementation of our CCMP – updating our Finance Plan, launching the new Ecohealth Tracking Tool, working with EPA ORD staff to develop indices for water quality that reflect habitat needs, and implementing area-wide research and monitoring to inform regional initiatives, including setting a target for diadromous fish habitat. Significant effort will also be spent on our 2023 EPA Program Evaluation. RSPs (Figure 3) are focused on local implementation and progress toward improved habitat and water quality conditions, through direct support for community-based actions. Taken together with the work planned through the separate Bipartisan Infrastructure Law (BIL) funding, MassBays is looking forward to a year in which we will see significant progress on both the MassBays-wide and regional level.

Figure 2. Central Staff (salary, fringe, and indirect charges) expenditures predicted for FFY2022 through both this workplan and that of the BIL. This includes funding from the 2021 EPA Exchange Network award (Strategy 1.2) and the Project of Special Merit grant from NOAA (Strategy 2.1) to support work of the Coastal Data Scientist.

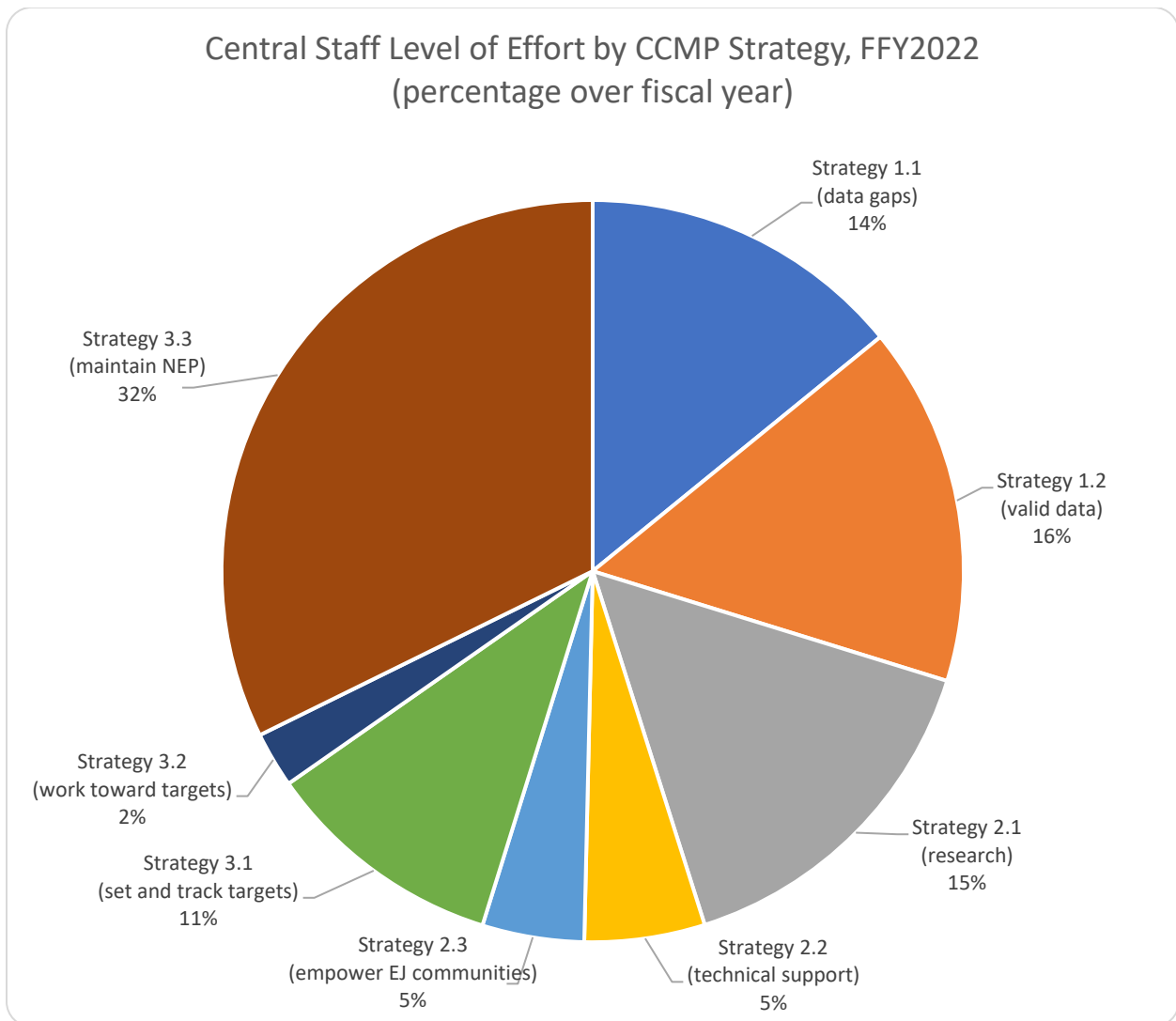
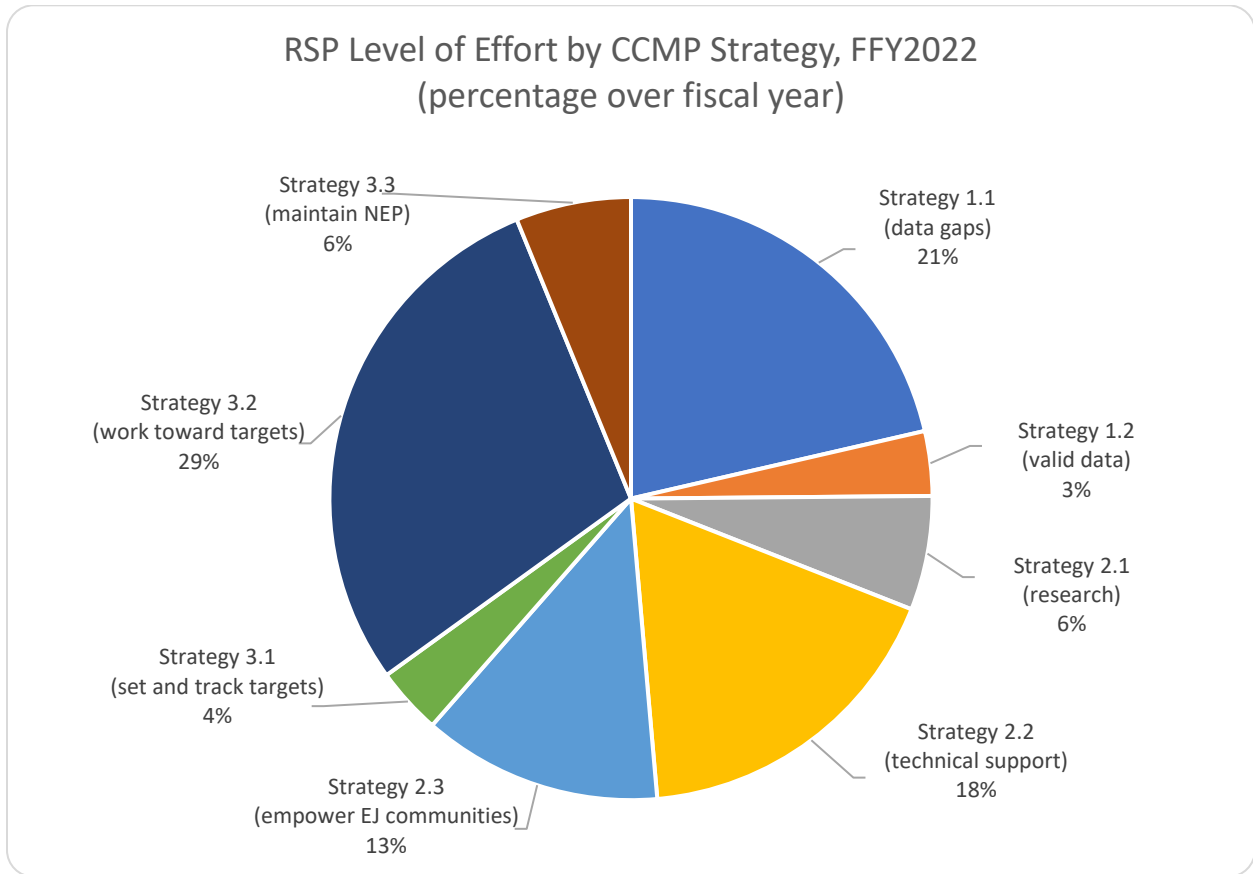


Figure 3. Regional Coordinator LOE allocated from RSP Subawards to each strategy (\$63,000 S.320 funds distributed per region).



The tables of proposed activities below, organized according to MassBays’ CCMP Strategies, include the following:

Title (Region), Budget/LOE: Activity name and MassBays geographic region in which it will be carried out, and non-s.320 funding and/or LOE (hours) to be committed by Central Staff or RSP (for region-specific projects)

Description: Status (New or Ongoing), project activities and objectives

CWA Core Program: Per list (1-7) above

CCMP Outcome: Per list (A-G) above

Partners: Collaborators not directly funded by MassBays/§320 funds

Timeline & Deliverables: Product(s) expected, and the quarter (Q1-Q4) projected for their completion

Strategy 1.1: Make new data available, especially to address specific gaps in knowledge

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Monitor Cyanobacteria blooms (Cape Cod)</p> <p>\$9000 + 180h</p>	<p>Ongoing Since FY18 APCC has monitored cyanobacteria in lakes and ponds that discharge to estuaries and serve as diadromous fish spawning habitat. The goals are to collect useful actionable information on harmful cyanobacteria blooms (HCBs) in order to raise public awareness of the risks posed by HCBs and to motivate public action to improve water quality to alleviate, reduce or eliminate HCBs. Monitoring data are translated into actionable information expressed as low, moderate, or high risk. Last year over 130 ponds were monitored. With FFY22 funding, APCC’s goals are to: continue monitoring of ponds across the Cape and in all 15 towns, to partner with Barnstable County’s Department of Health and the Environment which will provide toxin testing of moderate-to-high-risk samples pre-identified by APCC, to continue supporting action by the Barnstable County Health Agents Committee and individual health agents, and to motivate action to protect and improve water quality to reduce the threat of HCBs.</p>	<p>(2) Identifying polluted waters and developing plans to restore them; (6) Protecting coastal waters through the National Estuary Program</p> <p>(C) Improved water quality</p> <p>(F) Robust interagency and interdisciplinary collaboration and partnerships</p>	<p>MET; EPA R1; UNH; Lim-tex, Inc.; Barnstable County Dept of Health and Environment; 15 Cape Cod towns; and local watershed and pond associations.</p>	<p>(Q4) List of training sessions, number of participants, training materials, Train and supervise staff and interns re: protocol, collect and analyze data, (Q1-4) Cyanobacteria Risk Communication plan; Outreach and education including updates to the APCC Cyanobacteria Monitoring Program webpage and directed outreach to underserved communities; Recommendations, plans, or other examples of actions to improve water quality to reduce the threat of HCBs (Q4) Report on 2021 pilot “Ponds to Sea” study examining transport of cyanobacteria and cyanotoxins from ponds to estuaries via juvenile herring migration along transects in Brewster and Mashpee.</p>

Strategy 1.1 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Macro and Microplastics Sampling (Upper North Shore)</p> <p>\$65,000, 45h</p>	<p>Ongoing Conduct monitoring for micro- and macroplastics in the sand of beaches of Plum Island Sound, Essex Bay, and Annisquam River; develop a detailed sampling program for future efforts; conduct focused microplastics sampling in the waters of the Great Marsh informed by 2021 & 2022 sampling program results.</p>	<p>(4) Addressing diffuse, nonpoint sources of pollutants</p> <p>(C) Improved water quality</p>	<p>Seaside Sustainability, UNH, NECC, Governors Academy, 8TGM, Triple Ring Technologies</p>	<p>(Q1) Results of sampling at the high tide line carried out on Essex County beaches and via manta net from boat, (Q2) Results from sampling in both settings, (Q3-4) Revised sampling plan for rivers and outfalls</p>
<p>Marsh wrack evaluation and mapping (Upper North Shore)</p> <p>\$25,000 + 75h</p>	<p>New Determine the extent and impact of excessive wrack accumulating on the marsh in areas of upland edge, pannes, and woody vegetation causing vegetation die-off. Determine impact on marsh peat and other habitats. Develop recommendations for next steps.</p>	<p>(5) Protecting wetlands</p> <p>(B) Improved habitat continuity and restored hydrology</p>	<p>UNH, North Essex Mosquito Control and Wetlands District</p>	<p>(Q2) Map of wrack accumulation generated through field surveys; (Q3) Result of vegetation and soil condition assessments conducted beneath the wrack; (Q3) List of attendees and outcomes of a meeting to examine results and consider next steps</p>

Strategy 1.1 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Monitor diadromous fish runs (South Shore, Cape Cod)</p> <p>\$25,000 + 200h SS \$7000 + 140h CC</p>	<p>Ongoing Provide local, state and federal fisheries managers with population estimates of river herring at monitored runs to inform protection, restoration and management efforts. RCs will support citizen monitoring of fish runs by providing partners and volunteers with training, data management, QA/QC, reporting, and other assistance.</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>(B) Improved habitat continuity and restored hydrology</p>	<p>DMF; NOAA; Woods Hole Sea Grant; CCCE, River Herring Network; South Shore towns; 12 Cape Cod towns; local NGOs</p>	<p>(Q1-4) Participate in River Herring Network annual conference and/or other events as held; (Q1) Provide input to target-setting for diadromous fish habitat, (Q2) Final data report for Spring 2022 herring counts submitted to DMF, (Q3) Outreach materials used to engage students with South River camera, (Q4) Report on volunteer training and participation in for Spring 2023 herring counts, along with outreach materials; (Q4) Synthesis report of Cape Cod herring count data for 2007-2022</p>

Strategy 1.1 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Lower Merrimack River Initiative (Upper North Shore)</p> <p>\$35,000 + 120h</p>	<p>Ongoing Focused assessment of a variety of conditions and restoration activities in the lower Merrimack River including:</p> <ol style="list-style-type: none"> 1. investigation of eelgrass restoration potential in Joppa Flats and Black Rock Creek and pilot site development 2. restoration of native marsh vegetation through the removal of invasive pepperweed 3. ground truthing marsh die-off as a result of SLR in marshes of the Merrimack River 4. microplastic sampling in the water column and sand of beaches in the lower Merrimack River 5. investigation into opportunities for anadromous fish restoration in the Merrimack River and its tributaries. 	<p>(2) Identifying polluted waters and developing plans to restore them</p> <p>(5) Protecting wetlands</p> <p>(B) Improved habitat continuity and restored hydrology</p>	<p>Northern Essex Community College, UNH, Mass Audubon, USFWS, MRWC, BU, 8TGM, volunteers, towns of Salisbury, Newbury, and Newburyport, and when relevant, EJ communities of the lower Merrimack River including Lawrence and Haverhill.</p>	<p>(Q1, Q2, Q4) Microplastic sampling results and recommendations, (Q3) Map of investigated locations and photos of pilot eelgrass restoration sites (Q4) Map of native vegetation recovery where treatment of invasives occurred, (Q3) Map of die-off areas and potholes identified in lower Merrimack River salt marshes, (Q2-3) convene a working group and identify anadromous fish restoration opportunities</p>
<p>Water quality monitoring (South Shore)</p> <p>\$36,700 + 175h</p>	<p>Ongoing Citizen monitoring in coastal waters to identify potential for remediation and source control, through the Riverwatch program in the North and South Rivers and the DKP Water Quality Monitoring Program; conduct bacterial source tracking in North River Headwaters with Town of Hanover.</p>	<p>(2) Identifying polluted waters and developing plans to restore them</p> <p>(C) Improved water quality</p>	<p>Volunteers; Towns of Duxbury, Kingston, Plymouth, Norwell, and Hanover; JRWA</p>	<p>(Q1) Riverwatch volunteer monitoring completed, (Q2) monitoring results</p>

Strategy 1.1 continued

<p>Bacteria Monitoring: Clean Beaches & Streams and Upstream Tributary Sampling (Lower North Shore)</p> <p>\$20,000 +52h</p>	<p>Ongoing Identify sources of pathogen pollution to Massachusetts' waters, specifically Salem Sound and its tributaries, particularly illicit sewage discharges and faulty sewer and stormwater systems, and promote their remediation. Activities include biweekly summer water testing for <i>Enterococcus</i> at outfalls and streams, and sharing data with municipal staff to prompt action.</p>	<p>(2) Identifying polluted waters and developing plans to restore them</p> <p>(C) Improved water quality</p>	<p>Manchester Coastal Stream Team, Volunteers, DMF, EPA, DEP</p>	<p>(Q1) Report on bacterial levels for 15 - 18 outfalls or streams, results published on SSCW website, (Q2) current and historic monitoring data uploaded to WQX, (Q1-4) List of remediation actions taken up by municipalities.</p>
<p>Assessing water quality and presence of sea brook trout (Lower North Shore)</p> <p>\$2500 + 52h</p>	<p>New Begin a citizen monitoring program to record temperature Sawmill Brook & Cat Brook in Manchester-by-the-Sea and sample environmental DNA for sea brook trout, herring, and rainbow smelt. Support cold water fisheries DEP efforts.</p>	<p>(2) Identifying polluted waters and developing plans to restore them</p> <p>(C) Improved water quality</p> <p>(E) Restored natural communities</p>	<p>MCST, volunteers, Sea Run Brook Trout Coalition</p>	<p>(Q1) Number of volunteers trained, sampling plan; (Q2) results of temperature monitoring; (Q3-4) summary of results and recommendations for subsequent years; data shared with DEP.</p>
<p>Coastal Acidification Monitoring and Management (Central Staff, South Shore)</p> <p>100h CS \$750 + 50h SS</p>	<p>New (postponed from FFY21) Monitor coastal acidification conditions in Duxbury Bay, a hotspot for shellfish aquaculture industry in Massachusetts. Monthly samples will be collected by SS RC and trained volunteers for analysis of TA and DIC by EPA ORD (Narragansett Lab)</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>(C) Improved water quality</p>	<p>Town of Duxbury, UMB, EPA ORD, volunteers</p>	<p>(Q1) QAPP for discrete sample collection (CS); (Q1-2) Monthly discrete samples collected at low and high tide, with concurrent outreach about coastal acidification and its impacts; (Q4) Doctoral thesis data analysis by UMass Boston student and first technical report</p>

Strategy 1.1 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Monitoring Long-term Salt Marsh Vegetation Change (South Shore) 125h	Ongoing Work with volunteers to monitor salt marsh vegetation changes through the Salt Marsh Sentinels program; participate in the Massachusetts Salt Marsh Working Group and its Sea Level Rise Subcommittee	(5) Protecting wetlands (D) Resilient coastal habitat, including nature-based coastal protection	Dock owners, UMass Amherst	(Q2) Report on findings and project participation of dock owners in collection of salt marsh data, (Q1-4) Priority action plan developed by the Working Group and Subcommittee
Map Sea Level Rise-induced marsh platform die-off areas (Upper North Shore) \$15,000 + 60h	Ongoing Increased inundation from SLR and resulting impounded water is evidenced by small vegetation die-off areas where differences in marsh elevation exist. Ground-truthing of UAV (drone) imagery will be performed where die-off has been observed.	(5) Protecting wetlands (B) Improved habitat continuity and restored hydrology	UNH, drone contractor, 8TGM	(Q1, Q2) drone imagery; (Q2, Q3) field-verified mapping of marsh die-off presumed due to inundation
Horseshoe Crab Spawning Surveys (South Shore) 60h	Ongoing Conduct horseshoe crab spawning surveys in Duxbury Bay to assess the population and inform resource management.	(7) Protecting large aquatic ecosystems (E) Restored natural communities	DMF, Town of Duxbury, Duxbury Beach Reservation Inc.	(Q1) 2022 field work completed, and data submitted to DMF; (Q4) 2023 surveys completed with volunteers

Strategy 1.1 *continued*

Title (Region) , Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Marsh Edge Erosion Monitoring (Upper North Shore) \$20,000 + 56h	Ongoing Determine the erosional/deposition status of marsh bank and marsh edge in the creeks and rivers of Plum Island Sound and Essex Bay to determine future living shoreline potential.	(5) Protecting wetlands (D) Resilient coastal habitat, including nature-based coastal protection	BU, 8TGM	(Q2) Map of Plum Island and Essex Bay marsh banks depicting erosion/deposition status.
Monitoring Marine and Wetland Invasive Species (North Shore and South Shore) \$1000 + 52h LNS \$1800 + 25h UNS \$7500 + 55h SS	Ongoing Monitor established field sites for non-native species in cooperation with CZM’s MIMIC program, conduct training for monthly monitoring from July to October 2022 and May to June 2023, and share results with CZM and the public. LNS also monitors settle plates at the Beverly Pier to understand fouling organisms. New SS will assist the Town of Norwell with managing purple loosestrife at Jacobs Pond.	(7) Protecting large aquatic ecosystems (E) Restored Natural Communities	CZM, volunteers	(Q1, Q4) number of volunteers trained per season (Q2) data submitted to CZM, along with photodocumentation of Beverly Pier settle plate fouling; photos and data from beetle release and monitoring in Jacobs Pond; (Q4) list of presentations and publications describing the transport, population dynamics, and impacts of invasive species.

Strategy 1.1 continued

Title (Region) Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Water Quality and Benthic Communities Monitoring in Salem Sound (Central Staff, Lower North Shore) 240h CS 208h SS	Ongoing report on and analyze results of 2019-2020 nutrient monitoring and benthic community assessment program in Salem Sound.	(6) Protecting coastal waters through the National Estuary Program (C) Improved water quality	CZM, SSU, volunteers	(Q2) Technical report (with CS);(Q3) results of expert review and recommendations; (Q4) list of presentations and publications
Massachusetts Coastal Condition Assessment (Central Staff) \$184,000 +160h	Ongoing Coordinate water quality, sediment, and benthic monitoring survey in the nearshore of Massachusetts over the time period 2020-2023. Parameters include measures of water quality, sediment quality and benthic communities from a total of 90 sites (25 sites on the North Shore in 2021). The data serve to inform MassBays' State of the Bays reporting under CWA §320 and DEP's required reporting under CWA §109.	(2) Identifying polluted waters and developing plans to restore them (C) Improved water quality	DEP, STAC, Normandeau Consultants	(Q3) Amended contract and scope for Year 4 (2023) monitoring; (Q4) Year 3 (2022) data

Strategy 1.2 Support valid (QA/QC) data collection and use

Task Title (Region) Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Support use of AquaQAPP and data upload to WQX (Central Staff, Metro Boston, South Shore, Cape Cod) 100h CS 120h MB 20h SS 40h CC	New Increase accessibility to new and historic data generated by watershed groups by providing training and support to facilitate data upload to EPA's WQX framework Ongoing Increase accessibility to new and historic data generated by watershed groups by providing training and support to facilitate data upload to EPA's WQX framework	(2) Identifying polluted waters and developing plans to restore them (6) Protecting coastal waters through the National Estuary Program (C) Improved water quality	EPA Exchange Network, EPA Region 1, DEP, Citizen Science Association, Coastal Monitoring Coordinators' Network, other ngos	(Q1-4) List of organizations that received one-on-one AquaQAPP and WQX support; (Q4) List of groups supported via training, materials; (Q3) Status report re: RSP data uploaded to WQX, (Q4) Citizen data highlighted via the State of the Bays/ETT
Build technical capacity for data analysis and visualization (Central Staff) \$110,508 (EPA Exchange Network funds)	Ongoing Launch R-based packages for data QC, analysis and visualizations; host beta testing and training sessions.	(6) Protecting coastal waters through the National Estuary Program (C) Improved water quality	EPA Exchange Network, DEP, EnviroDev, ACASAK Aquatic Monitoring Technologies	(Q1) Coordinate a beta testing workshop where the new R tools are tested by 6-8 future users. Establish online Community of Practice for technical support (Q2) publish final R packages (Q3-Q4) conduct training and outreach efforts

Strategy 2.1 Support research to inform policy and actions

Task Title (Region) Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Quantifying Phytoplankton and Turbidity in Salem Harbor (Lower North Shore) \$2000 + 40h	Ongoing Collaborate with Salem State University to interpret results of research on phytoplankton community structure funded through the Healthy Estuaries Grant Program, including forcings causing high biomass that has been documented to be responsible for increased turbidity. Share results and specific remediation strategies for water quality improvement of Salem Sound waters.	(2) Identifying polluted waters and developing plans to restore them (C) Improved water quality	SSU	(Q1-2) List of remediation alternatives and strategies, (Q3) Attendee list and outcomes of a meeting for local, state, and federal stakeholders to convey results and recommendations, (Q4) Agenda and sign-in sheet for a public lecture
Pilot thin-layer placement of sediment (Upper North Shore) \$500,000 + 90h	New (pending funding) Develop site identification criteria, site selection, monitoring plan, and investigate permitting for a pilot dredged material placement in Essex Bay and Plum Island Sound.	(5) Protecting wetlands (E) Restored Natural Communities	BU, USFWS, 8TGM	(Q1) Funding secured from MA legislature, consultant hired; (Q2) Site selection and permitting plans; (Q3) QAPP for pre- and post-placement monitoring

Strategy 2.1 continued

Task Title (Region) Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Investigating eelgrass conditions, water quality, and sediment characteristics in Duxbury-Kingston-Plymouth Bays (Central Staff, South Shore)</p> <p>240h CS \$7000 + 140h SS</p>	<p>Ongoing Implement the annual “Eelgrass Blitz” rapid assessment with citizen scientists to monitor eelgrass extent and condition, and inform efforts to determine the causes of local eelgrass loss.</p> <p>New Conduct water quality monitoring and sediment core analysis to collect information on physical conditions that may be contributing to the losses.</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>(7) Protecting large aquatic ecosystems</p> <p>(E) Restored natural communities</p> <p>(C) Improved water quality</p>	<p>DMF, Duxbury Bay Maritime School, Town of Plymouth, Volunteers, EPA Region 1 (Chelmsford Lab), SSU</p>	<p>Eelgrass blitz: (Q1, Q3) List of attendees and outcomes of team meetings (CS); (Q1-2) Number of volunteers trained, training materials, photo documentation (SS), (Q2) Technical report describing findings & recommendations, (Q4) plan for 2023 assessment</p> <p>New analysis: (Q1) Conduct monthly water quality monitoring (June – August) and sediment sampling (July); Sample analysis;(Q2) Data analysis and meetings to discuss findings; (Q3) Report of findings and plan for 2023</p>
<p>Increasing agency confidence in eelgrass maps used for project review and ocean planning (Central Staff, South Shore, Metro Boston, Lower North Shore)</p> <p>\$56,837 + 90h (RSPs) + 520h (CS)</p>	<p>Ongoing Implement a project to correlate eelgrass edge-of-bed determinations generated by remote sensing methods (drone, satellite, side-scan sonar, and fixed-wing aerial mapping) with divers’ assessments to support more accurate mapping of the resource to inform policies and protective actions. Data analysis, reporting, and outreach will take place concurrent with FFY22 funding.</p>	<p>(7) Protecting large aquatic ecosystems</p> <p>(E) Restored natural communities</p>	<p>NOAA, CZM, DMF, DEP, MIT Sea Grant</p>	<p>(Q1) Train partners in image analysis techniques and oversee analysis process as detailed in project QAPP (Q2) publish final report (Q3) outreach to scientific and management communities.</p>

Strategy 2.1 continued				
Task Title (Region) Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Assessing Pesticide Impacts on Invasive Phragmites, native vegetation, and benthic communities in the Great Marsh and (Upper North Shore) \$8,000 + 60h	Ongoing Invasive Phragmites in the open marsh in east Salisbury marsh, northern Plum Island Sound, and along the marshes of the Plum Island River will be mapped to define the effectiveness of previous Phragmites management practices. Fifteen established treatment and monitoring locations will be surveyed, and a subset also assessed in terms of native marsh vegetation and benthic community response to pesticide treatment.	(5) Protecting wetlands (E) Restored Natural Communities	PRNWR, BU, NWF, 8TGM	(Q3) Final report on impact of Phragmites treatment, including: <ul style="list-style-type: none"> • photo documentation and maps of previously treated areas with current status • recommendations regarding continued pesticide application in light of effectiveness of treatment practices and impacts on the marsh ecosystem
Monitor and restore blue mussels (South Shore) \$4125 + 75h	New Initiate a multi-year restoration program for mussels in the near subtidal and low intertidal to benefit migratory shorebirds and restore a crucial hard-bottom species at the mouth of the North and South Rivers	(7) Protecting large aquatic ecosystems (E) Restored Natural Communities	MassAudubon, US Air Force (Hanscom/4 th Cliff), Texas A&M	(Q2) Maps of existing mussel beds and potential sites; (Q4) List of docks hosting mussels and owner-participants with their typical timing for dock removal; protocol for mussel transplant

Strategy 2.2 Provide education, training, and technical support; share case studies (successful and not); and support collaboration and cooperation on specific topics

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
MassBays State of the Bays planning and outreach (Central Staff) 240h	Ongoing Building on the ETT, plan and implement the State of the Bays water quality and habitat assessment, report(s), and outreach activities	All CWA core programs All CCMP outcomes	CZM, DER, DMF, DEP, MWRA, Mass Rivers Alliance, Management Committee, Towns, regional scientific and policy partners	1) State of the Bays Symposium or other public launch of the ETT, incorporating findings of the ESG
Investigating aquaculture-eelgrass interactions to inform policy (Central Staff) 30h	New Convene scientists, resource managers and aquaculturists in a series of workshops to discuss the occurrence, perception and solutions around eelgrass and aquaculture interactions. Ecosystem services provided by eelgrass, including carbon sequestration, will be presented.	(7) Protecting large aquatic ecosystems (G) Well-informed, multisector input to decision making which includes underserved communities	MIT Sea Grant, DMF, TNC	(Q1) List of workshop invitees and presenters, outline of workshop topics and discussions, (Q2 - Q3) workshops take place and meeting minutes shared with participants
Local priority program development and education and outreach, including regional conferences (Central Staff, All Regions) \$75,000 + 200h UNS \$2000 + 40h CC 100h SS 80h MB	Ongoing Partnership building and project development, funding efforts, and collaboration with environmental and other partner organizations and entities toward meeting the CCMP goals	All CWA core programs All CCMP outcomes	Municipalities, nonprofits, businesses, and government agencies	(Q1-4) Quarterly updates regarding local initiatives and progress (e.g., BHEN, WAA, BCCRS), (Q1-4) Quarterly updates as relevant regarding regional conferences (e.g., Cape Cod Coastal Conference, Great Marsh Symposium, NEERS), including copies of presentations, (Q4) List of networks and MassBays role

Strategy 2.2 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Support municipal and regional actions that promote resilient coastal habitats and communities through the use of nature-based solutions (Upper North Shore, Lower North Shore, Cape Cod)</p> <p>\$125,000 + 200h UNS \$40,000 + 400h LNS \$1000 + 20h CC</p>	<p>Ongoing Work with partners and communities to encourage planning for climate change and adoption of municipal bylaws and adaptation measures that promote resilient coastal habitats, and use of nature-based solutions. Activities include assistance to review stormwater, wetland, zoning, and subdivision bylaws and regulations as they relate to LID, green infrastructure, and climate resiliency; secure funding via MVP and Coastal Resilience grant programs and plan and implement those projects; and share lessons learned.</p>	<p>(5) Protecting wetlands</p> <p>(6) Protecting coastal waters through the National Estuary Program</p> <p>(D) Resilient coastal habitat, including nature-based coastal protection</p>	<p>NSF, EEA, DEP, IRWA, Upper and Lower North Shore, Metro Boston, and Cape Cod municipalities, especially Marblehead and Salem</p>	<p>(Q1) Model bylaw language for climate resiliency; (Q4) List of communities assisted and the assistance provided, (Q3) MassBays newsletter article describing one case study and lessons learned (Q3-4) At least two letters of support for municipal proposals, (Q4) List of and links to presentations and publications produced</p>
<p>Greenscapes, Merrimack Valley Stormwater Collaborative (North Shore)</p> <p>\$57,500 + 120h LNS \$14,500 + 50h UNS</p>	<p>Ongoing Create and disseminate outreach information, activities, and materials on stormwater management to <i>Greenscapes</i> member communities and Stormwater Collaborative members, in support of DPW directors and stormwater coordinators.</p>	<p>(2) Identifying polluted waters and developing plans to restore them</p> <p>(C) Improved water quality</p>	<p>IRWA, more than 25 municipalities</p>	<p>(Q1) List of Greenscapes communities, (Q2-3) MS4 Outreach and Education (via webinars, lectures, personal assistance), (Q1-Q4) Stormwater Collaborative meeting agendas and attendee lists, (Q1-4) “Keeping Water Clean (KWC)” school program, list of on-demand presentations delivered (“Why Stormwater Matters,” “Greenscapes 101,” “Slow the Flow” or other agreed upon topic); Updated SW Collaborative website</p>

Strategy 2.2, continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Great Marsh Symposium and field trips (Upper North Shore) \$10,000 + 35h	Ongoing Support outreach and education of local audiences through an in-person symposium focused on road elevations and crossings in the marsh, as well as field trips in Fall 2022 and Spring 2023	(6) Protecting wetlands (G) Well-informed, multisector input to decision making which includes underserved communities	IRWA, ECGA, Parker River Clean Water Association, CZM, ENHC, MAPC, MassAudubon, Trustees	(Q1) Agenda and list of presenters, (Q2) Copy of presentation by RC, (Q3) List of field trips and number of participants
Support municipal and regional actions that promote resilient coastal habitats and communities through the use of nature-based solutions (Metro Boston) 200h MB	Ongoing Connect NU researchers and other experts to communities interested in green coastal infrastructure and living shorelines. Support and collaborate on regional projects. New (postponed from FFY21) Organize and facilitate NSF Convergence Accelerator workshops that bring together experts and leaders from academia, government, industry, and nonprofits with the goal of leveraging nature-based solutions as a framework to explore and shape co-development of convergent research that is stakeholder-driven, inclusive, and focused on implementation of sustainability solutions that promote clean, safe, smart, and equitable coastal communities	(5) Protecting wetlands (6) Protecting coastal waters through the National Estuary Program (D) Resilient coastal habitat, including nature-based coastal protection	BHEN, Metro Boston municipalities, ; Knowinnovation, ngo partners	(Q1-4) Dates and locations, number of participants for three waterfront site visits (virtual as necessary), (Q3-4) Documentation of at least two letters of support for municipal implementation proposals, (Q3) Number of participants and outcomes of Convergence Accelerator Workshops

Strategy 2.2 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Adopt a Beach and Talking Trash for Clean Oceans (Lower North Shore) \$4000 + 40h	<p>Ongoing Work with the public and schools to build marine debris awareness and institute behavior changes. Projects include conducting <i>Adopt a Beach</i> trainings, supporting volunteer “Beachkeepers,” hosting community service projects, and educating the public of the seriousness of plastic litter on land and in the oceans</p>	(6) Protecting coastal waters through the National Estuary Program (E) Restored natural communities	NOAA, Volunteer Beachkeepers, Talking Trash Teens	(Q1-4) List of volunteer trainings and numbers of volunteers, (Q3) List of community service projects, (Q3) report on litter reduction projects implemented in cooperation with restaurants, (Q4) List of relevant publications and presentations
Maintain the Mystic River Urban Waters Federal Partnership and coordinate Federal input to Mystic River initiatives (Mystic River) 1040h	<p>Ongoing Coordinate the quarterly meetings of the EPA-convened Mystic River Watershed Steering Committee, represent the partnership by participating on regular conference/video calls organized by EPA, the Urban Waters Learning Network, and/or other Federal Partners, while maintaining contact with Region 1 and Urban Waters Program re: needs New Glean case studies and lessons from other Urban Waters locations to inform a detailed Action Agenda to be developed in collaboration with Region 1 staff and Federal Partners</p>	(2) Identifying polluted waters and developing plans to restore them (C) Improved water quality	EPA, DEP, USGS, HUD, FEMA, DHS Mystic River Watershed municipalities	(Q1-4) Agenda and sign-in sheets for quarterly meetings, quarterly updates on activities taken up in response to EPA requests, (Q2) Initial Mystic River Urban Waters workplan, to be revisited quarterly, Summary of findings from Urban Waters program interviews, etc., (Q3) convene Federal Partners to review the Partnership’s Action Agenda in light of findings from other Urban Waters programs

Strategy 2.2 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Implement local actions to improve conditions in the Mystic River Watershed (Mystic River) 624h	Ongoing Facilitate on-the-ground projects to increase public awareness of watershed natural resources and engage residents in stewardship efforts, especially those aligned with the Trash Free Mystic project	(2) Identifying polluted waters and developing plans to restore them (C) Improved water quality (G) Well-informed, multisector input to decision making which includes underserved communities	EPA, USGS, DEP, Mystic River Watershed municipalities	(Q1-Q4) Quarterly updates on activities and outcomes associated with Trash Free Mystic programs, invasive species management, Open Space and Mystic Greenways programs (Q2) Compilation of water quality report card announcements and data from the Neponset, Charles, and Mystic Rivers provided to EPA
Provide communications and outreach support to the Mystic and Merrimack watershed communities (Mystic River, Merrimack River) 416h	Ongoing Maintain public communications platforms and watershed-specific e-newsletters	(7) Protecting large aquatic ecosystems (G) Well-informed, multisector input to decision making which includes underserved communities	EPA, FEMA, HUD, USGS, DEP, MRWC, Mystic and Merrimack River municipalities	(Q1-4) Provide content to EPA Region 1 website (www.epa.gov/mysticriver) and other relevant pages, Quarterly e-news to the Mystic River Watershed Steering Committee, Quarterly e-news to Merrimack River watershed community (Q4) Distribution lists for both e-news outputs, Agenda, and attendee list from the biennial Mystic River Watershed Initiative Science Forum

Strategy 2.3 Provide access to, and increase influence on decision making by underserved communities

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Public outreach and education about climate change, its impacts, and adaptive measures (Lower North Shore) \$25,000 + 312h	Ongoing Increase general climate change literacy and knowledge about coastal resiliency in the region, involving EJ populations wherever possible. Activities will include public lectures and art installations, teacher training on climate change, and (pending funding) implementation of two MVP grants in EJ neighborhoods.	(6) Protecting coastal waters through the National Estuary Program (G) Well-informed, multisector input to decision making which includes underserved communities	Lower North Shore towns and cities, SSCW volunteers	(Q1-2) Lecture series “Keeping History Above Water,” climate sign project, “Remembrance of Climate Futures”; (Q1-4) report on outreach to EJ communities adjacent to <i>Peabody-Salem Resilient North River Canal Corridor & Riverwalk Connection Project</i> ; (Q4) list of events, photo-documentation of wave tank and other educational resources in use; (Q2-4) Summary of activities under MVP grants as funded
Expanding DEI in the marine sciences (Metro Boston) 320h	Ongoing Engage diverse learners in watershed and coastal science literacy, bring new audiences to MassBays’ mission. Share virtual / online learning tools and experiences with diverse audiences, including students in underserved communities, for example: Seagrass Explorer, a virtual seagrass aquarium game; a Career Panel to increase awareness of paid marine science opportunities in Boston and New England; and the annual High School Science Symposium, all with the goal of making the field more equitable, inclusive, and diverse.	All CWA core programs (G) Well-informed, multisector input to decision making which includes underserved communities	NUMSC Outreach Program, BHEN, MME, MMC	(Q4) List of accommodations implemented to support new participation by underserved communities, (Q4) Demographics of participants and summary of program evaluations of the High School Science Symposium, (Q4) List of panelists, number of attendees and summary of feedback related to a BHEN Career Panel for undergraduate and graduate students

Strategy 2.3, continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Watershed and coastal science education (South Shore, Lower North Shore, Cape Cod) 75h SS \$2000 + 40h CC	Ongoing Engage diverse learners in watershed and coastal science education, bring new audiences to MassBays’ mission, participate in classroom and field professional development for teachers	(6) Protecting coastal waters through the National Estuary Program (G) Well-informed, multisector input to decision making which includes underserved communities	Marshfield Community Television, Norwell Community Television, CCSCR, MassAudubon	(Q1-4) documentation of accommodation and outreach to support new participation by underserved communities, (Q4) List of events/presentations, videos and podcasts, and publications produced about coastal topics
Advancing meaningful engagement in decision making among EJ communities (Central Staff, All Regions) 60h CS \$5000 + 100h LNS 40h UNS 80h MB 50h SS \$1000 + 20h CC	New With materials and insights provided by Mystic River Ambassador, engage EJ and other underserved communities in activities and outreach efforts, e.g., field trips, Ask-Me-Anything sessions, orientations to state agencies and their roles, and/or hands-on assistance with local habitat or water quality investigations.	(2) Identifying polluted waters and developing plans to restore them (G) Well-informed, multisector input to decision making which includes underserved communities	EPA and EEA EJ Offices, MyRWA, UMB, Local and regional ngos working with EJ and underserved communities, especially the Herring Pond Wampanoag community (Plymouth)	(Q3) results of an NSF-funded investigation into environmental priorities of the Herring Pond Wampanoag community; (Q1-4) record of meetings with EJ organizations and priority issues identified, as well as projects taken up, (Q2) record of meetings with each RC, (Q3) list of potential partners for each region, and their audiences, (Q4) examples or list of outreach materials, training, and/or other support provided to the RCs
Connecting Coastal Communities (Central Staff) 120h	Ongoing As part of the NSF Smart and Connected Communities planning grant underway with UMB, facilitate a third workshop with each of the two underserved communities (Herring Pond Wampanoag tribal community [Plymouth] and the Cape Verdean community in Falmouth), and then a fourth, joint workshop to bring both groups together.	(2) Identifying polluted waters and developing plans to restore them (G) Well-informed, multisector input to decision making which includes underserved communities	UMB, Woods Hole Institute	(Q1) outcomes from each of the 3 rd workshops, (Q2) Outcomes of the joint workshop, (Q3) Determination of whether the group (including the community members) will make a full proposal for implementation funding from NSF under the same funding program.

Strategy 3.1 Establish target (improved) water quality and habitat conditions for each embayment tied to desired uses and ecosystem services

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Develop targets for diadromous fish habitat extent and condition (Central Staff) 80h	New Establish 2050 habitat goals to support diadromous fish migration, spawning, and feeding for MassBays embayments.	(6) Protecting coastal waters through the National Estuary Program All CCMP outcomes	EPA ORD, STAC, DMF, River Herring Network, MIT Sea Grant, Comprehensive Environmental	(Q1) Final historical data analysis; (Q2) Results of a workshop to characterize the habitat(s) required to sustain migration and nursery areas for diadromous fish species (represented by herring); (Q4) Diadromous fish habitat data layer, including targets, incorporated into the ETT
Update and expand utility of EDA (Central Staff, Metro Boston) 60h CS 240h MB	New (postponed from FFY21) Disseminate results of EDA 2.1 and add new variables to support examining relationships among stressor, resource, and socio-economic factors, and identify priorities for environmental justice and restoration	(6) Protecting coastal waters through the National Estuary Program All CCMP outcomes	STAC, EPA ORD	(Q4) Manuscript submitted; (Q2) List of socioeconomic metrics and associated datasets; (Q3) Shapefiles and characterization of each by EDA assessment area for MassBays Story Map update; List of potential areas for restoration to benefit EJ communities
Ecosystem Services Gradient assessment for Estuaries in MassBays (Central Staff) 160h	New ESG-based characterization of MassBays coastal habitats to facilitate relevant education and outreach to local stakeholders	(6) Protecting coastal waters through the National Estuary Program All CCMP outcomes	STAC, EPA, UMB	(Q1) ESG implementation plan; Results of updated EPA document analysis; (Q2) report from a meeting to examine outcomes of local stakeholder workshops (FFY20) alongside new data sets; (Q3) Suggested messaging for use with communities that connects priority ecosystem services with CCMP habitat targets.

Strategy 3.1, continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Develop Habitat Potential Indices (Central Staff) 220h	<p>New (pending funding) Develop water quality-based indices for habitat health to be incorporated into the ETT. The indices will facilitate interpretation of water quality data presented in the Tool, and provide water quality-based targets to meet the CCMP habitat goals. This project will build on previous work done to identify WQ thresholds for inclusion in the ETT</p>	(6) Protecting coastal waters through the National Estuary Program All CCMP outcomes	EPA ORD, UHI, STAC	(Q1-2) Proposal submitted for funding; (Q3-4) HPIs determined for salt marsh, eelgrass, tidal flats, and diadromous fish habitat
Merrimack River Water Quality Improvements (Upper North Shore) \$10,000 + 50h	<p>Ongoing Establish and implement regional goals to improve water quality on the Merrimack River. Oversee and provide administrative and technical support to the MRDC and its members in collaboration with MRWC</p>	(2) Identifying polluted waters and developing plans to restore them (G) Well informed, multisector input into decision making which includes underserved communities	MWRC, Merrimack watershed communities and legislative delegation, NECC, WWTPs, Merrimack River recreational users, Planning Commissions (MA & NH)	(Q2) Results of efforts to develop a Web-based Early Alert Monitoring Tool; (Q4) Tool available online to MVPC communities via MVPC website

Strategy 3.2 Guide and assist local action to expand habitat and improve water quality according to targets

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Publish Seagrass and Oyster Restoration Story Map (Metro Boston) 320h	Ongoing Disseminate the results of a project surveying seagrass and oyster restoration and management projects in Massachusetts to inform future efforts	(7) Protecting large aquatic systems (E) Restored natural communities	SeagrassNet, BHEN, others TBD	(Q2) Summary table of survey and interview responses from oyster and seagrass restoration practitioners; (Q3) Summary of comments on draft revised Story Map provided by at least two partner networks; (Q4) List of improvements made based on user feedback; Story Map launched
Finalize Boston Harbor Habitat Atlas (Metro Boston) 160h	Ongoing Update from the beta version the online, interactive Atlas depicting locations, background educational information about the habitats, past and ongoing research efforts, and opportunities to participate in habitat protection	(6) Protecting coastal waters through the National Estuary Program All CCMP outcomes	BHEN	(Q2) Fully functioning Atlas available; (Q4) incorporate Seagrass and Oyster Restoration Story Map
Greening Gateway Cities Program (Lower North Shore) \$15,000 + 312h	Ongoing Serve as outreach partner for Salem’s Greening Gateway City program, promoting progress toward the program goal of planting 2400 trees in EJ neighborhoods.	(7) Protecting Large Aquatic Ecosystems (E) Restored natural communities	Salem Tree Commissioner, DCR	(Q1-4) Number of trees planted, mapping distribution on public and private property; (Q4) List of education & outreach actions, including via social media
Northern Great Marsh Hydrology Restoration (Upper North Shore) \$20,000 + 35h	New Assess tide-shed hydrology and proximity to creek system, identify runnel application sites, obtain permits, and implement runnels in the Hampton/ Seabrook/ Salisbury marshes. Evaluate need for dune restoration in Salisbury, Newburyport and Newbury.	(5) Protecting wetlands (B) improved habitat continuity and restored hydrology (E) Restored natural communities	UNH, NWF, Towns of Hampton, Seabrook, Salisbury, Newburyport, Newbury, NHDES, NH-based ngos	(Q1) Map of potential runnel installations and planned dune stabilization; (Q2) Permits for work in wetland resource areas, (Q4) Map of implementation sites

Strategy 3.2 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Pepperweed Management and Control (North Shore) \$2000 + 52h LNS \$65,000 +65h UNS	Ongoing Physical pulling of pepperweed to restore native high marsh community and coastal resilience in Ipswich, Rowley, Newbury in the Great Marsh, and in Salem Sound communities	(5) Protecting wetlands (E) Restored natural communities	Volunteers, Parker River NWR, MassAudubon	(Q1, Q3) List and map of prioritized sites, (Q3) Number of trained volunteers & volumes pulled, (Q4) Map of pepperweed sites with list of areas monitored and/or treated, with status (presence-absence removal)
Eelgrass Restoration (Upper North Shore) \$60,000 + 90h	Ongoing Continue to restore pilot eelgrass site to Middle Ground in Plum Island Sound; investigate and establish pilot eelgrass sites where warranted in Northern Plum Island Sound and Salisbury waterways, using divers to re-establish eelgrass near the destroyed restoration site in Essex Bay; engage volunteers in Great Marsh eelgrass restoration effort via eelgrass seeding	(7) Protecting Large Aquatic Ecosystems (E) Restored natural communities	BU, Parker River NWR, Mass Audubon, Nantucket Land Council, volunteers	(Q1-4) Photos and interim reports documenting harvest and planting (restoring) at the Middle ground pilot site, (Q2, Q3) Report on investigations of potential new pilot sites, including number of green crabs trapped; (Q1, Q2, Q4) Monitor and report on eelgrass success in Plum Island Sound; (Q1, Q2, Q4) photo-documentation of diver restoration in Essex Bay
Taking steps to protect eelgrass from impacts of docks and recreational boating (Lower North Shore) \$2000 + 100h	New (pending funding) Enhance estuarine seagrass habitat by informing management efforts to reduce stressors impacting seagrass habitat, as well as new site-specific monitoring in Salem Sound.	(7) Protecting large aquatic ecosystems (E) Restored natural communities	Salem & Marblehead harbormasters, Conservation Commissions, private dock owners, DMF, EPA, ACOE, UNH, SSCW volunteer	(Q4) List of presentations, sample presentation materials used for outreach to describe the impact of docks and floats on eelgrass; (Q4) One-page summary report on community monitoring of eelgrass using iSeaGrass and the Eelgrass Blitz protocol

Strategy 3.2 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Promote LID (Lower North Shore) \$20,000 + 312h	Ongoing Promote and implement LID and stormwater green infrastructure in MassBays communities, maintain Commercial Street and Winter Island rain gardens in Salem, and share lessons learned	(4) Addressing diffuse, nonpoint sources of pollution (C) Improved water quality	Greenscapes North Shore Coalition; LNS municipalities	(Q4) List of presentations and publications, as well as technical assistance and grant support provided, (Q4) documentation of one newly implemented LID approach, (Q1-4) Photo-documentation of flood/storm conditions at rain gardens; (Q2-4) Document use of LID maintenance videos (produced with FY21 CZM CPR grant funds) by local DPW departments
Identify and implement stormwater mitigation and low-impact development projects (Cape Cod) 180h (plus \$19,000 + 200h under the BIL workplan)	Ongoing Identify and implement priority projects with partners, as part of APCC's Restoration Coordination Center (RCC) activities.	(2) Identifying polluted waters and developing plans to restore them (4) Addressing diffuse, nonpoint sources of pollution (C) Improved water quality (E) Restored natural communities	Cape Cod towns, CCCD, NRCS, DER, CZM, DMF, CCC, CCCE, WHOI Sea Grant	(Q1-4) Each quarter, provide the following: <ul style="list-style-type: none"> • list of communities assisted and type of assistance provided (e.g., grantwriting assistance, monitoring, training, other) • list of outreach and training events activities and audiences

Strategy 3.2 continued

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>State of the Waters: Cape Cod (Cape Cod)</p> <p>\$26,000 + 500h</p>	<p>Ongoing work with partners to maintain and update a comprehensive “State of the Waters: Cape Cod” program to report on the condition of the Cape’s coastal and fresh waters and their problems, causes, and possible solutions. Water quality grades will be reported via an annual report, rollout at APCC’s annual meeting, via a dedicated website, and other outreach materials. The goal is to promote action to protect and restore water quality through an Action Plan that contains recommendations for protection and restoration of water quality. Progress towards improving water quality and successes will be highlighted in the report and website. The project is intended to serve as a model for other communities</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>(C) Improved water quality</p> <p>(F) Robust interagency and interdisciplinary collaboration and partnerships</p>	<p>CCS, Buzzards Bay Coalition, CCC, SMAST-UMass Dartmouth, WBNERR, MBL Ecosystems Center, CZM, MET, Cape Cod towns</p>	<p>(Q2) List of WQ data sources for 2021 monitoring in coastal waters, fresh water bodies, groundwater, drinking water, and other water resources, including in underserved communities (Q2) Final report for 2022 (grades up to and including 2021 as available), (Q1-4) Dates and attendees lists from Advisory Committee meetings, (Q4) Draft list of 2022 data sources in preparation for 2023 update, (Q4) Updated outreach materials, including website; List of presentations and publications; Updated Action Plan to include reports on successes and progress in protecting and improving water quality; Document engagement with SNEP and CCC to assist CS in uploading water quality data to WQX</p>
<p>Launch and support use of Ecohealth Tracking Tool (Central Staff)</p> <p>120h</p>	<p>New Announce availability and provide demonstrations of the new ETT and its utility for informing local action, including monitoring, mapping, and restoration.</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>(C) Improved water quality</p> <p>(E) Restored natural communities</p>	<p>Mass Rivers Alliance, Coastal Monitoring Network, BHEN, Salt Marsh and Eelgrass Working Groups</p>	<p>(Q1) Announcements of ETT launch, presentations, and one-on-one demonstrations</p>

Strategy 3.3 Maintain MassBays' National Estuary Program Status

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
<p>Establish MassBays as a Center within the School for the Environment at UMass Boston (Central Staff)</p> <p>400h</p>	<p>New MassBays will implement transition to a new host institution, creating new opportunities for diversification of our funding and communications efforts.</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>All CCMP Goals</p>	<p>UMB</p>	<p>(Q1) Complete staff and files transfer to UMB, (Q2) Convert MassBays website to a new platform, (Q1-4) Explore opportunities and apply for new funding for implementing the CCMP, identify opportunities for new partnerships and research within the institution, and establish communication with legislative offices for education and outreach consistent with Federal guidelines.</p>
<p>Convene and support the Management Committee and Local Governance Committees for input on MassBays CCMP implementation, Prepare Program Evaluation materials and host an EPA site visit (Central Staff, All Regions)</p> <p>1200h CS est. 100h/Region</p>	<p>Ongoing Meet the requirements of S.320 Funding Guidance provided by EPA, soliciting community stakeholder input to prioritize yearly workplans to implement the CCMP. Develop and submit proposals for funding beyond S.320 from diverse sources. Implement strategic communications to highlight successes. Prepare for and host EPA Program Evaluation in Spring 2023.</p>	<p>(6) Protecting coastal waters through the National Estuary Program</p> <p>All CCMP Goals</p>	<p>MC members, STAC, LGCs (8TGM, LNS LGC, BHEN Steering Committee, SS LGC, BCCRS)</p>	<p>Central staff: (Q1) Final CCMP submitted to EPA Region 1, including updates to all sections and actions as needed, as well as planned spending under the Bipartisan Infrastructure Law (BIL, the Infrastructure Investment and Jobs Act of 2021); Updated Monitoring Plan to reflect planned BIL investments; (Q2) Updated Finance Plan and new Communications Plan that reflects MassBays' new host situation; (Q2-3) NEPORT submissions to EPA; (Q1-4) Management Committee quarterly meeting agendas and summaries; project and activity updates for MC review and information; List of at least four submitted proposals for funding; (Q4) Annual Report published; Proposed FFY23 workplan submitted to EPA Regional Coordinators: (Q1-4) Updates on activities and progress, attendance at quarterly MC meetings; (Q2-3) NEPORT submissions to MassBays; (Q1-4) Acknowledgement of EPA/ MassBays support noted on RSP</p>

				websites and (as relevant) outreach materials and publications; (Q4) End-of-year reports on progress and proposed ongoing and new activities for FFY23 developed with input from EJ/underserved communities, and LGCs
--	--	--	--	---

Other: Partnerships

Title (Region), Budget + LOE	Description	CWA core program CCMP outcome	Partners	Timeline & Deliverables
Chair the Gulf of Maine Council for the Marine Environment (Central Staff) 100h	New Between July 1, 2022-June 30, 2023, serve as Chair of the GOMC Working Group (1 st year of a 2-year term). This position will lead the Working Group to implement the tasks under the current GOMC Action Plan (ends 2022) and oversee the drafting of the new 5-year Action Plan. Work with Council Coordinator to: convene two joint council and working group meetings (Q2, Q4); convene two working group meetings (Q1, Q3); convene monthly Secretariat meetings. Oversee organization of annual award ceremony (Q4)		Gulf of Maine Council members (states, maritime provinces, federal agencies, academia, NGOs)	Central Staff: (Q1-Q4) Meeting notes and action items from all meetings, development of agenda and meeting materials; (Q4) Final 5-year action plan (2023-2027) with goals, objectives, and strategies to guide the Council’s work for the next 5 years.

D. Budget

MassBays is requesting reimbursement of pre-award costs, up to 90 days, for the work included in this plan.

Narrative

These notes refer to **Table 2, MassBays National Estuary Program Proposed Budget, FFY2022.**

Assumptions – Section 320 funding allocation to MassBays will be \$750,000. An additional \$909,800 will be allocated through a separate cooperative agreement under the Infrastructure Investment and Jobs Act appropriation (referred to as BIL).

Proposed Spending

Salaries for two staff: Executive Director (0.8FTE), and Staff Scientist (0.65FTE). The remainder of these full-time staff salaries will be funded under BIL, as described in a separate workplan. The Coastal Data Scientist's salary, fringe, and indirect costs are covered by the NOAA Project of Special Merit Grant, the EPA Exchange Network Grant, and BIL.

Fringe benefits: Fringe benefits are negotiated annually between the Commonwealth of MA, UMB and the Department of Health and Human Services (DHHS). Fringe benefits are costs associated with employee related expenses including health plan, pension plan, and workman's compensation expenses among others. UMB has four fringe rates in accordance with the University's FY2022 Fringe Benefits and Payroll Tax Rates memorandum and NICRA.

Rate #1 General Fringe, 37.46%

Rate #2 Health and Welfare, \$33 Bi-weekly/FTE

Rate #3 Payroll Tax, 1.97%

Rate #4 Worker's Compensation Insurance, 0.26%

These rates are applied based on the personnel appointment type, benefitted/non-benefitted status, period of service and salary rates. In this case the appointment, benefits status, period of service and applicable rates are as follows:

Personnel	Appointment	Period of service	Applicable Rates
PI Pam DiBona	Professional Benefitted	Calendar	Rates 1, 2, 3, 4
Senior Scientist Prassede Vella	Professional Benefitted	Calendar	Rates 1, 2, 3, 4

Contractual

- Heroku app hosting. MassBays is supporting access to iSeaGrass, an app that allows users to provide real-time, field-based reporting about eelgrass presence/absence, condition, and other parameters. Cost is \$24.99/month.

Other Expenses

- Regional Service Providers. This year we request a total of \$315,000 to come from the \$320 base grant monies for RSP support. Budgets and justifications are included in Table 5.
- Mystic River Watershed Association/Urban Waters Program. Pending allocation of up to \$90,000 supplemental funds through EPA's Urban Waters Program, MassBays will award those funds to MyRWA to carry out activities aligned with that program, including salary for a Mystic River Ambassador to ensure alignment of MyRWA activities across Federal entities and MassBays' CCMP. Budget and justification is included in Table 6.
- Meetings and refreshment costs. MassBays will host an event to announce the revised CCMP

for an assumed 100 participants. Costs include a light lunch (\$25 per person) and room rental fees (\$2500). In addition, we will provide light refreshments (\$5.55 per person) for our 25 MC members for an annual in-person Committee meeting.

Travel (see Table 3)

We propose new funding of \$6042 for the following:

- NEP national meetings
 - Fall Technical Transfer Meeting, to take place in New Orleans in association with the Restore America’s Estuaries Conference (Central Staff/3 travelers)
 - Spring 2023 Annual Meeting, Washington DC (Director/1 traveler)
- Other Professional Development Conferences
 - Assuming limited travel expenses and registration fees for professional development and regional conferences, New England-wide
- Regional meetings, workshops, and site visits
 - CCMP implementation oversight, regional education & outreach workshops, grantee site visits, etc., MassBays-wide
- NE Regional NEP meetings
 - Visits for collaboration and joint programming discussions, New England-wide (Director and Staff Scientist)

Indirect Charges

The University of Massachusetts Boston has a Facilities and Administrative overhead rate of 52.5%, which is a federally negotiated indirect cost rate agreement between University of Massachusetts Boston and the Department of Health and Human Services effective 10/02/2020. The indirect rate is charged to expenditures relating to direct costs including the first \$25,000 of each RSP subaward and excluding equipment. UMass Boston’s threshold for equipment is \$5,000.

Matching Funds

Subgrantees. Regional partners, in their scopes of work to serve as RSPs to MassBays, identify sources of match for the program. Direct match of at least 50% is required; this year a total of \$253,125 is offered by the RSPs (Table 7). Mystic River Watershed Association will provide 100% match to their Urban Waters subaward of \$90,000.

Program Match. Several of the RSPs have also identified a substantial cash and in-kind match, detailed in Table 7. These funding sources are linked directly to the implementation of the CCMP, a total of \$697,449 (detailed in Table 8). Sources of match offered include revenue from membership, state and local grants, private foundations, etc., as well as the work of staff within these organizations on projects specifically related to our estuarine restoration and conservation efforts.

In addition, \$7234 in-kind services are anticipated from Management Committee and Subcommittee members not already accounted for in the RSP match; MassBays will receive \$150,000 state funds this fiscal year from DEP for implementation of the Massachusetts Coastal Condition Assessment. These items total \$157,234.

Total match offered is \$846,266, or 101% match, comprised of the following non-Federal categories:

State: \$150,000
Local: \$57,000
Other (including in-kind labor): \$639,266

Table 2. MassBays National Estuary Program Proposed Budget, FFY2022

FFY22 Section 320 Grant Application Massachusetts Bays National Estuary Program Proposed Expenditures	
Personnel	
Executive Director, 0.8FTE	\$96,000
Staff Scientist, 0.65FTE	\$69,550
subtotal, salaries	\$165,550
Fringe benefits	
40.48% (salaries)	\$66,951
subtotal, fringe	\$66,951
total, salaries + fringe	\$232,501
Travel	
ANEP, EPA meetings	\$6,042
subtotal, travel	\$6,042
Contractual	
Heroku app hosting service, AquaQAPP & iSeaGrass	\$300
subtotal, contractual	\$300
Other	
Regional Service Providers (5 subawards)	\$315,000
Mystic River Watershed Association	\$90,000
Participant support costs	\$5,139
subtotal, other	\$410,139
Total Direct	\$648,982
Indirect	
52.5% (salaries + fringe, travel, supplies, & contracts)	\$125,393
52.5% on RSP subawards (first \$25K each, Y1 only)	\$65,625
subtotal, indirect	\$191,018
Total Request, FFY22	\$840,000
Matching funds	
Direct match	\$403,125
Project-specific match	\$443,141
Total Match, FY22	\$846,266

Table 3. Proposed Travel spending FFY2022

destination (# travelers)	airfare	meals	ground transportation	lodging	registration
NEP national Technical Transfer meeting (New Orleans), 4nt (3 travelers)	\$ 1,200	\$100	\$ 200	\$ 2,100	\$ 450
Spring 2023 (Washington DC), 4d (1 traveler)	\$ 250	-	\$ 100	\$ 600	\$ 150
Other PD/Regional Conferences (2 attendees)		-	\$ 127		
Regional meetings and site visits for CCMP implementation, regionwide education & outreach, etc.			1 car @ \$.585/mi		
Salem x2	0	0	\$ 46.80		
Newburyport x2	0	0	\$ 93.60		
Kingston x2	0	0	\$168.48		
Wellfleet x2	0	0	\$238.68		
Worcester (DEP) x1	0	0	\$ 59.67		
Malden x2					
Haverhill x2	0	0			
NE Regional NEP meetings (2 travelers)			1 car @ \$.585/mi		
Portsmouth NH	0	0	\$ 64.35		
Narragansett RI	0	0	\$ 93.60		
subtotals	\$ 1,450	\$ 100	\$ 1,192	\$ 2,700	\$ 600
Total S.320 Travel	\$ 6,042				

Table 4. Project Match

APCC Match	Amount	Type of match (non-federal)
Direct match	\$ 35,900	indirect, etc.
Monitor cyanobacteria	\$ 90,200	Eddy grant
Monitor herring	\$ 22,832	in-kind volunteer labor
State of the Waters	\$ 2,000	APCC operating
NSRWA Match	Amount	Type of match (non-federal)
Direct match	\$32,851	salaries, indirect, travel, supplies
diadromous fish monitoring	\$25,000	in-kind
Coastal acidification monitoring	\$750	in-kind
invasive species (purple loosestrife)	\$7,500	in-kind
monitor and restore blue mussels	\$4,125	In-kind
water quality monitoring	\$36,700	In-kind
eelgrass in Duxbury-Kingston-Plymouth	\$7,000	In-kind
MVPC Match	Amount	Type of match (non-federal)
Direct match	\$100,904	MVPC operating, indirect
Implement Restoration of Eelgrass in Plum Island Sound; Investigate potential pilot eelgrass sites	\$12,000	Cash (MVPC), inkind (BU)
Marsh Die-off Assessment	\$5,000	Cash (MVPC), inkind (MADMF)
Great Marsh Phragmites Monitoring	\$6,000	Cash (MVPC), inkind (contractor)
Great Marsh Pepperweed Management & Control	\$5,000	Cash (MVPC), inkind (volunteers, MAS)
Marine Invasive Monitoring	\$1,800	Cash (MVPC), inkind (volunteers)
Marsh wrack assessment	\$5,000	Cash (MVPC, MRWC), inkind (UNH)
Marsh Edge Erosion monitoring and analysis	\$3,000	Cash (MVPC), inkind (BU)
Stormwater Management	\$14,500	Cash (MVPC)
Lower Merrimack River Initiative	\$5,000	Cash (MVPC), inkind (BU, volunteers, BU)
Microplastic Water Sampling	\$5,000	Cash (MVPC), inkind (UNH)
Upper North Shore Specific Program Development	\$10,000	Cash (MVPC)
Merrimack River District Commission	\$10,000	Cash (MVPC)
Beach Sand Microplastic Sampling	\$5,000	Cash (MVPC), inkind (volunteers, NECC)
Great Marsh Symposium	\$3,000	Cash (MVPC), inkind (volunteers)
NUMSC Match	Amount	Type of match (non-federal)
Direct match	\$35,910	indirect

Table 4. Project Match *continued*

SSCW Task	Amount	Type of match (non-federal)
Direct match	\$45,860	indirect, operating
Sawmill Brook WQ & fisheries	\$2,500	in-kind volunteer, private
Greenscapes	\$57,000	Essex County municipalities

MyRWA Task	Amount	Type of match (non-federal)
Mystic Baseline Water Quality Monitoring Program	\$56,000	in-kind staff time, laboratory services, and volunteer labor
Cyanobacteria monitoring Program	\$10,000	Unrestricted private funds
River Herring Program	\$14,000	in-kind volunteer labor, onsite and virtual
Mystic Stewardship	\$10,000	in-kind staff time, volunteer labor

Item	amount	Type of match (non-federal)
Management Committee attendance	\$7,234	in-kind (15 non-fed, non-RSP participants x 3h/mtg x 5 mtgs/y * \$32.15/h)
MassDEP MA Coastal Condition Assessment	\$150,000	state cash match

Table 5. Regional Service Providers Budget Detail

Merrimack Valley Planning Commission				
Line Item	Requested	Match	Total	Detail/Justification
Salaries	\$24,000	\$41,869	\$65,869	1400 hours Regional Coordinator, no fringe charged
Travel	\$4,200		\$4,200	standard-rate mileage, travel throughout the Upper North Shore Region
Supplies	\$960		\$960	printing photos and maps; pvc transect frames, microplastics sampling supplies
Indirect	\$33,840	\$59,035	\$92,875	141% on Salaries
Total	\$63,000	\$100,904	\$163,904	

Salem Sound Coastwatch				
Line Item	Requested	Match	Total	Detail/Justification
Salaries	\$63,000	\$25,000	\$88,000	1700 hours, no fringe incurred
Travel		\$200	\$200	standard-rate mileage, travel throughout the Lower North Shore Region
Supplies		\$3,000	\$3,000	water quality monitoring supplies
Indirect		\$19,360	\$19,360	22% on Salaries
Total	\$63,000	\$47,560	\$110,560	

North and South Rivers Watershed Association				
Line Item	Requested	Match	Total	Detail/Justification
Salaries & Fringe	\$42,806	\$24,559	\$67,365	1700 hours Regional Coordinator, 11% fringe on salaries
Intern	\$4,083	\$1,677	\$5,760	stipend
Travel	\$1,985	\$815	\$2,800	standard-rate mileage, travel throughout the South Shore Region
Supplies	\$177	\$73	\$250	field monitoring supplies, including pvc pipes, duct tape, tools
Other Direct Costs	\$532	\$218	\$750	Regional conference registration, publication fees
Indirect	\$13,417	\$5,509	\$18,926	23% on Salaries and Fringe
Total	\$63,000	\$32,851	\$95,851	

Association to Preserve Cape Cod				
Line Item	Requested	Match	Total	Detail/Justification
Salaries & Fringe	\$63,000	\$17,600	\$80,600	1600 hours Regional Coordinator, fringe rate 22% on Salaries
Other Direct Costs		\$1,500	\$1,500	software, sampling supplies
Indirect		\$16,800	\$16,800	\$12/hour
Total	\$63,000	\$35,900	\$98,900	

Northeastern University Marine Science Center				
Line Item	Requested	Match	Total	Detail/Justification
Salaries & Fringe	\$62,000		\$62,000	1600 hours Regional Coordinator, fringe rate 25.5% on Salaries
Other	\$1,000		\$1,000	participant support costs: light refreshments for quarterly BHEN meetings
Indirect		\$35,910	\$35,910	unrecovered indirect costs, 57% of direct costs
Total	\$63,000	\$35,910	\$98,910	

Table 6. Urban Waters Budget Detail

Mystic River Watershed Association				
Line Item	Requested	Match	Total	Detail/Justification
Salaries & Fringe	\$75,855	\$0	\$75,855	Mystic River Ambassador salary, fringe rate 17.2% on salaries
Travel	\$2,000	\$0	\$2,000	standard-rate mileage, travel throughout the Mystic River Watershed
Other	\$0	\$0	\$0	
Indirect	\$12,145	\$0	\$12,145	15.6% on salary
Total	\$ 90,000	\$0	\$ 90,000	<i>programmatic match provided (see Table 4)</i>

Appendix N. Sample Healthy Estuaries Grant Request for Proposal

EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS

Bethany A. Card, Secretary

Request for Responses ENV 23 CZM 03

Dated: May 19, 2022

Massachusetts Bays National Estuary Partnership

FY23 Healthy Estuaries Grants

1. GRANT OPPORTUNITY SUMMARY

A. PROPOSALS SOUGHT FOR: The Executive Office of Energy and Environmental Affairs (EEA) Massachusetts Bays National Estuary Partnership (MassBays) within the Massachusetts Office of Coastal Zone Management (CZM) is soliciting proposals under the FY23 MassBays Healthy Estuaries Grant Program for projects that will advance the implementation of the MassBays [Comprehensive Conservation and Management Plan](#) (CCMP). Through the Healthy Estuaries Grant Program, MassBays will provide funding and technical support to those working in near-shore waters and coastal communities from Salisbury to Provincetown to:

1. Characterize estuary, rocky intertidal, and beach habitats and biological communities.
2. Document the impacts of human and natural stressors on those systems.
3. Evaluate effectiveness of habitat restoration efforts already implemented.
4. Design and scope larger habitat and/or water quality restoration projects for subsequent state or federal funding, especially in underserved communities.

B. OVERVIEW AND GOALS: MassBays is a United States Environmental Protection Agency (U.S. EPA) National Estuary Partnership dedicated to protecting, restoring, and enhancing the estuarine ecosystems of Massachusetts and Cape Cod Bays. Working toward our vision of sustainable estuarine ecosystems that support the life and communities dependent upon them, MassBays grant funds are dedicated to support local progress on protecting, restoring, and enhancing estuarine habitats (e.g., seagrass beds, salt marshes, diadromous fish habitat, beaches, and rocky shores) and to inform management efforts to reduce stressors (e.g., climate change, wastewater, stormwater, habitat fragmentation) impacting these habitats.

With the FY23 Request for Response (RFR), we are seeking projects focused on knowledge gaps revealed by MassBays' ongoing efforts to characterize the great variability across the planning area (see Section 2.B). We seek information to support MassBays-wide planning, as well as local, embayment-specific priorities identified by communities. Projects must include a robust project evaluation process with measurable outcomes that will track progress toward short- and long-term project goals.

A requirement of this RFR is the submission of a pre-proposal. The pre-proposal is the first step

in which respondents will provide a brief description of the purpose and goals of the study, a summary approach, and total proposed budget. Upon selection by a Review Committee, proponents of successful pre-proposals will be invited to submit a full proposal. Guidelines for submission of both the pre-proposal and full proposal are provided in Section 3.

C. ELIGIBLE PROJECTS: Eligible projects include research, monitoring and data analysis, and planning initiatives that advance MassBays' priorities which focus on protecting, restoring, and enhancing coastal habitats, including shellfish and seagrass beds, salt marshes, diadromous fish habitat, beaches, and rocky shores and the communities that these habitats support. Topics of specific interest include identifying and documenting impacts of climate change and sea level rise on natural systems and water quality in the [68 assessment areas](#) of the MassBays region. Proponents must demonstrate that projects will inform and advance near-term estuarine and coastal management initiatives consistent with the goals of the CCMP. For more details see Section 2B.

D. ELIGIBLE APPLICANTS: This solicitation is open to Massachusetts municipalities, Massachusetts 501(c)(3) organizations, regional planning agencies, and nonprofit research institutions, and institutions of higher learning in Massachusetts. See further detail in Section 2A.

E. APPLICATION DEADLINES:

Deadline for Pre-proposal: June 10, 2022, at 12:00 pm

Deadline for Full Proposal: July 15, 2022, at 4:00 pm

(See further details on deadlines and grant program calendar in Section 4).

F. FUNDING AVAILABILITY: We anticipate up to \$145,000 in federal funds will be available through this solicitation. EEA reserves the right to change the amount of available grant funding. Final funding amounts are subject to appropriation and approval. A single applicant may request funding amounts between \$8,000 and \$30,000 per project. MassBays may make a limited number of awards to collaborative, multi-partner projects. Budgets for these projects cannot exceed \$45,000. Respondents are strongly encouraged to identify and incorporate efficiencies and cost-saving measures to reduce costs as much as possible. (See Funding Availability in Section 2C).

G. MATCH REQUIREMENT: A non-federal match (cash or in-kind) that will equal or exceed 25% of the total project cost is required. Projects that provide additional match will receive additional consideration (see Match Requirement in Section 2D). Funds from other federal sources or grants, and funds committed to match other federal grants, are not eligible to be used as matching funds.

H. ANTICIPATED DURATION OF CONTRACT(S): Contracts are anticipated to last approximately 24 months, with an anticipated start date in September 2022 and a completion date of October 31, 2024 (See further detail on Anticipated Duration of Contract[s] in Section 2E).

I. REGULATIONS, STATUTES, OR AUTHORIZATION GOVERNING THIS GRANT PROGRAM: The award of federal sub-grants is subject to the regulations in 815 CMR 2.00. This grant program is also governed by cooperative agreements between the Commonwealth of Massachusetts and the U.S. EPA in support of the Massachusetts Bays National Estuary Partnership.

J. CONTACT INFORMATION: Prassede Vella
Massachusetts Bays National Estuary Partnership
251 Causeway St., Suite 800
Boston, MA 02114
Email: Prassede.Vella@mass.gov

2. PERFORMANCE AND CONTRACT SPECIFICATIONS

A. ELIGIBLE APPLICANTS: This solicitation is open to Massachusetts municipalities, 501(c)(3) non-profit organizations, non-profit research institutions, and institutions of higher learning. Where multiple entities propose a collaborative project, a single grantee will be the recipient of funds, and partners receiving funds through the grantee will be considered subawardees. The grantee must be a Massachusetts-based entity with a tax identification number and the authority to enter into contracts with the Commonwealth of Massachusetts, but subawardees and subcontractors need not be (see Section 2.C. for definitions). Subcontractors may include for-profit organizations and state agencies. Only one grant proposal per entity will be awarded, although more than one proposal from a given entity may be submitted for funding.

B. ELIGIBLE PROJECTS/SCOPES OF WORK: MassBays seeks proposals for projects that include research and planning initiatives that advance MassBays' priorities which focus on protecting, restoring, and enhancing coastal habitats, including shellfish and seagrass beds, salt marshes, diadromous fish habitat, beaches, and rocky shores and the communities that these habitats support, especially identifying and responding to projected impacts of climate change and sea level rise on those habitats. Proponents must demonstrate that projects will inform and advance near-term estuarine and coastal management initiatives consistent with the goals of the CCMP and in MassBays' planning area (Attachment A).

Applicants are encouraged to use available resources including, for example:

- **[Ecosystem Delineation and Assessment](#)** (EDA). The EDA characterizes 68 assessment areas (including 47 embayments, rocky shores and beaches) using data for the following indicators of estuarine conditions: salt marsh, tidal flats, eelgrass, shellfish habitat, shorebird habitat and nesting sites, anadromous fish passage, land use/land cover, stormwater discharge, impervious area, population density, wastewater discharge, 303(d) impairments (bacteria, nutrients), designated shellfish area classification, tidal restriction, barriers to fish passage, and stream crossings. These data are presented in an [ArcGIS Story Map](#).
- **[2019 Comprehensive Conservation and Management Plan \(CCMP\) Goals](#)**. This document, required of all National Estuary Programs under Section 320 of the Clean Water Act, describes long-term ecosystem goals and strategies to improve water quality

and coastal habitat in the MassBays planning area. Please refer to the [Table of Strategies and Actions](#) included in the 2019 CCMP on MassBays' website; Attachment B documents Short-term Priorities developed by MassBays' Management Committee, also based on the CCMP and input provided by local stakeholders.

- [MassBays Monitoring Framework](#). This document describes MassBays' approach to collecting and analyzing data from multiple sources to assess conditions and trends across the Bays (i.e., State of the Bays reporting). The document is an attachment to the CCMP.
- [Gaining Ground: Defining Priority Research for Resilient Salt Marshes](#). MassECAN's Salt Marsh Working Group has identified salt marsh research priorities to support collaboration and research that promotes resilient salt marsh habitat now and into the future. This summary document represents outcomes of a consensus-based process to inspire coordinated, transdisciplinary discussion and action around the complex and intersecting challenges of salt marsh management and resilience.

Respondents are encouraged to refer to these materials and submit proposals which build on these products. Project descriptions must describe how their own project goals align with the needs identified and documented by MassBays.

Project work must be focused on or around one of the 68 assessment areas described in the EDA (see Attachment A). Projects may be conducted in or around more than one area or include approaches and solutions that have wider applicability if they meet the goals of the solicitation. Eligible projects include research, monitoring and data analysis, and initiatives that will: (1) generate data and information on trends and conditions of local ecosystems for the purpose of filling data gaps, (2) apply new or innovative tools and approaches to improve ecological conditions (including restoration efforts), (3) demonstrate new or innovative research approaches to assess conditions and trends, (4) assist MassBays with education and outreach specific to its CCMP, and/or (5) design and plan future on-the-ground implementation projects to improve conditions of estuarine habitats through subsequent investment. Preference will be given to approaches and results that apply to or can be transferred to multiple MassBays assessment areas.

Competitiveness of a project will depend on its ability to meet grant selection criteria described in Attachment C. Note that projects must include an evaluation plan including means and measures for tracking progress toward project goal(s).

Projects not eligible for funding under this RFR include:

1. Projects required as part of compensatory mitigation or enforcement action.
2. Lobbying or political activities.

Interested parties may submit questions to Prassede Vella at Prassede.Vella@mass.gov by **June 6, 2022, at 4 pm**. Questions and answers will be posted on [COMMBUYS](#) concurrent with direct responses to the initial inquiries up until the deadline.

This RFR includes submission of a pre-proposal as a first step in which respondents will be required to provide a description of the purpose and goals of the study, a summary approach and total proposed budget. Upon selection by a Review Committee, proponents of successful pre-proposals will be invited to submit a full proposal. Guidelines for submission of both the pre-proposal and full proposal are provided in Section 3.

C. FUNDING AVAILABILITY, BUDGETING GUIDELINES & ALLOWABLE EXPENDITURES:

We anticipate that up to \$145,000 in federal funds will be available through this solicitation. EEA reserves the right to increase or decrease the amount of available grant funding. Grant funds are awarded on a reimbursement basis upon receipt of invoices from the grantee and are subject to 10% retention until all deliverables are met.

- **Project funding:** A single applicant may request funding amounts between \$8,000 and \$30,000 per project. MassBays may make a limited number of awards to collaborative, multi-partner projects. Budgets for these projects cannot exceed \$45,000. All contracts shall be subject to available federal funding. If available funding ceases for any reason, a contract shall be deemed under suspension and contract performance must halt. A contractor will not be entitled to compensation for any performance provided during the period of contract suspension. EEA may lift the suspension if available funding is received. In the absence of foreseeable available funding, EEA may terminate the contract.
- **Subawards:** The grantee may apply on behalf of one or more partners, who will be considered subawardees. Subawardees (in contrast to subcontractors) are engaged in the planning and implementation of the project, as well as post-award maintenance or outreach efforts resulting from the joint funding.
- **Subcontracts:** The grantee may subcontract a portion of the grant award for activities deemed eligible and which are completed under a scope of work negotiated between the grantee and EEA. These costs must be identified in the proposal. Examples of such eligible costs include laboratory work, engineering or survey services, printing, etc.
- **Multiple applications:** An eligible entity may submit more than one application but only one proposal per entity may be funded. Funding through a collaborative, partnership-based application under this opportunity is considered a funded proposal for all partners.

D. MATCH REQUIREMENTS: The Grantee will provide a non-federal match that will equal or exceed 25% of the **total** project costs. The match may be cash or in-kind contributions or a combination of both¹. Funds from other federal sources or in-kind value that is currently being used to

¹ Cash contributions are those funds that will be used to purchase goods or services associated with the project. In-kind contributions represent the value of non-cash contributions provided by the applicant, e.g., in the form of charges for real property and non-expendable personal property and the value of goods and services directly benefiting and specifically identifiable to the project.

match other government programs are not eligible to be used as matching funds. Costs incurred to prepare the project proposal will not be considered as part of the match requirement. Basis for cost estimates for both cash and in-kind match should be described as part of the project budget narrative when submitting the full proposal. All in-kind and cash match must be documented and received prior to the end of the contract period.

E. ANTICIPATED DURATION OF CONTRACTS: Contracts are anticipated to last approximately 24 months, with an anticipated start date in September 2022 and a completion date of October 31, 2024. Contracts and associated scopes of work must be completed by their contract end date. Awarded contracts will be reviewed during their course, and upon written request by the grantee, may be extended, at the sole discretion of EEA and subject to constraints of the funding source. Grantees must make all extension requests no later than 60 days prior to contract expiration.

F. PROJECT TERMS: If awarded, projects will be required to abide by the [Standard Commonwealth of Massachusetts Terms and Conditions](#). A final contract is subject to successful negotiation of a Final Scope of Work. Please note that EEA does not guarantee that any contracts may result from this RFR or that any particular funding level will be awarded. Projects will commence immediately upon execution of a final contract.

Additional requirements for funded projects:

1. For projects involving data collection and analyses, a Quality Assurance Project Plan (QAPP) may be required. A QAPP is a document that outlines the components of a monitoring program including the steps taken to assure the quality of the data generated. Depending on the type of project, proponents may use [MassBays AquaQAPP tool](#) to develop a QAPP; in any case, the proposal should include reference to whether a QAPP has been or will be developed for the proposed work. All QAPPs must be approved by the U.S. EPA prior to start of work. Depending on the project and intended use of results, approval from the Massachusetts Department of Environmental Protection (DEP) may also be required.
2. The scope of work will include a delivery/reporting schedule. Summary progress reports will be required at least quarterly, describing the project status or impediments to progress. Additionally, a final report will be required, which should describe the activities completed under the contract, data, results and findings, and management recommendations.
3. Upon completion of the project, the grantee's project team will be asked to: (1) provide a one-page summary of the project for publication on the MassBays National Estuary Partnership website, (2) upload any data generated under a QAPP to EPA's Water Quality Portal; and may be invited to (3) present project outcomes and recommendations to the MassBays Management Committee at one of its quarterly meetings.

4. Grantees are required to acknowledge the funding support and contributions of the MassBays National Estuary Partnership in any published material and/or oral presentations highlighting project implementation and successes, including websites and e-newsletters.

G. INVOICING: Contract funds are awarded on a reimbursement basis for expenditures made during the period of the contract. Only those tasks/deliverables completed after the contract start date and identified in the Scope of Work are eligible for reimbursement. Expenditures made outside of the period of the executed contract cannot be reimbursed.

3. INSTRUCTIONS FOR APPLICATION SUBMISSION

A. EVALUATION CRITERIA: Application to the Healthy Estuaries Grant Program is a two-step process that includes a pre-proposal (step 1) and a full proposal (step 2). A Review Committee will be convened to evaluate all pre-proposals and full proposals on a competitive basis. The Review Committee will be composed of MassBays and EEA staff, federal agency representatives, and members of the [MassBays Management Committee](#). Subject-matter experts may be included to serve in an additional advisory role to the Committee to assist in review of the scientific validity and technical merit of the proposals. Each pre-proposal will be reviewed and ranked in a competitive process by the Review Committee.

Using the Selection Criteria described in Attachment C, the Review Committee will assign a score to each pre-proposal, and based on these scores, assign a rank order to each. The average rank score among all reviewers shall be the basis of pre-proposal selection. All respondents will receive written notification from MassBays on the ranking. Only the highest mean-ranked pre-proposals will be invited to submit a full proposal, in order of rank. The number of applicants invited will be at the discretion of the Review Committee, depending upon the amount of funding requested among the highest ranked proposals and the total number of pre-proposals received. The goal of the Review Committee is to ensure that the proponents with the highest ranked and most promising pre-proposals are invited to submit full proposals. The Review Committee reserves the right to reject any proposals that do not meet the goals and terms of this RFR.

The same competitive review process will be followed for the selection of full proposals. Only the highest mean-ranked full proposals that demonstrate clear and significant benefits to MassBays planning area and support the goals of the CCMP will receive funding. Projects will earn points for meeting the requirements of each evaluation category as described in the Scoring Sheets provided in Attachment C of this solicitation.

Note that incomplete or incorrectly submitted applications may be disqualified.

B. APPLICATION CONTENT AND FORMAT: Applications to this grant program is a two-step process. The first step requires submission of a pre-proposal by **June 10, 2022, at 12:00 pm**. Full

proposals (step two) will be invited at the recommendation of the Review Committee. Full proposals must be received by **July 15, 2022, at 4:00 pm**. Additional deadline information is provided in Section 4.

STEP 1: Pre-proposal

A complete pre-proposal should follow the format included in Attachment D, and must include: (1) Cover Sheet, (2) Pre-proposal Narrative including names and roles of primary partners, and (3) estimated total budget, including the amount requested. The Pre-proposal Narrative should be single-spaced in 11-point font and should not exceed two (2) pages, including figures and tables. Pre-proposals must list primary partners and their specific role or contribution to the proposed effort. No additional support documentation is required at this time. Details regarding submission of the pre-proposal are provided in Section C.

STEP 2: Full Proposal (by invitation from MassBays only)

Only full proposals invited by MassBays based upon Committee review and approval of a pre-proposal will be accepted. Complete proposals must include all components (cover sheet, project description, and additional materials) described in Attachment E, and must be submitted as instructed in Section C. Ancillary materials included with the proposal but not specific to this solicitation will not be reviewed. The application must contain clear and concise narrative (and supporting graphics, maps, or tables as necessary) in each of the required sections.

Full proposals must be single-spaced and should be composed in at least 11-point font. The project description may not exceed ten (10) pages, exclusive of cover sheet/letter, project summary, literature cited, budget information, resumes of proposed staff, letters of support, or other attachments.

C: APPLICATION SUBMISSION INSTRUCTIONS:

Pre-proposal: Respondents must submit a signed cover sheet and pre-proposal narrative, clearly specifying the RFR number on the cover sheet sent by email (attached as a MS Word document or PDF) to Prassede.Vella@mass.gov by **June 10, 2022, at 12:00 pm**.

Full proposal: Invited respondents must submit one signed cover sheet and full proposal, clearly specifying the RFR number on the proposal cover sheet by email (attached as a MS Word document or PDF) to Prassede.Vella@mass.gov by **July 15, 2022, at 4:00 pm**. In addition, an Original signed full proposal shall be submitted to the following address:

**Prassede Vella
RE : RFR ENV 22 CZM 03
Massachusetts Bays National Estuary Partnership
251 Causeway Street, Suite 800
Boston, MA 02114-2126**

D. ADDITIONAL REQUIRED DOCUMENTATION: If awarded and if not already on file with the Department, the respondent will be required to submit the following forms to complete a contract:

- Commonwealth Standard Contract Form, signed and dated by the Respondent
- Scope of Services and Budget Attachments
- Commonwealth W-9 Tax Information Form completed and signed by the Respondent. (A DUNS number and TIN number must be included on the W-9 Form)
- Completed Contractor Authorized Signature Verification Form.
- Electronic Funds Transfer (EFT) Authorization Form
- Prompt Payment Discount Form

Respondents are encouraged to review these forms prior to submission of a Response. Forms may be downloaded from [COMMBUYS](#) as part of this solicitation.

4. DEADLINES AND PROCUREMENT CALENDAR

A. RELEASE OF SOLICITATION: The schedule below is anticipated. Dates and times are subject to change. Respondents are responsible for checking for any updates on the [COMMBUYS](#) system.

RFR posted on COMMBUYS	May 19, 2022
1 st Question and Answer period closes	June 6, 2022
Pre-proposals due	June 10, 2022, at 12:00 pm
Full proposals invited	June 22, 2022
2 nd Question and Answer period closes	July 8, 2022
Full proposals due	July 15, 2022 at 4:00 pm
Awards announced	August 2022 (estimated)
Contracts commence	September 2022 (estimated)
Projects completed by	October 31, 2024

B. INQUIRIES ABOUT THE SOLICITATION: Questions about the solicitation will be accepted in writing by email to Prassede.Vella@mass.gov in two phases: May 19 through June 6, 2022 (pre-proposals) and June 22 through July 8, 2022 (full proposals). Questions and answers will be posted on [COMMBUYS](#) concurrent with direct responses to the initial inquiries up until the deadline. These answers are for clarification purposes only and do not constitute an amendment of the RFR unless expressly stated as such.

5. MISCELLANEOUS

A. TYPE OF PROCUREMENT: Grant

B. USE OF THIS PROCUREMENT BY SINGLE OR MULTIPLE DEPARTMENTS: This RFR is a single department procurement. All contracts awarded under this RFR will be utilized solely by EEA.

C. REQUEST FOR SINGLE OR MULTIPLE CONTRACTORS: Multiple contracts may be awarded under this RFR.

D. RFR DISTRIBUTION METHOD: This RFR is distributed electronically using the [COMMBUYS](#) system. It is the responsibility of every Respondent to check COMMBUYS for any addenda or modifications to an RFR to which they intend to respond. The Commonwealth of Massachusetts and its subdivisions accept no liability and will provide no accommodations to respondents who fail to check for amended RFRs and submit inadequate or incorrect responses. Potential Respondents are advised to check for updates on the COMMBUYS system to ensure they have the most recent RFR files.

E. LIST OF ATTACHMENTS:

- A. MassBays Planning Area (Fig. 1); MassBays Assessment Areas (Fig. 2)
- B. MassBays Short-term Priorities
- C. Sample Selection Criteria (Scoring Sheets) for Pre-proposals and Full Proposals
- D. Pre-proposal Cover Sheet and Narrative Components
- E. Full proposal Cover Sheet and Narrative Components

ATTACHMENT A

FIGURE 1: MASSBAYS PLANNING AREA

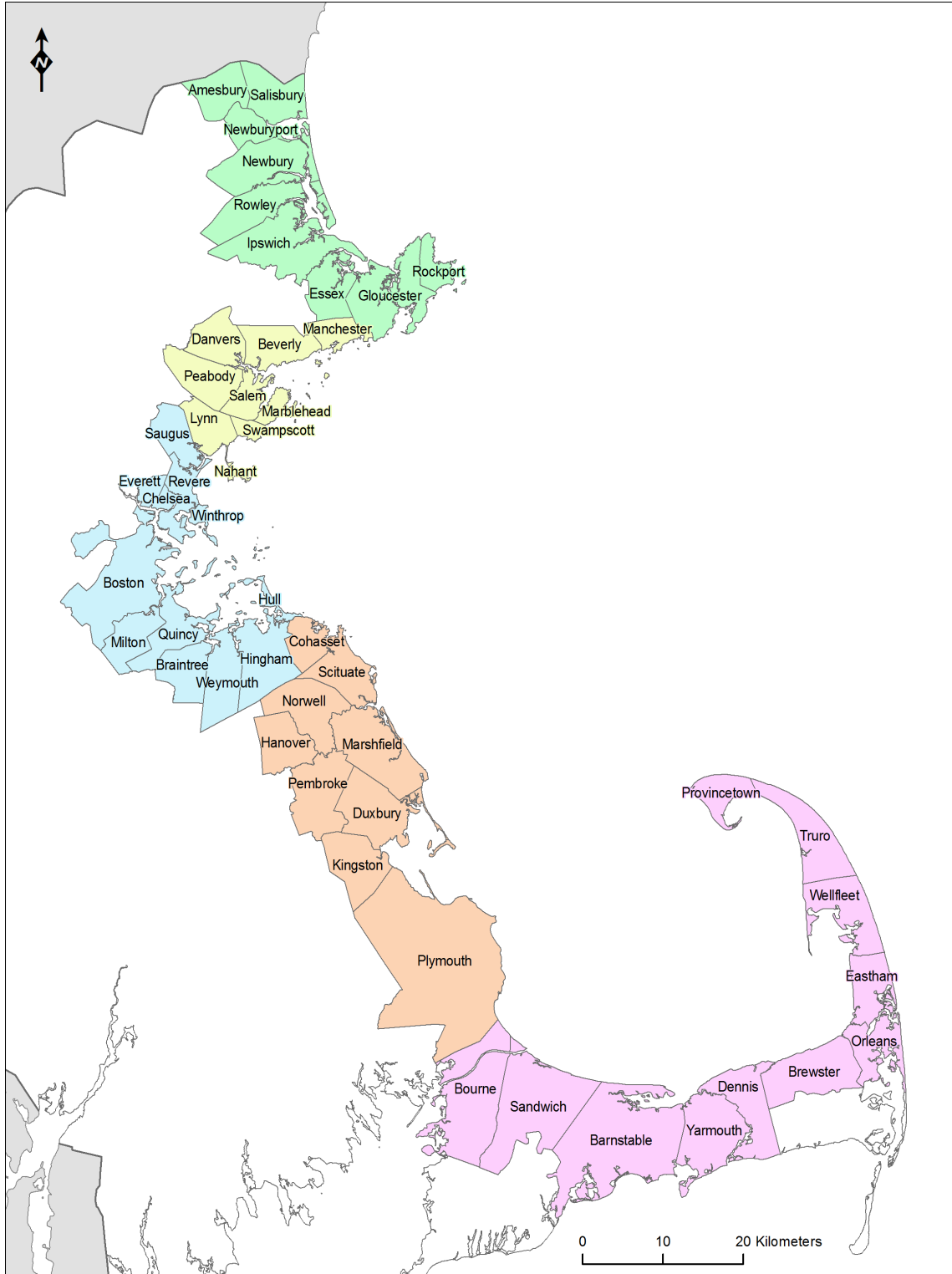
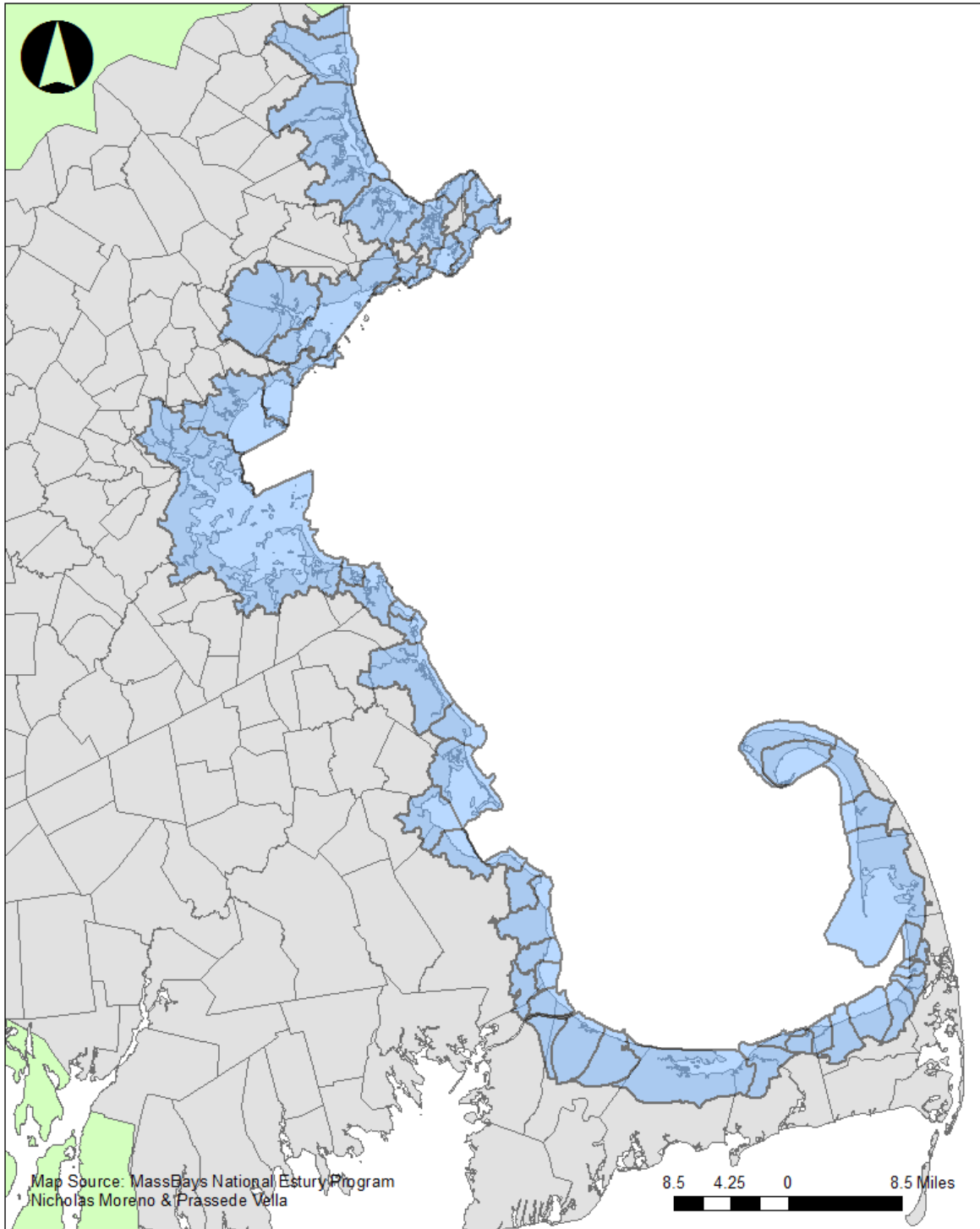


FIGURE 2

MassBays Assessment Areas (2017)



ATTACHMENT B
MASSBAYS SHORT-TERM PRIORITIES

MASSACHUSETTS BAYS NATIONAL ESTUARY PARTNERSHIP
FY23 HEALTHY ESTUARIES GRANTS

Request for Response ENV 23 CZM 03

Support policy and planning

- Prioritize, plan, or implement coastal *infrastructure projects* that result in habitat or water quality improvements.
- Conduct regional/watershed-based coastal *restoration prioritization*.
- Collect habitat and water quality data to *inform state & local condition assessments*.

Address research & data gaps

Climate change

- Influence on pollution and water quality
- Considerations for restoration of submerged aquatic vegetation and salt marsh
- Coastal acidification characterization and impacts
- Sentinel species assessments and/or documentation of population shifts
- Examine changing sediment budgets to forecast restoration needs

Water quality

- Determine water quality thresholds that optimize health of coastal habitats
- Investigate connections between water quality and habitat loss
- Expand existing freshwater monitoring programs to include estuarine systems
- Conduct marine benthic community assessments
- Assess emerging contaminants (PFAS, PPCPs)

Habitat condition

- Investigate the cause(s) of habitat deterioration and possible actions to improve conditions
- Investigate impacts of habitat loss on key ecosystem services
- Expand video-enabled diadromous fish run monitoring
- Conduct habitat restoration-related monitoring to inform future restoration efforts

Data products & analysis

- Digitize and conduct QA/QC assessments on historic data and upload to EPA's Water Quality Portal
- Analyze crowdsourced data (e.g., MassWreck, iNaturalist observations) to characterize conditions in MassBays
- Pilot innovative technologies and approaches to collecting, managing, and sharing monitoring and restoration data.

Evaluate impact

- Effectiveness of restoration, education, and outreach, and other actions that garner support from communities and stakeholders
- Qualitative and quantitative benefits of CCMP-related (including Healthy Estuaries Grant-funded) programs and projects

ATTACHMENT C
SAMPLE SELECTION CRITERIA (SCORING SHEET) FOR PRE-PROPOSALS

1) Project goal and outcomes		Score: _____ of 35 points
Assessment	maximum possible points	
Is there a clearly demonstrated need and justification for the action described in the pre-proposal (e.g., restoration, management efforts, data collection)?	10	
Are the project goal(s) and anticipated outcomes clearly articulated?	5	
Is the project relevant to the MassBays CCMP?	10	
Does the project address a priority action identified by MassBays?	10	

2) Anticipated benefits		Score: _____ of 30 points
Assessment	maximum possible points	
Does the project present a clear, logical, and achievable solution to the stated need?	10	
Does the project have a realistic potential of achieving anticipated outcomes?	10	
<i>If a planning effort is proposed, will the project set the groundwork for future implementation funding?</i>	<i>10</i>	
<i>If a research or monitoring effort is proposed, will the project provide a basis for future applied research or management action?</i>	<i>10</i>	

3) Qualifications and Budget		Score: _____ of 15 points
Assessment	maximum possible points	
Do the project lead and partners demonstrate capacity to implement the project as described?	5	
Is the budget reasonable for the work proposed?	5	
Does the project provide a match greater than 25% of total project cost?	5	

4) Transferability		Score: _____ of 20 points
Assessment	maximum possible points	
Are anticipated outcomes transferable to other regions? Can the approach be implemented in other assessment areas or regions?	10	
Are plans to share the approach and/or findings with specific target audiences adequate?	10	

ATTACHMENT C (CONTINUED)
SAMPLE SELECTION CRITERIA (SCORING SHEET) FOR FULL PROPOSALS

1) Project need, goals, and outcomes	Possible score: 25 points
<p><i>Request to applicants:</i></p> <p>Problem Description</p> <ul style="list-style-type: none"> • Describe the assessment area(s) need(s) and/or challenges that this project will address. Cite previous work to document the problem and any management needs. • Describe the location and assessment area(s) where the work will be focused and the habitats/water bodies of concern. A locus map of the project must be attached. <p>Project Goals and Anticipated Outcomes</p> <ul style="list-style-type: none"> • Describe the goals of the proposed project. Goals should be explicitly connected to desired outcomes of the project and any anticipated management activities. Connect the project to the MassBays CCMP. For example: <ul style="list-style-type: none"> ▪ Document and compare nutrient loads and habitat conditions in areas A and B. ▪ Advance activities described in the MassBays CCMP Strategy 3.2. • Describe the anticipated short-, medium-, and long-term outcomes that will result from the completion of this project. Connect project outcomes to desired CCMP outcome(s). For example: <ul style="list-style-type: none"> ▪ Short-term outcome: Data regarding embayment-specific nutrient loads are available. ▪ Medium-term outcome: Connections between nutrient loading and habitat condition inform management decisions. ▪ Long-term outcome: Changes in local nutrient loads result in improved habitat conditions. ▪ CCMP Environmental Outcome: Restored natural communities. <p><i>Evaluate whether the proposed project:</i></p> <p>___ is consistent with the strategies and advances the MassBays CCMP goals.</p> <p>___ focuses on one or more of the 68 assessment areas within the MassBays planning area.</p> <p>___ presents a clearly defined need for the project in the assessment area of interest, including specific end users.</p> <p>___ draws existing knowledge and materials, in particular the Ecosystem Delineation and Assessment (EDA), monitoring plan, and the MassBays Priority Action List</p> <p>___ builds on existing work and develops new knowledge that will inform the State of the Bays.</p> <p>___ clearly articulates the goal(s) of the project.</p> <p>___ describes outcomes that are clearly connected to desired goal(s).</p>	
<p>Reviewer Comments:</p> 	

ATTACHMENT C (CONTINUED)
SAMPLE SELECTION CRITERIA (SCORING SHEET) FOR FULL PROPOSALS

2) Project approach and evaluation plan	Possible score: 30 points
<p><i>Request to applicants:</i></p> <ul style="list-style-type: none"> • Provide a detailed description of proposed methodology and approach, including the potential for transferability to other assessment areas and ecosystem problems. • Identify project staff, partners, and subcontractors (if applicable) and describe their roles and responsibilities in the project. • Provide a Scope of Work/Tasks to be completed under grant request that includes: <ul style="list-style-type: none"> ▪ A detailed, step-by-step narrative for each task including supporting reference materials, plans, tables, or graphics, as well as an estimated cost associated with each task. ▪ If applicable, study design including methods of data collection, analyses, and QA/QC (including QAPP). ▪ Timeline and anticipated milestones, including written products and other deliverables. • List interim measures in progress toward anticipated short-term and medium-term outcomes and anticipated project benefits and describe how they will be tracked and documented. <p><i>Evaluate whether the proposed project:</i></p> <p>___ generates products or services that will result in concrete management activities or on-the-ground projects, e.g., implementation of BMPs or restoration efforts.</p> <p>___ is focused on addressing ecological functions of ecosystem resources and/or impacts of stressors</p> <p>___ addresses local priority concerns</p> <p>___ includes work in underserved communities</p> <p>___ approach, methodology, and anticipated outcomes are based on sound scientific principles.</p> <p>___ clearly aligns task-specific budgets within project scope and timeline.</p> <p>___ identifies outcome and impact measures to assess progress of the project towards anticipated goals.</p>	
Reviewer Comments:	

3) Project benefits and transferability	Possible score: 15 points
<p><i>Request to applicants:</i></p> <ul style="list-style-type: none"> • Articulate the direct benefits of the project to the local ecosystem and resource management. • Describe how the project results and findings may be applied beyond the target assessment area(s). • Identify specific target audiences for the project approach and results, and describe plans for sharing methodologies, results, conclusions, and management implications with those audiences. Include the anticipated reach of your dissemination plan (local, regional, national). <p><i>Evaluate whether the proposed project:</i></p> <p>___ has reasonable potential to benefit the local ecosystem and/or local resource management planning.</p> <p>___ will develop an approach or pilot a solution that can be applied to other assessment areas.</p> <p>___ includes a well-thought-out dissemination component that describes target audience(s), communication methods suitable for the audience(s), and anticipated reach.</p>	
Reviewer Comments:	

ATTACHMENT C (CONTINUED)
SELECTION CRITERIA (SCORING SHEET) FOR FULL PROPOSALS

4) Qualifications and partnerships	Possible score: 10 points
<p><i>Request to applicants:</i></p> <ul style="list-style-type: none"> • Describe the qualifications of the project’s lead applicant and staff. • Describe the qualifications of partners and/or subcontractors relevant to their roles. <p><i>Evaluate whether the applicant:</i></p> <p>___ demonstrates sufficient organizational capacity to administer and conduct the proposed scope of work.</p> <p>___ clearly describes partner and/or subcontractor roles and contributions.</p> <p>___ includes local stakeholders, e.g., municipal officials and underserved populations.</p> <p>___ builds on or establishes new partnerships that will improve the likelihood of success of the proposed project and future implementation projects.</p> <p>___ provided letters of support from collaborating partners.</p> <p>___ provided thoughtful letters of support from other stakeholder or interest groups.</p>	
Reviewer Comments:	

5) Project budget, match, and administration	Possible score: 20 points
<p><i>Response request:</i></p> <ul style="list-style-type: none"> • Use the template to provide a detailed, itemized budget breakdown for the funds being requested. [salaries, fringe, subcontract, other direct costs, indirect costs] • Clearly indicate the fringe benefits and indirect/direct overhead rates. Provide justification detail for travel, supplies, etc. • Describe the source of match, including both cash and in-kind contributions. <p><i>Evaluate whether:</i></p> <p>___ the proposed scope of work, timeline and budget are detailed, realistic and clear.</p> <p>___ where applicable, a strategy for acquiring permits is outlined.</p> <p><i>Evaluate whether the budget:</i></p> <p>___ includes budget breakdown.</p> <p>___ demonstrates that the project is cost-effective.</p> <p>___ each partners’ match is confirmed in their letter of support.</p> <p>___ match amount is equal to or more than 25% of the total project cost.</p> <p>___ indirect costs, if requested, are reasonable. Note: While submissions will not be disqualified because of high indirect program rates, rates of 25% or lower will be considered evidence of cost-effectiveness.</p>	
Reviewer Comments:	

**ATTACHMENT D
PRE-PROPOSAL COVER SHEET AND NARRATIVE COMPONENTS**

**MASSACHUSETTS BAYS NATIONAL ESTUARY PARTNERSHIP
FY23 HEALTHY ESTUARIES GRANTS
Request for Response ENV 23 CZM 03**

Name of Applicant: _____

Contact Information

Name: _____

Title: _____

Organization: _____

Phone: _____

Email: _____

Address: _____

Project Title: _____

Target Assessment Area(s)²: _____

Amount Requested: _____

Match Amount (at least 25% of TOTAL project cost): _____

Total Project Cost: _____

² Refer to MassBays' 2017 Ecosystem Delineation and Assessment [maps](https://www.mass.gov/lists/2017-ecosystem-delineation-and-assessment-eda-20-maps), available at <https://www.mass.gov/lists/2017-ecosystem-delineation-and-assessment-eda-20-maps>

ATTACHMENT D (Continued)
PRE-PROPOSAL COVER SHEET AND NARRATIVE COMPONENTS

The pre-proposal provides a summary of the proposed project according to the information requested below. Please limit your response to two (2) pages (single-spaced, 11-point font) including figures, tables etc.

1. Describe the project need, goal(s), anticipated outcomes, and relevance to MassBays goals and management priorities (see RFR Section 2B).
2. Describe the proposed approach, and how and with whom the approach and/or findings will be shared.
3. Provide a draft timeline for the project.
4. List project partners and their anticipated roles.

ATTACHMENT E
FULL PROPOSAL COVER SHEET AND NARRATIVE COMPONENTS

MASSACHUSETTS BAYS NATIONAL ESTUARY PARTNERSHIP
FY23 HEALTHY ESTUARIES GRANTS
Request for Response ENV 23 CZM 03

Name of Applicant: _____

Contact Information

Name: _____

Title: _____

Organization: _____

Phone: _____

Email: _____

Address: _____

Project Title: _____

Project Partners: _____

Target Assessment Area(s)³: _____

Amount Requested: _____

Match Amount (at least 25% of TOTAL project cost): _____

Total Project Cost: _____

³ Refer to MassBays' 2017 Ecosystem Delineation and Assessment maps, available at <https://www.mass.gov/lists/2017-ecosystem-delineation-and-assessment-eda-20-maps>

ATTACHMENT E (Continued)

FULL PROPOSAL COVER SHEET AND NARRATIVE COMPONENTS

Problem Description

- Describe the assessment area(s) need(s) and/or challenges that this project will address. Cite previous work to document the problem and any management needs.
- Describe the location and assessment area(s) where the work will be focused and the habitats/water bodies of concern. A locus map of the project must be attached.

Project Goals and Anticipated Outcomes

- Describe the goals of the proposed project. Goals should be explicitly connected to desired outcomes of the project and any anticipated management activities. Connect the project to the MassBays CCMP. For example:
 - Document and compare nutrient loads and habitat conditions in areas A and B.
 - Advance activities described in the MassBays CCMP Strategy 3.2.
- Describe the anticipated short-, medium-, and long-term outcomes that will result from the completion of this project. Connect project outcomes to MassBays CCMP outcome(s). For example:
 - Short-term outcome: Data on embayment-specific nutrient loads are available.
 - Medium-term outcome: Connections between nutrient loading and habitat condition inform management decisions.
 - Long-term outcome: Changes in local nutrient loads result in improved habitat conditions.
 - CCMP Environmental Outcome: Restored natural communities.

Project Approach

- Provide a detailed description of the proposed methodology and approach, including the potential for transferability to other embayments and ecosystem problems.
- Identify project staff, partners, and subcontractors (if applicable) and describe their roles and responsibilities in the project.
- Provide a Scope of Work/Tasks to be completed under grant request that includes:
 - A detailed, step-by-step narrative for each task including supporting reference materials, plans, tables, or graphics, as well as an estimated cost of each task.
 - If applicable, study design including methods of data collection, analyses, and QA/QC (including QAPP).
 - Timeline and anticipated milestones, including written products and other deliverables.

Project Measures/Outputs

- List interim measures in progress toward anticipated short-term and medium-term outcomes and anticipated project benefits and describe how they will be tracked and documented.

Project Benefits

- Articulate the direct benefits of the project to the local ecosystem and resource management scheme.
- Describe how the project results may be applied beyond the target assessment area.

ATTACHMENT E (Continued)
FULL PROPOSAL COVER SHEET AND NARRATIVE COMPONENTS

Outreach/Dissemination

- Identify specific target audiences for the project approach and results, and describe plans for sharing methodologies, results, conclusions, and management implications with those audiences. Include the anticipated reach of your dissemination plan (local, regional, national).

Qualifications

- Describe the qualifications of the project’s lead applicant and staff.
- Describe the qualifications of partners and/or subcontractors relevant to their roles.
- Resumes may be included as part of the application packet but are not required.

Project Budget

- Use the template below to provide a detailed, itemized budget breakdown for the funds being requested.
- Clearly indicate the fringe benefits and indirect/direct overhead rates. Provide justification detail for travel, supplies, etc.
- Describe the source of match, including both cash and in-kind contributions.

MASSBAYS HEALTHY ESTUARIES GRANTS BUDGET FORMAT

BUDGET ITEM			GRANT \$	MATCH \$	TOTAL \$
Salaries	Hours (#)	Hourly Rate (\$)			
[Staff name & role]					
[Staff name & role]					
Fringe	Rate (%)	Assessed against (\$)			
Contractual					
[Contractor name and role]					
Other Direct Costs					
Travel (miles at \$0.45/mile)					
Supplies (consumables)					
Indirect charges	Rate (%)	Assessed against (\$)			
TOTALS					

ATTACHMENT E (Continued)

FULL PROPOSAL COVER SHEET AND NARRATIVE COMPONENTS

Required Supporting Materials:

Project proposals must include the following supporting materials with the response. The following documents must be attached with the full proposal:

- Proof of support of the organization, such as an IRS letter of non-profit status or, in the case of municipally sponsored groups, a letter of support on letterhead by its overseeing municipal board, town manager, or mayor's office.
- Disclosure of any concurrent funding requests in support of the proposed project.
- A statement from an authorized signatory acknowledging and accepting the following:
 - The organization commits to match at least 25% of total project cost and acknowledges that funding is provided on a reimbursement basis.
 - Matching funds have been approved and/or appropriated (or are in the process of being approved) by the organization's authorized body.
- Partner letters: Statement of commitment on letterhead from each partner detailing the partner's intention to contribute to the project as described in the proposal narrative.
- Letters of support: Include up to three statements of support on letterhead and must be relevant to the proposed project. Generic letters of support will not be reviewed. Statements of support must be submitted with the response and not separately.

Suggested Supporting Materials:

Project Goals, Activities, and Outcomes may be presented in a logic model, demonstrating connections between proposed approach and anticipated impacts. Refer to the University of Wisconsin's Program Development and Evaluation website for guidance and samples:

<http://www.uwex.edu/ces/pdande/evaluation/evallogicmodel.html>.

Attachment 1

A Fiscal Plan for MassBays National Estuary Program

Report of the MassBays Finance Subcommittee, October 2018

Subcommittee Members: Colin Van Dyke (Chair), Mark Fine, Andrew Gotlieb, Margherita Pryor, Kristin Uiterwyk, Samantha Woods

Charge:

At the January 10, 2018 MassBays Management Committee meeting, the Management Committee charged the ad hoc Finance Subcommittee with responsibility for carrying out the following:

1. Prepare a draft Fiscal Plan for discussion at the October 2018 Management Committee meeting that specifically addresses options and opportunities for diversified funding, including (1) potential partnership with Restore America's Estuaries, (2) strategies for securing directed state funding, and (3) establishing a affiliated fundraising non-profit. Supporting materials for Finance Subcommittee use include:
 - a. EPA Guidance for NEPs regarding components of a fiscal plan.
 - b. A 2014 draft Financial Approach prepared by MassBays' Executive Director (Attachment A).
 - c. Fiscal plans approved by EPA Region 1 and Headquarters for other NEPs.
 - d. Input from MassBays' EPA Region 1 Coordinator (garnered via calls and meetings).
2. Advise MassBays' Executive Director in responding to comments from the Management Committee (and others as needed) regarding MassBays' Fiscal Plan.
3. Review and approve a final Fiscal Plan to be submitted as an Appendix to MassBays' Comprehensive Conservation and Management Plan by October 2019.

Principles:

1. While the CCMP has been designed to allow for its implementation relying solely on §320 funds; its impact will be greater with additional resources: financial and in-kind support to MassBays directly, or indirectly through MassBays' existing and potential partners.
 - a. Example: MassBays has secured funding to support collaborative projects with DMF. In those cases, DMF provides state-funded services and in-kind match for those projects.
2. We must be careful to avoid cannibalizing existing sources of support. (MassBays v. RSPs and MassBays v. other agencies)
3. Further consideration must be given to obtaining increased financial support from the Commonwealth.

Process:

The Subcommittee met via two conference calls and two in-person meetings and provided regular updates to the Management Committee. The Subcommittee reviewed the following, described in more detail in the following sections:

- Funding history
- Federal funding predictability/reliability
- Expenditures history
- Funding options

- Direct funding versus leveraged resources
- Addressing constraints on funding diversification
- Recommendations

Funding History

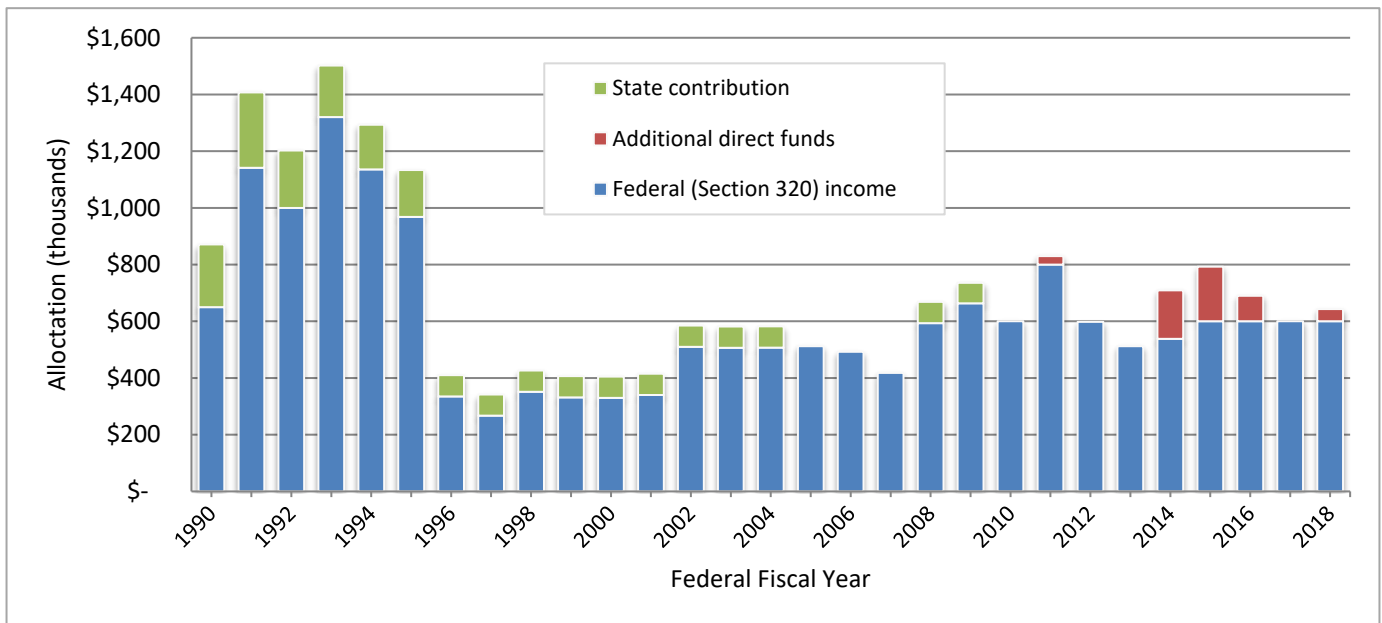
The Massachusetts Bays Program (now the Massachusetts Bays National Estuary Program) was launched in 1988 with \$2 million in fees resulting from a lawsuit brought against the state regarding polluted discharges to Boston Harbor. According to the settlement, these funds were to be used “to coordinate and fund projects dedicated to the restoration, protection, and environmental education for Boston Harbor and the Massachusetts Bay.” Subsequent legislation (MGL ch. 236, §7 [1988]) directed the \$2 million to be spent on:

projects to restore, protect, and improve the quality of Boston and Lynn harbors and Massachusetts, Buzzards and Cape Cod Bays, to increase understanding of the Bays and their resources and the effect of human activities upon them, and to encourage public involvement in activities which promote the harbors and Bays as living resources and public treasures for present and future citizens of the commonwealth of Massachusetts.

With these funds in hand, the Program led a major scientific research initiative to determine specific pollution problems in Boston Harbor. From 1988 to 1992, MassBays distributed \$1.6 million to researchers characterizing the major physical and biological features of Boston Harbor and Cape Cod Bay.

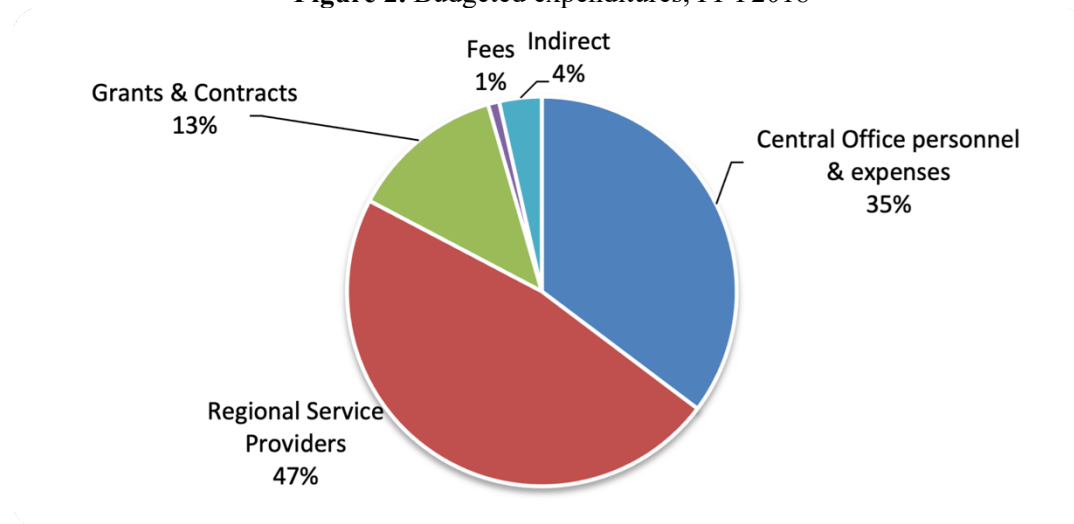
Meanwhile, MassBays applied for and received designation as a National Estuary Program in 1990. As an NEP, MassBays is eligible for funding from EPA under CWA §320. That funding has been relatively consistent since 1990. This is in contrast to state investments, which decreased over time until Federal Fiscal Year 2009 *et seq.*, when no funding was allocated to MassBays in the state budget (Figure 1).

Figure 1. Funding allocations to MassBays, Federal Fiscal Year (FFY) 1990-2018



MassBays' FFY2018 Workplan allocated \$643,000 income from EPA in the proportions illustrated in Figure 2 and as described below. This relative spending distribution has remained stable since 2013.

Figure 2. Budgeted expenditures, FFY2018



Salaries and Fringe

MassBays currently employs a full-time Executive Director and part-time (0.6FTE) Staff Scientist. In 2014, MassBays reallocated funding from Central Staff (a part-time [0.8FTE] outreach coordinator/Metro Boston RC) to fund a fifth RSP for the Metro Boston Region.

Regional Service Providers

Yearly grants to Regional Service Providers have varied from a high of \$68,207 each in FFY2006 (\$54,000 EPA funds, \$14,207 state funds) to a low of \$59,7500 each in FFY2010; RSPs have each received \$61,000/y since 2013.

Grants & Contracts

MassBays established a Research and Planning Grant program in 2011. The Management Committee formed a working group to evaluate the program and relaunched it as the Healthy Estuaries Grant Program in 2016. Between 2013 and 2018, disbursement of funds to municipalities, ngos, and other state agencies (note that state agencies are not eligible for the Healthy Estuaries Grant) totalled \$440,150.

Fees/Shared agency expenses

MassBays' annual budget provides up to one percent of the total §320 grant amount to CZM to offset costs of services including program-level fiscal management, computers and phones, day-to-day printing capacity, and internet access. Between 2013 and 2018, MassBays allocated a total of \$30,000 to cover these services, which are separate from those included in indirect charges described below.

Indirect Charges

Indirect charges allocate monies directly to the Commonwealth, to support state-level administrative and overhead costs. Each year the Executive Office of Environmental Affairs and the Department of Commerce/NOAA negotiate a rate for indirect charges (applied to salary and contractual line items). Expenses included in calculating yearly rate are partial salaries for the Secretary and his executive staff, as well as the Director of Legislative Affairs, Office of Counsel, Finance and Budget Officers, Human Resources, Information Technology, and Communications/Public Affairs (See Figure 3). The rate has

varied from 11.15% (FFY2018) to 36.27% (FFY2017) with an average of 18.01%. Between 2013 and 2018, EPA has contributed a total of \$139,966 to support positions similar to those listed in Figure 3.

Funding options

In 1994, MassBays commissioned a survey of possible means to finance implementation of the first CCMP.¹ The resulting report, *Financing the Massachusetts Bays Program Comprehensive Conservation and Management Plan*, was divided into three sections: Grants, Revenues, and Financing Mechanisms. While many of the suggested financing options included have been phased out or defunded since 1994, relevant suggestions are listed below.

Federal Grants

- EPA funding via DEP, e.g. funding under CWA §604(b) (mitigating nonpoint sources) and §319 (stormwater treatment and management). MassBays’ RCs work closely with municipalities to bring those funds to MassBays’ planning area. In Federal Fiscal Year 2017, for example, RCs reported on the following assistance to municipalities:

DEP 604b Water Quality grant, MS4 Municipal Assistance Grant (https://www.mass.gov/service-details/grants-financial-assistance-watersheds-water-quality)	Cape Cod: Cape Cod Commission (\$50,000)
DEP 319 grant program (https://www.mass.gov/service-details/grants-financial-assistance-watersheds-water-quality)	Cape Cod: Brewster (\$105,000) (Cape Cod)

- Federal grant programs like EPA’s environmental education grant program. MassBays Central Staff has applied for and secured funding from NOAA, though that agency is not mentioned in the 1994 document. Availability of funds for these programs is decreasing, however.

State Grants

- Environmental bonds. In 2018 MassBays’ Management Committee worked with the legislature to include \$660,000 per year as match to EPA’s §320 grant allocation. The bill was signed by the Governor, so the funds are authorized but not yet allocated. Any future advances will require advocacy by MassBays’ supporters.
- Municipal incentive grants; parks and watershed improvement grants. A contemporary equivalent to the Municipal Incentive Grants Program is the Municipal Vulnerability Program Grants, which have been targeted successfully by the RCs and municipal partners. During the 2017 and 2018 funding cycles, RCs assisted municipalities to secure more than \$1.5 million in state funds for projects aligned with the CCMP through the following programs:

¹ Northbridge Environmental Management Consultants and the Massachusetts Bays Program Staff, *Financing the Massachusetts Bays Program Comprehensive Conservation and Management Plan: Federal, State, and Local Funding Sources and Mechanisms*, December 1994.

State Coastal Resiliency Grant Program (https://www.mass.gov/service-details/coastal-resilience-grant-program)	Upper North Shore: Newbury (\$225,840), Essex (\$75,000), and Newburyport (\$122,695)
Coastal Pollutant Remediation Grant Program (https://www.mass.gov/service-details/coastal-pollutant-remediation-cpr-grant-program)	South Shore: Kingston (\$161,288) and Plymouth (\$175,000)
Massachusetts Municipal Vulnerability Preparedness (MVP) grant program (https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program)	Upper North Shore: Newbury, Ipswich, and Essex (\$60,000); Gloucester (\$107,044) Lower North Shore: Peabody (\$224,216), Peabody (\$243,400), Salem (\$345,000), and Manchester-by-the-Sea (\$88,180)
Cape Cod Commission District Local Technical Assistance (DLTA) grant (http://www.capecodcommission.org/index.php?id=50)	Cape Cod: Wellfleet (\$20,000)
Massachusetts Environmental Trust (https://www.mass.gov/orgs/massachusetts-environmental-trust)	Lower North Shore: Manchester-by the-Sea (\$41,885)

Private Funding

- Foundation grants. Few private foundations will support government agencies.
- Corporate funds. Government agencies are not allowed under ethics laws to solicit corporate funds.

As is the case for many of the funding options included in this section, while MassBays has little direct access to private funding, our partners do have access and already take advantage of these resources. MassBays’ past efforts to establish an associated nonprofit “Friends” group as a means for accessing these types of funds for CCMP implementation was not successful for multiple reasons, including the crowded field of environmental nonprofits in Massachusetts.

In relation to this source of funding, the Subcommittee discussed Tampa Bay NEP’s partnership with Restore America’s Estuaries, a national nonprofit with a mission similar to the NEPs’. RAE solicits and distributes private funds for CCMP implementation in cooperation with the NEP. The funds do not flow directly to the NEP, but instead can be considered match in some cases, or at least leverage (see next section).

Revenues

- Taxes and fees. MassBays is not in position to propose these types of revenue streams, which require legislative action. Where our partnering agencies (e.g. DMF, DER, and DEP) already are supported by user fees and in-lieu-fees, MassBays can encourage spending to meet the CCMP’s goals. Two specific proposals in the 1994 document are a real estate transfer tax and mooring fees.

- Fines. EPA's Supplemental Environmental Project program, through which monetary penalties are directed toward on-the-ground work, has become less and less accessible over the course of the past 20 years. For the most part, SEPs tend to be "surprises," brought to the table by legal counsel rather than program staff.
- Corporate donations. Government entities are not allowed to accept corporate donations, though they can partner with business to achieve goals. MassBays has benefitted from a partnership with SeaTrac, for example, receiving free time on their new autonomous monitoring vehicle. Note that MassBays did not directly solicit this contribution (which could be a violation of ethics laws), but rather applied for the in-kind services via a competitive grant.
- Partnerships with academia. MassBays has applied for Federal grant monies with academic partners. College- and graduate-level interns (both paid and unpaid) have produced valuable products for MassBays. These benefits do not fall under the category of "revenues," but instead can be in-kind match to the §320 funds.

Financing Mechanisms

- Special betterment or utility districts. Massachusetts' process for establishing special districts across towns is complex and requires several steps for approval. Cape Cod (Barnstable County) has been successful in applying as a special district to generate revenues for land protection (through a real-estate transfer fee, the model for the state-wide Community Preservation Act enabling legislation) and most recently (pending legislative passage), habitat restoration (through a tax on local home rentals). MassBays has promoted stormwater utility districts in individual towns and regionally as a means to generate funds for stormwater management and infrastructure.
- Enterprise funds. Enterprise funds hold monies that are collected and spent separately from the general budget. The 1994 report provides Marblehead's Harbor and Water Fund as a case study. Revenues include boat excise taxes and mooring fees, dockside storage fees, and space rental at the yacht club; expenditures include boat pump-out facilities, and dock operations and maintenance.
- Bonds and loans. The primary example of this type of financing is the State Revolving Loan Fund Program established under the CWA and administered by the states. Massachusetts' Clean Water and Wastewater SRFs regularly receive requests for funding that outstrip available funds, due to the age of Massachusetts' water infrastructure, and the extent of the need among the Commonwealth's 351 cities and towns. Any loan application requires a dedicated source of funding for repayment, a significant hurdle for MassBays. These types of financing mechanisms are better left to the municipalities.

Direct State Funding

The Finance Subcommittee noted that the 1994 report did not address the significant role that could be played by the Commonwealth itself. MassBays, especially through its regional service model, provides consistent technical assistance to municipalities (including support in securing funding as detailed above under Federal Grants and State Grants, on a variety of issues, from stormwater management, to coastal habitat protection and restoration, to community education and outreach on coastal issues, and to goal-setting for local habitats and water quality. For example, MassBays reached 45 of the 50 communities in the MassBays region with training about stormwater management in 2015, and in 2016 we collaborated with MassDEP and MassDOT to provide 40 municipalities with grantwriting training.

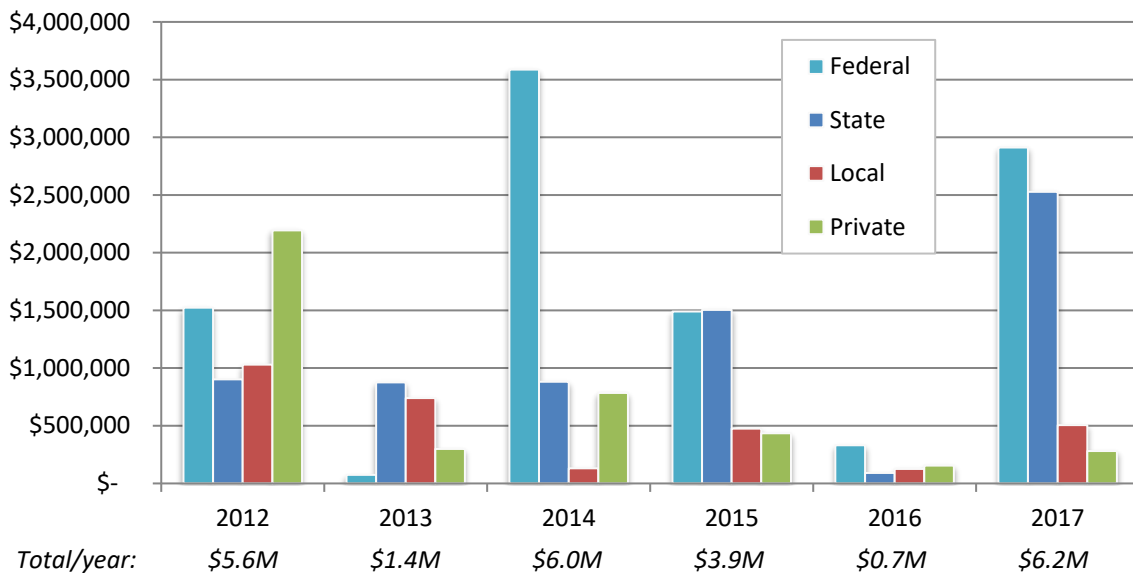
The Subcommittee asserts that Commonwealth operating and capital funds should be directed to MassBays in recognition of the role the NEP plays in providing local services. Such funds should be provided to fulfill the §320 match requirement of 1:1 funding from the NEP. Setting the stage for this investment, the Finance Subcommittee advocated for, and secured, a \$660,000 per year line item in the 2018 Environmental Bond Bill. The Finance Subcommittee asserts that Management Committee and Regional Service Provider representatives should advocate for the annual release of the designated funds. Such funds should be programmed with input from the Executive Director.

Direct funding versus leverage

MassBays' Executive Director has suggested (see Attachment B) that MassBays' finance plan should not be focused entirely on securing monies to be brought in-house and redistributed. It should also establish means for tracking and reporting on outcomes gained through the significant leveraged resources MassBays gains to support CCMP implementation.

Each year, MassBays provides a tally of federal and state funds leveraged with §320 funds to EPA through the NEPORT system. Funds and in-kind resources move the region toward meeting the CCMP goals when RCs and staff work with municipalities to secure grant funding, recruiting volunteers to conduct monitoring and restoration, and work with state and federal agencies to prompt spending. Figure 4 illustrates leverage reported by MassBays from 2012-2017 where staff had a primary (leading), significant (active), or supporting (minor) role.

Figure 4. Sources of Leverage, 2012-2017



Recommendations

[Note: The following recommendations should be articulated in the form of targets and measures, with level of effort associated with each.]

1. MassBays should have as a primary objective maintaining eligibility for §320 funding as a National Estuary Program.
2. MassBays should participate in efforts to ensure continued provisions for §320 funds in congressional budgets, especially through the Association of National Estuary Programs (ANEP). ANEP routinely generates letters of support from Members of Congress for continued funding of NEP, and though they are likely supportive, not all Massachusetts coastal Representatives or even both Senators have signed those letters. MassBays staff should provide information to both the Federal and State legislature regarding programming and funding needs; Massachusetts' DC lobbyist should be aware of NEP funding needs in Federal budget discussions. The Management Committee should also participate in this education and outreach effort to legislators.
3. MassBays should include "wish lists," or descriptions of what could be accomplished with additional funds, as a section in its annual workplan.
4. The Management Committee should advocate for operating and capital funds to support MassBays' work and to meet the required 1:1 match for §320 funds. MassBays should be included in the Green Budget proposal developed annually by a consortium of environmental nonprofits.
5. MassBays' matching funds should include in-kind support from agency partners like DMF, DEP, and DER (where those efforts are not already funded by Federal dollars).
6. MassBays should identify and quantify the benefits provided to local communities and the Commonwealth as a whole through technical support and local assistance efforts.
7. MassBays should continue to explore opportunities for partnerships that bring private funds to projects that advance its goals.
8. MassBays Regional Service Providers should explore potential local funding streams, like Community Preservation Act funds, mooring fees, and utility districts.
9. MassBays' EPA Region 1 Program Coordinator should bring NE NEPs' CCMPs to the table when negotiations about specific SEPs are underway.
10. MassBays should discuss with CZM and EEA the potential for and feasibility of corporate partnerships, emphasizing the need to make the partnerships mutually beneficial through press coverage, etc..
11. Education and outreach by MassBays should ensure that municipalities apply SRF loan monies to advance the CCMP goals.
12. EPA Region 1 and Headquarters should acknowledge the funding constraints on NEPs hosted by government agencies, and recognize leveraged resources as valid option for diversifying the sources of funding for CCMP implementation. MassBays should continue to document state and federal funds leveraged with EPA's §320 investment, even if EPA discontinues this reporting requirement.
13. While the CCMP is designed to be implemented based solely on EPA funding, the Management Committee should assist staff in maximizing the impact of the CCMP across the planning area. This requires maximizing MassBays' ability to secure additional project funds. In the course of discussions, the Subcommittee identified tasks and projects that are more easily described and more likely to be funded as stand-alone efforts. Several aspects of MassBays' cutting-edge effort to set out targets for individual embayments would be good candidates for proposals, for example, as well as the capacity-building efforts planned for the Citizen Monitoring Coordinators' Network.
14. The task of identifying additional funding and resources is challenging regardless of how MassBays is organized; its position in a state government agency creates additional constraints. The Management Committee should address constraints on diversification of funding, evaluate the extent to which those constraints are offset by the benefits by its position in a state government agency, and identify alternatives that would eliminate or mitigate those constraints without losing the benefits.

Attachment A ***Toward a MassBays Finance Plan***

Prepared 2014 by Pam DiBona for consideration by the Management Committee

Finance Plan Requirement

EPA, in its 2012 Program Evaluation Letter dated November 28 2012, directed MassBays, as a condition of meeting the Financial Element of the next evaluation (scheduled for 2017), to

“...have in place a Finance Plan or business plan that identifies new and diverse sources of funding. The plan could also include a call for Management Committee members and other partners to assist more than they do now in garnering other sources of funds or in-kind support...”

In addition, EPA’s 2016 Guidance for preparation of Comprehensive Conservation and Management Plans calls for a:

Finance strategy that will establish long-term financial sustainability to implement the CCMP through diverse resources and partners. The strategy can be a separate document or chapter or action in the CCMP. The strategy should discuss: a) priorities for funding; b) current funding and other support such as staff assignments, or in-kind partnering; c) short- and long-term resource needs; and d) proposed actions or strategies to maintain or garner new resources for CCMP implementation and their timeframe.

EPA Headquarters hosted a panel discussion about finance options at the annual gathering of NEPs in February 2013. All invited panelists represented NEPs that are stand-alone nonprofit entities; they shared suggestions for hosting fundraising events and silent auctions, collecting dues from Management Committee member organizations, establishing fees for service, and holding recreational events that require entry fees. Unfortunately, this session was less useful to those NEPs hosted by government agencies and universities, entities prohibited or otherwise restricted from taking advantage of these fundraising methods.

Following that meeting, MassBays and its sister programs have sought to provide EPA staff with insights into the varied financial structures encompassed by the NEPs. In preparation for the 2014 annual meeting, for example, I conducted a survey of NEPs to document fundraising potential among the programs, based on their structure. During the meeting, we shared the results of the survey (see figure attached) and hosted breakout conversations based on organizational sector to share commonalities and best practices (unfortunately EPA staff did not participate in the breakouts!). The bottom line: the potential fundraising capacity of NEPs is not equal across sectors, and so a one-size-fits-all fiscal plan will not serve all purposes.

This document examines how our current and future program funding can meet the spirit of EPA’s 2012 Program Evaluation letter and CCMP requirements in light of our own funding situation, and identify opportunities for project-based funding to address our CCMP goals.

Introduction and overview

Objectives

1. Hire one additional Central Staff person responsible for Outreach and Communications
2. Establish and maintain funding for monitoring data collection and analysis
3. Increase funding for Regional Service Providers
4. Increase funding for Healthy Estuaries Grant Program
5. Increase MassBays’ reported leveraged resources

Steps toward meeting our objectives

1. Strengthen and expand the scope of existing partnerships
2. Form new, larger-scale collaborations to support fundraising (including §320 allocations)
3. Carry out consistent and creative grantwriting

MassBays Finance Plan Objectives

1. Hire one additional Central Staff person responsible for Outreach and Communications

A primary function of MassBays, and a central goal of our CCMP, is to conduct outreach and share findings with decisionmakers at the state and local level. Our Regional Service Providers are excellent ambassadors to local governments and community groups, and we do not need to duplicate their efforts. Their work should be supported from the Boston office, however, with common messaging and materials. Our current staffing is not adequate to assist the RSPs in this way, nor do we have the capacity to carry results of MassBays-funded research efforts to state decisionmakers, or to share accomplishments and opportunities with the larger community. The recently launched monitoring network will require ongoing and increasing “care and feeding” as we secure funding (see below) to build regional capacity.

2. Establish and maintain funding for monitoring data collection and analysis

The Clean Water Act directs NEPs to periodically document environmental trends and conditions. For MassBays, covering three bays and 47 sub-embayments along 1100 miles of Massachusetts coastline, this represents a massive undertaking that is beyond our reach. We have traditionally relied on sister government agencies to provide us with information about water quality, habitat condition, and species status. Government-led monitoring programs, however, are focused on regulatory need, and over time have encompassed a narrower set of parameters and geographic range, so MassBays has turned to citizen monitoring carried out by community-based environmental organizations. These groups have, by default, become the primary source of current water quality and pathogen data for most of our region. In addition to meeting the State-of-the-Bays reporting requirements of our funding, we seek to bring volunteer-generated data—which in many cases have been inaccessible to decisionmakers—to bear on policy and management decisions.

It is not sustainable, nor will we receive robust data sets, if we simply acquire others’ data sets and walk away. We must provide direct and in-kind support to these partners to ensure ongoing and reliable monitoring. When MassBays solicited input via the Citizen Monitoring Coordinators’ Summit, organizational needs ranged from tools for data management, to grantwriting to fund equipment and lab services, to assistance with statistical data analysis. In response, we have established a new MassBays Monitoring Network to meet these needs and support long-term monitoring in coastal watersheds.

3. Increase funding for Regional Service Providers

The diversity of our NEP makes planning difficult, but it also represents opportunities. We have a ready-made testing ground for new approaches to habitat protection and restoration, with urban, suburban, and rural watershed land use; sandy, rocky, and marshy near-shore habitats; and a multitude of existing partners, from local nonprofits to academic and research institutions. MassBays can create and identify opportunities for joint grant proposals among the RSPs, and between RSPs and their regional stakeholders, to address priorities identified in the new CCMP. Partners’ programs funded through multi-partner grant proposals could be counted toward our fiscal planning goals, even if MassBays receives no direct funding, if we serve as facilitator of the partnership, and provide in-kind support to the effort.

4. Increase funding for Healthy Estuaries Grant Program

MassBays' small-grant program is an important means for supporting local activities aligned with our CCMP to generate environmental improvements in our planning area. Previously called the "Research and Planning Grant Program," these funds have jump-started regional coalitions (e.g., the Herring Network), funded stormwater design and planning (e.g., Kingston's town-wide needs assessment and prioritization), and supported research relevant to state policy (e.g., impacts of docks and piers on salt marshes). In its first year as the Healthy Estuaries Grant Program, the focus was on characterizing local habitats (e.g., herring habitat preference in newly restored river systems) and the relationship of land use on water quality. In future years, the RFR will direct applicants to implement the CCMP, especially characterizing existing conditions, filling gaps in our understanding, and working toward ecosystem targets.

5. Increase MassBays' reported leveraged resources

MassBays' Regional Service Providers consistently provide matching funds and in-kind support, and access to leveraged resources, for an average from 2003 to 2015 of \$9 for every \$1 granted by EPA. This is half of than the national average for NEP leveraging success. While this disparity is likely due to several factors, MassBays could increase this average – first by documenting leverage fostered through our Healthy Estuaries Grant, and in the future by catalyzing even more investment into meeting our CCMP goals. Obtaining formal commitments to implementing CCMP actions from partners would formalize leveraging.

Attachment 2

Massachusetts Bays National Estuary Program Strategic Communications Plan

Cyndi Roy Gonzalez

PACER STRATEGIES, LLC [Company address]

Table of Contents

1. Introduction	3
2. Target Audiences	6
3. Key Messages	7
4. Messaging Toolbox	14
5. Partnerships	27
6. Resources & Metrics	30
7. Conclusion	36

INTRODUCTION

The Massachusetts Bays National Estuary Program's Strategic Communications Plan is designed to broaden awareness of MassBays' program, work and accomplishments and is intended to help implement its Comprehensive Conservation and Management Plan (CCMP). When successfully executed, this communications plan will help grow MassBays' audience and partnerships and help achieve its underlying mission to protect, restore and enhance the estuarine resources of Ipswich Bay, Massachusetts Bay and Cape Cod Bay.

This communications plan also responds to many of the findings and recommendations made by the U.S. Environmental Protection Agency in its 2017 Program Evaluation (PE). The EPA identified a number of areas for improvement in MassBays outreach and public involvement plans and program recognition.

This communications plan will allow the Management Committee to successfully address EPA's PE findings and help ensure that MassBays remains eligible for future funding authorized by the Clean Water Act.

The CCMP is an 8 to 10-year roadmap for achieving the organizational and programmatic goals identified by the Management Committee. Key to reaching those goals over time will be the continued engagement and support of a wide and diverse group of stakeholders. This communications plan identifies those stakeholders, the unique messages we believe will move them to action, the tools to deliver those messages and metrics for determining success.

COMMUNICATION PLAN GOALS AND OBJECTIVES

The overall goals of the communications plan are to:

1. Broaden awareness of MassBays and its programs
2. Highlight scientific research, monitoring and management needs across the planning area.
3. Invite current and new partners to participate actively in implementing the CCMP

These goals will help MassBays achieve the organizational goals laid out in the CCMP:

- Position MassBays as a primary source for information about the conditions and trends in Ipswich Bay, Massachusetts Bay and Cape Cod Bay
- Increase the level of influence MassBays has on local decision making that recognizes the roles, functions and values of healthy habitats in the Bays

- Make MassBays a model program for management and planning that addresses diversity among estuaries

SITUATIONAL ANALYSIS

MassBays staff has made great progress over the last few years in raising awareness of the organization and bringing clarity and cohesiveness to its vision, mission and branding. A new logo has given the organization a clear public identity and the mission and vision give the organization a succinct way to explain its work.

MassBays has also developed partnerships with organizations who are similarly concerned with protecting our waters and our environment and have worked creatively together to raise awareness of critical issues like the localized impacts of sea level rise, while at the same strengthening MassBays' identity and influence.

For example, MassBays participated in 2014 and 2015 in a Gulf of Maine-wide photo contest documenting the localized impacts of King Tides. When notified that the effort had not been funded in 2016, MassBays took the lead on creating a Massachusetts-specific partnership to raise awareness of the impact of the King Tide on local Massachusetts communities. The 2016 King Tide photos were uploaded by partners and citizens to Massachusetts Office of Coastal Zone Management's MyCoast website using a free smartphone MyCoast app, resulting in MassBays' name and mission being shared with citizens throughout the region and more than 200 photos shared each year.

MassBays has also been successful in increasing its visibility through the co-sponsorship of regional conferences with its Regional Coordinators. Each MassBays Regional Coordinator worked closely with partners to plan and implement conferences for stakeholders, on topics relevant to MassBays' goals and intended outcomes.

Conferences have included the *Annual Great Marsh Sea Level Rise Symposium*, which educates and informs the Great Marsh community on the local threat from sea level rise and potential mitigation; the *25th Anniversary Symposium: Finding Solutions to Our Coastal Challenges*, exploring local impacts and responses to climate change in the Lower North Shore region; *North Shore Resiliency Workshop* regarding tools and methods for engaging communities in successful coastal resiliency planning and implementation; *Colleague Tour and Reception* in the Metro Boston region to explore opportunities for partnerships and collaboration; the Cape Cod Coastal Conference and The Future of Water in Southeastern Massachusetts Conference among others.

While MassBays continues to make progress through these methods and others in raising awareness of its brand to a larger audience, there other elements of MassBays' organizational structure that make it challenging to deliver a cohesive message and share timely and important information and successes with key stakeholders.

As noted in the EPA's 2017 Program Evaluation, the current organizational structure, whereby MassBays is hosted by the Massachusetts Office of Coastal Zone Management, has created real and perceived challenges to MassBays' autonomy and its effectiveness. Press materials, social media and other key communications tools must be approved by CZM, the Executive Office of Energy and Environmental Affairs and the Governor's Office. This multi-layered approval process slows MassBays' ability to share important information and to receive the credit it needs to continue to raise its profile with key stakeholders. The state website and social media guidelines, also applied to MassBays, severely limit MassBays' ability to engage stakeholders and the public.

And while MassBays is hosted by CZM, MassBays does not receive any state funding that would allow MassBays to increase its communications capacity. With just one full-time staff and one part-time employee, MassBays does not have the personnel bandwidth to develop or execute on a successful communications strategy. Without a dedicated communications employee, MassBays will continue to struggle to deliver its message, increase its visibility and share its successes.

This plan recognizes those challenges and includes recommendations for remedying them in order for MassBays to reach its communications goals and successfully implement the CCMP.

TARGET AUDIENCES

Support for the protection, restoration and enhancement of the MassBays area depends heavily on effective communications that are aligned with the concerns and goals of the intended audience. The general public, for example, may be more interested in the recreational opportunities afforded by the MassBays coastal areas, while local governments may be highly focused on the resiliency needs of their communities in the face of increasing evidence of the impacts of climate change. Communication efforts are intended to influence stakeholders and target audiences to support MassBays' objectives, which in turn will allow MassBays to meet the requirements set forth for NEPs within the Clean Water Act. Each target audience has different needs, issues and/or interests which require special messages delivered through various communications channels.

Internal Stakeholders/Audiences

- Management Committee
- Regional Service Providers and Coordinators
- US EPA
- CZM/EEA

External Stakeholders

- Municipal leaders and departments
- State and federal lawmakers and agencies
- Academia/Researchers
- Environmental advocacy organizations & NGOs
- Current and new funders
- General Public
 - Homeowners/renters
 - Developers
 - Recreationalists
 - Visitors/Tourists
 - Water commuters
 - Students
- Business community and industries
 - The Business Community as an Association
 - Aquaculture
 - Development
 - Fisheries
 - Real estate
 - Technology
- Media

KEY MESSAGES

Key Branding Message

To achieve the goal of increasing awareness of MassBays, we need a Key Branding Message. An overall Key Branding Message shares with its intended audience(s) who/what MassBays is and the value it provides. The General Value Proposition or Key Branding Message should clearly and concisely answer the question: **Who/What is MassBays?**

With an area encompassing more than 1,000 miles of coastline and 50 distinct communities, MassBays is unique from many of its NEP counterparts. Recognizing the diversity of the MassBays area, MassBays has employed a ground-up organizational model that relies on five regional coordinators and a small Boston-based central office. This model allows MassBays to most effectively achieve its goals for the entire area while still meeting the unique geographic needs of the various regions.

At the same time, the diversity of the regions and the de-centralized work model creates challenges when it comes to effectively branding and communicating what MassBays is and what the organization's value is. Based on conversations with each of the five regional coordinators, articulating the value of MassBays to their individual constituents can prove challenging depending on the audience and the discussion.

We will address some of these challenges in later sections of this plan and recommended ways to successfully address them.

Based on discussions with the MassBays staff, regional coordinators, Management Committee members and EPA Region 1 staff, it is evident that MassBays' chief value-add is as a **convener and collaborator** around issues of coastal habitat protection and restoration. Given its support by both the federal government (as funder) and state government (as host), MassBays is uniquely positioned to reach decision-makers at the highest levels. In addition, the de-centralized, regional organizational model of MassBays allows for more targeted outreach to local decision makers. While there are any number of federal, state and local agencies, non-profits and organizations that work on coastal habitat protection, the mission, model and mandate of MassBays makes it uniquely positioned to bring these various partners together to support and execute on protection and restoration efforts. Through education, data-sharing, grant-making, research and technical assistance, MassBays can be a primary resource for and an important influence on key decision makers.

Thanks to the broad makeup and guidance of the Management Committee, MassBays is also fortunate to have many key individuals and organizations represented as part of its organization. By engaging the Management Committee in implementation of MassBays' CCMP, MassBays stands alone in its ability to help ensure that the relevant and necessary organizations, authorities and decision-makers are working collaboratively to meet the stated goals.

To better reflect its General Value Proposition, as a starting point, Pacer Strategies recommends modest changes to MassBays' organizational name and its mission statement.

Current Organizational Name: Massachusetts Bays National Estuary Program

Proposed Organizational Name: Massachusetts Bays National Estuary Partnership

Current Mission Statement: The Massachusetts Bays National Estuary Program is dedicated to protecting, restoring, and enhancing the estuarine ecosystems of Ipswich Bay, Massachusetts Bay, and Cape Cod Bay. We facilitate partnerships to prompt local, state, and federal action and stewardship, by convening stakeholders on the local and regional level, providing scientific basis for management decisions, and working with decision makers to identify problems and solutions.

Proposed Mission Statement: MassBays National Estuary Partnership is dedicated to protecting, restoring, and enhancing Massachusetts coastal habitats. Working collaboratively with local, state and federal agencies and organizations, MassBays provides funding and technical support across 1,000 miles of coastline in 50 communities.

This name and mission statement and accompanying logo should be on nearly every single document, presentation, written or electronic communication and signage that is affiliated with MassBays. This includes information distributed by MassBays Central Office as well as that of the regional partners. All other past mission statements should be removed from materials.

Unique Value Proposition Messages

Once it is clear to the target audience who and what MassBays is, it is important to deliver messaging that answers the second key question: **Why is MassBays important to me?**

For each audience, we need to deliver a uniquely-tailored message – an answer – that responds to their cares and concerns.

As part of its mission, MassBays provides research assistance, technical support and grant-making to partners to fulfill its mission of protecting, enhancing and restoring our coastal resources. To accomplish its work, MassBays has a multitude of stakeholders who share unique perspectives and are driven by different goals and outcomes.

MassBays has both internal and external critical audiences.

Key Messages for Internal Audiences

MassBays' internal audiences include the following:

- The Management Committee

- EPA
- Regional Service Providers and Coordinators
- CZM/EEA

MassBays internal audiences are both the receiver of information as well as MassBays messengers. It is important that the internal stakeholders understand the goals, challenges and successes of the organization.

First and foremost, CZM/EEA, the Management Committee, EPA and regional partners should all know and support the MassBays mission statement. They should understand the General Value Proposition and Key Branding Message.

The regional coordinators are most often associated with their host organizations. While that is important in its own right, it's critical to the awareness-building effort of MassBays that the RCs are seen as part of MassBays. To achieve this goal, it is important that MassBays Central Office regularly shares information with these key audiences that can then in turn be shared with their unique stakeholder groups. RCs should receive regular (weekly, bi-weekly or monthly) updates on happenings from the Central Office, from each other and from other key partners. As a convener and collaborator, MassBays should be seen as the ultimate source of information on efforts related to the CCMP, grant opportunities, best practices and other coastal habitat-related news.

To execute on this goal, the RCs must also regularly share news and information from their regions with the Central Office in a formal, rather than ad-hoc, way so that they may be shared with other key audiences and stakeholders.

The regional service providers and Management Committee, in particular, are the key messengers for MassBays. They should see themselves and their organizations as integral to MassBays mission.

The internal audience (RCs and Management Committee) are unique in that they are both the receiver of MassBays' message as well as the deliverer. The messages below are intended to be the key messages that each of these groups use with their own stakeholders to explain their role with the MassBays organization and the value MassBays provides.

KEY MESSAGE 1: MassBays National Estuary Partnership is dedicated to protecting, restoring, and enhancing the Massachusetts coastal habitats. Working collaboratively with local, state and federal agencies and organizations, we provide funding and technical support across 1,000 miles of coastline in 50 communities.

KEY MESSAGE 2 (For Regional Coordinators): MassBays supports the work we do on the ground in this region by bringing together interested stakeholders and providing funding, technical support and hands-on assistance. For example: [Each regional service provider should have 3 specific projects they can point to that were made possible through MassBays support]

KEY MESSAGE 3 (For Management Committee Members): As a member of the MassBays Management Committee, our organization provides a forum for discussion about the critical issues affecting our coastal habitat. MassBays is dedicated to bringing together environmental and resource management agencies, nonprofit environmental groups, academic institutions, business interests, government agencies and other stakeholders to ensure the most coordinated and comprehensive approach to the protection, restoration and promotion of Massachusetts' coastal habitat.

Key Messages for External Audiences

Municipal Governments

Successful implementation of the CCMP is predicated on local solutions to environmental challenges. The unique organizational structure of MassBays allows us to offer targeted technical assistance and hands on support to local communities.

In targeting municipal audiences - including municipal Boards of Health, Conservation Commissions, Planning Boards, Boards of Selectman, Public Works departments, Shellfish Constables and other key implementing agencies, MassBays should focus on the local and regional nature of the organization and on the value of the resources it provides – both technical assistance and funding opportunities.

KEY MESSAGE: MassBays' mission is to protect, restore and enhance our coastal habitats. We take a regional approach to our work. Supported by the EPA, we are a resource for local communities and provide assistance as municipalities undertake projects with significant environmental impacts. We have dedicated resources in each region of the MassBays planning area to help communities with things like project development, stormwater remediation design, plan review, permitting assistance, technical evaluations, planning, GIS support, and environmental analyses. We also support innovative approaches to coastal habitat protection by providing grant funding to communities each year.

State and Federal Lawmakers

State and federal policymakers are another key audience for MassBays and the successful implementation of the CCMP. Much like the messaging for municipal partners, state and federal policymakers and agencies should understand the unique value MassBays provides in its mission to protect, restore and enhance coastal habitat. This can help MassBays secure additional support and funding to carry out its mission.

By providing an informal, non-regulatory forum for agencies to share and receive information, MassBays can help government agencies improve their efficiency and make better-informed decisions that consider the environmental impacts of their work.

KEY MESSAGE: MassBays' mission is to protect, restore and enhance our coastal habitats. We take a regional approach to our work. We are supported by EPA and provide assistance to communities undertaking projects with significant environmental

impacts. We have dedicated resources in each region of the MassBays planning area to help communities with things like project development, stormwater remediation design, plan review, permitting assistance, technical evaluations, planning, GIS support, and environmental analyses. We also support innovative approaches to coastal habitat protection by providing grant funding to communities each year.

Academia/Researchers

Given the many partners and stakeholders around the MassBays table, particularly through its Management Committee, MassBays can be a valuable partner to environmental researchers and academic institutions.

KEY MESSAGE: MassBays works collaboratively with local, state and federal policymakers to protect, restore and enhance our coastal habitats. Given our mission, our structure and our reach, we can help turn your research into action. We connect the decision makers with the science to help them make well-informed decisions that impact our coastal environment. In addition, MassBays supports research through grant funding opportunities.

Environmental Advocacy Organizations & NGOs

As noted in the CCMP, cross-agency and cross-discipline communication and collaboration can be challenging. Many local, state and national organizations work in their own ways to protect and enhance our coastal habitats. By better coordinating these groups, MassBays can help ensure that resources and information are shared to produce positive, measurable outcomes. MassBays should position itself as a convener and collaborator with this audience rather than a competitor.

KEY MESSAGE: MassBays works collaboratively with local, state and federal policymakers to protect, restore and enhance our coastal habitats. Given our mission, our structure and our reach, we help bring together like-minded organizations to share research, resources and best practices. Given the makeup of our Management Committee that guides our work, we can help connect organizations with leading decision makers.

Current and new funders

We believe that funders are most likely to fund specific initiatives and projects that align with their giving policies. Therefore, MassBays should promote the innovative work it does in each region of the state and stress the regional collaboration that occurs.

KEY MESSAGE: MassBays is an incubator for great ideas. We generate locally-based models for addressing environmental challenges and work with our regional partners to replicate success region-wide. Our work is guided by a diverse Management Committee made up of individuals representing environmental and resource management agencies, nonprofit environmental groups, academic institutions, business interests, and other important stakeholders. We connect science to action to produce desirable outcomes that contribute to the protection, restoration and enhancement of our coastal

habitat. We are supported by the EPA and reach a large, diverse area where projects reflect the local priorities of five unique regions.

Business Community

The business communities within the MassBays planning area are a key constituency. Whether its resiliency efforts or success of coastal-dependent businesses, business leaders have a vested interest in the protection of coastal habitat. As such, local and regional businesses, Chambers of Commerce and other similar business organizations should be aware of and engaged with MassBays.

KEY MESSAGE: The work we do at MassBays directly impacts your businesses, your employees and your customers. We work with a broad coalition of stakeholders including environmental agencies and non-profits, municipalities, researchers and others to protect, restore and enhance the coastal habitat of our region. Working with our many partners and through our regional coordinators, we can help you and your businesses plan for things like climate change, environmentally smart development and sustainable business solutions.

For Business Associations: An association like a Chamber of Commerce or local Economic Development Group should understand that MassBays can help their members both individually through information sharing and grant-making but also through the work it does to improve resiliency efforts and local climate change impact mitigation that help the business community at large.

Individual Industries: Industries dependent on coastal resources should understand that MassBays is a partner in promoting and supporting the work they do. Fishing and tourism, in particular are two key industries that rely on the continued protection of coastal habitat. In addition, technology companies with products related to waterways could benefit from MassBays' broad network to test and implement their technology.

General Public

Raising the public's awareness of MassBays can help create allies and supporters of MassBays work and help influence decision makers. The general public here includes the following:

- Homeowners/renters
- Recreationalists
- Visitors/Tourists
- Water commuters
- Students & educators

With this key audience, MassBays should focus on highlighting projects that serve to benefit the community. Knowing that projects are prioritized at the local and regional level can help make the general public more invested in the work and outcomes. Estuaries are a treasure for local communities, offering recreational activities, water activities, transportation, access to shellfish and other opportunities. Climate change, in

particular, is an issue that most people are aware of and a good opportunity to introduce the work that MassBays does.

KEY MESSAGE: MassBays, funded through your federal tax dollars, is working hand-in-hand with decision makers in your community to protect, restore and enhance coastal habitat. We're working to fight the local impact of climate change, which threatens our homes, our food supply, our transportation system and the recreational opportunities we enjoy. We are partners in protecting your communities today and for the future.

THE MESSAGING TOOLBOX

To most effectively deliver its message to its intended audiences, MassBays should employ a mix of traditional and digital tactics.

Below are tools Pacer Strategies recommends for MassBays to raise its profile, deliver its messages and attract new partners.

Website

The MassBays website should tell a story. It is a critical tool for raising awareness of the organization and allows MassBays to put its best face forward. The site is a primary resource for information and education and will likely deliver the first impression many of your target audiences have of the organization.

When we look at the website as a tool for delivering MassBays' messages, we consider how well it adheres to the following principles:

- Appearance
- Content
- Functionality/Usability

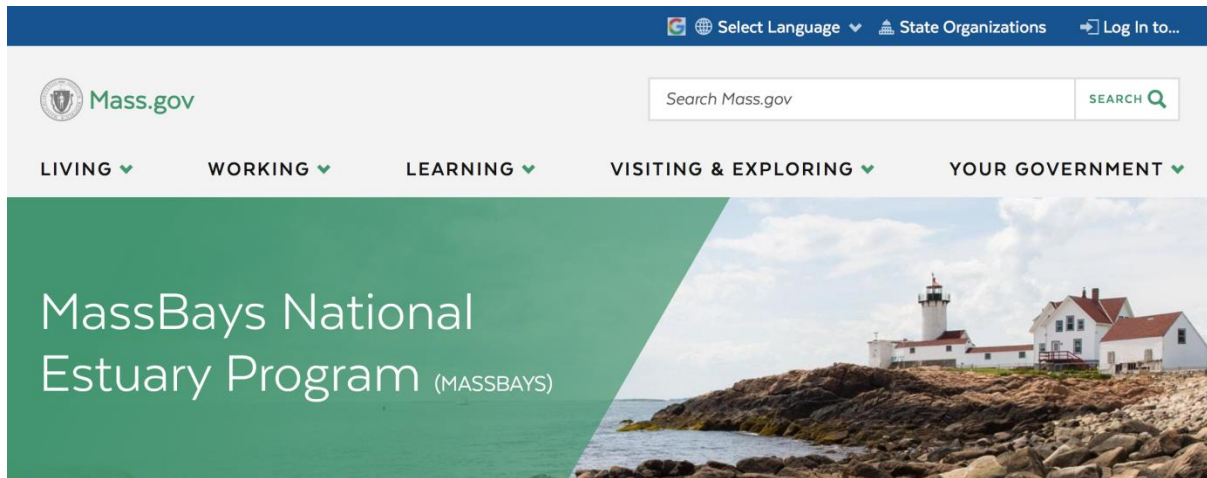
1. Appearance: You have one chance to make a first impression, right? Therefore, you want your website to be visually appealing, engaging and informative. An effective website should grab the eye, use meaningful images and be simple and easy to read.

Analysis: MassBays' current website contains a lot of great information, but is text-heavy, visually unappealing and difficult to navigate. The logo, which should appear prominently on the homepage, is small and haphazardly placed to the right side. When a user lands on the homepage, the first thing s/he finds is contact information for staff rather than a description and images that convey what MassBays is and does. Given that its mission is to protect and restore our estuaries and coastal habitat, it is natural that the homepage would feature pictures of those resources. However, the current site lacks high-quality, relevant photos, and simple, easy to understand description of what MassBays is. While the mission statement is included on the homepage, visually, it blends in with the rest of the text on the page and can be easily overlooked by a user.

Furthermore, the MassBays site is tied up in the structure of the Mass.gov portal. To the average user, MassBays appears to be a sort of state agency, which it is not. Because of that, MassBays' identity and brand is unclear to the user.

MassBays Homepage

Lacks prominent logo, lacks eye-catching imagery, mission statement gets lost among the page, top tabs are not relevant to the organization.



MassBays is an EPA National Estuary Program dedicated to protecting, restoring, and enhancing the estuarine resources of Ipswich Bay, Massachusetts Bay, and Cape Cod Bay.

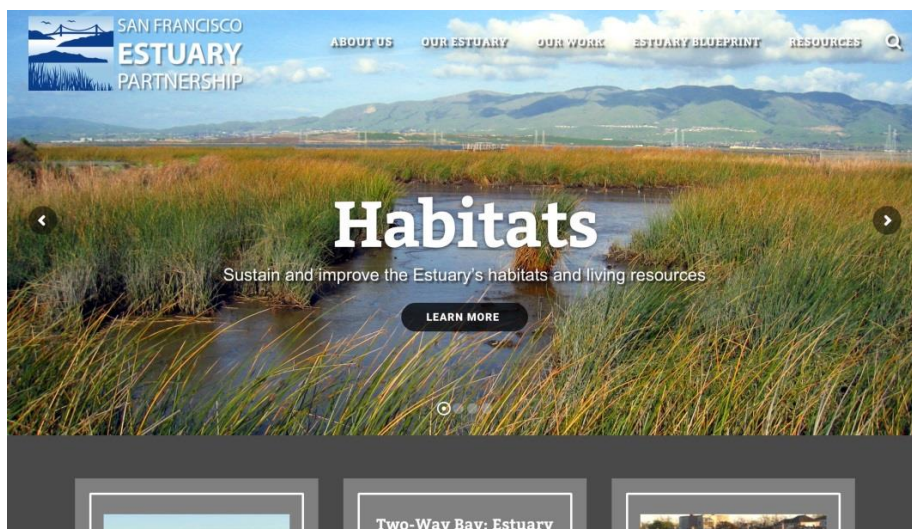
TELL US WHAT YOU THINK

Contact Us

Examples of sites that successfully adhere to the appearance principles:

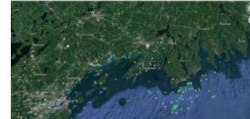
San Francisco Estuary Partnership

Prominent logo, visually appealing with appropriate imagery to convey what the partnership cares about, menu tabs that explain further the work of the organization.



Casco Bay Estuary Partnership

Prominent logo, visually appealing with appropriate imagery to convey what the partnership cares about, menu tabs that explain further the work of the organization.



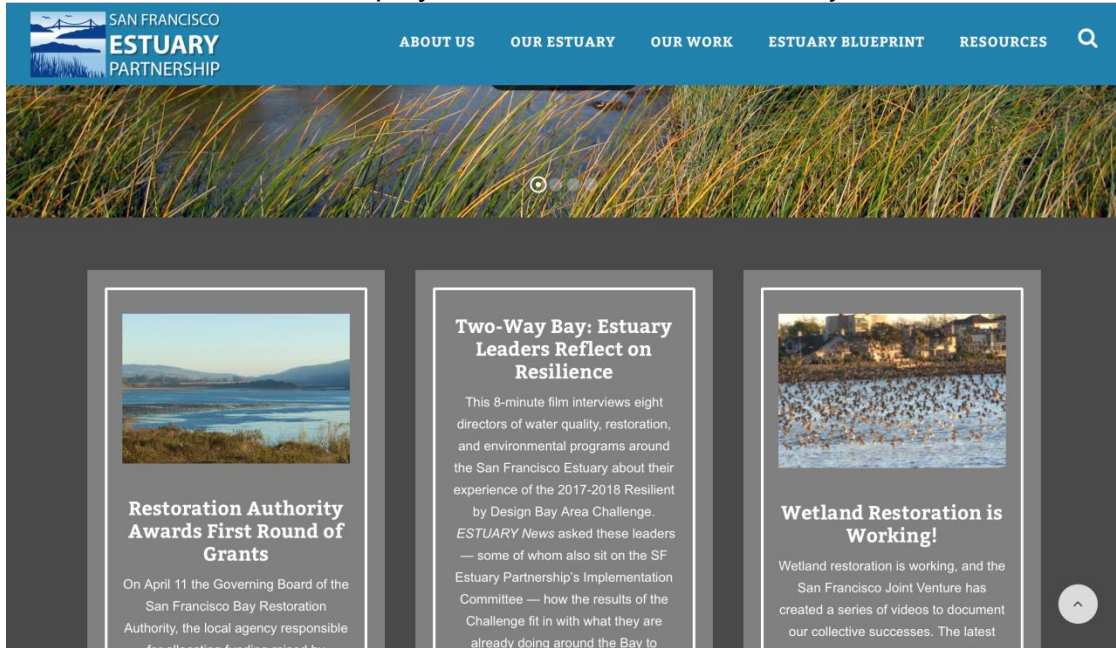
When we look at the sites from San Francisco and Casco Bay, we see that they share common characteristics:

- Beautiful, eye-catching images
- Prominent logo
- Menu tabs with relevant information
- Easy to read, simple text
- Rule of 3rds – both sites use an image that takes up ~ 2/3 of the homepage screen

2. Content: Your website tells your story. Website content should be clearly labeled and should be clear, concise and compelling. A text-heavy site can bore the reader – the more you can incorporate images, the easier it will be to hold a user's attention. Content should be up-to-date with significant news and announcements front and center.

Analysis: MassBays' current site contains a lot of relevant and important information. However, the content is displayed in such a way that it is difficult for the end user to find what s/he is looking for. Links are stacked one on top of the other in no discernable order, requiring the user to scroll (which, especially on a mobile platform, can be a turn off for users). Additionally, information does not appear on the site in a way that tells a story. For example, the leading information on the current homepage is staff contact information. A reader must scroll down nearly to the bottom of the website in order to learn that MassBays has recently awarded \$110,000 to partners through the Healthy Estuaries Grant – a key program that MassBays offers and could help create new partnerships. (Also note that the accompanying photo of the State House is not the most effective or engaging image).

Let's look at how content is displayed on the San Francisco Bay website:



- Menu tabs are clearly marked for users to access the information they are seeking
 - The three main news tabs in the center of the page tell the story of what SF Bays is working on. The information is presented in a visually appealing way and highlight SF Bay's success. Headlines are clear and concise, and images are relevant to the text.
3. Functionality/Usability: Does your website work? Broken links, out-of-date information, and unrelated information and tools will leave your user confused and frustrated and is likely to prompt them to leave the site. In a nutshell, everything on the site should work, and everything a user clicks should keep them engaged with MassBays.

Analysis: While MassBays' site generally meets the functionality standards, there are areas for improvement:

- Several links on the MassBays site that take users to a page that says "under development."
- The site map section explains to users that a new website process began in 2017 – well over a year ago.
- "Submit a proposal" is not a live link.
- The search box at the top right side of the page allows a user to search Mass.gov but not MassBays specifically, resulting in the generation of information that may be useless to your user

- The “contact form” is a useful tool for MassBays only if someone on staff receives the information submitted and uses it to improve the user experience. Otherwise, users who submit information but receive no response will likely be left with a poor impression of the organization.

These are just a few examples of the limited functionality of the current site. Anything displayed on the MassBays website should be complete (versus under development) or it is best to leave it off entirely. Information that is not relevant to MassBays or its partners should be left off the website.

Website Recommendation: MassBays is limited by the inflexibility of the current mass.gov platform. Pacer Strategies recommends that MassBays migrate off the system to its own web platform. Platforms like WordPress and Squarespace allow organizations to display their information in user-friendly, visually appealing ways that are intuitive and easy for staff or contractors to maintain. Given that MassBays is not a state agency, it should not be constrained by mass.gov’s limitations. Buzzards Bay Estuary Program, for example, has its own website managed outside of the mass.gov system. At least one state agency, MassDOT, also controls its own site.

On its own platform, MassBays could increase its use of images (including those of its staff and regional coordinators in addition to photos of coastal habitat), highlight the work of its regional partners, include video, and integrate social media among other features.

Finally, moving from the mass.gov portal would allow MassBays to address several concerns raised by EPA, including demonstrated autonomy from state government and better display of MassBays’ successes and achievements.

Regional Coordinators’ Websites

Every regional coordinator’s host organization should be required as a condition of the partnership to prominently include MassBays’ logo, link to MassBays website, and a consistent way to talk about the partnership between the host organizations and MassBays.

Social Media

“Content is fire and social media is gasoline.” – Jay Baer, President, Convince & Convert

Among the most important tools MassBays should have in its toolbox to disseminate its messages and share its information are dedicated social media channels including **Facebook**, **Twitter** and **Instagram**. Other platforms like YouTube and blogs may also be relevant but the three specific channels are a good place to start. In particular, they are each a good way to build awareness of the organization, make connections to key audiences, create and develop relationships, increase public support and identify potential donors.

A 2017 Pew Research Center survey¹ found that two-thirds of American adults get their news from social media platforms like Facebook, Twitter and YouTube. In our current environment, as more Americans become concerned with the impacts of climate change and other environmental challenges and protection efforts, MassBays should share its voice, its expertise and its work with those who engage in this type of public conversation. MassBays can either be present on social media or it can risk being ignored and unheard.

Analysis: MassBays currently lacks active and engaging social media platforms, creating not only a challenge to awareness-raising and information-sharing efforts but also creating the appearance that MassBays is an organization that has fallen behind the times.

While MassBays has a reserved Twitter account, it's bio lacks the organization's mission statement and relevant information. The account has just 4 tweets and 15 followers. It fails to project a sense of authority and expertise and risks projecting a poor image of the organization. Pacer Strategies recommends deactivating the current account until a decision has been made to actively use Twitter as a tool. If the Twitter reactivation occurs more than 30 days after the account is deleted, MassBays will have to create a new account. If the handle @MassBays is no longer available, we recommend using the handle @MassBaysNEP. MassBays has no other social media channels.

On a positive note, some of the Regional Coordinators' host organizations have social media platforms that could be used to help disseminate and amplify messages, campaigns and relevant MassBays news.

Social Media Recommendation: MassBays should create and maintain dedicated social media channels including Facebook, Twitter and Instagram. These channels should each be branded with the MassBays logo and mission statement, should be image-rich, and should be maintained and updated with new content on a regular basis (at least once a week for Facebook and Instagram, daily for Twitter). MassBays should have one staff member dedicated to maintaining the social media channels and should require its regional coordinators to contribute on a regular basis to content. Social media platforms should not be one way-streets. In addition to posting content, the dedicated staff member should take the time to engage with followers who comment on MassBays content, ask questions or offer ideas.

How do you use social media to deliver your messages and strengthen your connections with key audiences? Below, we look at several ways to do just that.

¹ <https://www.reuters.com/article/us-usa-internet-socialmedia/two-thirds-of-american-adults-get-news-from-social-media-survey-idUSKCN1BJ2A8>

Social Media to Raise Awareness

Social media is just that – social. It means you are connecting with audiences in a give-and-take sharing of information. When content is interesting, visually appealing and easy to understand, you are likely to engage more followers in your conversation.

According to Sprout Social, 97 percent of adults between 16-64 say they logged on to at least one social media platform in the last month.² Because so many of your target audiences are likely to be active on at least one social media channel, it's important to create and disseminate content across all platforms.

Here are a few ways to raise awareness of MassBays via social media:

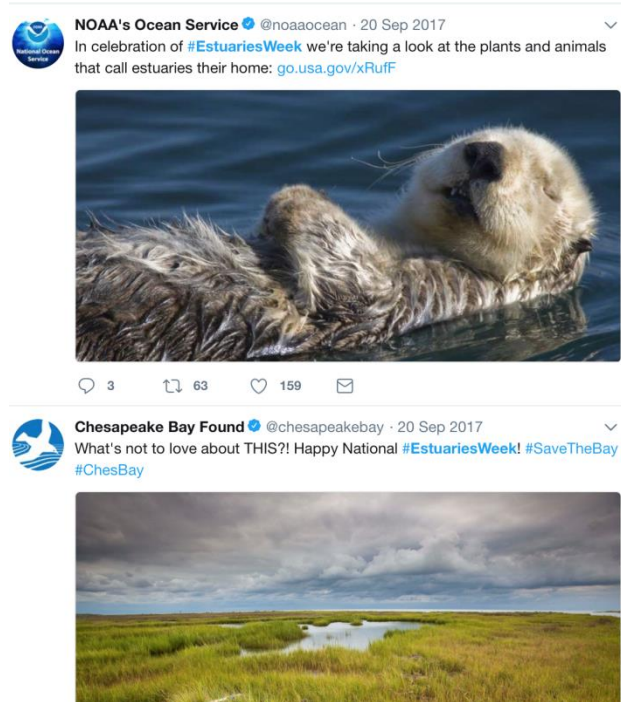
- **Create compelling content** – MassBays and its partners have a wealth of information and data to share. Pulling out key information in current reports, sharing data visually with maps and infographics and Did You Know campaigns can give your growing audience a sense of who MassBays is and what it does. Regional coordinators should be required to provide easily postable content about what's going on in their regions on a regular basis to help populate the platforms.
- **Make content visually appealing** – This goes hand –in-hand with creating compelling content. The very mission of MassBays lends itself to creating beautiful and engaging images of coastal habitat, wildlife and the impacts of climate change. People are more likely to “like” and “share” your content – and remember the information – when included with an image.
 - A great example of this is the King Tides. Without images, the King Tides are interesting, but with images, people can see directly the impact these tides have on surrounding land, homes and familiar places.
 - Videos – videos can be a great way to show off the work in the field that regional coordinators are doing. When people can see the resources MassBays is working to protect, the work is no longer abstract.
- **Connect with followers who share similar interests.** To start growing your audience, connect with other users who share an interest in the work MassBays does. Start by connecting with MassBays' Regional Coordinator organizations and Management Committee members. Follow and like statewide environmental groups, local towns, state and federal lawmakers, tech companies, fishing industry groups, business associations and the like. Often times followers will return the favor by following you back, growing your audience and spreading



² <https://sproutsocial.com/insights/social-media-statistics/>

your reach. Ask your audience to share your content on their own platforms. Over time, you'll grow your reach and increase MassBays' visibility.

- Create and Join Mini Social Campaigns: Creating or participating in week-long or month-long campaigns around a specific topic is a great way to boost your presence. You can schedule these campaigns around holidays, key dates or “designated weeks.” In September, for example, we celebrate Estuaries Week. MassBays should join in the campaign by posting images and facts relevant to Massachusetts estuaries. Using the hashtag **#EstuariesWeek**, MassBays can raise its awareness among users interested in learning more about the topic and can connect with potential new partners.



MassBays could also launch its own campaigns, encouraging the general public and partners to **share photos** of their favorites places in the MassBays area. Encouraging people to submit photos and a description of why they love that particular spot engages your audiences and helps create a connection to MassBays.

MassBays could also control the content of a campaign while highlighting a certain issue. For example, MassBays could do a week-long **#Invaders** campaign, raising awareness of invasive species in our estuaries and what MassBays is doing to fight invasive species. Regional coordinators should promote the campaign on their own social media platforms to maximize reach.

Using Social Media to Build Partnerships

Because MassBays views itself as a convener and facilitator of partnerships, one of the best ways it can use social media is to create and strengthen key connections. MassBays should build into a social media strategy a plan for cross-promoting its partners. Promoting organizations and individuals who are targets for *new* partnerships is an important part of that strategy.

Cross promoting means giving “likes” to other organizations’ content, reposting relevant posts, promoting each other’s events, sharing news and tools from each other’s sites,

and recognizing and boosting each other's work. This allows MassBays to create and strengthen relationships with target audiences including environmental advocacy organizations and NGO, researchers and academic institutions, and decision makers while expanding its influence on social media.

There are natural social media partnerships for MassBays to pursue including the Regional Coordinators, grantees, environmental organizations with a focus on clean water, schools, marine-based businesses and more.

Other Digital Communications Tools

In addition to an updated website and social media, there are other electronic tools MassBays can use to reach its intended audiences and help achieve its goals.

Email Branding: While email's primary purpose is to send and receive information, it should also be considered a marketing and branding tool. Pacer Strategies recommends that every MassBays staffer and regional coordinator include in their email signature the MassBays logo, website link and link to MassBays' social media.

Digital Digest: One of the goals laid out in the CCMP is to position MassBays as a primary source of information about conditions and trends of coastal habitat across the MassBays region. To be seen as a primary source, MassBays should send regular (weekly if possible) email communications to its network in the form of an easy to read digital digest. Similar to the quarterly MassBays newsletter, it could contain up-to-date links to upcoming events, a few news items and relevant news articles. Short summaries with links are likely to be the best format to engage readers.

Online CCMP Scorecard: To engage your audiences in the CCMP, Pacer Strategies recommends creating an online scorecard that gives stakeholders a regular update on progress.

Updated Downloadable FAQ (frequently asked questions) sheets: There are a number of great reference documents on MassBays current website but they are difficult to find and some are a few years out of date. Pacer Strategies recommends broadening the available reference materials to include updated downloadable MassBays fact sheets for use and distribution by Regional Coordinators, Management Committee members and external audiences who want to learn more or share information about the kind of work MassBays does. These fact sheets should be front and center on the MassBays website under a "Resources" or "Facts and Information" tab.

Fact sheets may include:

- The MassBays Story – basic info about MassBays and highlights of its successes
- Issue Briefs covering areas like Stormwater Management; Climate Change Resilience
- 5 Things You Can Do To Protect Your Estuaries
- All About Invasive Species

- Updated Stormwater Management Guide and other helpful guides for Municipal Officials

Videos: MassBays work is well-suited for images, whether it's photos or videos. MassBays should develop a series of short (2-5 mins) videos that can be featured on the website and shared with audiences and potential funders to better demonstrate the work MassBays does. For example, MassBays could produce a video showing an audience what eelgrass is, what problems result when eelgrass is lost, and how eelgrass is restored.

Grantees could also be asked to produce videos as part of their application process or as part of the contract to highlight the kinds of partnerships MassBays supports.

Web-Based Events Calendar

MassBays should host on its website a calendar of events occurring across the MassBays region. This calendar can be populated monthly by MassBays staff, regional coordinators and partners. Events do not need to be MassBays-sponsored but should be relevant to MassBays' mission.

Hack-a-thon Events

MassBays could partner with universities, students and researchers to host day-long hack-a-thon events using MassBays data. By sharing this data with "hackers," MassBays could create new apps, visualization and interesting tools for sharing its data with wider and relevant audiences.

Non-Digital Tools

In addition to the electronic tools above, MassBays should also target its audience through in-person events, press outreach and branding.

Press materials

Press releases and media kits allow reporters and editors to become familiar with MassBays as a resource for information about our estuaries and coastal habitat. All materials should be branded with the MassBays logo on MassBays-specific letterhead and should include boilerplate language that includes MassBays' mission. Press releases should be prominently featured on the MassBays website so that members of the media can easily access new and recent announcements.

Analysis: On the current MassBays website, news and announcements are located towards the bottom of the website, making them easily overlooked. The current press release looks to have come from the Executive Office of Energy and Environmental Affairs and the Office of Coastal Zone Management rather than MassBays. In addition, the media contact is a non-MassBays employee and there is no boilerplate description of what MassBays is. While a press release from the Governor's office may garner attention and raise awareness of the substance of the announcement, it presents a missed opportunity to raise awareness of MassBays and the work it does.

Based on conversations with MassBays staff, it is also apparent that MassBays, despite the fact that it is not funded by state government, is required to follow the media protocol of the current Administration. This protocol includes several layers of sign off and can result in the delayed release of timely information.

Recommendation: MassBays should be responsible for distributing its own press releases and announcements, and they should include contact information for a MassBays employee. Further, press releases should be printed on MassBays letterhead with MassBays boilerplate.

Regional coordinators should also be required to use MassBays boilerplate and letterhead when making MassBays-relevant announcements and include a quote from the MassBays Executive Director.

Finally, MassBays should create and maintain its own media database that includes contact information for local reporters across the entire MassBays region. By engaging those reporters, MassBays can position itself as a primary source of information on issues affecting the coastline.

Events

Tours for Media, Local Elected Officials, Students and the Public

One way to make the work MassBays does relevant and tangible to target audiences is to bring those audiences out in to the field. MassBays Regional Coordinators should host regular educational tours (monthly during good weather, for example) aimed at educating the media, the public and state and local elected officials about the estuaries and watersheds. These could be lunch-time tours on a boat, evening tours and info sessions with a BYO picnic dinner or tours centered around specific initiatives taking place in each of the regions.

Bring the Bays to the People

To reach community members who may not be naturally inclined to participate in tours, MassBays Central Staff and Regional Coordinators should work together to bring the Bays to the people where they are. Consider touch-tanks at Town Hall or exhibit booths at already-established events like Farmers' Markets, Town Days, Earth Day events and the like. Some of the Regional Coordinators already have hands-on tools they use in schools to educate students about clean water. Bringing those tools to a wider audience can be an effective way to connect people to MassBays' work.

Along the same lines, MassBays should have access to an exhibit booth and materials that could be easily set up at events like business or trade association meetings, municipal association gatherings, and similar events where large members of the general public and decision-makers are likely to gather.

Out of the Box Events

"Pop-Up" events are an increasingly popular way to bring awareness to brands and businesses. MassBays could partner with local business to host pop-ups to help raise

awareness of the MassBays brand while benefiting local businesses? Working with grantees like the Massachusetts Oyster Project, for example, MassBays could host an oyster shucking pop-up.

Based on conversations with Upper North Shore coordinator Peter Phippen, the invasive Green Crab is a culinary treasure just waiting to be discovered. MassBays could partner with a local restaurant on a special Green Crab dish that introduces local residents to the issue of invasive species in a fun and memorable way.

Legislative Briefings

MassBays should both conduct its own annual legislative briefings for state lawmakers and staff as well as testify at legislative hearings where bills relevant to MassBays work are heard. Understanding the limits on direct lobbying, MassBays should use these briefings and hearings as opportunities to highlight ongoing work in the communities served by relevant state lawmakers. Similar educational briefings are regularly hosted at the State House and are most often sponsored by lawmakers from districts impacted by the organization's work or lawmakers from a relevant committee (Joint Committee on Environment, Natural Resources and Agriculture, for example). These briefings could be billed as annual State of the Bays reports.

Public Awareness Campaigns

Much of the work that MassBays does takes place right in the communities where target audiences live and work. Monitoring work and other in-the-field activities and projects should have signage to indicate that the project or ongoing work is supported by MassBays. Pacer Strategies recommends that all projects supported by MassBays include visible signage with MassBays' logo and web address.

Signage templates can be uploaded to MassBays' website and made to be downloadable by the relevant partners. Other NEPs have made similar signage available on their own websites. In addition, many of the regional coordinators host public awareness campaigns that should include MassBays' logo and website on handouts and other publications.

EXAMPLES:

The Casco Bay Estuary Partnership funded the creation of educational signs that provide a primer on the ecology and history of Casco Bay and encourage individuals to help protect water quality. The signs were created by Montgomery Designs, and they are on display in Bell Buoy Park on Commercial Street in Portland. Click on any of the signs to download a PDF.



Toolbox wrap-up

Consistent branding and regular communication is key to increasing MassBays' visibility and generating new support for its work. Armed with diverse and creative tools, MassBays should be able to grow its reach and make significant progress toward its goals.

As noted in an earlier section of the Communications Plan, MassBays currently lacks the personnel resources to deliver on a robust communications strategy. To successfully create and execute the messaging toolbox discussed in this section, MassBays will need additional personnel resources. Those resources and recommended metrics for measuring the success of these tools are contained in the third section of the Communications Plan.

MASSBAYS' PARTNERSHIPS

To achieve the goals set forth in the Comprehensive Conservation and Management Plan, MassBays must rely on a wide array of partners. Thanks to its current and ongoing efforts, MassBays already has a good working relationship with numerous stakeholders at the local, state and federal levels, in addition to non-profit partners, funders, researchers and others.

By implementing the messaging strategies discussed earlier in this plan, MassBays can continue to build upon that network, create new and exciting partnerships and potentially generate additional new revenue to deliver additional programming, technical assistance and education about efforts to protect, enhance and restore coastal habitat.

New to the CCMP is a focus on Climate Change and Environmental Justice. With an eye on strengthening MassBays' impact in these areas, we focus on developing new partnerships with like-minded organizations and individuals in these key areas. In addition, because many of these relationships are made and maintained at the regional level, we recommend some additional partnerships for MassBays' central office to explore.

This section outlines broadly the partnerships MassBays should work to develop. With this framework, MassBays could develop a more specific and targeted list in consultation with key members of the Management Committee, Regional Coordinators and staff.

Current decision-makers and internal partners

- Management Committee
- Regional Coordinators
- Municipal officials including planners, conservation commissions, harbor masters, public works departments and similar municipal offices
- State and federal agencies, including CZM

External Partners

- Local and regional environmental organizations including watershed associations, citizens' monitoring groups
- Research institutions and universities
- Healthy Estuaries grantees

Prospective Partners to Target to Help Raise Awareness of MassBays

- **Educators** – MassBays currently has an informal partnership with educators through the New England Ocean Science Education Collaborative. MassBays should explore partnering more directly with NEOSEC members and/or other similar organizations focused on educating the public about oceans, watersheds and coastal habitat.

- **Neighborhood Associations** – In coastal communities, MassBays could partner with Neighborhood Associations to bring greater awareness to the challenges facing coastal habitat and work together to generate educational tools for the community.

- **Issue-Specific Organizations** including Climate Change and Environmental Justice Groups
 - Conservation Law Foundation
 - GreenRoots
 - New England Environmental Justice Foundation
 - Alternatives for Community and Environment
 - Environmental League of Massachusetts

- **Trade Associations**
 - Massachusetts Municipal Association
 - Local Chambers of Commerce or Chamber subcommittees
 - Mass Marine Trades Association
 - Massachusetts Lobstermen’s Association
 - Environmental Business Council of New England
 - Massachusetts Harbormasters Association
 - Massachusetts Shellfish Officers Association

- **Funders**
 - Foundations including Barr, Island Foundation (focused on environmental justice)
 - The State – MassBays at one time received state funding, yet today there is no state financial support. While MassBays is housed within a state agency and follows the rules and policies of state agencies, there is no dedicated state funding for the organization. Pacer Strategies strongly recommends that MassBays seek dedicated state funding through the annual budget. There are a number of ways to do this, including an annual earmark for MassBays or a dedicated earmark for regional partners, specifically dedicated to MassBays activities. Because MassBays is currently constrained in its ability to directly request state funding, this would require either a new host for MassBays or approval and cooperation from the Executive Office of Energy and Environmental Affairs. As a state-hosted program, MassBays is constrained in its ability to request state funding. The Management Committee should seek authorization and cooperation from EOEEA to communicate with state and local lawmakers with regard to funding and programming. (See lawmakers section below). Without this support, MassBays should explore host organizations outside of government that will provide the funding and flexibility it needs to be successful over the long-term.

- **Local, State and Federal Lawmakers**
 - Conduct educational briefings at the State House with relevant lawmakers/aides on the work MassBays is doing. These could be done in conjunction with CZM or EOEEA if it would make it easier to organize.
 - Given that MassBays' existence depends on the EPA, it's important that MassBays communicate with federal lawmakers on a regular basis. We recommend providing quarterly updates via email to members of the Congressional Delegation. In addition, MassBays should add the delegation and its key staff to its email lists.
 - While much of the work MassBays does is in partnership with municipal agencies, MassBays should also ensure that the decision makers (i.e., elected leaders) are aware of the work MassBays is doing in their areas. Educational briefings similar to those recommended at the State House could be conducted regionally.

In addition to the partnerships above, we recommend a review of the organizations and individuals included in the original Management Conference convened by MassBays in its early years. The Conference included nearly 300 representatives from federal, state, and local government agencies, regional planning agencies, various user groups, public and private institutions, and the general public. This review creates an opportunity to re-engage former partners and identify new ones.

To properly develop and maintain these relationships will require additional work by MassBays staff and regional coordinators. Therefore, Pacer Strategies recommends MassBays hire a full-time employee or contract worker who can identify specific organizations for partnership, schedule meetings, create and execute events and communicate regularly with all partners.

COMMUNICATIONS RESOURCES & METRICS

Communication Roles

Clearly defined communications roles are essential for the successful delivery of the communication strategy. The communication objectives set out in this strategy will only be achieved if all contributors deliver on their actions.

Current Challenges:

- MassBays' Central Office has just one FTE and one part-time employee to oversee the entirety the work of the sprawling MassBays region. MassBays' current resources are insufficient to deliver on a robust communications strategy.
- While the regional structure of MassBays is intended to ensure a local approach to managing and protecting coastal habitat and communicating with key local stakeholders, the lack of centralization around communications makes it challenging to deliver a clear message about MassBays across the entirety of the region.
- While MassBays is not a state agency, the organization has been instructed to follow the media relations protocols of Coastal Zone Management, which has resulted in delayed responses to media and missed opportunities to promote good work done by MassBays.

Recommendations:

1. Hire a MassBays Communications and Outreach Manager

To deliver fully on this plan, Pacer Strategies recommends MassBays immediately engage a full-time communications and outreach manager. The manager's primary responsibilities would include:

- Executing on the strategies outlined in this communications plan;
- Serving as the primary liaison with regional partners regarding MassBays communications efforts;
- Identifying opportunities for media coverage;
- Responding to media inquiries;
- Proactively communicating with key stakeholders via the tools outlined in the toolbox section and respond to public inquiries;
- Planning and executing workshops, programs, and public events
- Serving alongside the Executive Director as chief spokesperson for MassBays

The communications manager should plan, manage, review and deliver the communications strategy and should take the lead in ensuring MassBays' branding elements are in place on all communications.

The communications manager should final editorial sign-off on all communications (e.g. publications, videos, online material, press material, website and social media) and should be the chief liaison with any outside communications vendors.

PUBLICATIONS /PROMOTIONAL MATERIAL

The communications manager should:

- lead on the production of all publications and promotional material
- primarily create and write content, along with the regional coordinators and MassBays central office
- plan, manage, edit and produce visual and written content and documents
- draft all talking points, public reports and other public materials

DIGITAL

The communications manager should:

- coordinate content and manage website, e-newsletter, videos
- primarily write content, with responsibility for region-specific news to be led by regional coordinators
- maintain, review and regularly update the website
- lead on and manage social media presence

MEDIA

The communications manager should:

- develop and coordinate media plans in coordination with regional partners
- coordinate content and write news releases with input from partners
- serve as point of contact with CZM and EOEEA regarding media activities
- Draft op-eds, letters to the editor, bylined articles

OUTREACH

The communications manager should:

- Serve as a public representative of MassBays at relevant workshops, conferences, legislative briefings and other meetings as appropriate
- Communicate regularly with the MassBays Communications Subcommittee about ongoing communications activities

Short of hiring a Communications and Outreach Manager, MassBays should retain a communications consultant to draft and edit written and digital materials, manage social media and liaise with the Regional Partners, Management Committee and Key Stakeholders to deliver on key parts of the Communications Strategy.

2. Engage a website developer

As discussed earlier in this plan, MassBays should give strong consideration to migrating off the mass.gov web portal and create its own website, maximizing MassBays' ability to share its story. MassBays should immediately engage a web developer who can create a new website for MassBays by early 2019.

3. Create clear information-sharing and communications protocols.

As identified earlier in the plan, one of the main challenges to creating a defined brand for MassBays is the de-centralized model through which MassBays does its work. Based on discussions with Regional Coordinators, there are varying degrees to which announcements and activities are linked to MassBays.

Information Sharing: To help create a more cohesive MassBays brand, Regional Coordinators should share a set number of activities each month that can be promoted through MassBays social media, newsletters, and other communications tactics.

Pacer Strategies also recommends that MassBays central office communicates more formally and regularly (once or twice per month) with the Regional Partners and Management Committee via email updates.

Publications and Press materials

All press releases, reports and other public documents highlighting work carried out with MassBays funding should include the MassBays logo. Drafts should be shared with the Executive Director before dissemination. Management Committee members should always receive a copy of the public materials. Press releases, reports and other public materials prepared by MassBays Central Office should likewise be shared with Regional Partners and Management Committee.

In summary, much of the success of MassBays' communications efforts will depend on clearly defined roles and responsibilities within the organization. Such roles and responsibilities can help ensure timely, accurate dissemination of information and position MassBays to grow its brand.

METRICS

To measure the success of MassBays' communications efforts and make necessary adjustments, MassBays must put in place metrics for measurement.

While there are recommended targets for each measurement category below, Pacer Strategies recommends identifying a current baseline for each measurement tool first. This is an important task that should be undertaken and completed in Year 1. The Communications Manager should an analysis of current measurements including website statistics, reciprocal links, media coverage, email opens and engagement,

newsletter audiences and engagements. Social media baselines should be established at the end of Year 1 as MassBays does not currently use social media channels.

Below are the measurements and specific targets. Targets may be adjusted based on current baselines, and should be revisited annually to maintain a robust communications effort.

Communication objectives	Measures	Targets
<p align="center">Broaden awareness of MassBays and its programs</p>	<ul style="list-style-type: none"> • Website statistics including number of visits and then how visitors behave once on the website • Social Media statistics including numbers of new followers and the reach of messages • Number of reciprocal links on appropriate websites • Media Coverage • Email open and click rate 	<ul style="list-style-type: none"> • Increase number of website visitors by 50 percent each year of the CCMP • Grow Facebook, Twitter and Instagram followers by 10 percent each year of the CCMP • 5 new reciprocal links per year • 3 press releases per year, picked up by news outlets • 2-5 percent increase in email open rate per year
<p align="center">Highlight scientific research, monitoring and management needs across the planning area.</p>	<ul style="list-style-type: none"> • Number of stakeholders at workshops/conferences • Number of stakeholders signed up to receive e-newsletters • E-newsletter statistics -open rate, click through, forwards • Number of grant applications received • Dissemination of best practice tools, guides and other published 	<ul style="list-style-type: none"> • Increase by 10 percent the attendees at workshops and conferences each year of the CCMP • Increase by 5-10 percent the number of stakeholders signed up to receive newsletters • Increase by 2-5 percent the open rate of e-newsletters • Increase by 20 percent the number of Healthy Estuaries grant applications received • Meet with 3-5 new stakeholder groups/decision makers throughout the entire MassBays region each year

	<ul style="list-style-type: none"> materials Number of decision makers and stakeholders MassBays collaborates with *define successful collaboration 	<ul style="list-style-type: none"> MassBays-created materials cited or referenced by an increased number of stakeholders
<p>Invite current and new partners to participate actively in implementing the CCMP</p>	<ul style="list-style-type: none"> Number of local decision makers engaged in meetings and discussions re: CCMP Public participation Number of funders Leverage reported to EPA via NEPORT 	<ul style="list-style-type: none"> Increase by 2 per year the number of new local decision makers, state elected officials or federal agencies reached by MassBays in each region Increase by 3 per year the number of public organizations that partner with MassBays *define successful partnership Increase by 1-2 per year the number of new funding partners Increase by 25 percent the amount of funding support from current funders. Increase by 10 percent the leverage reported to EPA

COMMUNICATIONS SEQUENCING

There are many components of this plan that will take time and resources. In light of that, Pacer Strategies recommends MassBays sequence some of the communications efforts in the first year(s) of the CCMP.

January – June, 2019

- Retain communications consultant
- Begin hiring process for communications manager
- Engage a website developer
- Update all materials with logo and mission statement
- Create and begin using social media channels
- Update email newsletters

- Introductory outreach to new partners
- Plan for upcoming workshops

June – December, 2019

- Onboard communications manager
- Launch one new public awareness campaign
- Introductory meetings with policymakers
- Host workshops with focus on engaging new and returning partners

CONCLUSION

The work MassBays is undertaking to protect our oceans and coastal habitat is vital to the future of Massachusetts and all who live and work here. It's important to make the public, policymakers and stakeholders aware of MassBays' efforts and feel connected to its mission.

As MassBays' embarks on the next chapter for the organization and its work, this comprehensive strategic communications plan should guide its communications and outreach efforts. MassBays should share its success stories and its critical research with as many of its intended audiences as possible and continually engage with its audiences to help it reach its goals and fulfill its mission.

Communications plans are intended to be flexible and should be regularly adjusted and updated to reflect organizational realities, needs changes and progress. We recommend annual reviews of this plan and periodic updates to ensure it remains a reliable roadmap over the life of the CCMP and MassBays' work.

###

Attachment 3

Monitoring Framework for the MassBays National Estuary Partnership

Massachusetts Bays National Estuary Partnership Comprehensive Conservation and Management Plan

2021



Contents

1. Introduction	3
2. Goals and Objectives.....	4
3. The MassBays Planning Area and its Estuaries	5
3.1 Ecosystem Delineation and Assessment.....	6
3.2 Establishing Environmental Targets.....	7
4. Environmental Monitoring in MassBays.....	10
4.1 Government Monitoring Programs.....	10
4.2 Monitoring Coordinators' Network	10
4.3 Current Monitoring Programs in the MassBays Planning Area	11
4.3.1 Water and sediment quality monitoring	13
4.3.2 Habitat monitoring.....	15
4.3.3 Species Monitoring	16
4.4 Gap Assessment	18
5. MassBays Monitoring Framework Approach.....	19
5.1 Qualifying Monitoring Programs.....	19
5.1.1 Quality Assurance Project Plan	20
5.1.2 Where and when to sample.....	20
5.1.3 What and how to sample.....	21
5.2 Addressing Data Gaps	21
5.3 Making Data Available	22
5.4 Adaptive Monitoring.....	22
6. DATA MANAGEMENT AND ANALYSIS	23
7. REPORTING	24
References	25
Appendix 1: Water Quality Monitoring Programs	26

1. Introduction

Massachusetts Bays National Estuary Partnership's (MassBays) 2020 Comprehensive Conservation and Management Plan (CCMP) seeks to fulfil MassBays' mission *to empower 50 coastal communities protect, restore, and enhance their coastal habitats.*" The MassBays planning area, including its coastal zone and watersheds, has historically been used for a variety of commercial, residential, recreational, and agricultural activities. Stakeholders from different backgrounds and across all five regions of the planning area have identified a central environmental issue with multiple manifestations: "[c]oastal habitat degradation and loss of biodiversity characterized by altered hydrology, impaired water quality, vulnerability to climate change, increasing numbers of invasive species, and habitat fragmentation."

Beginning with MassBays' initial CCMP in 1996, significant actions were taken to address specific environmental concerns. For example, the construction of a wastewater treatment plant, separation of many combined sewers, and the relocation of the outlet to offshore waters have served to vastly improve water quality in Boston Harbor and surrounding watersheds, enhancing the wellbeing of communities whose livelihood is dependent on it.¹ However many water bodies within the MassBays planning area are still facing environmental challenges. Excess bacteria in the water render beaches unfit for swimming. In 2018 elevated bacteria and rainfall (typically associated with elevated bacteria) accounted for 95% of beach postings for poor water quality.² Contaminants in stormwater, accidental discharge of untreated sewage, and similar incidents lead to closure of shellfish beds. In 2018, 422 legal notices were distributed for sanitary reclassification, rainfall closures and re-opening, paralytic shellfish poisoning events, Vibrio closures, oil spills, and more typical emergency closures (e.g. extreme rainfall, and sewage discharge).³

A key requirement of National Estuary Programs under Section 320 of the Clean Water Act is to document the effectiveness of efforts designed to improve or preserve the environmental integrity of estuarine resources and share the results via a "State of the Bays" report. This requires an understanding of the natural variability of the ecosystem. A key piece of the CCMP is the development of a monitoring framework strategy to document progress toward the desired environmental outcomes that MassBays stakeholders have identified:

- Improved habitat continuity and hydrology
- Improved water quality
- Restored natural communities
- More resilient coastal habitat

Under Goal 3 of the CCMP, MassBays has taken up a multi-faceted process to set target conditions related to these outcomes for each of the 44 embayments in the planning area. This document provides a framework for identifying existing data sets, supporting ongoing monitoring efforts, prompting new monitoring, and analyzing and interpreting the results in relation to those targets.

Traditionally MassBays has reported on the State of the Bays by coordinating updates from partners and stakeholders across different levels of government, academia, non-profits, and municipalities. A State of

¹ <http://www.mwra.com/harbor/html/bhrecov.htm>

² <https://www.mass.gov/doc/2018-annual-beach-report/download> (page 3)

³ <https://www.mass.gov/doc/2018-dmf-annual-report/download>

the Bays report or conference was organized every 5 years featuring writers or speakers that provided a wealth of information that made these reports and presentations a success. A major challenge to MassBays' ability to fully report on the State of the Bays, however, is the lack of a continuous and coordinated data collection system across the Bays. This is due to a variety of reasons, including financial and personnel constraints among federal, state, and local government agencies. Existing monitoring programs are separate and distinct, often with a limited scope. Although these programs provide valuable information on the condition of the system they were developed to study, inconsistent approaches limit the availability of data that can be integrated into more comprehensive assessment and reporting.

The MassBays Monitoring Framework is a supplemental technical document of the CCMP. It describes MassBays' approach to integrate data from multiple monitoring programs to support State of the Bays reporting. It also describes how MassBays will address data gaps by providing support to citizen scientists to improve existing programs and create new programs that generate data that can be used for decisionmaking.

2. Goals and Objectives

Since its designation as a National Estuary Program in 1990, MassBays has supported scientific research, monitoring, and management actions through technical support, direct funding, and partnerships. Most recently, MassBays engaged local, regional, and statewide stakeholders to develop goals and strategies for inclusion in the CCMP. Each strategy encompasses actions and activities designed to improve local environmental conditions toward the desired outcomes listed previously (Improved habitat continuity and hydrology, improved water quality, restored natural communities, more resilient coastal habitat).

The goals of the MassBays Monitoring Framework are to:

- Document trends in water quality and the health of living resources to measure progress towards targets and better characterize conditions in the Bays;
- Understand causes of impairment, inform responsive action, and assess the effectiveness of the management actions implemented under the CCMP;
- Inform research and modeling efforts by providing data on spatial and temporal variability of environmental conditions and providing regular and locally informed State of the Bays reporting;
- Communicate with the public and decision-makers;
- Enable adaptive management.

To ensure direct alignment to the CCMP and MassBays' mission, the MassBays Monitoring Framework takes up these key questions:

- *Are the goals and objectives of the CCMP being met?*
- *Is the health of the Bays improving?*
- *Are natural/living resources restored/protected?*

3. The MassBays Planning Area and its Estuaries

For a full description of the planning area geomorphology, please refer to the CCMP, Chapter 2. The following sections summarize the primary drivers of environmental conditions in the Bays and MassBays' approach to documenting those.

In the 1990s, Massachusetts invested in capacity-building among community watershed groups, and many of them continue to provide leadership in their watersheds with regard to river health. Beginning in 2008 with the Commonwealth's Oceans Act, Massachusetts has consistently invested in ocean planning. With those two efforts flanking (but generally not directly addressing) the near-shore environment, MassBays has chosen to focus on this dynamic ecosystem. MassBays has deliberately and meticulously defined its planning area using ecosystem-based landward and seaward boundaries, rather than municipal or political boundaries. Geospatially available data provided a glimpse into the relative ecological condition of estuaries within Ipswich, Massachusetts, and Cape Cod Bays. This approach helps MassBays focus its efforts and resources to address estuarine management (conservation and restoration) priorities as directed in the CCMP.

The 1100 mile coastline extending from the town of Salisbury on the New Hampshire border to the town of Provincetown at the tip of Cape Cod is characterized by a variety of habitats that are mainly controlled by land use and land cover, hydrological conditions and salinity levels, as well as geological and physical setting and exposure to wind and wave action. MassBays has defined five sub-regions for management purposes:

- Upper North Shore is dominated by the Great Marsh, which is the largest salt marsh north of Long Island Sound and is fed by the Parker-Ipswich-Essex river system. The Merrimack River, at the northern boundary of the planning area, is the largest source of freshwater to the Bays and played a historic role as a focal point of the U.S. Industrial Revolution. Both the Great Marsh and the Merrimack River are characterized by important habitats and species that play a vital role in these ecosystems.
- Lower North Shore which includes Salem Sound and the shoreline around the towns of Swampscott, Saugus and Nahant, is a densely urbanized watershed with more than 65% impervious cover. Significant loss of saltmarsh (<65.5 acres left in Salem Sound) and eelgrass (81% loss in Salem Harbor) have taken place over the past several decades because of urban spreading and concomitant increase in pollution.
- Metro Boston is heavily urbanized and characterized by around 50% impervious cover (EDA, 2017) and significant water transport, shipping, and recreational usage of Boston Harbor. The primary rivers leading to Boston Harbor (the Charles and the Mystic) are dammed, thereby providing limited freshwater input. Ecologically significant salt marsh areas can be found just on the outskirts of Boston including Rumney Marsh to the north and marshes at the mouth of the Neponset River to the south.
- South Shore suburban development adjacent to the metro Boston region gives way to rocky intertidal shores, transitioning into wetlands and sandy beaches and dune systems.

- Cape Cod Bay shores are dominated by sandy coves, dunes, barrier beaches and tidal flats, the results of a terminal moraine. Cape Cod Bay receives most of its freshwater input from groundwater inflow rather than from surface water (rivers). There, nutrient input conveyed by groundwater discharge often exceeds riverine input (Slomp and Van Cappellen 2004).

The following section describes the approach used to characterize and assess estuarine embayments and inter-estuarine areas to develop the Ecosystem Delineation and Assessment (EDA2.0), how the EDA 2.0 tool is being used to categorize estuarine embayments into classes, and how targets will be established to measure progress towards improved environmental conditions and ecosystem health in the estuaries.

3.1 Ecosystem Delineation and Assessment

As described in detail in the CCMP the geomorphology of MassBays creates rich and diverse ecosystems along the coast. In order to get a glimpse into the relative ecological condition of these complex estuaries, MassBays applied ecosystem-based landward and seaward boundaries to define 69 assessment areas between the towns of Salisbury and Provincetown.

Broadly, the assessment areas include 44 estuarine embayments and 21 inter-estuarine areas (defined as linear intertidal shoreline and barrier beaches). In general, the landward boundaries of estuarine embayments that are significantly influenced by riverine input were based on the furthest extent of tidal influence geospatially depicted in wetland and jurisdictional maps for Massachusetts. In the few cases where the embayments had no riverine input, the proximal area of influence was determined using topography. The inter-estuarine areas were delineated using topography, mainly at the sub-basin scale. The Cape Cod region is groundwater-dominated, and the hydrologic basis cannot be delineated using surface topography. Instead, its delineation was primarily based on the groundwater contributing areas (GWCAs) data layer developed by the U.S. Geological Survey (USGS) and by the U.S. Environmental Protection Agency (EPA) (Geosyntec, 2017).

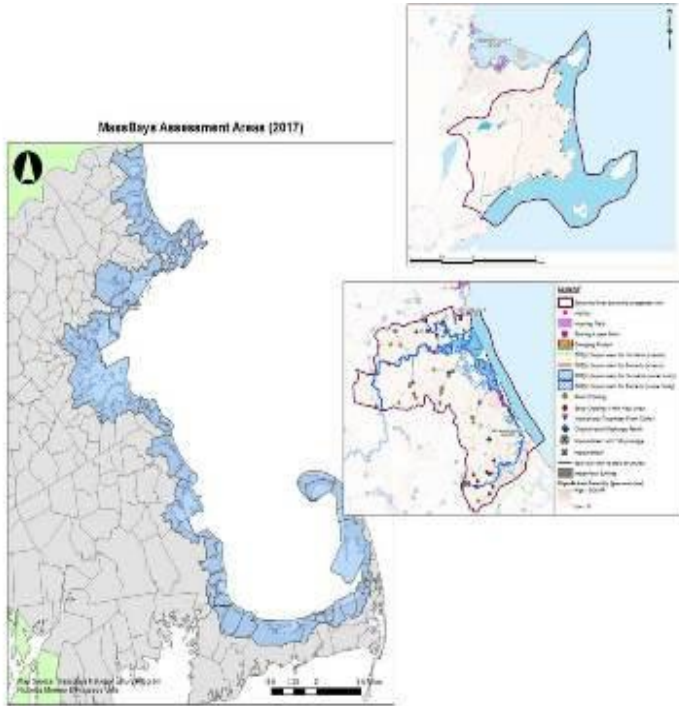


Figure 1: Map of assessment units. Insets show an inter-estuarine area (top) and an estuarine embayment (bottom)

The 10-meter bathymetric contour was generally applied as the seaward boundary of the assessment areas. This depth encompasses the photic zone, which includes many of the near-shore marine ecological resources of interest, and therefore approximates an ecologically informed boundary (Geosyntec, 2017). Detailed descriptions of how the boundaries were selected and what datasets were used are provided in 2017 MassBays Ecosystem Delineation and Assessment, Geosyntec Consultants, Inc.

Characterization of the assessment areas is based on carefully chosen attributes that describe the estuary and potential stressors. These include extent of tidal flats, salt marsh, eelgrass beds, shellfish habitat, and shorebird habitat, number of nesting sites, length of anadromous fish passage, , size of impervious area,

volume of stormwater and waste water discharge, percent land use change, population density, water quality conditions, designated shellfish growing area classification, and number of fish barriers and stream crossings. The attributes were selected based on a set of criteria including requirements that data are readily available; data are QA/QC'd, data are collected on an ongoing basis, and data have an approved QAPP.

The resulting Estuarine Delineation and Assessment, now the Ecosystem Delineation and Assessment (EDA 2.1) lays the groundwork for MassBays to compile information on water quality and habitat condition and identify restoration and conservation needs. MassBays developed an interactive story map to allow users to get a closer look at their embayment of interest. The map, available on the MassBays website,⁴ shows ecological resources and anthropogenic conditions for each assessment area.⁵

3.2 Establishing Environmental Targets

Since 2018 MassBays has been working on an ambitious project (developed as Goal 3, Strategy 3.1 in the CCMP): establishing target (improved) water quality and habitat conditions for the 47 embayments in the planning area.⁶ Strategy 3.2 is to guide local action to expand habitat and improve water quality according to these targets.

Figure 2 illustrates the activities MassBays is taking up under these two strategies. The steps include:

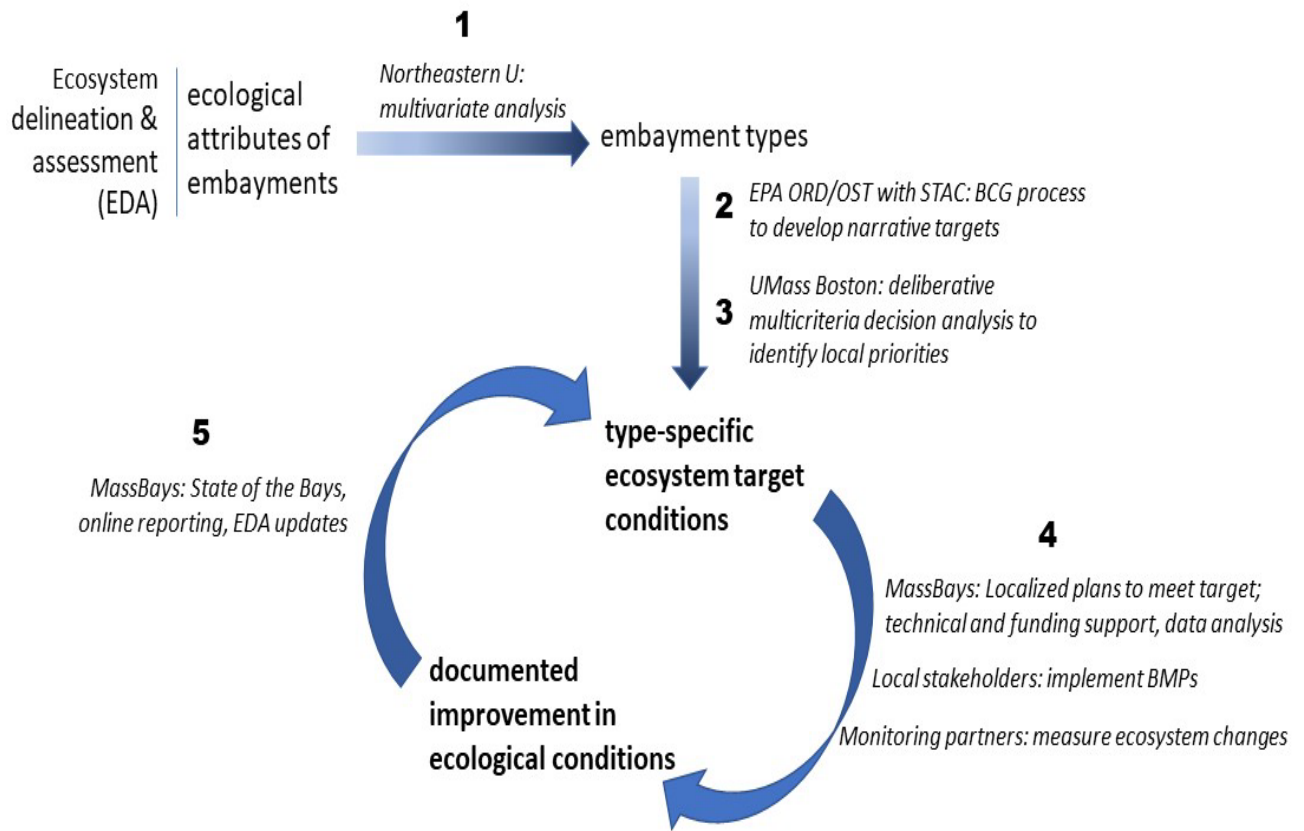
⁴ <https://www.mass.gov/service-details/ecosystem-delineation-and-assessment>

⁵ <https://mass-eoea.maps.arcgis.com/apps/MapSeries/index.html?appid=1b4ed0e72ccd4942a78b6ae36d6f6f36>

⁶ MassBays will expand target-setting to the inter-estuarine areas using lessons learned in this initial effort focused on estuaries.

1. Northeastern University researchers utilized data from the EDA to conduct a multivariate analysis and split the 47 embayments into four categories.
2. EPA scientists from the Office of Research and Development (ORD) and Office of Science and Technology (OST) are working with MassBays' Science & Technical Advisory Subcommittee (STAC) to apply the Biological Condition Gradient framework (Cicchetti et al. 2017). This tool considers the impact of specific stressors on ecosystem health. A significant outcome of this work will be habitat-specific target conditions for each ecological class, informed by existing conditions (e.g., current seagrass coverage) and restrictions (e.g., the physical shape of the embayment). The indicators for which targets will initially be established include water quality parameters like dissolved oxygen and nutrients, eelgrass extent, salt marsh extent, and anadromous fish counts and run (habitat) continuity.
3. Researchers at the University of Massachusetts Boston (UMB) will lead stakeholders from each embayment class in a deliberative multicriteria decision analysis. Identifying and defining the connections between biological conditions in the embayments and the ecosystem services they provide, is a critical step in garnering support for future actions by MassBays and its partners, as it has been in other restoration efforts (DeAngelis et al., 2020). With information from local stakeholders regarding their priorities for future conditions, and what they are willing to commit to realize the benefits of those improvements, MassBays will be well-situated to work with municipalities to reach those targets.
4. Embayment-specific targets generated via steps 1-3 will drive on-the-ground efforts by MassBays and its partners to mitigate the impact of stressors and improve local conditions. MassBays' Regional Coordinators and Central Staff will engage municipal, nonprofit, and state partners to develop and implement best management practices and restoration efforts. Monitoring results are an important piece of the puzzle and will provide information on whether the management actions and decision-making (as outlined in the CCMP) are having the desired results for improved ecosystems. The MassBays Monitoring Framework is focused on this aspect of the overall process – identifying embayments where monitoring is conducted, gaps that need to be addressed, and the proposed approaches to address these gaps.
5. Under Section 320 of the Clean Water Act, MassBays is required to report regularly on the conditions of the estuaries. Step 5 establishes frequent and regular reporting on the condition of the Bays that depends directly on data gathered from monitoring programs in the planning area, in addition to other work, through online data-sharing and regular State of the Bays reports. Monitoring data will not only provide scientific information on the ecology of the Bays but will also help measure the effectiveness of the management actions taken as part of the implementation of the CCMP.

Figure 2. Process flow chart for CCMP Goal 3, Strategies 3.1 and 3.2.



4. Environmental Monitoring in MassBays

Currently there is no comprehensive monitoring program run by the State or other entities that monitors water quality and/or habitat condition across the entire Massachusetts coastline, or even the MassBays planning area. However, several monitoring programs gather data on a local geographical scale that includes one or more embayments. A few of these programs are managed by government entities but the majority are run by community-based environmental organizations and implemented by citizen scientists. In order to fulfill the goals of the CCMP MassBays has turned to nonprofit, citizen-led efforts which are the primary source of current water quality and pathogen data for most of the planning area.

These efforts carried out by agencies and citizen science groups provide a wealth of data that will allow MassBays to monitor trends in estuarine condition across the Bays over time. As indicated earlier, the purpose of this document is not to describe each monitoring program in detail, but rather to summarize the nature of the programs whose data will be incorporated into the MassBays Monitoring Framework to report on the State of the Bays. Nevertheless, a list of programs by embayment is provided in Appendix 1.

4.1 Government Monitoring Programs

In Massachusetts there is currently no continuous comprehensive statewide monitoring program. The largest program conducted by state government entities in the estuaries and marine waters is administered by the Massachusetts Water Resources Authority (MWRA) which monitors areas in Boston Harbor and northern Massachusetts Bay for impacts from the Deer Island Wastewater Treatment Plant. Massachusetts Department of Public Health monitors bathing waters for pathogens and the Massachusetts Division of Marine Fisheries (DMF) monitors shellfish growing areas across the state and collects temperature data in association with species-specific programs such as the lobster program.

Over time, large government-run programs have shrunk as the scope of their investigations has narrowed substantially. At the same time, under Section 302 of the Clean Water Act, MassBays is tasked with reporting on the environmental health of the bays. Lacking the resources to conduct a full-scale comprehensive monitoring program, and understanding that such a program may not be appropriate across all the planning area, given its size and diversity, MassBays is turning to citizen scientists as a strong emerging resource that has been gathering data for a long time and its expansive capacity rarely tapped into.

4.2 Monitoring Coordinators' Network

In order to foster a strong partnership with citizen science groups, MassBays established the Monitoring Coordinators' Network. The goals of the Network are: (1) to bring volunteer-generated data to bear on policy and management decisions; and (2) to support citizen monitoring groups in meeting their own goals for volunteer recruitment and training, data collection and analysis, sharing of results with their audiences, and long-term sustainability of the monitoring program.

This network of about 45 watershed groups was convened in 2016 to discuss the primary challenges faced by non-profit environmental organizations and how MassBays can provide support including sharing information with audiences and improving the quality of data collection and analysis efforts. In

response to a survey conducted by MassBays to identify priority needs by monitoring groups, program coordinators indicated needs in three areas: program design and planning; data management and analysis; and interpretation and dissemination of results. The survey also revealed a need for support in development of Quality Assurance Project Plans (QAPP) and writing successful grants to obtain funding.

Lack of funding and staff capacity has resulted in some monitoring groups being unable to continue their data gathering programs. By working closely with citizen science groups, MassBays is working to help them build capacity to collect and share quality data and information and to have the data available for robust State of the Bays reporting. The steps taken to address these needs are described in more detail in Section 5.

4.3 Current Monitoring Programs in the MassBays Planning Area

As described in Section 3.2, MassBays' CCMP requires careful monitoring and analyses of data collected to track changes over time relative to ecosystem targets. The planned reporting, both online and via State of the Bays events and documents, will serve to inform local and state managers and decisionmakers about the condition of embayments within their jurisdiction so that they are able to better identify priorities for improvement, conservation, and restoration. For example, data on deteriorating water quality in an embayment will alert decisionmakers to respond to and address stormwater issues, perhaps by designing and implementing BMPs. Then, over time, as data from targeted monitoring show steady improvement in water quality conditions, shellfish beds within the embayment may be deemed suitable for harvesting by DMF.

MassBays has compiled a comprehensive list of monitoring programs conducted in the planning area. Detailed information on each program was gathered in 2016 primarily through a survey of monitoring groups and agencies. 25 government agencies and watershed associations responded to the survey. Metadata gathered on each monitoring program includes: name of program, organization, location, water body monitored, primary goal of the program, parameters measured, availability of an approved QAPP, information on data management and analysis, and information on data sharing and availability. The inventory was shared with MassBays' Regional Coordinators and MassBays' Management Committee who provided feedback as well as information on additional efforts which may have been overlooked. The list of programs and related information are currently being updated.

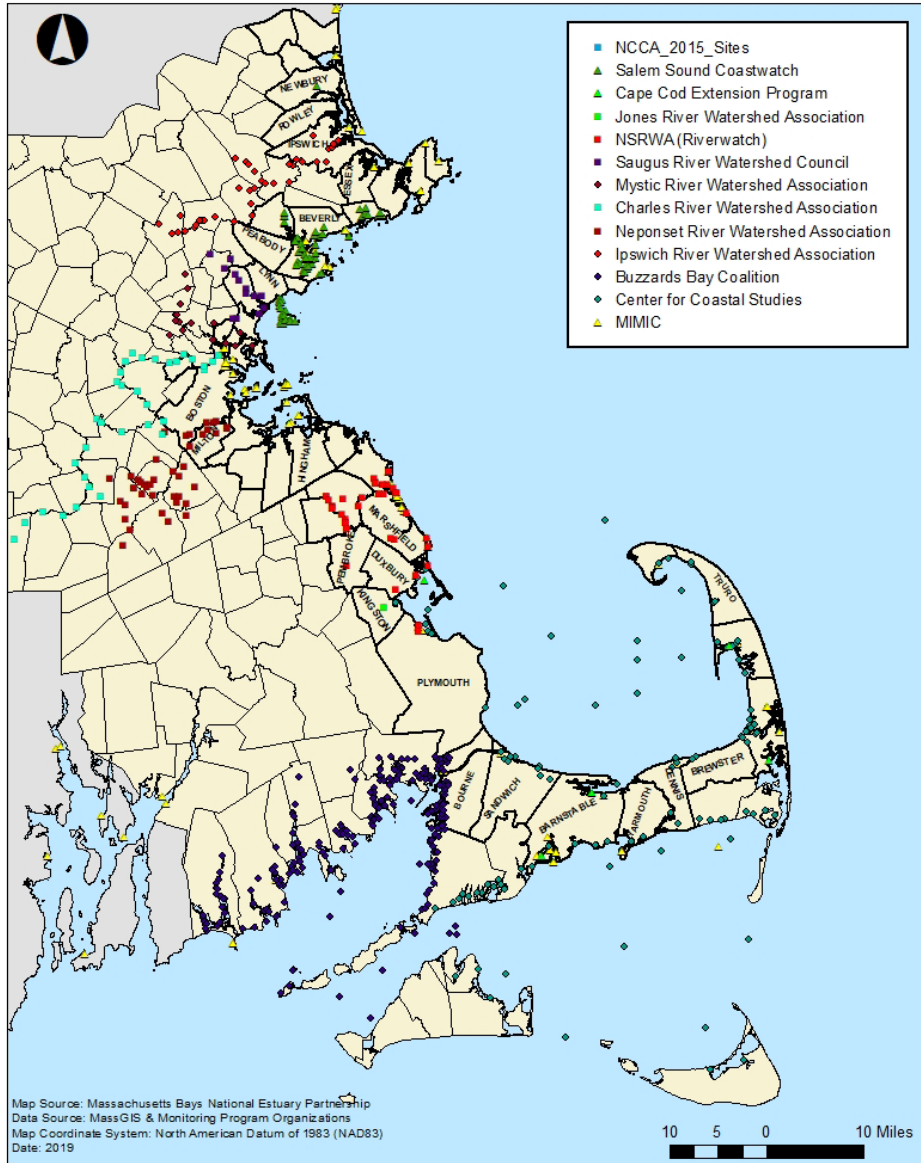


Figure 3. Coastal Citizen Monitoring Programs in Massachusetts, 2019

Because monitoring programs within the MassBays planning area vary widely in geographic scope and capacity, MassBays applied a set of screening criteria to identify the programs that can produce regular, robust data which will provide information on trends and changing conditions in the estuaries. An important asset that a monitoring program needs is the availability of an approved QAPP that improves the confidence level in the data for use by MassBays for State of the Bays reporting. Monitoring encompasses water quality, habitat, and species diversity and abundance, all useful to MassBays' efforts to track changing conditions in the Bays, measure the effectiveness of management actions, and prioritize management needs. The programs selected to be included in the MassBays Monitoring Framework are administered by government agencies, academia, and local watershed groups (some of which may not have approved QAPPs yet).

The sections below describe the types of monitoring programs currently underway within the MassBays planning area. This list is not exhaustive. Data from some of these programs as well as others will be incorporated into the MassBays Monitoring Framework after rigorous QA/QC. A list of monitoring programs implemented in Massachusetts is provided in Appendix 2.

4.3.1 Water and sediment quality monitoring

MassBays-wide monitoring programs

National Coastal Condition Assessment: EPA administers the National Aquatic Resource Surveys (NARS) which are collaborative programs between EPA, states, and tribes designed to assess the quality of U.S. waters using a statistical survey design. Coastal waters are surveyed every five years through the National Coastal Condition Assessment (NCCA), a coastal monitoring program with rigorous quality assurance protocols and standardized sampling procedures designed to produce national and regional estimates of coastal condition.⁷ The NCCA program gathers data on water quality, sediment quality, and toxic contaminants in fish tissue. In 2015 MassBays administered the probabilistic survey on behalf of the Commonwealth of Massachusetts and had the opportunity to participate in the allocation of 52 sampling stations, ensuring MassBays had adequate representation in the survey. Although the survey is only conducted every five years, MassBays can look at long-term trends in environmental conditions.

Massachusetts Coastal Condition Assessment: The Massachusetts Coastal Condition Assessment (MCCA) is a probabilistic survey for coastal/estuarine/marine waters. The Massachusetts Probabilistic Monitoring & Assessment Program (MAP2) is a component of the Massachusetts Department of Environmental Protection (MassDEP)'s water monitoring strategy that uses randomly selected sites or waterbodies to provide an unbiased assessment of water quality throughout Massachusetts. Section 305(b) of the Clean Water Act requires states to report on the condition of all waters in their respective state. MAP2 will focus on coastal/estuarine/marine waters between 2020 and 2023. Considering the shared needs and responsibilities between the respective programs, MassDEP and MassBays formed a partnership to conduct a probabilistic MCCA that meets the needs and responsibilities of both programs.

The overall goal of the MCCA is to provide an unbiased assessment of designated uses, specifically aquatic life, and water quality trends and conditions in Massachusetts coastal/estuarine/marine waters determined from future surveys. This goal will be achieved by collecting physico-chemical and biological data at 90 probabilistically selected stations between 2020 and 2023, providing statewide coverage over three years. Monthly water and sediment data will be collected at each station (June-August) to reach this goal. Presence/absence and percent cover of eelgrass (where possible) will also be recorded.

Massachusetts Beaches Monitoring Program: The Massachusetts Department of Public Health administers a beach monitoring program under federal and state law. During the bathing season, weekly samples are collected from over 500 marine public beaches sampling points across Massachusetts and analyzed for Enterococci. Similarly, data are collected from freshwater (riverine) and analyzed for Enterococci and E. coli. Sample exceedances may result in beach closures and the public is notified. These data will help inform MassBays on the presence of pollution discharge into the embayments.

Fisheries Program: The Massachusetts Division of Marine Fisheries (DMF) implements several monitoring programs that include collection of temperature data associated with target species surveys. Data are collected from seafloor stations as well as estuarine and riverine benthos (May – October).

⁷ <https://www.epa.gov/national-aquatic-resource-surveys/ncca>

Over 7 million records have been collected since 1986. Data are QA/QC'd and compiled by the Fisheries Habitat Program into a dataset that is publicly available.

Embayment-specific monitoring programs

There are several embayment-specific programs in the MassBays planning area. These programs will be integrated into the MassBays Monitoring Framework based on the location of the monitoring stations and the scope of the program. MassBays continues to work closely with some of these groups to expand sampling into the estuarine part of the watershed and into the embayment. This section provides a brief description of some of these programs.

Massachusetts Bay Monitoring Program: Massachusetts Water Resources Authority (MWRA) has been managing a comprehensive monitoring program in Boston Harbor and Massachusetts Bay to monitor potential impacts of discharge of treated sewage effluent into the Bay since 1995. Data show trends in water quality over time in response to a set of questions. Data are used to inform revisions of the monitoring program, mainly sampling stations. Water and sediment samples are collected from May through October from a major part of Massachusetts Bay, including Boston Harbor and Broad Sound up to Salem Sound. Field work and analysis follow protocols laid out in an approved QAPP and reports on data gathered are discussed with MWRA's Outfall Monitoring Science Advisory Panel (OMSAP) and provided to EPA and are publicly available.

For the past several years, MWRA has observed consistently improving conditions in water and sediment conditions at stations proximal and distal to the outfall. Due to these positive results as well as in response to increasing research on emergent contaminants, MWRA has recently initiated discussion on the possibility of shifting its monitoring focus to respond to more urgent needs and evolving conditions. Discussions are still underway at the time of this report.

Cape Cod Bay Monitoring Program: The Center for Coastal Studies (CCS) in Provincetown has been monitoring Cape Cod Bay since 2006, making it the longest-running and only Cape Cod Bay-wide monitoring program. It includes over 60 nearshore stations and 11 offshore stations in the MassBays planning area sampled every two weeks from May through October. Sampling is a collaborative effort between CCS and several volunteer citizen scientists. Key indicators of environmental health (i.e. nutrients, chlorophyll, temperature and turbidity) are analyzed at the CCS laboratory. These data represent critical information about long-term trends of changing conditions in Cape Cod Bay. In 2019, CCS data as well as data from Buzzards Bay Coalition and other smaller organizations were used by the Association to Preserve Cape Cod (MassBays' Regional Service Provider in Cape Cod) to assess the health of Cape Cod waters. A report and associated reporting system were developed to help communities understand the water quality problems they face and the actions that are needed to address these problems.⁸

Offshore Buoy Network: Several buoys are located offshore but still within the coastal zone and collecting data relevant to the estuaries. Buoys deployed by NOAA and NERACOOS collect real-time continuous meteorological data as well as temperature and salinity from various locations in Massachusetts Bay (Boston Harbor) and Cape Cod Bay. These data are streamed to the NERACOOS website where they are publicly available. These datasets will provide valuable baseline data on the outer areas of estuarine embayments within MassBays.

⁸ State of the Waters: Cape Cod <https://capecodwaters.org/>

Watershed monitoring programs

As mentioned previously, several non-profit/local groups conduct monitoring in their respective watersheds. Most of the monitoring is implemented in the freshwater segment of the watershed, but some groups also monitor the estuaries. These monitoring programs vary in scope and extent, mainly depending on issues and priorities of concern and resources available. Water samples, mostly collected between May and October by citizen scientist volunteers, are analyzed for nutrients and pathogens. In addition, in situ measurement of dissolved oxygen, temperature, and salinity, provides data on water column conditions.

4.3.2 Habitat monitoring

Habitat monitoring in MassBays is focused mainly on eelgrass, shellfish beds, and salt marsh. These programs are conducted to answer specific questions rather than to carry out a comprehensive assessment through long-term baseline data collection. The data will be incorporated into the MassBays Monitoring Framework as available for specific embayments and analyzed accordingly.

Eelgrass Monitoring

Eelgrass (*Zostera marina*) is a critical marine habitat and has been the center of many studies and restoration efforts. The MassDEP Eelgrass Mapping and Monitoring Program was initiated in 1994. The statewide mapping effort was conducted in phases between 1994-2012 following standard protocols using aerial surveys and ground truthing in specific areas. An assessment of data collected between 1994-2006 concluded that eelgrass is in a state of statewide decline (Costello & Kenworthy, 2011). A detailed report and viewer are available online.⁹

Since 2006, DMF has conducted research, monitoring, and restoration of eelgrass in Massachusetts. In 2014, DMF and MassBays coordinated to develop a protocol for photointerpretation of MassDEP aerial images using eelgrass data collected by acoustic surveys. This method will generate more reliable information on changing eelgrass conditions in embayments. Monitoring of an eelgrass bed in Beverly, MA, is conducted regularly as part of the international SeagrassNet program that collects data to track trends in seagrass conditions worldwide. Starting in 2013, DMF divers have conducted annual monitoring using the SeagrassNet protocol at four eelgrass reference beds (Marblehead, Boston, Broad Sound, and Nahant). Conditions and changes in these natural areas are compared to transplanted sites to determine restoration success. Acoustic mapping of restoration and reference beds was conducted in 2018 in order to determine the vegetated areas and patchiness of both types of meadows (DMF 2018)¹⁰.

Acoustic mapping of eelgrass beds by DMF, with support from EPA and MassBays, has yielded information about eelgrass bed extent and condition in Salem Sound and Duxbury-Kingston-Plymouth Bays. In 2018, MassBays and DMF developed a rapid assessment protocol for eelgrass monitoring to be implemented by citizen scientists, with support from EPA. Data from annual assessments conducted in August (eelgrass growing season) in conjunction with less frequent acoustic monitoring (e.g. every 3 years) will allow scientists and managers to observe changing areal extent and spatial variability of eelgrass in this embayment. This protocol may be adopted for implementation in other embayments by citizen science groups. Results of the 2018 study at 250 locations were published in Carr et al. 2018 (2019 results are forthcoming).

⁹ <https://www.mass.gov/guides/eelgrass-mapping-project>

¹⁰ <https://www.mass.gov/doc/2018-dmf-annual-report/download>

Saltmarsh Monitoring

Saltmarsh Sentinel Project: Salt marsh monitoring is conducted by various agencies, academia and organizations to answer specific questions. CZM established sentinel sites in three salt marsh locations in 2017 to collect long-term biological and physical data at permanent transects at two locations within MassBays' planning area (Barnstable and Essex). Also beginning in 2017, North and South Rivers Watershed Association has been working with 20 volunteer dock owners to document vegetation presence and changes along established points in the North River and South River estuaries. The goal is to assess changes in saltmarsh extent and community composition over time. Several agencies and research facilities also conduct monitoring and research on saltmarsh ecosystems in the MassBays planning area, for example the Plum Island Estuary LTER, Northeastern University, The Trustees of Reservations, and others.

These long-term monitoring programs will provide MassBays with important information regarding changing conditions in these local settings, providing guidance for decision-making across the Bays. Importantly, saltmarsh extent will serve as a target indicator in the Biological Conditions Gradient process.

4.3.3 Species Monitoring

Several monitoring programs in the Bays are focused on a single species or a group of species. The programs cover different geographic scopes, from one embayment to the entire MassBays planning area. An in-depth assessment of these programs will be conducted in order to better understand how these data may be used to enhance reporting on conditions in the Bays. Species data that are based on approved protocols and QAPPs will be integrated to build knowledge of trends in key species that may serve as indicators of conditions in the estuaries. Standard protocols will be used and described in the MassBays Monitoring QAPP.

Shellfish

The Shellfish Program is administered by DMF. Two methods are applied to control harvesting access: classification and status. Every year, multiple water samples are collected from over 300 shellfish growing areas and analyzed for fecal coliforms. If water quality results trend towards permanent improvement or impairment, the shellfish growing area's classification is upgraded/downgraded. The status of a growing area (open or closed) is adjusted in response to sudden changes in water quality resulting from emergency or unexpected conditions. Changes in the classification of the shellfish growing areas may serve as an indicator of water quality conditions in an embayment.

Phytoplankton

In response to harmful algal threats, DMF's Shellfish Program has been monitoring phytoplankton for several years. On the north shore, qualitative monitoring was conducted with weekly PSP (paralytic shellfish poison) sampling between April and November until 2016. Since 2017, year-round sampling is conducted in the four primary regional stations in Newburyport, Ipswich, Essex, and Gloucester. Additional samples are collected as needed at various times and locations in response to elevated *Pseudo-nitzschia* counts and PSP toxicity. On the south shore, qualitative sampling has been conducted.

Since 2017 quantitative monitoring has replaced the qualitative monitoring that has regularly co-occurred with PSP monitoring.¹¹

Horseshoe crabs

In April, May and June, North and South Rivers Watershed Association, MassBays' Regional Service Provider on the South Shore, coordinates a group of trained dedicated citizen scientists to count and tag horseshoe crabs (*Limulus polyphemus*) individuals during the spawning season on Duxbury Beach. This monitoring program has been taking place since 2008. Data are reported to DMF; since 2012, data from tagged animals have been shared with the U.S. Fish and Wildlife Service.

Fish

Diadromous fish

- Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) are commonly referred to as river herring. In response to declines in river herring populations in Massachusetts harvesting has been banned since 2006. As a result, management goals to restore river herring populations include monitoring programs. DMF's Diadromous Fish Project³ includes at least one station targeting spawning run counts and biological data for each of the major coastal drainage areas. Additionally, DMF and local partners use electronic or video technologies to record spawning run counts at 12 river systems. In 2018, a total of 46 rivers in 34 municipalities were monitored by citizen scientists in Massachusetts¹² including several in MassBays. Some of these efforts are coordinated by MassBays' Regional Coordinators who train volunteers to count herring in the runs. In addition, the Massachusetts River Herring Network established through funding by MassBays (2011) is instrumental in supporting efforts to restore river herring populations to their former numbers. At the end of the season, the data are submitted to DMF. These data will be available to MassBays and integrated into the MassBays Monitoring Framework.
- American Shad (*Alosa sapidissima*): DMF monitors American shad in cooperation with Massachusetts Division of Fisheries and Wildlife (MassWildlife) each spring/summer at the Essex Dam fish lift on the Merrimack River in Lawrence, MA. This area now serves as a source of shad larvae, which are then raised at the U.S. Fish and Wildlife Services (USFWS) hatchery in Nashua, NH. Historically, the Charles River was populated by large numbers of shad which over the years have dropped drastically. Since 2006 the Charles River Watershed Association has been working with DMF and USFWS to help restore the shad population to pre-development levels. Since 2011, the released shad have returned each year to the Charles River to spawn. Improved tracking techniques are beginning to provide a fuller picture of the challenges facing the American shad in the Charles River.
- Rainbow Smelt (*Osmerus mordax*): Rainbow smelt population declines since the 1980s prompted DMF to initiate spawning run monitoring using in-stream fyke nets in 2004. This monitoring continues as an annual data series to provide a relative index of abundance and size and age data. The project presently maintains four stations, three of which are in the MassBays planning area: Parker River (Newbury), Fore River (Braintree), and Jones River (Kingston)³.

¹¹ <https://www.mass.gov/doc/2018-dmf-annual-report/download>

¹² <https://www.mass.gov/doc/2018-dmf-annual-report/download>

- American Eel Young-of-Year (*Anguilla rostrata*): DMF has been monitoring the spring migration of Young-of-year (YOY) eels in the Jones River (Kingston) using a Sheldon trap since 2001 and in the Essex River (Essex) with a fyke net since 2014 to contribute to a coastwide index of eel population relative abundance. DMF also monitors eight eel ramps that are installed in coastal rivers to provide eel passage over barriers. The majority of ramps are managed cooperatively with local groups and outfitted with a collection tank to evaluate the performance of the eel ramp and the potential to use the location as a monitoring station for census counts of YOY or older eels³.

Fish Resource Assessment Program: Since 1978, DMF has implemented an annual fish trawl survey. In May and in September, DMF conducts trawling within Massachusetts coastal waters and collects abundance and/or biomass data for fish, squid, whelks, and crabs⁷. Although the trawling gear cannot be used in very shallow estuarine areas, the data are still useful to MassBays especially as data on trends in fish biodiversity, abundance, and juveniles can inform on the condition in the embayments. This program will be incorporated into the MassBays Monitoring Framework if it enhances the information on estuarine conditions.

Fisheries Species Surveys: DMF conducts yearly surveys on targeted species, mainly American lobster (*Homarus americanus*) and Winter flounder (*Pseudopleuronectes americanus*). Because of their estuarine habitat preference, population data of these and similar species may reflect water quality conditions in the embayments where they inhabit. Although the scope of the survey is for fishery management, the data will still provide long-term trends on embayment condition for the past several decades.

4.4 Gap Assessment

At first glance it may seem that most embayments across the MassBays planning area have some form of monitoring underway (Figure 3). However, MassBays' 2016 survey of monitoring programs served to highlight gaps in data and information in a number of embayments that are not immediately apparent. Survey results revealed that some embayments have (almost) never been monitored, while monitoring programs in others have been discontinued from lack of funding and/or staffing.

Depending on their objectives, existing programs in the embayments vary in geographic scale, frequency and timing of sampling, methods used, data collected, and parameters measured, making it difficult to compare conditions among different embayments. Not all programs collect samples under approved QAPPs, which makes it difficult to assess the reliability and confidence level of the data collected. In some cases, the parameters collected may not be suitable to meet the program objectives or answer the main questions, resulting in wasted efforts. Lack of staff or volunteers often result in data sheets filed away in cabinets for years, and the data never shared.

For example, the Merrimack River Watershed Council (MRWC) conducted a monitoring program in the Massachusetts area of the Merrimack River, including the estuary. The Merrimack River is the largest river that discharges into the MassBays planning area. The river is surrounded by a highly urbanized and industrial watershed with numerous non-point sources as well as discharge from treatment plants and other infrastructure. The river is classified for impairments by zinc and phosphates. At the same time, parts of the river serve as essential habitat for Atlantic sturgeon. Previously, Joppa Flats at the mouth of the river was populated by eelgrass beds which have since disappeared (Novak, pers. comm.). Between 2008 and 2012, MRWC collected monthly water quality data, mainly temperature, salinity, DO, and fecal coliforms. In addition, nutrient data (nitrates, phosphates, and ammonium) were collected during 2011.

However, when funding ceased after 2012, MRWC was forced to discontinue its monitoring program. Over the last decade, government agencies have conducted targeted sampling tied to MS4 and other regulatory programs, but to date no comprehensive ambient monitoring program has been reinstated. MassBays, through its Regional Service Provider for the Upper North Shore, is laying plans to help MRWC and surrounding communities develop a comprehensive monitoring plan and secure resources to implement the plan.

5. MassBays Monitoring Framework Approach

The goal of the MassBays Monitoring Framework is to develop an approach for comprehensive data collection and analysis that will help MassBays integrate data from existing, qualifying programs in order to track changes in spatial and temporal conditions in the Bays. Where geographic or monitoring gaps exist, MassBays will work to identify the reasons for these gaps and will work with local groups and relevant agencies to address them.

As described in Section 4, monitoring programs within MassBays target varied aspects of environmental monitoring. The majority of the programs monitor water quality. Some programs also look at sediment quality while others track abundance and population dynamics of specific species. This section describes the approach by which MassBays will seek to support the gathering of statistically and scientifically robust data for measures relevant to the CCMP, use the data to track and report on changes in estuarine conditions, and use the results to communicate to stakeholders and to leverage support for decision-making and actions that will address environmental concerns.

5.1 Qualifying Monitoring Programs

In order for data generated by monitoring programs in the MassBays planning area to be incorporated into the State of the Bays reporting, the data need to be, at a minimum: (1) collected and analyzed based on an approved QAPP, (2) based on state or federal standard methods or equivalent alternatives; and (3) available in a consistent and usable format. In addition, data need to be statistically and scientifically robust and datasets should include a minimum set of parameters depending on the scope of the program.

Monitoring programs administered by government agencies or conducted by academia for research purposes operate under approved QAPPs and generate statistically reliable data, for example, Massachusetts Bay Monitoring Program (MWRA), Beach Monitoring Program (DPH), and Cape Cod Bay Monitoring Program (CCS).

Through the 2016 survey of monitoring programs, MassBays identified and evaluated citizen-generated datasets and defined two tiers: (1) A Tier 1 program holds datasets that cover water quality (at a minimum) in one or more embayments, is based on a state- or federally formally approved QAPP, uses methods or protocols approved by state or federal agencies, and maintains electronic data files. (2) A Tier 2 program collects data from one or more embayments, but data are not collected according to a QAPP. MassBays will focus its efforts to help and support local groups so that the monitoring programs they implement will generate usable and informative data.

Most local groups, in both Tier 1 and Tier 2, conduct monitoring programs which typically collect samples from one embayment. The majority of the sampling stations are located in the freshwater part

of the watershed but some of the programs have stations in the estuarine parts as well. MassBays will seek to expand sampling in the estuaries by all partners and will continue to work closely with the program managers to encourage sampling in the estuary with technical support and assistance in obtaining funding. The goal is to gain adequate numbers of sampling stations to provide data for analyses and reach statistically reliable conclusions about conditions in the given embayment. The sections below describe briefly some of the steps that will be taken by MassBays to provide this support to community-based monitoring groups.

5.1.1 Quality Assurance Project Plan

Developing a QAPP was identified as one of the bigger challenges faced by local monitoring groups. In order to be state or federal-approved, a QAPP must include specific elements: include description of a statistically robust sampling design, have a stated purpose addressing clearly identified questions, include data quality objectives, and have a data QA/QC and management strategy.

To assist monitoring groups that do not meet these requirements, MassBays is working with MassDEP, EPA and Eastern Research Group (ERG) to develop a master QAPP and an associated open-source, web-based tool (AquaQAPP) that guides users in the development of a QAPP and help improve citizen monitoring data quality for use by decisionmakers. This tool will streamline the current process for producing QAPPs, support QA/QC development, and establish consistent data collection methods across MassBays. The tool's flexible design will allow it to be adapted to the needs of stakeholders and users. The tool will be registered with EPA's Reusable Component Services¹³ and EPA's Developer Central.¹⁴

AquaQAPP allows users to develop a QAPP for monitoring marine and freshwater quality and marine and freshwater benthic sediment chemistry and benthic infauna. Preset parameters allow users to create a QAPP that is state and federally pre-approved. Standard operating procedures (SOPs) were compiled by MassBays from agency-developed or approved sources, to provide field sampling guidance to volunteer monitoring groups.

5.1.2 Where and when to sample

Sampling design is a critical component of generating data that address the initial concern, whether an interest in general health of the system, or suitability for recreational use. Depending on the objective of the monitoring program, either a random or targeted sampling design will be applied to identify sampling stations. Sampling stations are frequently located at points that are more accessible from land or by small boat. Although some of these stations may not always be optimally located to capture water quality status or changing conditions, samples from long-established programs will be valuable because of the extent of data on temporal variability available.

Most monitoring programs focus on the time period between May and October, when weather conditions permit easier access to waterbodies for sample collection. Depending on the issue being addressed, this period is also the most appropriate to observe changing conditions over several years, as this is the most active growing period in the Massachusetts climate. Within this time period, groups monitor at varying frequencies, often depending on capacity and needs. Most samples are collected every 2 to 4 weeks. If enough samples are collected to provide statistically robust results, the data will be useful to show changing conditions over time.

¹³ www.epa.gov/rcs

¹⁴ For more information on this project, visit <https://www.mass.gov/info-details/exchange-network-project>

For specific monitoring, wet and/or dry samples may be required. This entails the need to have staff or volunteers available to collect samples at the appropriate time and deliver to the laboratory for analysis within a set period of time that does not exceed holding time.

5.1.3 What and how to sample

Most monitoring groups measure basic water quality parameters including temperature, salinity and dissolved oxygen. Several groups monitor pathogens. The larger monitoring groups also collect data on nutrients and chlorophyll depending on the sampling area and scope of the monitoring program. MassBays will work with monitoring groups to provide technical support where needed to ensure that a basic set of water quality parameters are measured. This will enable MassBays to look at changes within individual embayments and compare across embayments, thereby providing information for State of the Bays reporting and to guide management actions. The parameters measured are selected based on the issue that a monitoring group is addressing and the questions it is trying to answer. Categories may include nutrient sampling (in areas close to outfalls and to non-point discharge), pathogen sampling (in areas close to septic systems), among others.

Benthic sampling including sediment characterization and chemistry, and identification of infauna assemblages may also be conducted, especially by larger monitoring organizations with adequate resources for the specialized analyses required. These data are valuable in characterizing the health of benthic ecosystems in the MassBays planning area. Embayment health and condition may be correlated to the state of eelgrass beds where these exist. However, in embayments where habitat is not suitable for eelgrass growth (e.g. due to sediment type or exposure), benthic community structure and sediment condition are often used to track changing conditions.

Information on the specific methods used to collect and analyze samples is important for integration of the data into MassBays State of the Bays reporting. If a group wants their data used by decision makers, they should collect and measure samples according to state and/or federally approved standard procedures. MassBays will work with the program's monitoring coordinator to develop a QAPP for agency review. The QAPP development process includes consideration of sample and data QA/QC. Monitoring groups that have existing approved QAPPs will already have QA/QC process in place. Even those groups that do not have an approved QAPP may still be using standard field SOPs, and if so, would likely already be implementing these measures and it will be a simpler matter to develop a QAPP. The 2016 survey results indicate that the majority of monitoring programs are already following standard field and laboratory SOPs which could make their data usable for MassBays' purposes.

5.2 Addressing Data Gaps

Data gaps across the MassBays planning area range from watersheds/embayments that have no long-term comprehensive monitoring program, to programs that have a limited focus, to monitoring programs that are not operated under an approved QAPP. MassBays will address data gaps through several avenues, for example MassBays will:

- 1) Provide support to existing monitoring groups to expand spatial and temporal coverage, for example sampling in estuarine waters, conducting sampling based on a statistically robust sampling design, and sampling for additional parameters that address concerns more directly.
- 2) Initiate baseline monitoring tailored for a specific area to support longer-term assessments. For example, in 2019 MassBays led a survey to collect data on nutrient dynamics in Salem Sound. In

2020 MassBays will continue this sampling and expand to include a benthic assessment. These preliminary data will be used to shape a long-term monitoring program in Salem Sound that can be handed over to the MassBays Regional Coordinator and local communities.

- 3) Support groups that want to implement new monitoring programs or restart discontinued programs in their embayments. MassBays can provide guidance on the appropriate sample and analysis plans to address their needs as well as collect data that will provide MassBays with information about ecosystem health. For example, a local group in Duxbury Bay is currently exploring the possibility of establishing a monitoring program in the embayment. MassBays provides guidance regarding potential research and monitoring approaches to fill data gaps. In the case of Duxbury Bay, potential investigations include identifying the causes of extensive eelgrass loss, building on monitoring that has been conducted by CCS since 2006, and expanding sampling site coverage into Kingston and Plymouth Bays.
- 4) Provide grant-writing support to obtain funding for monitoring programs. MassBays' Healthy Estuaries Grant program provides an opportunity for monitoring groups to collect data for specific purposes, including addressing knowledge gaps. MassBays encourages groups to use funding under this grant to propose projects that will assist groups in identifying monitoring goals and establish capacity needs.

5.3 Making Data Available

As indicated previously, the capacity of monitoring groups will impact how the data are used and shared. Several watershed organizations with ongoing monitoring programs share their data through their websites. Data analysis, including graphics that summarize changing conditions, are often provided as a best practice for retaining volunteers. (West and Pateman, 2016). Some groups also upload their data to government portals such as EPA's WQX where data may be shared and downloaded by other entities.

Not all groups, however, have the capacity needed to maintain a robust data management system. Smaller groups have reported to MassBays that their data are entered into spreadsheets and saved to different computers; others keep years-old, hand-filled field sheets stored in boxes or file cabinets. In response to this obvious need for support with data analyses and sharing, MassBays is implementing a plan to upload citizen monitoring data into EPA's WQX database. By leveraging the available tools and components from EPA such as WQX web templates, and with support from MassBays' Circuit Rider, citizen groups will develop capacity to use customized templates so that their data can be downloaded and utilized for a variety of purposes. Finally, MassBays is partnering with the Massachusetts Rivers Alliance to support data sharing with multiple audiences to meet their own organizational goals.

5.4 Adaptive Monitoring

Once MassBays defines targets for specific ecosystem indicators (eelgrass extent, saltmarsh extent, fish runs, and water quality index), data provided by multiple monitoring programs described above will be analyzed to measure changes relative to those targets. The analysis will inform local efforts to improve water quality and ecosystem health, as well as State of the Bays reporting through a MassBays Eco-health Tracking System. This online system will provide stakeholders and the general public with

information on estuarine conditions in the MassBays planning area on a more tailored and frequent basis than the five-year reports required by EPA.

Comprehensive and holistic analysis of longer-term datasets will also inform decision makers and monitoring groups about additional monitoring which may be needed as conditions change. MWRA's outfall monitoring program is a model for this approach: the quasi-governmental agency has been monitoring numerous parameters in Boston Harbor for 20 years. Over time, improving conditions triggered MWRA to revise data collection frequency in some stations, and advisors to the program have stated that it may be time to shift attention to emergent contaminants which had previously not been monitored.

Applying an adaptive monitoring approach supports flexibility. While certain basic parameters such as temperature will always be tracked, and certain key locations will always be monitored for baseline conditions, MassBays' priorities are likely to evolve over time according to changing conditions. With climate change, for example, increased stormwater discharge, continued coastal acidification, and more coastal erosion are expected. Already, increased eelgrass loss and marsh flooding are being observed. With data in hand, MassBays can work with partners to redirect resources and efforts to where there are most needed.

6. DATA MANAGEMENT AND ANALYSIS

Three main challenges will need to be addressed as MassBays collects data from a variety of sources: (1) scope and scale of data collected; (2) availability and accessibility of data; and (3) data quality.

Scope and scale: Monitoring programs across the MassBays planning area are varied in their geographic and time scope. Integrating multiple datasets will require several QA/QC steps prior to data analysis and interpretation for data standardization.

Accessibility: Data collected by government entities are usually either available online or upon request. MassBays' 2016 survey of citizen scientist groups revealed that only some citizen-generated datasets are readily accessible. Data sharing is restricted partly due to the format in which data are stored and partly because some community-based monitoring groups are reluctant to share data they lack the resources to analyze.

Quality: A survey focused on Cape Cod nonprofit organizations in 2014 (n=25) revealed that while some organizations have approved QAPPs, others use protocols that may not meet the standards required by regulators. Some groups have never conducted statistical analyses of their data alongside a trained scientist or with an accredited institution. These findings are consistent with subsequent investigations by the Massachusetts Rivers Alliance and the New England Interstate Water Pollution Control Commission (NEIWPC).

To document steps taken to address these challenges, and to carry out this Monitoring Framework, MassBays will develop a QAPP for secondary data. The MassBays Monitoring QAPP will include a comprehensive data management and analysis plan describing in detail how secondary data will be checked, analyzed, and integrated into the MassBays Monitoring Framework for State of the Bays reporting. The MassBays Monitoring QAPP will be submitted to EPA for review and approval.

7. REPORTING

Effective dissemination and reporting is the primary goal of the MassBays Monitoring Framework. The results of data analyses using the Framework and according to the MassBays Monitoring QAPP will be shared with multiple audiences, including local residents, nonprofit partners, federal, state, and local agencies and other decisionmakers, and academic researchers. The reporting methods are listed below, with the intended audience(s) indicated.

Regional Symposia: Each of MassBays' Regional Service Providers periodically reports on local trends and conditions. The Cape Cod Coastal Conference Great Marsh Symposium, State of Salem Sound Symposium, Boston Harbor and Islands Science Symposium, and the Watershed Action Alliance of Southeastern Massachusetts's biennial conference bring together community members, researchers, nonprofit environmental groups, and state and local decisionmakers to share knowledge of the local resources, and the results of monitoring, restoration, and conservation actions taken over the previous year.

Online reporting: In 2019, MassBays' Cape Cod Regional Service Provider initiated a State of the Waters report based on data collected by monitoring programs in Cape Cod Bay, Buzzards Bay, and Nantucket Sound. With input from an expert advisory group, APCC integrated data from these programs to develop a water quality index for Cape Cod. The resulting report has been covered extensively by the press, and desired water quality improvements have been incorporated into the Cape Cod Commission's regional planning.

With funding from the EPA Exchange Network, MassBays will work CEI to develop a MassBays Ecohealth Tracking Tool to integrate data from across the planning area and provide assessments of progress toward habitat and water quality targets to multiple audiences in a user-friendly interface. The process will include compiling and analyzing monitoring data from various monitoring groups downloaded from EPA's WQX Portal, and designing a MassBays-specific, web-and map-based visualization of water quality, indicating both current conditions and longer-term trends towards established targets. The audience for the online tool is broad, and MassBays and its Regional Service Providers will use it as a starting place for prompting action among community members, municipal staff and elected officials, and state agencies to support on-the-ground efforts to improve ecosystem conditions.

References

- Carr, J. and Ford, K. 2017. Historic eelgrass trends in Salem Sound, Massachusetts. Massachusetts Division of Marine Fisheries Report.
- Carr, J. et al. 2018. Rapid Assessment Protocol for Eelgrass Monitoring in Estuarine Embayments.
- Cicchetti, G., M. Pelletier, M. Pryor, S. Jackson, P. Bradley, S. Davies, C. Deacutis, K. Rocha, Debbie Santavy, and E. Shumchenia. Implementing the Biological Condition Gradient Framework for Management of Estuaries and Coasts. U.S. EPA Office of Research and Development, Washington, DC, EPA/600/R-15/287, 2017.
- Costello, C. T., Kenworthy, W. J., 2011. Twelve-year mapping and change analysis of eelgrass (*Zostera marina*) areal abundance in Massachusetts (USA) identifies statewide declines. *Estuaries and Coasts* 34, 232-242.
- DeAngelis, B.M.; Sutton-Grier, A.E.; Colden, A.; Arkema, K.K.; Baillie, C.J.; Bennett, R.O.; Benoit, J.; Blich, S.; Chatwin, A.; Dausman, A.; Gittman, R.K.; Greening, H.S.; Henkel, J.R.; Houge, R.; Howard, R.; Hughes, A.R.; Lowe, J.; Scyphers, S.B.; Sherwood, E.T.; Westby, S.; Grabowski, J.H. 2020. Social Factors Key to Landscape-Scale Coastal Restoration: Lessons Learned from Three U.S. Case Studies. *Sustainability* 12(3):869. Accessed online 2/3/2020 at <https://www.mdpi.com/2071-1050/12/3/869/htm>
- Ford, K. and Carr, J. 2016. Eelgrass loss over time in Duxbury, Kingston, and Plymouth Bays, Massachusetts. Massachusetts Division of Marine Fisheries Report submitted to Massachusetts Bays National Estuary Partnership. Project funded by U.S. Environmental Protection Agency.
- West, S. and Pateman, R., 2016. Recruiting and Retaining Participants in Citizen Science: What Can Be Learned from the Volunteering Literature? *Citizen Science: Theory and Practice*, 1(2), p.15. DOI: <http://doi.org/10.5334/cstp.8>

Appendix 1: Water Quality Monitoring Programs

The list includes embayments with water quality monitoring programs in Massachusetts. The list is being revised, confirmed and updated and therefore may not be exhaustive.

Estuarine Embayment	Organization	ongoing water monitoring
ALL/VARIOUS	MA Division of Marine Fisheries	shellfish growing areas
		temperature
	MA Department of Public Health	bathing water quality
UPPER NORTH SHORE REGION		
Merrimack River	Merrimack River Watershed Council	None (only research)
	U.S. EPA	water quality program
Parker River	Parker River Association	Parker River Clean Water
Rowley River		
Ipswich River	Ipswich River Watershed Association	Riverwatch
Plum Island Sound	PIE LTER	Research
Essex River/Essex Bay		
Annisquam River		
Gloucester Harbor		
LOWER NORTH SHORE REGION		
Salem Sound	Salem Sound Coastwatch	Clean Beaches & Streams
Manchester Harbor		
Danvers River		
Forest River/South River/Salem Harbor		
Marblehead Harbor		
Saugus River/Pines River/Lynn Harbor	Saugus River Watershed Council	Saugus River Monitoring Program
METRO BOSTON REGION		
Belle Isle Creek/Winthrop Bay		
Chelsea Creek/Mystic River/Charles River	Charles River Watershed Association	Charles River Monitoring
	Mystic River Watershed Association	Mystic River Water Monitoring
Neponset River/Dorchester Bay	Neponset River Watershed Association	Citizen Water Monitoring Network
Boston Harbor	Massachusetts Water Resources Authority	Harbor and Bay Marine Program
Blacks Creek/Quincy Bay		

Estuarine Embayment	Organization	Ongoing water monitoring
SOUTH SHORE REGION		
Back River/Fore River/Hingham Bay		
Weir River/Straits Pond		
Cohasset Harbor		
Scituate Harbor		
North River/South River	North & South Rivers Watershed Association	Riverwatch
Back River/Bluefish River/Duxbury Bay	Center for Coastal Studies	Cape Cod Marine Program
	Cape Cod Cooperative Extension	Marine Monitoring Program
	North & South Rivers Watershed Association	
Jones River/Kingston Bay	Jones River Watershed Association	None (herring counts)
	Center for Coastal Studies	Cape Cod Marine Program
Eel River/Plymouth Bay	Center for Coastal Studies	Cape Cod Marine Program
Ellisville Harbor		
CAPE COD BAY (ALL)	Center for Coastal Studies	Cape Cod Marine Program
	Barnstable County DPH	Beach Water Quality Program
Sandwich Harbor		
Scorton Creek		
Barnstable Harbor	Cape Cod Cooperative Extension	Marine Monitoring Program
Chase Garden Creek		
Sesuit Creek/Sesuit Harbor		
Quivett Creek		
Paine's Creek/Stony Brook		
Estuarine Embayment	Organization	ongoing water monitoring
Namskaket Creek/Little Namskaket Creek		
Boat Meadow Creek/Rock Harbor		
Mayo Creek/Wellfleet Harbor/Herring River	Friends of Herring River	project-based
	Cape Cod Cooperative Extension	Marine Monitoring Program
Pamet River/Little Pamet River		
Provincetown Harbor		