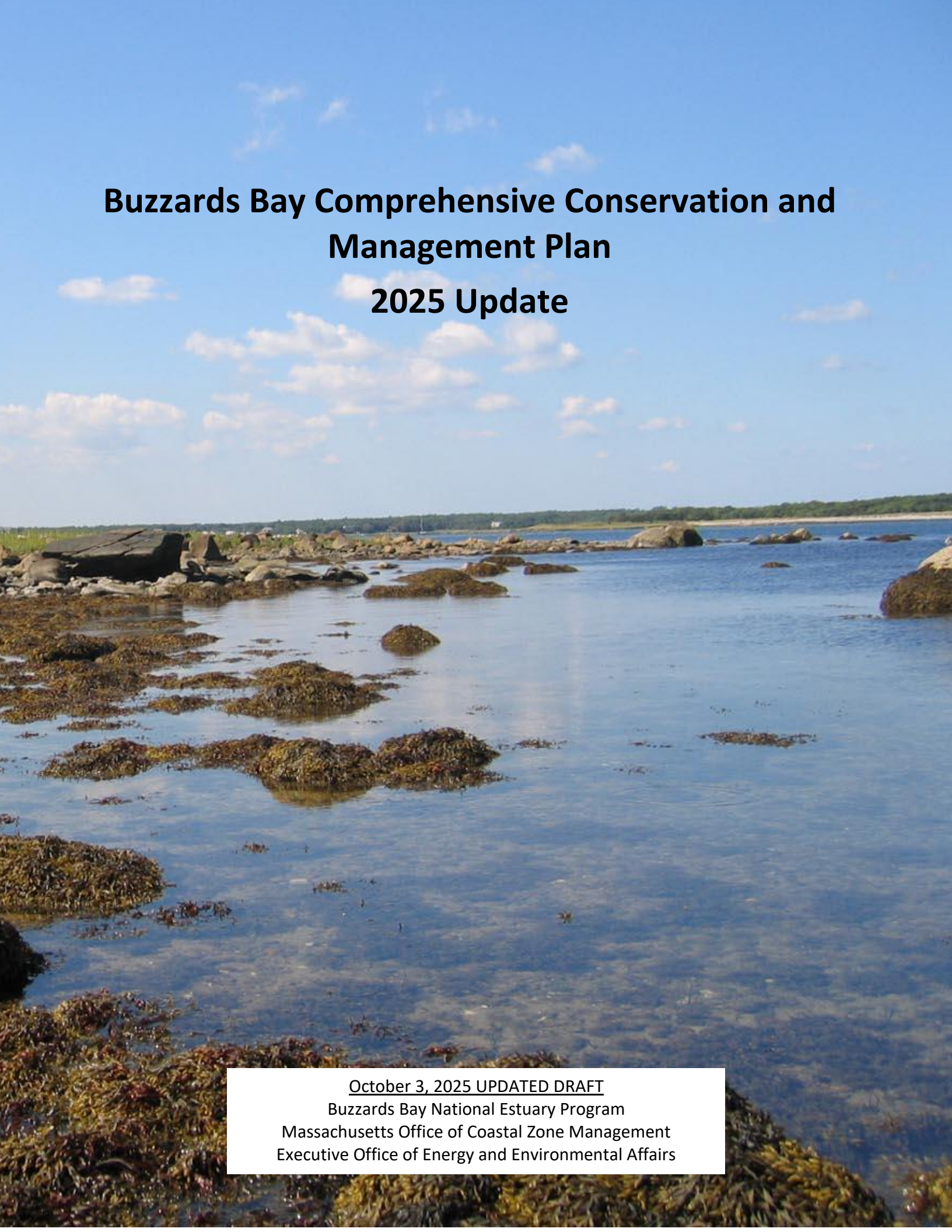
Buzzards Bay Comprehensive Conservation and Management Plan

2025 Update



October 3, 2025 UPDATED DRAFT
Buzzards Bay National Estuary Program
Massachusetts Office of Coastal Zone Management
Executive Office of Energy and Environmental Affairs

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Acknowledgments

This Buzzards Bay Comprehensive Conservation and Management Plan (CCMP) 2025 Update is based on a review and evaluation of action since the *2013 CCMP Update*, together with a climate vulnerability assessment conducted in 2022. The 2013 update revised the original 1991 Buzzards Bay CCMP. These earlier documents were the products of dozens of individuals, including Buzzards Bay National Estuary Program (Buzzards Bay NEP) staff, state, and federal agency personnel, and many non-governmental contributors. In that regard, we give credit to Bruce Rosinoff, the lead CCMP writer of the 1991 document (and later EPA project manager to the Buzzards Bay NEP until 2004), for designing a well-organized and well-thought-out document that lasted more than three decades, and which is still the framework for the current update.

Many individuals contributed to the 2025 Update. Buzzards Bay NEP Executive Director Dr. Joe Costa was the lead writer and managing editor for the effort, and Buzzards Bay NEP staff Sarah Williams, Bernadette Taber, Kevin Bartsch, and Dave Janik provided extensive comments and reviewed all action plans. South Coastal Regional Coordinator Sam Haines of the Massachusetts Office of Coastal Zone Management (CZM) also contributed to the review and update. Special thanks to CZM staff Alexis Neffinger and Adrienne Pappal for rewriting the Invasive Species Action Plan, and Patricia Bowie and Rebecca Haney, who added text and improved the Shifting Shoreline Action Plan. Other CZM staff who suggested helpful revisions to action plan goals and objectives included Todd Callahan and Kathleen Mason. DEP staff Mathew Reardon and Richard Carey provided detailed comments on the Nitrogen Management Action plan, and Brian Harrington provided comments on the Habitat Protection and Restoration Strategy chapter. DMF staff Chrissy Petitpas and Matt Camissa reviewed the Shellfish Action Plan. Jesse Leddick of the Massachusetts Natural Heritage & Endangered Species Program provided comments on the Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species Action Plan. Mark Rasmussen and Brendan Annett, of the Buzzards Bay Coalition, provided valuable edits to the Open Space Action Plan. Alicia Grimaldi helped revise the Beach Action Plan. Bob Bowen, UMass Boston, provided a reminder of the relevance and importance of the Buzzards Bay NEP's Management Conference committee structure in creating the CCMP, the challenge of communicating scientific results and management decisions to the public, and the need to better document the relationship between environmental risks and human health.

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Foreword

Since our start, the primary goal of the Buzzards Bay National Estuary Program (Buzzards Bay NEP) has been to help "restore and maintain the chemical, physical, and biological integrity of the estuary" (Section 320[b] of the Clean Water Act, our authorizing legislation). In 1991, we completed our original Buzzards Bay Comprehensive Conservation and Management Plan (CCMP), a landmark document providing a blueprint for the forthcoming efforts to protect and restore the water quality and living resources of Buzzards Bay and its surrounding watershed. The CCMP introduced many new concepts to local planners including the need to define watershed limits on the discharge of nitrogen from wastewater (including septic systems and other nitrogen sources), the importance of stormwater discharges to bathing beach and shellfish bed closures, and recognition that the climate was changing. The 2013 update to the CCMP affirmed these priorities and refined strategies.

The 2025 Update to the CCMP reflects continued progress achieved, new challenges facing the bay and its surrounding watershed, and still-unresolved problems. This updated Buzzards Bay CCMP includes existing, new, and revised goals that relate to 20 key issues facing the bay and watershed. In each of the 20 "Action Plans," we describe management strategies for government, citizens groups, and the public to employ to meet the continuing challenges we face. It also recognizes the immense cost of fulfilling some goals and the time horizon to meet those challenges, in a revised chapter, *Implementing and Financing the CCMP*.

While the updated CCMP is not a regulatory document, our goal is to lay out a vision to guide municipalities in their ongoing efforts to protect and restore the environment. It will also help state and federal agencies direct grants and technical assistance programs, and update policies and regulations, to help the bay and watershed for years to come.

Joseph E. Costa, PhD
Executive Director
Buzzards Bay National Estuary Program

Executive Summary

Section 320 of the 1987 Clean Water Act requires each National Estuary Program (NEP) to develop and implement a Comprehensive Conservation and Management Plan (CCMP). In 1991, the Buzzards Bay National Estuary Program developed the Buzzards Bay CCMP which characterized problems facing Buzzards Bay, established priorities for research, specified monitoring, identified funding, and proposed action to protect and restore water quality and living resources in Buzzards Bay and its surrounding watershed. In 2013, the Buzzards Bay NEP updated the CCMP after reviewing progress and accomplishments in meeting the original goals and recommendations of the plan. Between 2022 and 2025, the Buzzards Bay NEP conducted a similar review, including climate vulnerability assessments, adaptation strategies, changes in laws and regulations. This effort culminated in the 2025 Update.

Chapter 1 describes Buzzards Bay and its setting and provides a brief history of the Buzzards Bay NEP. Chapter 2 summarizes past climate and extreme weather vulnerability assessments. Chapter 3 holds updates to 20 Action Plans. Chapters 4 through 6 describe implementing the CCMP, a finance strategy, and an overview of habitat protection and restoration actions. An appendix includes a side-by-side comparison of changes in goals and objectives between the 2013 and 2025 updates.

The Buzzards Bay CCMP is not a regulatory document. Rather, it is a watershed plan and a detailed outline for action. It not only defines what types of projects or activities the Buzzards Bay NEP may fund or aid; it also defines projects and activities that are priorities and eligible for funding through other state and federal grant programs. As described in Section 320 (b)(7) of the Clean Water Act, the Buzzards Bay NEP and the Commonwealth of Massachusetts have authority to assess whether other federal grants and initiatives are consistent with the Buzzards Bay CCMP. The CCMP is a dynamic document that reflects the evolving knowledge and understanding of Buzzards Bay and its watershed, changing laws and regulations, changes to the environment, past accomplishments, and changing community needs.

One of the overarching goals of the Clean Water Act is to make waters drinkable, fishable, and swimmable. The law's intent is that water quality provides for the protection and propagation of fish and shellfish, wildlife, and recreation in and on the water. The 20 Action Plans in the 2025 update will help meet these goals in Buzzards Bay and its watershed. Actions are directed at all levels of government, non-profits, business, industry, and the public. Each Action Plan defines the problem, describes goals and action-oriented objectives to help meet the named goals. The Goals are aspirational and without a deadline, and the Objectives are key intermediate steps needed to achieve the overarching goals. The objectives are not meant to be an exhaustive list of all actions in support of the goals but identify important action items that should be implemented and supported by funding and technical assistance by all levels of government. New research-related objectives were added to identify essential information needed to achieve the goals and objectives of that Action Plan. The Action Plans also identify management approaches. A single agency or level of government may be required to act, but in other cases all levels of government, the public, and private entities may have a role. Each Action Plan also describes costs, how those costs will be financed, and what the NEP or partners must monitor to track progress toward meeting the Action Plan goals.

In implementing the CCMP, the Buzzards Bay NEP's primary responsibility is to develop plans to help implement CCMP goals, and to monitor the effectiveness of actions taken. The Buzzards Bay NEP also facilitates action through its grant and technical assistance programs.

The CCMP stresses the importance of public awareness of environmental problems and the need for all stakeholders to engage in dialog to develop consensus solutions to the many environmental problems facing the bay and surrounding watershed. Among these partners, under Massachusetts Home rule, municipalities often have the greatest authority and burden to implement most Action Plans. However, municipalities also often lack the staff or financial capacity to act. It is for this reason that most action plans include objectives for state and federal agencies to increase financial and technical support to Buzzards Bay municipalities to help them implement CCMP action objectives to protect and restore Buzzards Bay.

Acronyms Used

Acronyms used in this work plan.

Acronym	Definition
ACEC	Area of Critical Environmental Concern
APR	Agricultural Preservation Restriction
ASMFC	Atlantic States Marine Fisheries Commission
BBAC	Buzzards Bay Action Committee
BBC	Buzzards Bay Coalition (or Coalition)
BBP	Buzzards Bay Project
BMP	Best Management Practice
CCMP	Comprehensive Conservation and Management Plan
CMR	Commonwealth of Massachusetts Regulations
CR	Conservation Restriction
CSO	Combined Sewer Overflow
CZM	Massachusetts Office of Coastal Zone Management
DCR	Massachusetts Department of Conservation and Recreation
MassDEP	Massachusetts Department of Environmental Protection
DMF	Massachusetts Division of Marine Fisheries
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EPA	U.S. Environmental Protection Agency
FDA	U.S. Food and Drug Administration
IDDE	Illicit Discharge Detection and Elimination
IIJA	Infrastructure Investment and Jobs Act of 2021
MassDOT	Massachusetts Department of Transportation
MDAR	Massachusetts Department of Agriculture
DPH	Massachusetts Department of Public Health
MEMA	Massachusetts Emergency Management Agency
MEPA	Massachusetts Environmental Protection Act
MESA	Massachusetts Endangered Species Act
MGL	Massachusetts General Law
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
MSGP	Multi-sector General Permit
MVP	Municipal Vulnerability Preparedness
NEP	National Estuary Program
NHESP	Natural Heritage and Endangered Species Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NRCS	[USDA] Natural Resource Conservation Service
NRDA	Natural Resource Damage Assessment
PCB	Polychlorinated Biphenyl
PFAS	Per- and Polyfluoroalkyl Substances
RGPCD	residential gallons per capita day
SFHA	Special Flood Hazard Area
SLOSH	Sea Lake and Overland Surge from Hurricanes
SNEP	Southeast New England Program
SRF	State Revolving Fund
TMDL	Total Maximum Daily Load, or Loads
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VMRS	Vessel Movement Reporting System
WPA	Wetlands Protection Act

Chapter 1. Buzzards Bay and the National Estuary Program

The Buzzards Bay Setting

The Buzzards Bay estuary is bounded by the western-most part of Cape Cod, Southeastern Massachusetts, and the Elizabeth Islands (Figure 1). The bay is 28 miles long (45 kilometers), averages about 8 miles (13 kilometers) in width and has a mean depth of 36 feet (11 meters). The coastline stretches over 350 miles (563 kilometers) [1] and includes over 13 miles (21 kilometers) of public beaches that lure thousands of residents and tourists.

Glacier erosion of bedrock created ancient river valleys along the jagged western coast of Buzzards Bay and glacial deposits created the Elizabeth Islands. This geology created many diverse marine environments around the bay characterized by important habitats including salt marshes, tidal streams, eelgrass beds, tidal flats, barrier beaches, rocky shores, and various subtidal habitat types. Buzzards Bay is within the Virginian Biogeographic Province, which means that the species in Buzzards Bay are typical of those found along the east coast between Chesapeake Bay and Cape Cod. The Cape Cod Canal, however, forms a direct tie to the cold-water species found north of Cape Cod. For these reasons, you can find a unique mix of semitropical and Arcadian species in Buzzards Bay during different times of year.

The Buzzards Bay watershed or drainage basin together with the surface of Buzzards Bay are the National Estuary Program (NEP) study area [2] (Figure 1). The estuary covers 250 square miles (650 square kilometers), has 310 miles of coast [3], and the watershed covers 435 square miles (1209 square kilometers). Within the watershed are 21 municipalities in part or their entirety. These include two cities and 19 towns in two states, although 5 towns, including the two in Rhode Island, cover small areas of the towns and a small percent of the Buzzards Bay watershed (<2.3%). Approximately 260,000 people live in the watershed, with 40% living in the City of Bedford. The part of the City of Fall River in the Buzzards Bay watershed is mostly undeveloped state forest, and most of that city's population lives within the Narraganset Bay National Estuary Program watershed. Table 1 shows a complete list of all municipalities and their area and population within the watershed.

The watershed landscape has diverse habitats largely defined by its geology. Drowned river valleys carved into bedrock by ancient glacier meltwater define the western half of the watershed. This part of the watershed includes large areas of forested wetlands that feed into the Agawam, Wankinco, Weweantic, Mattapoisett, Acushnet, Paskamanset, and Westport Rivers. These rivers and their tributaries total roughly 100 miles [4]. Glacial outwash and moraine deposits dominate the northern and eastern (Cape Cod) part of the watershed. Precipitation to these glacial deposits recharge large groundwater aquifers. Groundwater seepage through sandy soils and small groundwater fed streams account for a large fraction of freshwater inflow along the shores of Wareham, Bourne, and Falmouth. The groundwater-fed streams on the Cape Cod shore include the Back River, Pocasset River, Wild Harbor River, and Herring Brook.

Watershed development and land use (Figure 2) reflects the region's economic history and patterns of population growth. New Bedford has the densest and oldest industrial and urban development because of its economic importance since colonial times. In the northern part of the watershed, cranberry agriculture was a dominant feature of the landscape, and in the twentieth century crops, orchards, and dairy farms were prominent landscape features in the towns of Westport, Dartmouth, Acushnet, and Fairhaven. Watershed population expansion after 1970 resulted in the extensive subdivision of the land for residential purposes as populations moved out of cities and town centers. Between 1970 and 2020, population growth in the watershed outside of New Bedford increased

[1] Includes embayment coastlines and 40 miles of bay facing coastline of the Elizabeth Islands. but excludes 9 miles of coastline along the Cape Cod Canal within the NEP study area.

[2] Watershed boundaries on Cape Cod and around Plymouth/Carver have been revised based on groundwater models and other information (see the NEP study area web page).

[3] Other agencies and publications define different boundaries for Buzzards Bay. The Buzzards Bay NEP jurisdictional area and the EPA approved No Discharge Area is a straight line drawn from the Rhode Island Border to Cuttyhunk Island. The boundary based on nautical chart and US Coast Guard definitions (a line drawn from Gooseberry Point to Cuttyhunk Island, and which excludes the Cape Cod Canal), is approximately 233 square miles. If all state waters to the south of the Buzzards Bay NEP line are included (as employed by the Division of Marine Fisheries), the bay area is roughly 280 sq. miles.

[4] Based on MassGIS "major stream" coverage, which includes key tributaries and small pond connections.

by nearly 77% (Figure 3; 88,591 to 156,387 persons), and between 1990 and 2020, housing units among coastal towns increased by 23% (Figure 4).

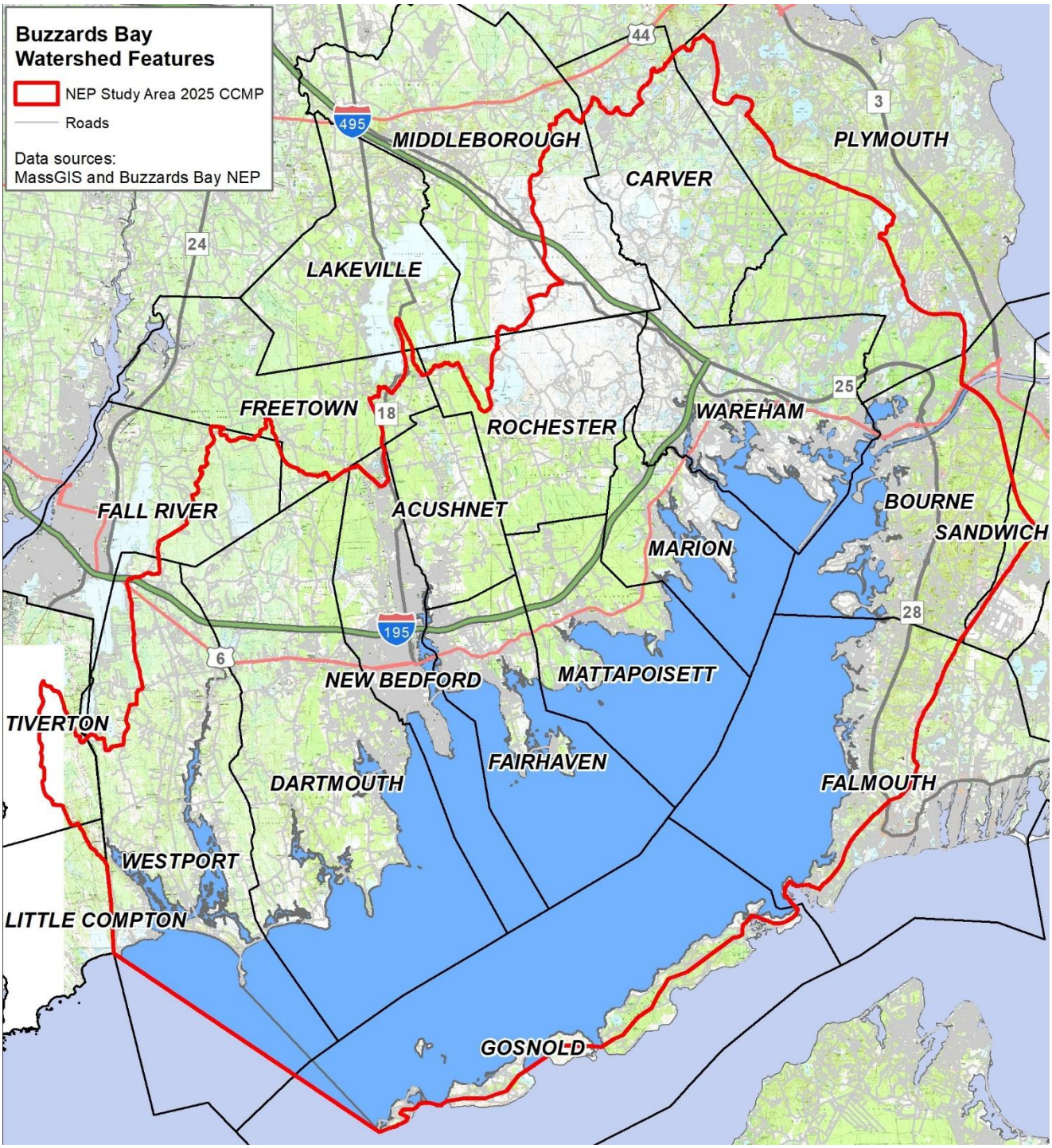


Figure 1. Buzzards Bay NEP study area (watershed and municpal boundaries) as defined in the Buzzards Bay CCMP 2025 update.

The NEP changed the 2013 Buzzards Bay CCMP watershed boundary in the vicinity of the top of the Cape Cod Sagamore aquifer in Bourne and Sandwich based on new USGS models and data. Tiverton and Little Compton are Rhode Island municipalities. Figure by Joe Costa.

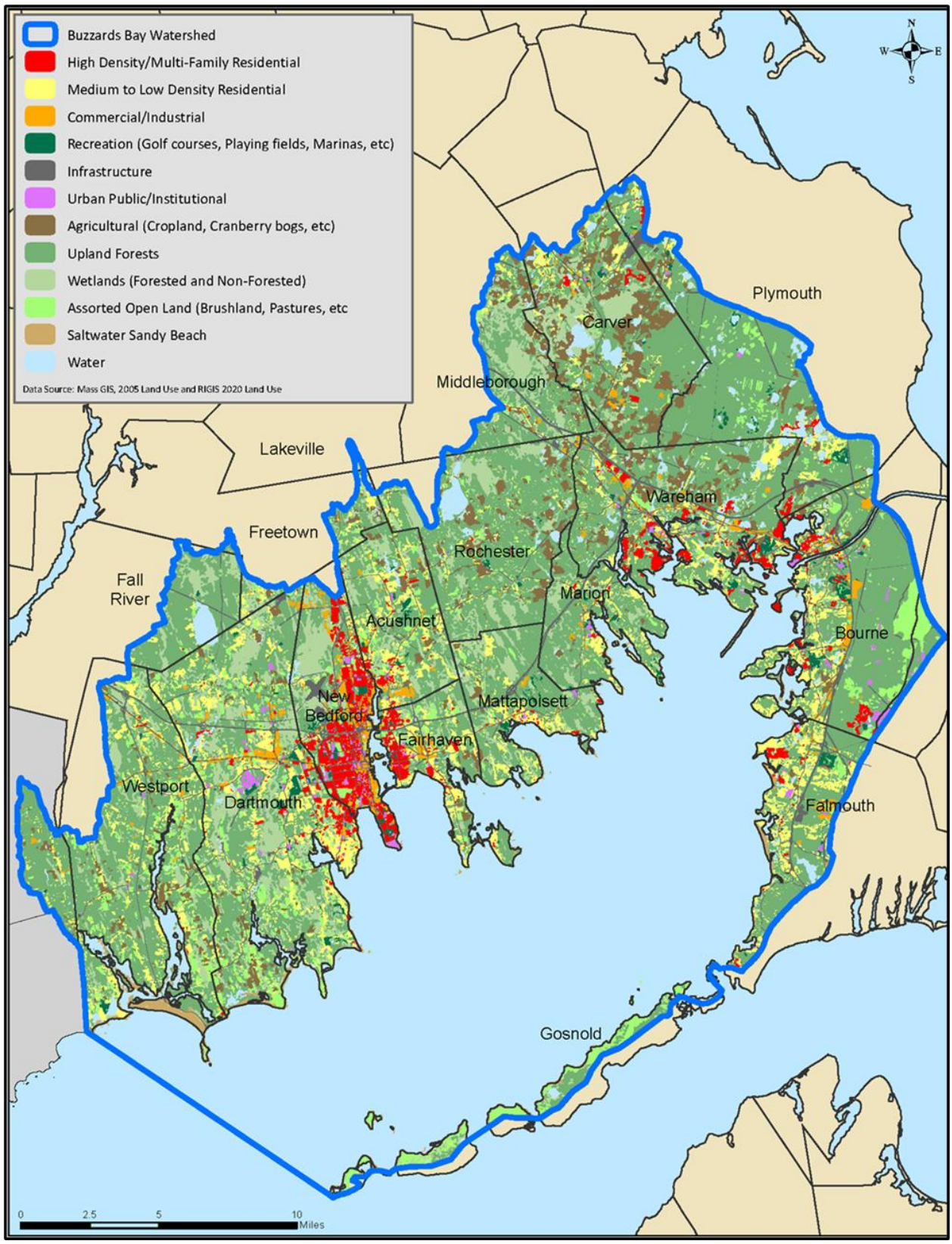


Figure by Sarah Williams, Buzzards Bay NEP.

Figure 2. Land use in the Buzzards Bay watershed based on MassGIS 2005 land use.

Figure 3. Top: Estimated year-round population within the Buzzards Bay watershed with subtotals for the City of New Bedford and other watershed municipalities combined. Percentages show increased watershed population change (left) and change for municipalities excluding New Bedford. Bottom: cumulative watershed residential units and new units be decade. The greatest increase in units occurred during the 1970's, and is reflected in the 1980 census.

[1]The 2020 data based on a GIS analysis of census block population within the watershed, with population of split blocks calculated from area within the watershed. Calculation of earlier decades based on the fraction of the 2020 population inside watershed. Data excludes Rhode Island populations. Figures prepared by Joe Costa.

Table 1. Town areas and year-round population (U.S. 2020 Census) within the Buzzards Bay watershed.

Town	Municipal area w/ coastal waters sq. mi (1)	Buzzards Bay Coastal Waters (sq. miles)	Land sq. miles (2)	% in the watershed	sq miles in watershed	US Census 2020 population	Estimated 2020 population in water-shed (3)	% of 2020 popula-tion in the watershed
Acushnet	18.9	0.1	18.9	100.00%	18.88	10,559	10,559	100%
Bourne	57.3	16.2	41.1	83.20%	34.17	20,452	15,346	75%
Carver	39.7	0.0	39.7	84.30%	33.5	11,645	9,364	80%
Dartmouth	96.2	34.2	62.0	100.00%	61.95	33,783	33,781	100%
Fairhaven	40.9	28.5	12.4	100.00%	12.41	15,924	15,924	100%
Fall River	40	1.5	38.5	27.60%	10.65	94,000	456	0%
Falmouth	103.2	58.1	45.1	41.80%	19.05	32,517	8,621	27%
Freetown	36.4	0.9	35.5	13.70%	4.88	9,206	1,689	18%
Gosnold	135	121.6	13.4	52.30%	7.04	70	34	49%
Lakeville	36.1	0.0	36.1	0.60%	0.21	11,523	53	0%
Little Compton RI	NA	0.0	22.6	1.20%	0.28	3,616	289	8%
Marion	28	13.9	14.1	100.00%	14.12	5,347	5,347	100%
Mattapoisett	42.3	24.8	17.5	100.00%	17.49	6,508	6,508	100%
Middleborough	72.1	0.0	72.1	23.50%	16.99	24,245	2,038	8%
New Bedford	33.4	13.1	20.3	96.10%	19.48	101,079	99,132	98%
Plymouth	176.7	74.7	102.0	43.60%	44.73	61,217	7,771	13%
Rochester	36.1	0.1	36.0	91.50%	32.96	5,717	5,226	91%
Sandwich	67.7	0.0	43.0	4.30%	1.88	20,259	0	0%
Tiverton, RI	NA	0.0	30.4	8.20%	2.49	16,359	1,923	12%
Wareham	46.4	9.3	37.1	100.00%	37.14	23,303	23,303	100%
Westport	89.8	37.7	52.1	85.30%	44.46	16,339	12,311	75%
Watershed Totals	1196.2	434.7	811.1	53.70%	435.24	523,668	259,675	50%

Notes: (1) data source = bondyp1.shp from MassGIS, (2) Includes ponds and fresh surface waters, (3), Table excludes 4 acres and 3 persons in the Town of Kingston within the watershed. In this analysis, within the watershed boundary there are 113,126 residential housing units (both year-round and seasonal/vacant).

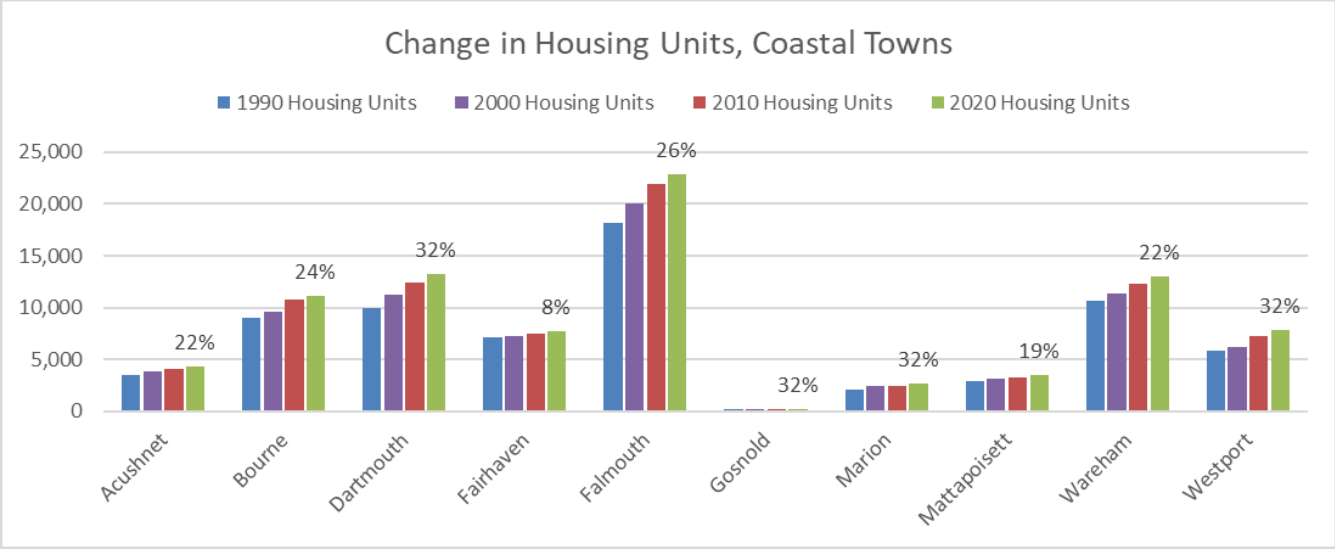


Figure 4. U.S. Census Housing Units for Buzzards Bay coastal towns[1], 1990-2020.

[1]Townwide, not adjusted for watershed boundary. Figure prepared by Joe Costa.

The Massachusetts Constitution Home Rule Amendment (Article 89) and Massachusetts General Laws delegate considerable authority to municipalities to implement certain state laws and adopt laws and regulations more stringent than promulgated by the state. This is especially true in the administration of laws related to development, public health and the environment, and the actions of municipal planning boards, conservation commissions, and boards of health are an important focus of this document.

The Buzzards Bay watershed has all or portions of 2 cities and 17 towns. Cities in Massachusetts have mayors who constitute the executive branch and city councils are the legislative branch, passing ordinances. In contrast, in Massachusetts towns the Select Board is the executive branch, and town meeting is the legislative branch, passing bylaws. Towns vary in the number of selectboard members, and town meetings membership may be open to all residents, or only elected representatives. The ability of municipalities to adopt environmental laws and regulations depends on government structure and various other factors including local economic and political conditions.

National Estuary Program Origins

In 1985, the United States Congress appropriated funds for U.S. Environmental Protection Agency (EPA) to create programs to study and manage four nationally significant estuaries, including Buzzards Bay. These programs were meant to emulate the approaches of the Chesapeake Bay Program that Congress had created in 1983. These four estuary studies would become the pilots for the National Estuary Program (NEP) that Congress would eventually create under the Clean Water Act in 1987 [5].

In 1985, the EPA and Commonwealth of Massachusetts entered into a cooperative agreement to create the Buzzards Bay Project (BBP). In 1987, after passage

[5] In the Buzzards Bay Project's December 1985 newsletter, we wrote, "Congress also recognizes the unique value of Buzzards Bay and selected the bay as one of four estuaries in the country to be studied under a special $4 million appropriation in 1985." The original efforts to study and protect these four estuaries began with a 1983 attempt to reauthorize the Federal Water Pollution Control Act (98th Congress S431, the Clean Water Act of 1983), which included funding amendments for studies of Buzzards Bay, Narragansett Bay, Puget Sound, and Long Island Sound. Although the legislation did not pass into law, the effort apparently led to appropriations for the four programs. In 1984 and 1985, Congress tried to formalize the designation of estuaries of national significance in various bills to reauthorize the Clean Water Act. It was not until 1987 that Congress finally passed the Clean Water Act, approving it over a presidential veto. Section 320 of the Clean Water Act of 1987 created the National Estuary program. By that time, Congress gave priority to 10 estuaries to be included in the program, including Buzzards Bay. The 1972 law and its later revisions have become the basis of a large body of state and federal regulations to "...restore, and maintain the chemical, physical, and biological integrity" of the United States waters and bordering wetlands that are the basis of most recommendations in this CCMP. By controlling water pollution, the Clean Water Act attains and maintains a level of water quality that supports the "protection and propagation of fish, shellfish, and wildlife and for recreation in and on the United States' waters" (USC 33 Section 1251). The NEP 40-year anniversary webpage has other details of this era.

of the Clean Water Act, the BBP applied for designation under the Clean Water Act, and in January 1988, the EPA formally designated the Buzzards Bay Project a National Estuary Program. In 2005, the BBP renamed itself the Buzzards Bay National Estuary Program (NEP) to avoid confusion with other similarly named organizations. Today the Buzzards Bay NEP is one of 28 such programs in the United States.

The management structure created in 1985 for the BBP included a Policy Committee composed of the state Environmental Secretary and EPA Regional Administrator who were jointly responsible for overseeing and implementing a federal cooperative agreement that supported the BBP. A Management Committee more directly oversaw the program. This committee was composed of state, federal, and local officials, citizen groups, and others. Subcommittees to the management committee included a citizen advisory committee, a technical advisory committee, and a management plan advisory committee. This structure placed on equal footing scientists and engineers, local officials, and interested citizens to ensure that a balanced approach to goal setting was used, based on sound science and local implementation. Committees had overlapping membership to improve communication and foster collaboration and cooperation among the members.

Under this management structure, between 1985 and 1990, the BBP funded characterizations and assessments of water quality and living resources. Based on those findings, the program summarized management options to address the identified problems and conducted financial assessments of these solutions. With feedback from the public, state, and local government, the BBP drafted the CCMP in 1989, the first NEP to do so. Massachusetts Governor William Weld approved this management plan in September 1991, followed by EPA approval in April 1992 [6].

The Buzzards Bay CCMP was one of the country's first coastal watershed plans, and one of the first to focus so strongly on nonpoint source pollution and the cumulative impacts of development on water quality and living resources. Moreover, the plan did not focus exclusively on the quality or the long-term protection of Buzzards Bay waters—it also recognized that the protection of freshwater wetlands and inland habitat throughout the watershed was vital and better land use decisions and improved management of development impacts were important parts of a holistic watershed protection strategy to protect and restore the estuary. The 1991 CCMP also included a Buzzards Bay Action Compact, signed by the member towns of the Buzzards Bay Advisory Committee (later calling itself the Buzzards Bay Action Committee (BBAC), a Buzzards Bay NEP subcommittee composed of municipal officials, and letters of commitment from key federal and state agencies supporting the management plan goals.

The CCMP broke much new ground including an innovative coastal nitrogen management strategy that paved the way for the adoption of later Total Maximum Daily Load (TMDL) strategies. It was also the first CCMP to address increased sea level rise from climate change. The CCMP was also innovative in its focus on support of local government. In fact, nearly three quarters of the 119 recommendations contained in the 1991 CCMP focused on local government action. This focus on local government reflected Massachusetts' environmental regulatory framework, particularly the "home rule" laws, which empowers municipal government more than any other level of government, with the greatest authority to address the cumulative impacts of nonpoint source pollution and of growth.

Program Restructuring and New Focus

At the establishment of a management conference in 1985, a subcommittee of the Management Committee, called the Buzzards Bay Citizen Advisory Committee formed to help consider and evaluate management options to protect and restore Buzzards Bay. By 1987, the Citizen Advisory Committee separated into two new organizations. The first organization called itself the Coalition for Buzzards Bay and became a nonprofit and focused on education, outreach, and land protection. The second group, consisting of municipal officials, became the Buzzards Bay Advisory Committee. In 1992, the Buzzards Bay Advisory Committee broke off the Buzzards Bay NEP and became an independent non-profit called the BBAC. The BBAC focused on state, local, and federal legislative and regulatory issues, provided a forum for the exchange of ideas among municipal officials, and helped develop watershed wide consistent strategies among Buzzards Bay communities. Today both the BBAC and the Buzzards

[6] Buzzards Bay Project. 1991. Buzzards Bay Comprehensive Conservation and Management Plan, 8/91 Final. Volume 1, EPA and EOEA (U.S. Environmental Protection Agency and Massachusetts Executive Office of Environmental Affairs). 246 pp.

Bay Coalition (BBC) have adopted, as one of their major goals, the implementation of recommendations contained in the CCMP.

In the 1990s, the U.S. Congress changed the focus of the Buzzards Bay NEPs. Although Congress initially conceived NEPs as temporary programs charged with developing management plans, Congress later recognized that these new programs should monitor and facilitate the implementation of the management plans they created. By the late 1990s, Congress authorized the funding of roughly $500,000 per NEP (together with an equivalent required non-federal match) to achieve these new goals. Appropriations in subsequence decades rose somewhat.

During this period, the BBP Management Committee also restructured the program's management oversight. The Policy Committee remained in place (composed of the EPA Regional Administrator and the Secretary of the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), however, about 1993, with the completion of the Management Plan, the Management Committee replaced itself with a 5-member Steering Committee composed of those parties most interested in ensuring implementation of the Management Plan. These members were Massachusetts Office of Coastal Zone Management (CZM), the EPA, the Southeast Regional Planning and Economic Development District and the program's two nonprofit partners–BBAC and BBC. The Steering Committee abolished the other standing committees. In 2008, the Massachusetts Department of Environmental Protection (MassDEP) joined the Steering Committee.

With the completion of the CCMP, and new mandates and funding from Congress, the BBP transformed itself into a technical assistance and implementation program dedicated to working with municipalities, nonprofit organizations, and the public to implement the recommendations contained in the CCMP.

In 1995 the Buzzards Bay NEP developed a Memorandum of Understanding (MOU) with the BBC and BBAC to improve coordination among the three Buzzards Bay partners. This MOU helped clarify the interests and activities of each group to minimize duplication of effort. The Buzzards Bay NEP abandoned most public outreach efforts and instead focused primarily on providing technical aid to the municipalities.

2013 Update of the Management Plan

The 2013 CCMP update reflected changes in the regulatory landscape, changing environmental conditions, and new management needs. The original CCMP had 119 recommended actions. Soon after the completion of the CCMP, seven actions were no longer relevant because of changes in law or other circumstances, and the Buzzards Bay NEP began tracking progress of the remaining 112 recommendations. By 2009, we considered 61 of these remaining 112 CCMP recommendations largely complete with significant progress on many of the remaining recommendations. Through 2013, some water quality indicators like shellfish bed closures showed appreciable declines, mostly because of combined sewer overflow (CSO) improvements in New Bedford, sewering and stormwater management in Fairhaven and Dartmouth, and rainfall condition shellfish closure programs in Wareham and Westport.

Despite this progress, continued development caused degradation of Buzzards Bay water quality. While the population of the City of New Bedford changed little between 1990 and 2020, development pressures continued in the more rural areas of Buzzards Bay. During this period, the watershed population outside of New Bedford increased by more than 20% (Figure 3, top). Similarly, among the towns shown in Figure 4, housing units increased by an average of 25%. The increased nitrogen and stormwater inputs from this development continued to degrade water quality and cause loss of important habitat like eelgrass beds.

One of the most important institutional changes reflected in the 2013 CCMP update was that Massachusetts legislature passed the Oceans Act in 2008. The Oceans Act changed the existing Massachusetts Ocean Sanctuary Act and required the Secretary of EEA to develop a comprehensive plan to manage development in the state waters planning area (Figure 5) that balanced natural resource preservation with traditional and new uses, including renewable energy. The plan was based on scientific information and stakeholder input and completed in 2009. The Oceans Act requires activities in the planning area to be consistent with the Ocean Management Plan, and that CZM update the plan every five years.

In most ways, the 2013 CCMP was like the original CCMP but dropped specific recommendations in favor of a focus on goals, objectives, and the steps for achieving those goals in the narrative. This change was a recognition that there is no one-size-fits-all approach

to environmental management. Each community must define the approaches and financial solutions that make the most sense to them. We dropped the chapter titled Pollution Remediation Projects in New Bedford and interspersed relevant actions into other action plans. The focus on new issues (e.g., freshwater pollution, and trash in the environment), resulted in 20 Action Plans as compared to 14 Action Plans in the original document.

New Issues, New Mandates

After the 2013 update to the CCMP, several new priorities arose within state agencies. Climate concerns were at the forefront for many agencies, and in 2014, CZM established the Coastal Resilience Grant Program to help Massachusetts coastal communities better address risks and challenges from coastal storms, flooding, erosion, and sea level rise. The grant program supports studies to evaluate municipal vulnerabilities from coastal storm and climate impacts, conduct adaptation planning, redesign and retrofit vulnerable public facilities and infrastructure, and restore shorelines to enhance natural resources and provide storm damage protection. Similarly, in 2017, EEA created the Municipal Vulnerability Preparedness (MVP) program. MVP provides support for cities and towns in Massachusetts to begin the process of planning for climate change resiliency and implementing priority projects including inland projects related to river flooding and dam vulnerabilities. EEA first awards Communities funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities who complete the MVP program become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities. To better educate the public about climate risks, CZM developed map viewers to enable residents and town officials to see potential sea level rise scenarios and future storm impacts in their communities.

In 2011, the Conservation Law Foundation, joined by the BBC, filed a suit against the EPA about the failure to update the 1978 Cape Cod Clean Water Act Section 208 Areawide Water Quality Management Plan to address nitrogen pollution issues. In 2013, the Commonwealth directed the Cape Commission to update the plan to address nitrogen pollution in Cape Cod embayments. In 2014, the Conservation Law Foundation and the Environmental Protection Agency reached a settlement agreement, ending the lawsuit. The settlement conditions required EPA and the Commonwealth of

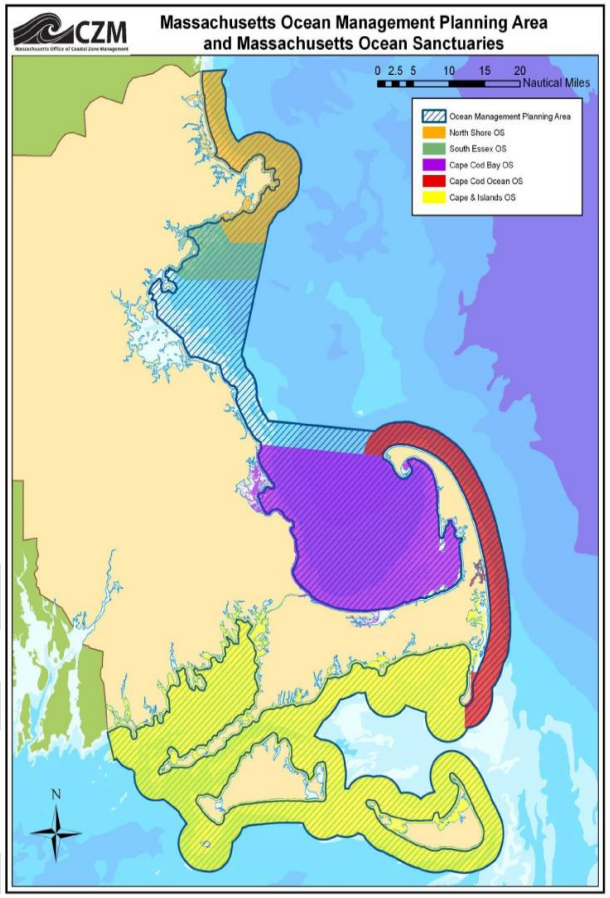


Figure 5. Massachusetts Ocean Management Planning Area and Massachusetts Ocean Sanctuaries.

Massachusetts to approve an updated Section 208 Water Quality Management Plan Update drafted by the Cape Cod Commission that included watershed strategies to reduce nitrogen to impaired water bodies. In June 2015, the governor approved the plan, followed by the EPA in September. The 208 Plan Update provides a framework to restore embayment water quality on Cape Cod using a watershed-based approach with suggested strategies, regulatory reforms, and a process for communities to reduce excess nitrogen.

DEP, after funding two decades of coastal watershed nitrogen TMDL studies, and with dozens of TMDLs approved by the EPA, embarked on a strategy to encourage municipalities, through grants and technical assistance, to implement watershed management plans to reduce nitrogen. They also worked with municipalities to similarly upgrade their wastewater facility plans. For most impaired water bodies, the solution primarily entailed eliminating septic system inputs through sewering to treatment facilities that removed nitrogen.

Progress toward nitrogen reduction goals remained slow, so in 2022, MassDEP proposed changes in the state's sanitary code. In areas designated by the state as Natural Resource Area Nitrogen Sensitive Areas, MassDEP offers municipalities a choice between developing watershed management plans through a voluntary 20-year permit to reduce nitrogen, or the state would require all existing and future septic systems in nitrogen sensitive embayment watersheds, to be upgraded to nitrogen removal septic systems. These regulations [310 CMR 15.213(1)(b)1] became effective in July 2023.

Changes to the Buzzards Bay Watershed

Throughout this document we use an updated watershed boundary study area that differs from the 2013 update of the Buzzards Bay CCMP (Figure 6). Land surface topography defines the western boundary of the Buzzards Bay Watershed, but the northern and eastern boundaries are based on estimated groundwater divides on the north boundary (Plymouth Carver Aquifer) and on the east boundary (Sagamore lens of the Cape Cod Aquifer). Groundwater divides are estimations based on the best available information and estimated groundwater divides can change based on new data and conditions, like changes in recharge or water withdrawals.

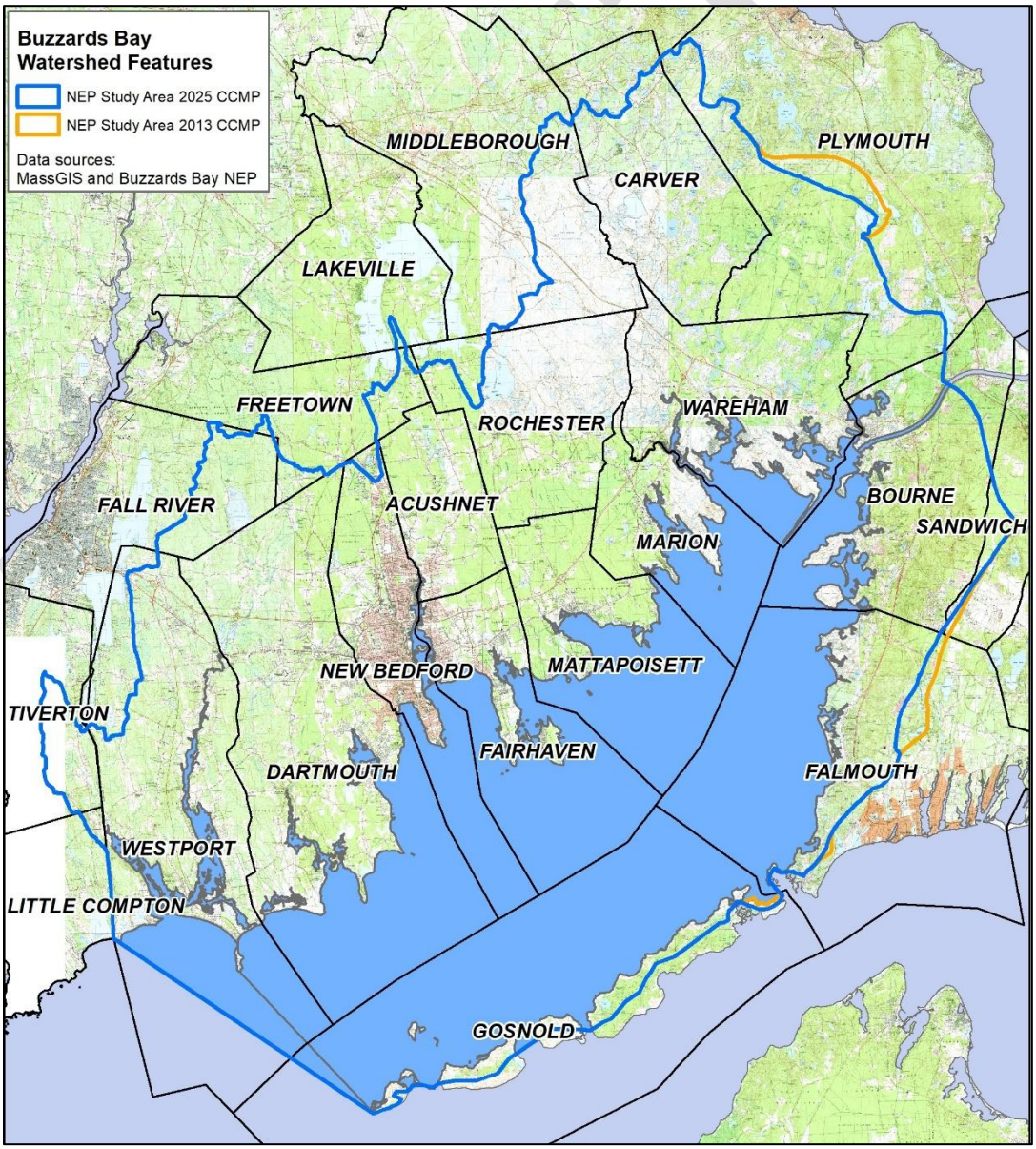


Figure 6. Revisions to the watershed and study between the 2013 CCMP update and the 2025 CCMP update.

For the changes in the watershed boundary in Plymouth and on Cape Cod shown in Figure 6, these changes were adopted to be consistent with the final TMDL watershed boundary approved by MassDEP and EPA for the Wareham River Estuary. For the change on Cape Cod in Falmouth, this revision was made to be consistent with MassDEP's newly designated Natural Resource Area Nitrogen Sensitive Areas. These boundaries are also consistent with MassDEP and EPA approved TMDLs adopted after the 2013 CCMP update, and boundaries adopted by the Cape Cod Commission. Additional information is available on the Buzzards Bay NEP's Watershed and Study Area Change page.

Current Activities

Since the 2013 update, the NEP continued to provide technical and financial support to Buzzards Bay watershed municipalities and to partners to support habitat and water quality monitoring, like Baywatchers, the river and marsh monitoring programs, and the monitoring efforts of the Buzzards Bay Stormwater Collaborative. The NEP participates in meetings of the BBAC, BBC Science Advisory Committee, and SNEP to stay informed about current issues and needs of its partners. The NEP is also a participant in multiple partner grants, providing various services like GIS analysis and watershed loading models in support of embayment TMDLs.

Buzzards Bay Stormwater Collaborative

The Buzzards Bay NEP launched the Buzzards Bay Stormwater Collaborative in 2016, as a partnership between the Buzzards Bay NEP, the BBAC, and five municipal public works departments (Dartmouth, Acushnet, Fairhaven, Mattapoisett, and Wareham). The U.S. EPA Region I initially funded the initiative with a Healthy Communities grant. The purpose of the Collaborative was to map stormwater infrastructure and monitor both wet and dry weather discharges (if present). An essential first task of the program was to precisely locate all stormwater discharges along the coast (both in and out of MS4 areas) and define the stormwater network connections to those discharge pipes and structures.

In 2018, with SNEP funding from the Buzzards Bay NEP, the Stormwater Collaborative expanded through a new partnership with the Massachusetts Maritime Academy (MMA). This new initiative added three municipalities (Westport, Marion, and Bourne). Under this partnership, MMA provided staff support and co-op students to work with Buzzards Bay municipalities and the Buzzards Bay NEP to continue the monitoring and mapping tasks.

In January 2020, with a grant from SNEP, MMA became the lead in managing the Stormwater Collaborative. MMA also began entering into new agreements with Buzzards Bay municipalities for additional work beyond the scope of the SNEP grant. In 2020, MMA also received a $46,000 grant from MassDEP to purchase a trailer and equipment to establish an Illicit Discharge Detection and Elimination (IDDE) field investigation trailer that can be borrowed by Buzzards Bay municipalities for their own investigations (Figure 7). In 2021, the MMA, with guidance from the Buzzards Bay NEP outfitted the utility trailer, and produced training videos posted on YouTube. The trailer is stationed at MMA and made available to the Stormwater Collaborative municipalities.

As of 2025, the Stormwater Collaborative continues as a strong partnership between the Buzzards Bay NEP, MMA, and now eight Buzzards Bay towns (Bourne, Wareham, Marion, Mattapoisett, Acushnet, Fairhaven, Dartmouth, and Westport). Municipal public works departments pay for the students participating in the program. EPA Infrastructure Investment and Jobs Act (IIJA) funds provided to the NEP pay for school

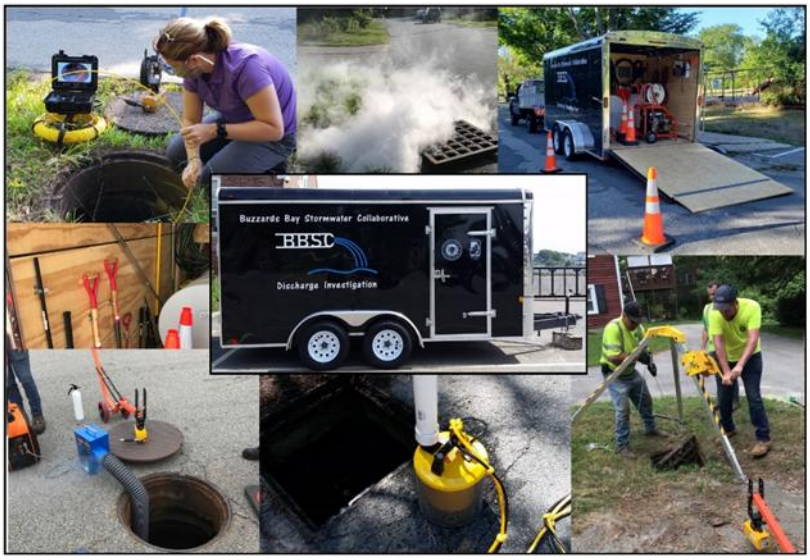


Figure 7. Stormwater Collaborative IDDE trailer

staff to oversee the students and administer the program. The Buzzards Bay NEP provides technical oversight, and MMA is the lead in completing field work and evaluations undertaken by university students to fulfill service agreements with participating towns. The NEP provides student training and continues to provide funds for laboratory testing of stormwater samples. In 2023, the cost of the laboratory testing was moved to the IIJA Cooperative Agreement. Between July 2024 and June 2025, ten cadets completed their cooperative assignment with the Stormwater Collaborative. The cadets gained valuable experience and can enter the workforce with added skills. The municipalities funded the students with $88,500 in contracts to MMA beginning in the summer of 2024.

The Buzzards Bay NEP staff maintains a Geographic Information System (GIS) with updates to mapping and incorporation of field investigations. The Buzzards Bay NEP posts all data online under a MMA ArcGIS Online license, and also guides the collection of, and does quality assurance checks of, the water quality data. Both the GIS and water quality data are used to prepare MS4 permit materials for Stormwater Collaborative participants. Buzzards Bay NEP staff also worked with an EPA contract to enter data in EPA's water quality exchange database framework.

Since 2022, the Buzzards Bay NEP has supported a Stormwater Collaborative online map service. In July 2024, the interactive map was converted to four different new map products (Figure 8). The Stormwater Management Map is a complex map to evaluate outfalls and catchments. The Water Quality Dashboard is used to evaluate outfalls and view water quality data. The IDDE Map provides a simplified view structures during field work, and the Sampling Dashboard is accessible only on smart phones and is used to help with field sampling. These map products follow standards set by the MS4 permit for features required to be illustrated on a map and they are valuable tools for Stormwater Collaborative communities.

The Stormwater Collaborative's IDDE trailer continues to be an effective asset in comprehensive field studies. From July 2024 to June 2025, 140 additional catchments were evaluated, two potential illicit connections were identified and addressed by the effected town, and several smaller issues were addressed throughout the watershed. The Buzzards Bay Stormwater Collaborative page has additional information about the Stormwater Collaborative, as well as useful stormwater monitoring training videos on the Monitoring Discharges page.

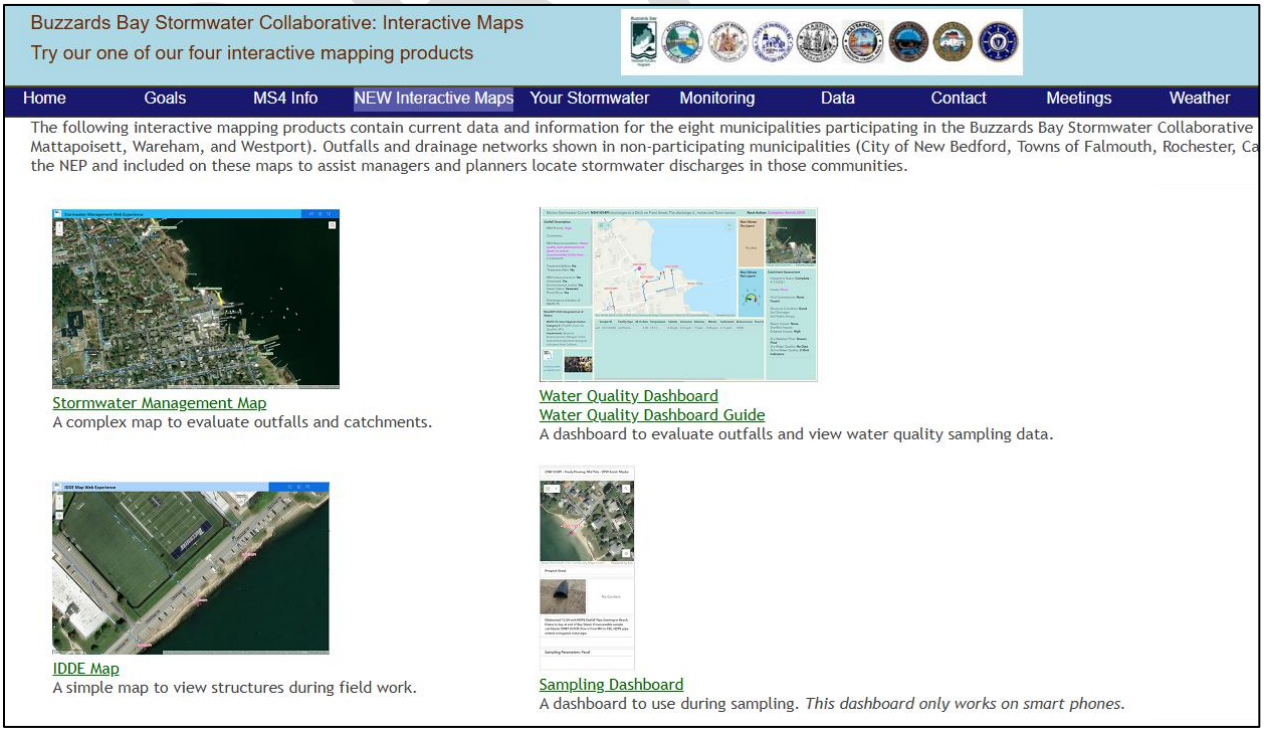


Figure 8. Four mapping product services are offered by the Stormwater Collaborative.

Buzzards Bay NEP Municipal Grant Program and Technical Assistance

Through our grant and technical assistance programs, the Buzzards Bay NEP helps municipalities, and our other partners achieve the goals and objectives of the CCMP. Below are some grants awarded in 2024 and 2025 by the Buzzards Bay NEP. Table 2 summarizes Year 1 and Year 2 IIJA funds awarded.

- The Town of Plymouth was awarded $69,000 to design and construct a stormwater treatment system that will prevent contaminants and nutrients from entering Clear Pond. The pond has documented low levels of oxygen and elevated levels of chlorophyll, phosphorus, and nitrogen, which are leading to repeated seasonal outbreaks of cyano-bacteria. The town's goal was to eliminate the first flush of stormwater from being discharged directly into the pond, thereby reducing nutrients, sediment, and contaminants contributing to poor water quality.

- The Town of Westport was awarded $69,000 to complete preliminary engineering design plans to advance the replacement of three undersized and deteriorating culverts at Angeline Brook at Cornell Road, and Snell Creek and Lyons Brook on Drift Road. The culverts are reducing aquatic connectivity, serving as barriers to native fish migration, and posing risks to public safety. Eventual replacement of these culverts will provide access to critical habitat for migratory fish including sea-run brook trout, as well as river herring and American eel.

- The Town of Bourne was awarded $183,500 to hire an engineering firm to address nutrient and bacteria loading to Queen Sewell Pond. The grant funded stormwater treatment designs for a discharge near a freshwater bathing beach and development of an action plan for nine other stormwater discharges in the watershed. The pond has been impaired by harmful algal blooms and elevated bacteria levels, which have caused beach closures.

- The Town of Dartmouth was awarded $250,000 to make modifications to its wastewater treatment facility to better meet permitted discharge limits for certain pollutants and significantly reduce nitrogen discharges to Buzzards Bay. While the Town is not required to remove nitrogen from its discharge, adding aeration to certain tanks during this upgrade will cut nitrogen discharges in half, potentially removing more than 100,000 pounds of nitrogen pollution from the facility's discharge to Buzzards Bay each year. The nitrogen removal upgrade costs are $475,000, and the Town will contribute the needed additional funds from their capital account.

- The City of New Bedford was awarded $375,000 to complete Phase II of the Buttonwood Park stormwater management project at the Buttonwood Senior Center. The project addressed sediment erosion and pollutant discharges from the property and nearby neighborhoods. The site also has a large waterfowl population problem, notably Canada

Table 2. Municipal grants awarded with IIJA Year 1 and Year 2 funds

Grantee	Project Name	Contract Amount	IIJA YR	Leveraged funds
Bourne	Queen Sewell Pond Watershed Action Plan	$183,500	1	$10,000
Contractor	Grant development specialist	$27,000	1	$0
Dartmouth	Reduction in Nitrates to BB from WWTP outfall	$250,000	1	$0
Fairhaven	Jerusalem Road Stormwater Remediation	$125,000	1	$300,000
MMA	Stormwater Collaborative Support (Year 2/Year 1 BIL)	$90,206	1	$89,796
New Bedford	Buttonwood Park Green Infrastructure	$375,000	1	$237,499
Envirotech Lab	Stormwater Testing	$4,000	1	$0
NB Health Lab	Stormwater Testing	$4,000	1	$0
New Bedford	Riverside Park Salt Marsh Restoration	$93,531	2	$0
Contractor	Grant development specialist	$28,342	2	$0
MMA	Stormwater Collaborative Support (Year 3/Year 2 BIL)	$127,042	2	$94,050
Wareham	Denitrifying Woodchip Bioreactor Field Trial	$275,000	2	$20,000
Wareham	Neighborhood-scale N Reductions at Little Harbor	$40,000	2	$10,000
Westport	MS4 Investigations	$25,000	2	$6,000
Total		**$1,622,621**		**$761,345**
Percentage of funds awarded:				*47%*

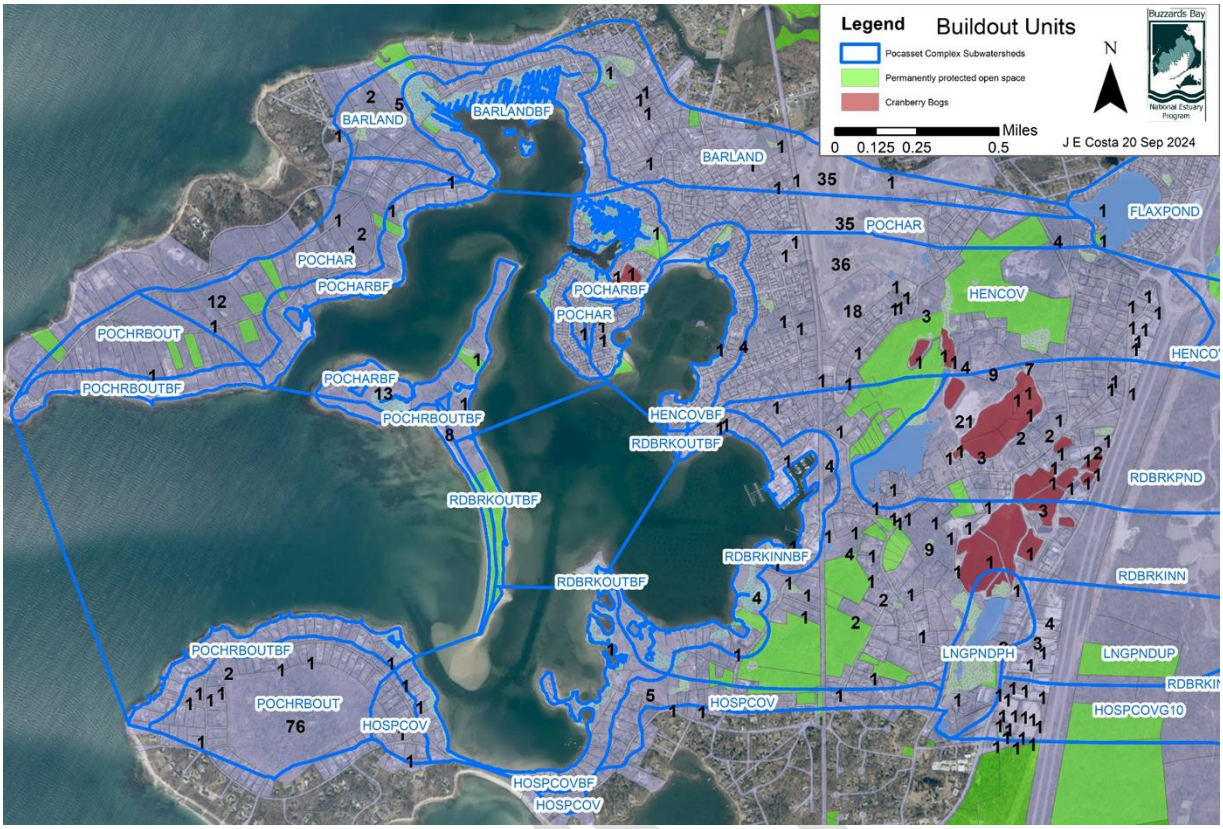


Figure 9. Results of the buildout analysis for the Pocasset Harbor Estuary Complex (number of potential new units from subdivision).

geese, whose wastes contribute to bacteria and nutrient pollution of the pond. The stormwater treatment system consists of a biofilter raingarden, and the City used habitat alteration techniques and barriers to exclude the waterfowl from the property. The Parks Department worked with the Conservation Commission to restore a vegetated buffer along the pond. Scientific collaboration on nitrogen TMDLs, vulnerabilities, and water quality impacts on natural resources.

Support for TMDL studies

The NEP continued to work with the Buzzards Bay Coalition and two watershed municipalities in the development of watershed nitrogen TMDLs. Work focused on the Town of Dartmouth and City of New Bedford for an Apponagansett Bay TMDL, and with the Town of Bourne for a TMDL for Red Brook Harbor. The work in Apponagansett Bay was a companion project to the Buttonwood Brook project in Task 8. NEP support for these projects in 2024 to 2025 included preparation of maps and GIS data, stormwater data assessment, historical aerial interpretation, land use analysis, and preparation of a Quality Assurance Project Plan (QAPP) for the development of a TMDL for the Apponagansett Bay watershed and the Red Brook Harbor watershed in Bourne. The Buzzards Bay NEP assisted in the preparation of a final report to DEP in 2024. (Fig. 8). A special focus of the Dartmouth effort was identifying homes in the watershed not tied to available sewer lines.

Salt Marsh Loss Assessment Collaboration with Coalition and Runnel Study with Coalition

The NEP and our non-profit partner organization, the Coalition, continued to study salt marsh erosion, die-off and runnel studies in Buzzards Bay. The NEP Executive Director helps train new seasonal Coalition interns and staff on the use of a Leica Laser Leveler for the precise measurement of elevations within the salt marsh and converted GPS data to generate marsh vegetation-elevation profiles. The NEP Executive Director incorporates new seasonal monitoring data in the marsh elevation database. Some of the work funded by a SNEP grant was published in a Salt Marsh report posted on the Coalition's website. The NEP continued to oversee the creation and implementation of the unmanned aerial vehicle (UAV) salt marsh monitoring subaward to UMass Dartmouth.

This task supported several CWA core programs indirectly including elements: 2) improving water quality monitoring, 4) controlling non-point source pollution on a watershed basis, 6) supporting sustainable wastewater infrastructure and CWA and state wetland protection efforts, and adaptation and resilience related priorities.

Buzzards Bay Citizens' Water Quality Monitoring

With its support from the NEP, the Commonwealth of Massachusetts, citizens, Coalition dues, and other sources, the Coalition will continue its nationally recognized Baywatchers water quality monitoring program which costs roughly $250,000 annually. The NEP is providing $69,000 in this year's budget for that task (Task 3 of the sub-award to the Buzzards Bay Coalition). The NEP will continue to provide technical support to Coalition staff in implementing the Monitoring Program. The NEP and the Coalition use the data to advocate for nitrogen management in Buzzards Bay Watershed communities and to evaluate trends in Buzzards Bay and Buzzards Bay Coalition state of the bay reports (Figure 10). The data is also used by DEP's Massachusetts Estuaries Project in the development of TMDLs. The Commonwealth of Massachusetts for several years has provided between $50,000 and $150,000 annually towards this program and used as match to our program.

The NEP Executive Director participates in the Coalition SAC workgroup, which continues to work on several tasks, including a recommended monitoring and modeling requirements for any potential new wastewater outfalls allowed under a changed state law that would enable such new outfalls.

These activities principally supports Action Plan 1: Managing Nitrogen Sensitive Embayments, Action Plan 2: Protecting and Enhancing Shellfish Resources, Action Plan 4: Improving Land Use Management and Promoting Smart Growth, Action Plan 5: Managing On-site Wastewater Disposal Systems, Action Plan 19: Protecting Public Health at Swimming Beaches, Action Plan 20: Monitoring Management Action, Status, and Trends, Action Plan 21: Enhancing Public Education and Participation.

Monitoring Nutrient Inputs to Buzzards Bay from Coastal Rivers, Year 3

Since 2021, the Buzzards Bay NEP supports regular sampling of water chemistry of the coastal rivers flowing into Buzzards Bay. This effort is yielding new insights into the magnitude and controls of the nitrogen and phosphorus that reach the Bay through river discharge. Nitrogen and phosphorus arriving in the water discharged through coastal rivers is one of the major sources of these nutrients to Buzzards Bay1. Because nutrient loads result from both concentration and total water fluxes, it is important to understand these flow-concentration relationships. These relationships likely vary across the geology of Buzzards Bay rivers that range from rivers draining sand aquifers, sand-infilled river valleys, and wetland-rich glacial valleys with more near-surface bedrock2. Because of increasingly variable precipitation to the Northeast U.S.3, understanding the dynamic flow-influenced responses of river discharge and concentrations will be critical to understanding the controls on river-borne sources of nutrients to Buzzards Bay.

Stream and river discharge and chemistry are sampled at 13 locations. Two additional rivers are gauged by the U.S. Geological Survey as part of the Waters Resources of the United States4 network. In March 2021, in the same 12 rivers, the Woodwell Center began sampling water chemistry monthly (during November to April) and twice monthly (during May to October). One stream (Buttonwood Brook, which drains part of urban New Bedford and Dartmouth) was added to this network in March 2022 as part of a Southern New England Program Pilot Watersheds Project at the Coalition). Stage recorders on all these streams provide

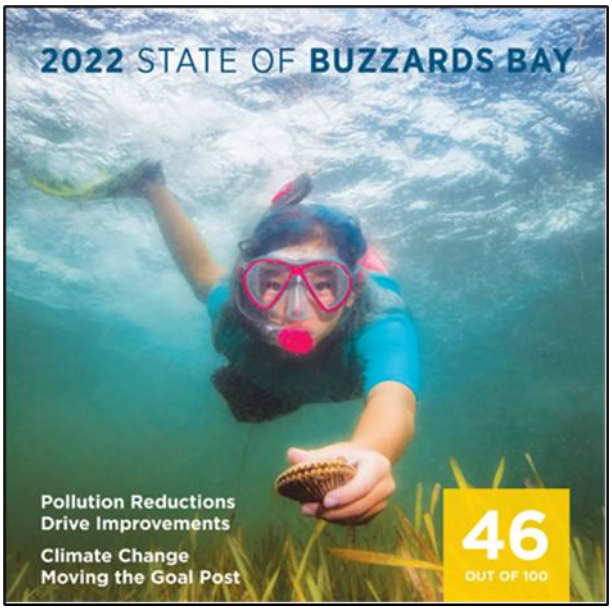


Figure 10. Baywatchers data was used and summarized in the 2022 state of Buzzards Bay report.

measurements every 30 minutes. The data from the Woodwell and Coalition gages are downloaded and quality checked monthly. The data from the USGS gages are downloaded periodically and combined into the same Buzzards Bay Rivers database.

Interesting findings from sampling include: (1) predominance of dissolved organic nitrogen (DON) over the inorganic forms (nitrate and ammonium) in the largest rivers with substantial are-as of wetland floodplains; (2) higher concentrations of nitrate over DON in two small streams (Angeline Brook, Red Brook); (3) much lower concentrations of nitrate in the four rivers draining cranberry farming areas (Sippican, Weweantic, Wankinco, Agawam) compared with groundwater fed rivers on Cape Cod or in the groundwater-dominated Red Brook, and (4) almost uniformly low concentrations of phosphate. We also found that concentrations of major solutes tended to drop during high water flows, indicating dilution by rainwater rather than flushing of solutes from soils or impervious surfaces. This is important because it suggests that higher flows associated with the intense rainfalls that are projected to become more frequent will not result in large increases to nutrient loads.

New Bedford Sea Lab Buzzards Bay NEP Partnership to support Youth Marine Education

The Sea Lab Marine Science Education Center is New Bedford Public Schools' (NBPS) marine and aquatic educational summer- school program supported through tuition and the Local Education Agen-cy. Sea Lab is found on the Fort Rodman peninsula in New Bedford, MA, close to the City's public beaches. Since 1968, third grade students, through sophomores in high school, who present with an interest in the ocean sciences, have attended Sea Lab's six-week program. The curricula are cumulative from Level One - through Level Seven (in grades four through nine). Science curricula developed covers oceanography, limnology, meteorology, geology, marine biology, and chemistry as they relate to the marine environment. Course work includes boating skills (Fig. 1), laboratory work (Fig. 2) and field studies (Fig. 3) along the Massachusetts and Rhode Island coastlines. As noted on the program's website, the school curriculum achieves a balance between the introduction of basic scientific concepts and the discussion of observable phenomena with a focus on high interest, hands-on, intensive study designed to appeal to the serious student. Simone Bourgeois, Sea Lab Facilitator, has noted the program's emphasis is on

Figure 11. Image of staff gauge setup in the West Westport River on the border of Westport, MA and Little Compton, RI. Data are downloaded with a Bluetooth connection to a tablet.

experiential learning, with science content classes complemented by field studies and hands-on activities, focusing on scientific inquiry and observation. The Program is nationally recognized and has received past support from the National Oceanic and Atmospheric Administration and the Naval Research Center. The curricula include collaboration with area universities, and Sea Lab students have had the opportunity to take part in on-going scientific research.

The Sea Lab program provides students with a rigorous program of environmental studies where they learn to use scientific equipment and learn the scientific method. Many visit and study the ocean for the first time, and learn the historical significance of marine resources, and environmental stewardship practices in the city in which they live. To take part in this voluntary summer program, the families of resident children must pay $400 tuition plus certain field trip fees. This tuition covers the costs of teacher salaries, some supplies, and some field trip costs. Scholarships help students with financial needs so that they can participate. The parent-teacher organization, the Sea Lab Keel, supports these scholarships and raises money to buy and repair equipment, defrays the costs of field trips,

provide snacks for the children, purchase trophies and awards, and award scholarships to Sea Lab alumni as they go off to college. Several other individuals, businesses, and organizations provide similar support, as does the NEP's partnership with the city through the grant. The NEP support for the program includes providing tuition waivers for students that cannot afford to attend the program, cover material and supplies for the curriculum, and by funding field trips including whale watches and the study of the Cuttyhunk Is-land ecosystem (Figure 12).

Figure 12. Eighth graders take part in field studies and trips to study different types of ecosystems.

Chapter 2. Climate Vulnerabilities Assessments

Introduction

The 1991 CCMP was the first in the country to contain recommendations to adapt to expected increasing rates of sea level rise from global warming. To better define how various climate stressors will affect Buzzards Bay and the ability to achieve the goals of the CCMP, the Buzzards Bay NEP subsequently completed several climate change vulnerability assessments, some with support from EPA's Climate Ready Estuaries program. This chapter provides a brief overview of the NEP's past climate change vulnerability assessments of action plans, water quality conditions, and natural resources most affected by climate stressors.

In 2012, the NEP conducted sea level rise assessments in Fairhaven, Westport, Dartmouth, New Bedford, Mattapoisett, Marion, and Wareham[7]. Using Federal Emergency Management Agency (FEMA) LiDAR data, the Buzzards Bay NEP evaluated the potential expansion of the FEMA one percent ("100-year") floodplain given projected 1-foot, 2-foot, and 4-foot rises in sea level using a simple bathtub model of flood plain expansion (Figure 13). The Buzzards Bay NEP produced maps and identified municipal structures and their assessed values within the floodplain expansion scenarios for the seven Buzzards Bay towns. This effort preceded the 2013 updated Army Corps Sea, Lake, and Overland Surges from Hurricanes (SLOSH) maps and later CZM online mapping efforts. The reports helped municipalities inventory infrastructure and facilities that would benefit from resiliency measures. These efforts also help develop local proposals for state Coastal Resilience Grants.

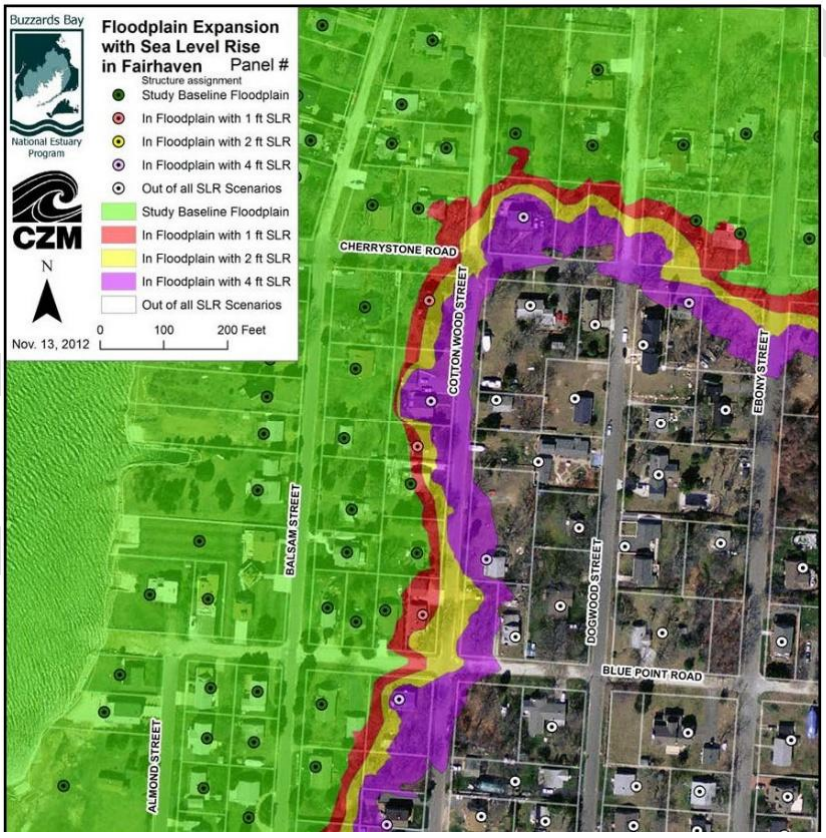


Figure 13. NEP analysis of flood zone expansion with sea level rise in a portion of the Town of Fairhaven.

From Costa, J.E, D. Janik, and J. Rockwell. 2012. Projected Expansion of the Floodplain with Sea Level Rise in Fairhaven, Massachusetts. Buzzards Bay National Estuary Program and Massachusetts Office of Coastal Zone Management. Technical Report SLR12-1. Final November 13, 2012. 34pp.

[7] Reports available at Buzzards Bay NEP Floodplain Expansion webpage

Building upon the 2012 Buzzards Bay NEP effort, in 2014, with funding from the U.S. EPA Climate Ready Estuaries program, the Buzzards Bay NEP hired SeaPlan, an environmental planning firm, to conduct a climate ready estuary assessment and planning effort for the municipalities surrounding New Bedford Harbor. The purpose of this project was to develop an understanding of possible impacts of climate change and potential future responses by the Towns of Acushnet and Fairhaven, and the City of New Bedford. Of specific concern was how future increases of sea level, precipitation, and frequency or intensity of storms may affect public infrastructure related to water quality and habitat protection. The U.S. Army Corps of Engineers built a hurricane barrier around portions of New Bedford and Fairhaven in the 1960s to protect the harbor waterfront, important industrial buildings, and significant parts of the three municipalities (New Bedford, Fairhaven, and Acushnet), including large populations of disadvantaged communities. The study assessed what intensity of storm would overtop the lowest points of the hurricane barrier. This funding was part of a national effort by the U.S. EPA to encourage municipalities to enact strategies to be more resilient to climate stressors and extreme weather events.

SeaPlan and the Buzzards Bay NEP hosted meetings and workshops, developed an interactive website, and created products that included Geographic Information System (GIS) data and a final report. The report identified strategies and actions needed for the three participating municipalities and included a list of important infrastructure. Another key finding of the SeaPlan study was that the hurricane barrier will likely be widely overtopped by a 1% storm ("100-year storm event" equivalent to the Hurricane of 1938) in conjunction with a 4-foot sea level rise (Figure 14).

In 2015, the Buzzards Bay NEP conducted a pilot assessment of the potential migration of salt marshes at selected sites [8]. This analysis was similar to the floodplain expansion study in that it evaluated salt marsh expansion and migration by applying 1-foot, 2-foot, and 4-foot increases in sea level to LiDAR data (Figure 15). The analysis and EPA-approved quality assurance project plan established methodologies and approaches the Buzzards Bay NEP would later use in its studies of salt marsh loss. CZM has posted a more up-to-date marsh migration interactive map page to provide such information.

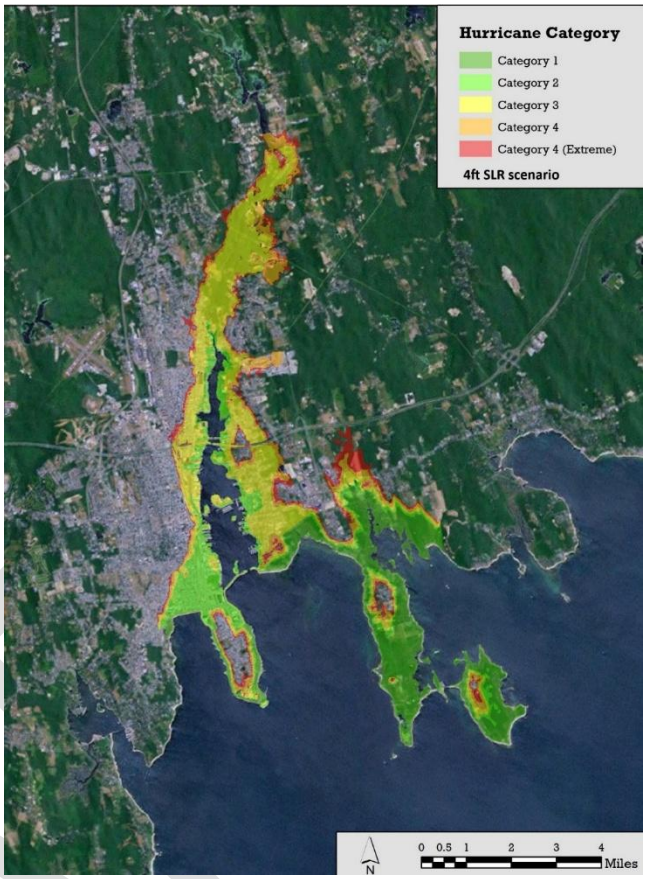


Figure 14. SeaPlan vulnerability assessment for New Bedford Harbor with a 4-ft rise in sea level rise.

Also in 2015, the EPA Climate Ready Estuaries program administered a grant to support the New England NEPs in meeting their climate change vulnerability assessment needs. The product of this effort was a report prepared by the project consultant (Battelle 2016a; 2016b). This report evaluated how stressors like changes in rainfall patterns, storm intensity, air and water temperatures, rising sea level and ocean pH might affect the ability to meet the goals and objectives of the CCMP. The evaluation supported section 320(b)(4)(B) of the Clean Water Act by identifying impacts of recurring extreme weather events.

In 2022, the Buzzards Bay NEP began a climate change vulnerability assessment with support from the BBC to evaluate how climate stressors might affect the Management Conference's ability to meet management

[8] Description and maps available at the NEP's marsh migration web page.

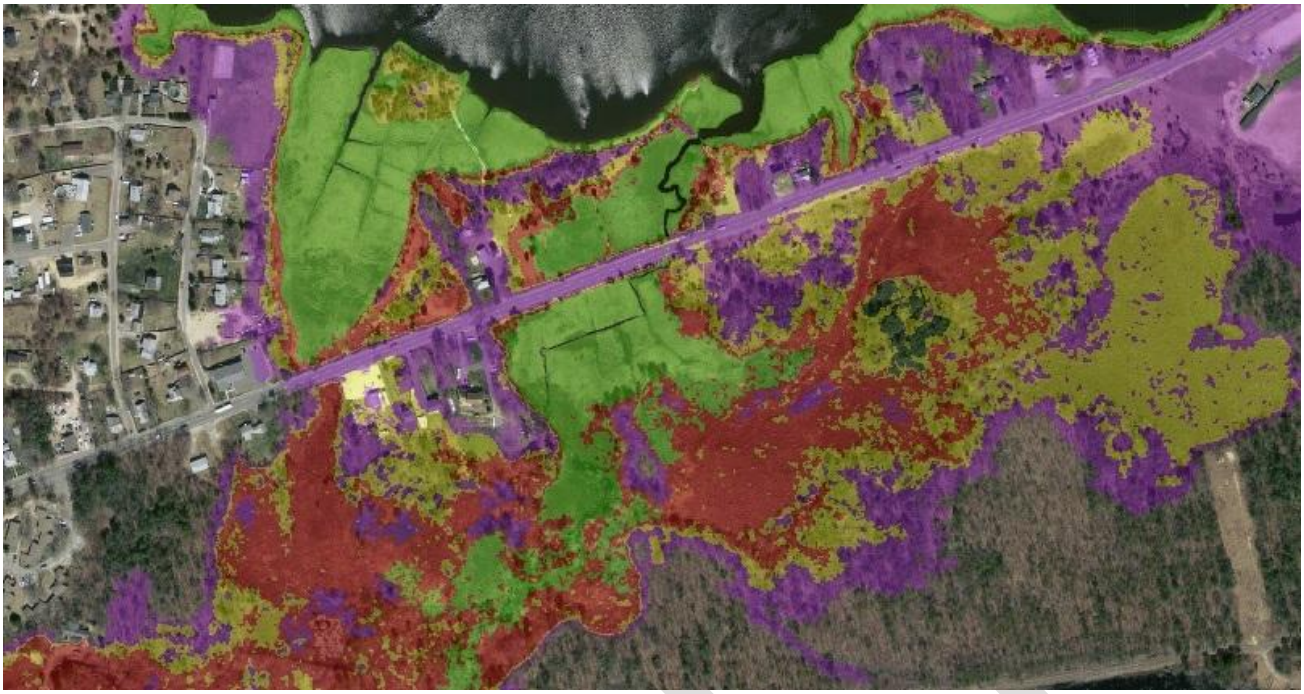


Figure 15. Buzzards Bay NEP analysis of salt marsh expansion potential in an area of Wareham (along Rt. 6 near the Agawam River). The green shaded areas show elevations currently below the high tide line. Red = +1-foot sea level rise, yellow is +2 feet, and purple is +4 feet.

goals contained in the 2013 Buzzards Bay CCMP. The assessment also considered potential climate resilience approaches and other updates needed in the 2013 CCMP. The Buzzards Bay vulnerability assessment used EPA's *Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans* (U.S. EPA, 2014) to guide its work. This workbook provided a framework for conducting risk-based climate change vulnerability assessments and developing adaptation action plans.

The Buzzards Bay NEP used the resulting Buzzards Bay Climate Change Vulnerability Assessment (Costa, 2023) for the 2025 CCMP update. Assessment participants developed a list of 69 climate risks (stressors and outcomes) that relate to specific goals contained in the Buzzards Bay CCMP. Assessment participants included scientists, federal, state, and local regulators and managers, non-profits, members of the public, and members of the business community. Each participant assessed each risk for likelihood of occurring and severity of impact during the next 20 years. Participants scored risks as high, medium, and low (3 to 1 points) and identified potential adaptation strategies.

Table 3 shows the ranking of Actions Plans using this scoring approach. Action Plans with higher scores are those where climate stressors will make it more difficult to achieve the Action Plan goals. As shown, efforts to adapt to shifting shorelines, manage stormwater, protect wetlands, protect biodiversity and threatened species, manage nitrogen pollution, manage water withdrawals, and protect shellfish are the top third of

Table 3. Mean rank vulnerability scores of the Buzzards Bay CCMP Action Plans

Action Plan 17 Shifting shorelines	2.8
Action Plan 3 Managing stormwater	2.5
Action Plan 7 Protecting wetlands	2.5
Action Plan 9 Biodiversity, rare, endangered	2.5
Action Plan 1 Managing nitrogen pollution	2.5
Action Plan 10 Water withdrawals	2.4
Action Plan 2 Protecting shellfish	2.4
Deleted Waterfront / watersheet action plan	2.3
Action Plan 5 Managing onsite wastewater	2.3
Action Plan 8 Fish passage	2.2
Action Plan 13 Protecting ponds and streams	2.2
Action Plan 11 Managing invasive species	2.2
Action Plan 15 Reducing toxic pollution	2.1
Action Plan 4 Managing land use	2.1
Action Plan 18 Protecting swimming beaches	2.1
Action Plan 12 Open space protection	2.0
Action Plan 19 Monitoring implementation	1.9
Action Plan 16 Reducing petroleum pollution	1.9
Action Plan 14 Reducing Trash	1.8
Action Plan 20 Public education participation	1.8
Action Plan 6 Boating impacts	1.7

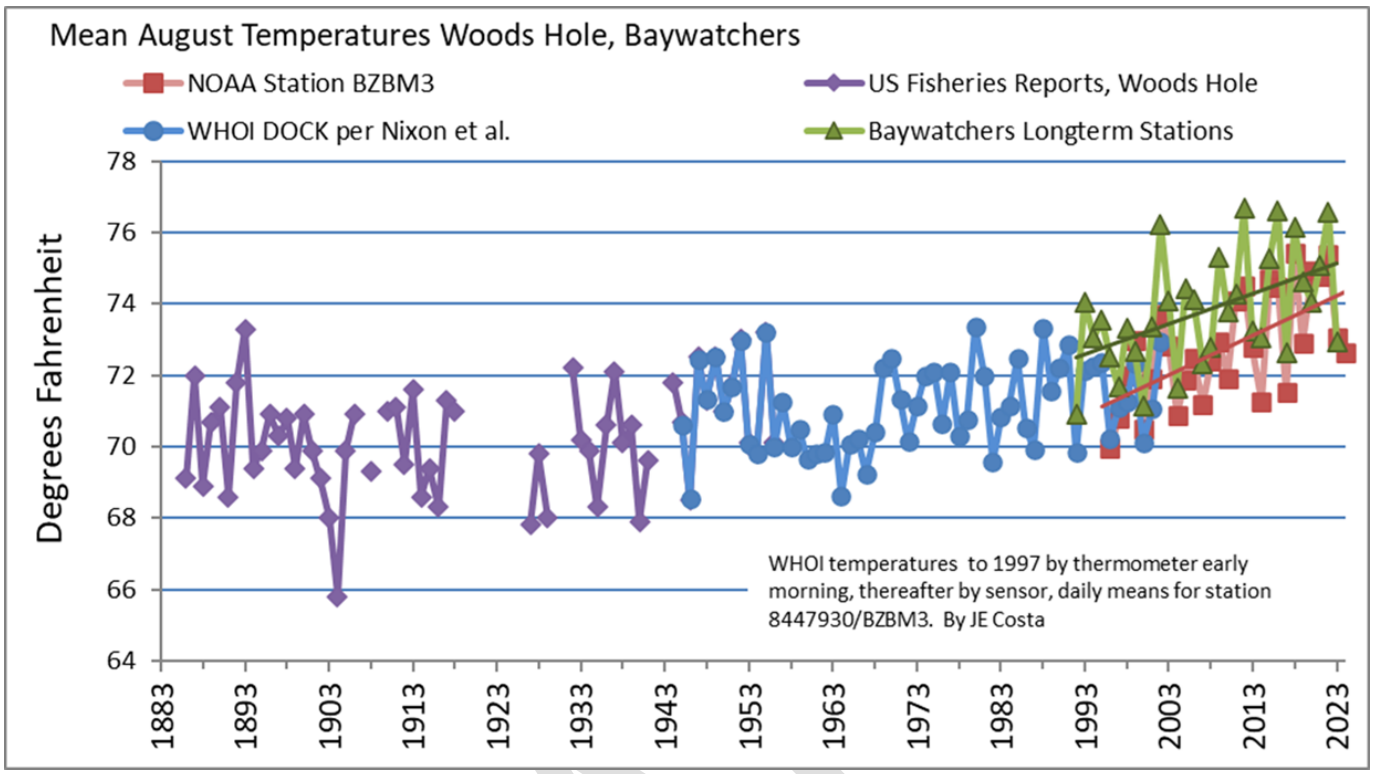


Figure 16. Baywatchers water temperature data compared to various long term records for Woods Hole. Trendlines shown for Baywatchers data (typically morning grab samples) and the NOAA Woods Hole tide station (continuous data recorder).

Action Plans most vulnerable. Climate stressors least affect the goals to manage boating impacts, educate the public, reduce trash, reduce petroleum pollution, and monitor implementation of the CCMP. In the sections below we summarize in more detail where ongoing and future trends in climate stressors will most affect CCMP goals and objectives.

Temperature

Air temperature can affect terrestrial species and help warm fresh and marine waters. Between 1895 and 2011, air temperatures in the Northeast U.S. rose by almost 2°F. However, by the 2080s, some models project a warming air temperature between 4.5°F to 10°F (Horton et al. 2014), with the frequency, intensity, and length of heat waves also increasing. While heat waves are a threat to human health and stress biota, increases in mean summertime and wintertime temperatures, and changes in dates of first and last frosts, will affect bird migration, species growth, timing of life events, reproductive success, and the geographic range of many species, which will generally shift northward.

Changes in water temperatures will occur concurrently with air temperature. Figure 9 shows average August temperatures for long-monitored Baywatchers stations compared to historic and recent data from a monitoring station at the Woods Hole Oceanographic Institution and National Oceanic and Atmospheric Administration (NOAA) fisheries station in Woods Hole. Both data sets show a similar rate of temperature increase (0.8 and 1.1 °F per decade respectively). Increased water temperatures cause range shifts in species, with cooler water species declining in abundance, and warm water species increasing. The decline in lobster abundances in Narragansett Bay has been attributed to increased stressful summertime water temperatures coupled with shell disease and the increase of an invasive crab species (Wahle et al. 2015). These processes have likely caused the disappearance of Buzzards Bay lobsters since the 1980s.

In the 2023 climate vulnerability analysis, increasing water temperatures were identified as having a high severity of impact for achieving the goals of Action Plan 1 Managing Nitrogen Pollution. This is because warmer water holds less oxygen, and increased water temperature increases the growth of algae, decreasing transparency, increases plant and animal respiration, and increases decomposition of organic matter. These

responses all contribute to low oxygen, more rapid algal growth, decreased water transparency, and increased nutrient fluxes of ammonium from benthos. These processes collectively lead to low oxygen or anoxic conditions causing death of fish and shellfish. Warmer water creates added stress to eelgrass survival on top of eutrophication shading effects. Collectively, these changes will further degrade water quality for any given watershed and increase nitrogen load. Other climate stressors like increased precipitation will compound the effects of temperature. Consequently, existing adopted TMDL targets may prove inadequate to restore water quality and habitat because lesser rates of loading may result in the same water quality degradation.

Warmer water temperatures were also identified as posing a moderate to high risk of affecting goals of Action Plan 9 Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species, particularly for cold water marine species and freshwater stream fish species, and potential geographic range shifts - with species that were previously abundant moving north and new species coming into Buzzards Bay.

Warmer water temperatures will enhance the survival of fecal bacteria in sea water. The combined effects of greater stormwater discharges of bacteria and nutrient pollution will contribute to increased swimming beach and shellfish growing area closures. These changes will require treatment of greater volumes of stormwater and make it more challenging to achieve goals in Action Plan 2 Protecting and Enhancing Shellfish Resources and Action Plan 18 Protecting Public Health at Beaches.

Another identified concern with temperature increases in Buzzards Bay include enhanced survival of certain invasive species that may degrade both freshwater and salt-water wetlands (Action Plan 11 Managing Invasive Species).

Changes in Precipitation

A warming climate also changes precipitation patterns, including seasonality, intensity of storms, and annual volumes. Since 1950, increased averaged global temperature has resulted in an overall increase in volume and intensity of global precipitation, although at the same time, certain regions are experiencing agricultural and ecological droughts (Masson-Delmotte et al. 2021). For the Northeast, models predict an additional 7-14% increase of annual precipitation by the year 2100, mostly the result of increased rainfall in cooler months (Frumhoff et al. 2007; Melillo, Richmond, and Yohe 2014). Annual precipitation for New Bedford increased during the past century (Figure 10). Between 1958 and 2012, heavy precipitation events in the Northeast U.S. increased more than 70%, more than in any other region in the U.S. (Melillo, Richmond, and Yohe 2014). This increase is evident in the number of precipitation events greater than 1 inch in East Wareham, MA weather station data (Figure 11).

Collectively, these shifts in precipitation will strain stormwater management networks designed for less intense storms and lesser volumes. For stormwater treatment systems very close to shore, groundwater levels may rise as sea level rises affect infiltration of existing systems. Overall, Buzzards Bay may concurrently see an increase in annual precipitation and

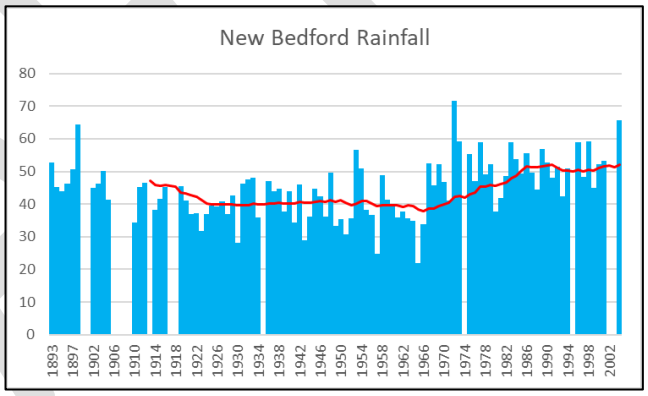


Figure 17. New Bedford annual precipitation with 20-year rolling average (red line). Years with incomplete data omitted. Data for New Bedford COOP station GHCND-USC00195246 (Data downloaded from NOAA Find Weather Stations). Prepared by Joe Costa.

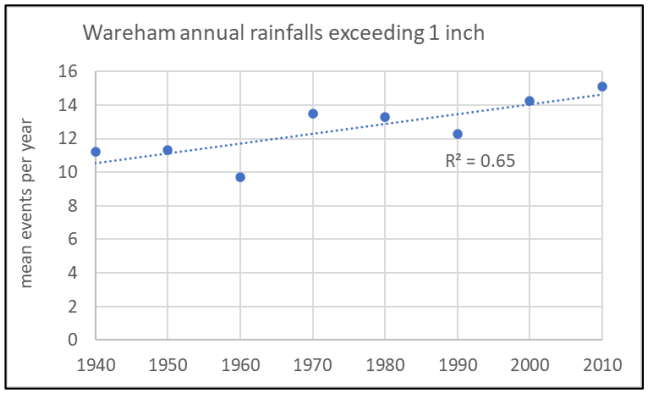


Figure 18. Wareham decadal mean annual number daily precipitation events exceeding 1 inch. Data for East Wareham COOP station GHCND-USC00192451.

more frequent intense storms, but with a potential increase in summer droughts.

Several actions plans were identified as having a medium or high likelihood that increased precipitation, storminess, and summer droughts could make reaching water quality and living resource goals more difficult. Increased storminess and precipitation was the greatest concern for Action Plan 2 Protecting and Enhancing Shellfish Resources, Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure, and Action Plan 17 Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms. Runoff from more frequent and intense extreme precipitation events will contribute to expansion in the geographic extent and duration of shellfish bed closures. Increased volume of precipitation on impervious surfaces connected to sewer networks increases CSO discharges or wastewater facility failures causing more frequent emergency shellfish bed closures between Westport and Marion. Increased storm intensity also threatens aquaculture hard infrastructure.

In Action Plan 1, increased precipitation intensity may increase the frequency of discharges from combined sewer overflows resulting in increased N-loading to New Bedford waters. Similarly increased precipitation may change nutrient input loads and patterns conveyed by rivers. Increases in stormwater in combined sewer systems and illicit connections can reduce treatment facility capacity and nitrogen removal efficiency.

In some parts of the watershed, increasing summer drought will reduce groundwater levels impacting drinking water supply availability (Action Plan 10 Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies). Although not identified as a high risk in the assessment, the MDPH has found a strong link between summer rainfall and beach closures, so there is a strong likelihood that increased storminess will result in increased frequency and duration of beach closures (Action Plan 18 Protecting Public Health at Beaches).

Sea Level Rise

Sea level has risen hundreds of feet since the last ice age. Scientists predict the rate of relative sea level rise [9] will increase along the Northeast U.S. coastline. Figure 12 shows the ninety-year tidal records for Woods Hole and Newport. For the long-term record, both locations show an average annual increase of 3.0-3.1 mm per year, which equals about 1 foot per century. However, the average for the last two Metonic tidal cycles (previous 38 years) shows the more recent rate of increase of 4.8 to 5.5 mm per year (1.6 to 1.8 ft per century). Sweet et al. (2022) have estimated that in the next 30 years (2020-2050), sea level will rise 10 - 12 inches.

Increased sea level rise will worsen the effects of storms and tidal surge of vulnerable areas. Increases in the rate of sea level rise will strain coastal ecosystems and their ability to adapt to change. While salt marshes have naturally migrated inland for thousands of years, development and infrastructure will obstruct or occlude such marsh migration. Salt marsh islands are unable to migrate, and where sedimentation rates on the marsh are less than the rate of sea level rise, marsh islands will disappear. The accelerated rate of island marsh loss is observed in the Westport River (Figure 20) (Buzzards Bay Coalition 2017; Costa and Weiner 2017).

Sea level rise was identified as a risk to goals in several Action Plans. Increasing rates of sea level rise will be most impactful to Action Plan 17 Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms. Sea level rise is contributing to an increasing rapid marsh loss in Buzzards Bay (Action Plan 7 Protecting and Restoring Wetlands). Sea level rise will cause sea water intrusion into sewer networks through CSOs, reducing wastewater treatment capacity and nitrogen removal efficiency (Action Plan 1). Sea level rise will result in saltwater intrusion of some drinking water supplies and increase pressure on those not impacted (Action Plan 10). The Town of Fairhaven lost one of its drinking water wells to this effect after Hurricane Bob in 1991. Sea level rise will lead to public beach loss, a threat to nesting habitat for endangered and threatened shore birds (Action Plan 9), and increased desire for armoring the coast hindering marsh migrations and longshore sediment transport.

[9] Relative sea level rise is the net change in sea level relative to land which may be subsiding or uplifting.

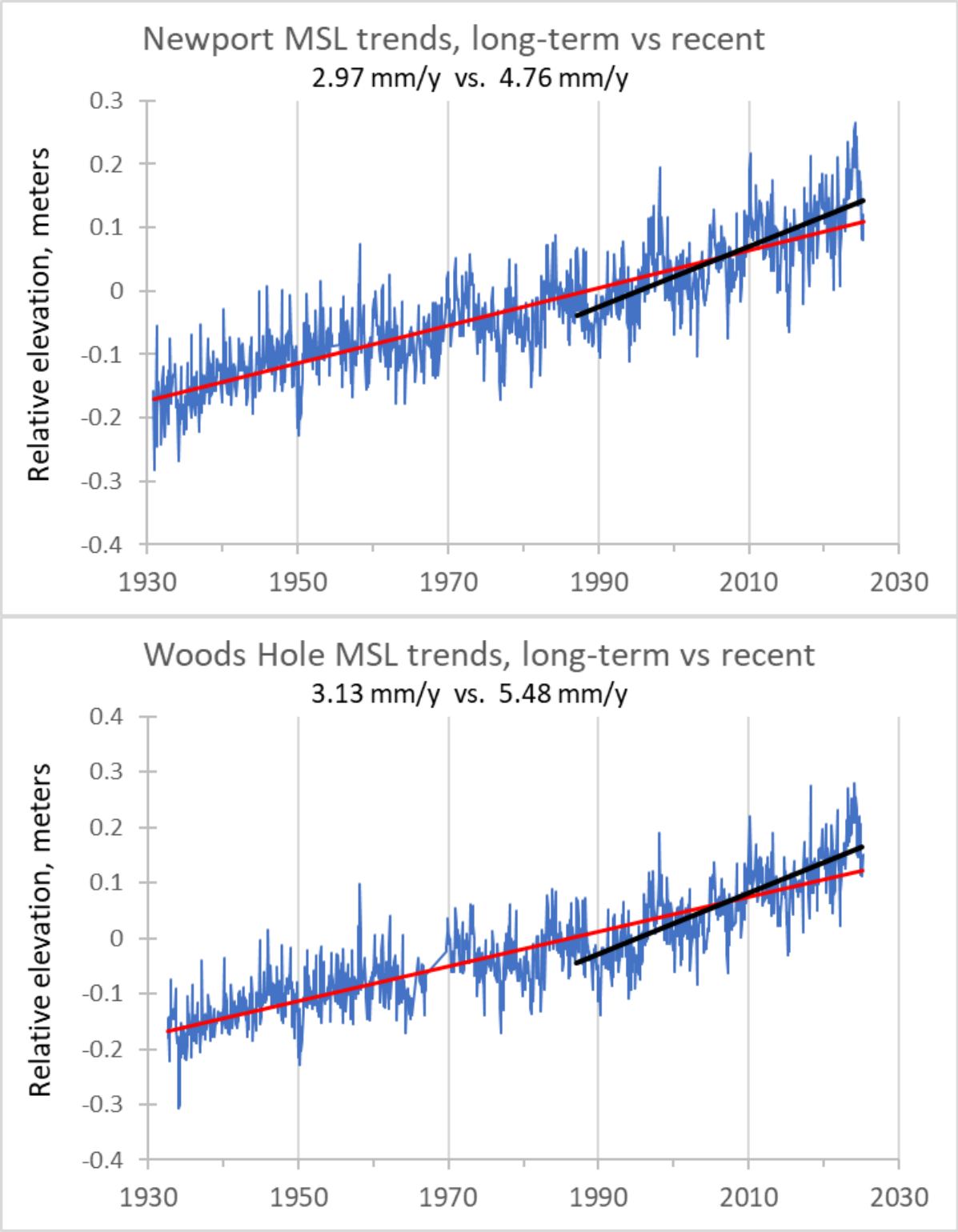
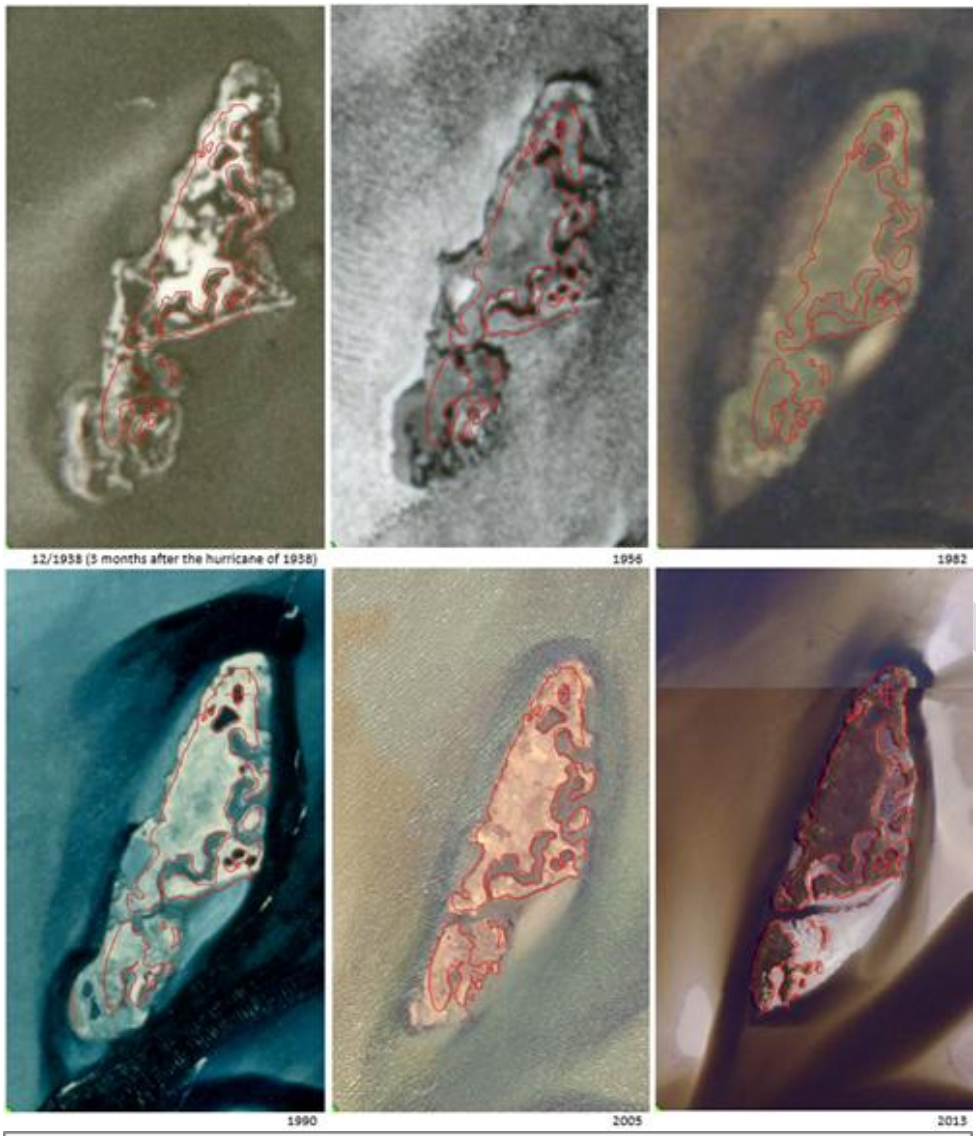


Figure 19. Long-term mean sea level trends for Newport, RI (top) and Woods Hole, MA (bottom) showing long term trends compared to the last two Metonic tidal cyles (38 years, 3/1987 to 3/2025). Data from NOAA Relative Sea Level Trends



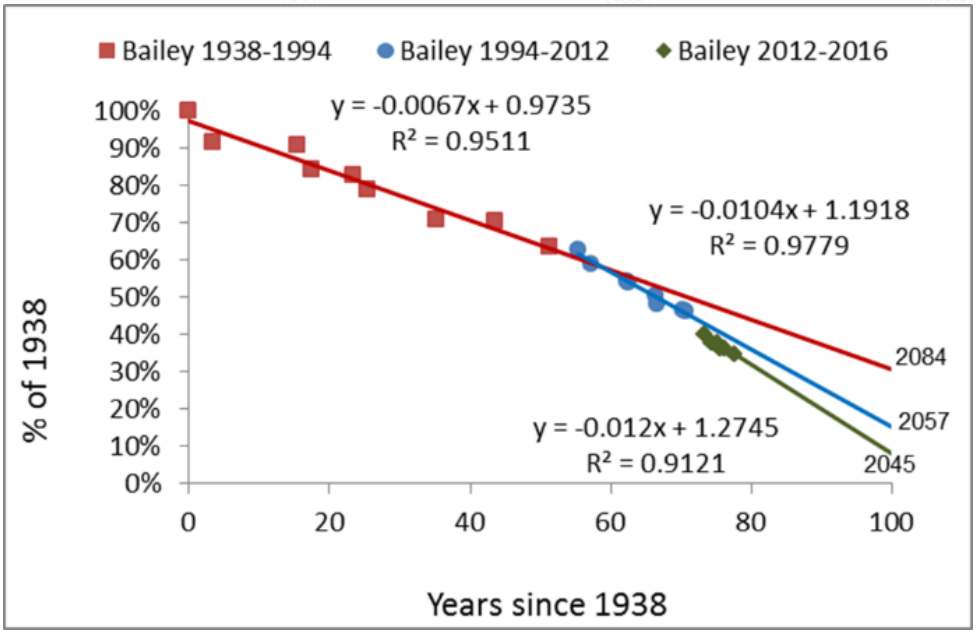


Figure 20. Top: Aerial images of Bailey Flat on six dates. Bottom: Loss trends and estimated dissapearence for three periods during the aerial image record, 1938-2013.

From Costa and Weiner, 2017

Ocean Acidification

Increased CO2 in the atmosphere reduces the pH of precipitation, which in turn lowers the pH and alkalinity of the ocean. This ocean acidification reduces the availability of calcium carbonate in the water, which in turn affects the ability of animals like shellfish and corals to build shells and coral skeletons. This in turn may affect shellfish survival from predators and reproductive success. How reductions in pH and alkalinity in coastal waters (ocean acidification) affect marine animals was identified as a concern in two action plans. Ocean acidification impairs shellfish development, survival, and growth resulting in population declines (Action Plan 2). Ocean acidification may impact additional species besides shellfish. Low pH, particularly in combination with hypoxia, can negatively impact sensitive larval stages of other species (Action Plan 9).

The climate stressor of ocean acidification is an emerging concern with very limited Buzzards Bay-specific data available. The absence of available data led to the addition of a new Objective 2.11, "Support efforts to monitor water pH and carbonate and related impacts to shellfish and other living resources."

Chapter 3. The 2025 Update of the Buzzards Bay CCMP

Clean Water Act and the CCMP

One of the key goals of the federal Clean Water Act is that water quality provides for the protection and propagation of fish, shellfish and wildlife and recreation in and on the water. For estuaries that Congress designates to be of national significance, Clean Water Act Section 320 (the National Estuary Program) requires each NEP to develop a CCMP consistent with the Clean Water Act (Table 4) and meeting EPA guidance. As required in the Act, a CCMP "recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected." A CCMP "contains goals and objectives and provides a long-term framework for action" (EPA 2020 guidance).

CCMPs focus on locally actionable solutions to address estuary-specific problems. A CCMP is a consensus approach of the Buzzards Bay NEP's Management Conference, and all the participants involved. A CCMP defines the collective goals, objectives, and actions needed by the participants in the conference. The Buzzards Bay Management Conference, which included government agencies, non-profits, and various public and private interests defined the priorities, goals and objectives of the 1991 Buzzards Bay CCMP, and that approach is continued in the 2013 and 2025 updates.

The original CCMP and successive updates are fully consistent with Clean Water Act Section 320 (b) [purpose of the Management Conference].

As described in the Clean Water Act, after completion of a CCMP, the Buzzards Bay NEP's primary responsibility is to develop and promote strategies to help implement the CCMP, monitor the effectiveness of actions taken, and to develop plans and revise strategies to meet CCMP goals. Changes or revisions of goals, objectives, strategies, or targets are included in updates completed every 10 years. The last update of the Buzzards Bay CCMP was in 2013.

Table 4. Clean Water Action Section 320 (b)
PURPOSES OF CONFERENCE

The purposes of any management conference convened with respect to an estuary under this subsection shall be to—

(1) assess trends in water quality, natural resources, and uses of the estuary;

(2) collect, characterize, and assess data on toxics, nutrients, and natural resources within the estuarine zone to identify the causes of environmental problems;

(3) develop the relationship between the in place loads and point and nonpoint loadings of pollutants to the estuarine zone and the potential uses of the zone, water quality, and natural resources;

(4) develop a comprehensive conservation and management plan that—

(A) recommends priority corrective actions and compliance schedules addressing point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the estuary, including restoration and maintenance of water quality, a balanced indigenous population of shellfish, fish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected;

(B) addresses the effects of recurring extreme weather events on the estuary, including the identification and assessment of vulnerabilities in the estuary and the development and implementation of adaptation strategies; and

(C) increases public education and awareness of the ecological health and water quality conditions of the estuary;

(5) develop plans for the coordinated implementation of the plan by the States as well as Federal and local agencies participating in the conference.

(6) monitor the effectiveness of actions taken pursuant to the plan; and

(7) review all Federal financial assistance programs and Federal development projects in accordance with the requirements of Executive Order 12372, as in effect on September 17, 1983, to determine whether such assistance program or project would be consistent with and further the purposes and objectives of the plan prepared under this section.

For purposes of paragraph (7), such programs and projects shall not be limited to the assistance programs and development projects subject to Executive Order 12372, but may include any programs listed in the most recent Catalog of Federal Domestic Assistance which may have an effect on the purposes and objectives of the plan developed under this section.

Who implements a CCMP?

A CCMP is not a work plan for the Buzzards Bay NEP, rather it is a blueprint or course of action for all the management conference participants. The Buzzards Bay NEP's primary responsibility is to develop plans to help implement CCMP goals, and to monitor the effectiveness of actions taken.

The goals and objectives in CCMP Action Plans might require action by a particular agency or level of government. Other goals and objectives might require action by all levels of government, the public, and private entities. In most cases, each level of government may play a different role. For example, local government might have the legal authority to act on a particular goal, while a state agency might only be able to support those activities through grants and technical assistance. In other instances, a state or federal agency must be the lead. The narrative of each Action Plan names those responsible for implementing the goals and objectives.

Differences between the New and Old Plan

We updated the Buzzards Bay CCMP to include a summary of past findings and recommendations from past climate vulnerability assessments conducted by the NEP, and the 2023 Assessment is a companion document to this 2025 Update. Chapter 2 provides an overview of past assessments, and in each action plan we explain how these climate stressors affect the ability to reach specific goals or objectives. We also updated each Action Plan to reflect new information, changed conditions, past successes, changes to laws and regulations, new EPA CCMP guidelines, comments by reviewers, and other concerns. In the development of the CCMP 2025 Update, changes to the goals and objectives were based on sound science and reflect the existing regulatory framework. The 2025 Update also better reflects EEA climate resilience and environmental equity goals.

The 2025 Update is similar in structure to the 2013 update. We removed one Action Plan contained in the 2013 CCMP: Action Plan 15 Managing Coastal Watersheets, Tidelands, and the Waterfront. This action plan was created from other earlier action plans to help focus on the state's Ocean Plan under development at the time. However, with completion of the state plan, goals and objectives relating to Managing Coastal Watersheets, Tidelands, and the Waterfront were moved to other action plans, or deleted where complete or no longer relevant as summarized in Appendix B. In other changes, we moved tables and information contained in Chapters 2 and 3 of the 2013 update (*Buzzards Bay: Its Watershed, Living Resources, and Governance* and *Characterization of Pollution Sources*, respectively, to Chapter 1 and to relevant action plans in this update. We rewrote Chapter 5 in the 2013 plan (*Implementing the Buzzards Bay CCMP*) into Chapter 5 Finance Strategy to more clearly articulate how the CCMP actions will be financed.

Each Action Plan in the CCMP first defines the problem or issue facing the bay or watershed, then articulates overarching goals. These goals are aspirational and without a deadline. Each Action Plan also articulates Objectives, which are key intermediate steps needed to achieve the overarching goals. Each Action Plan also identifies resources that will benefit, and the role of entities responsible for implementing actions or achieving objectives. We identify actions eligible for funding or required by Section 320 of the Clean Water Act. Some objectives may include measurable targets and timelines (e.g., numbers of acres of open space protected by 2035). The objectives are not an exhaustive list of all actions in support of the goals but identify important action items that NEP management conference members and all levels of government should implement through changes in laws and regulations, technical assistance, or funding. We added some new research-related objectives to highlight essential information needed to achieve or assess the goals and objectives of that Action Plan.

After the problem, goals, and objectives, a Management Approaches section describes what must be done to remedy the problem and who must take action. Next the costs of those actions are summarized with options to finance those costs. Finally, in the Measuring Success sections we describe how the NEP and management Conference participants can track progress toward meeting the goals and objectives. Because many Action Plans have complex problems, solutions, or regulatory framework, many action plans include an Additional Information section where we provide these insights.

We looked to improve the clarity and conciseness of the wording and make it more accessible to a general audience. Some changes proposed are minor word changes. Other changes include adding additional concepts (like climate resilience) or represent complete re-writing of sentences to improve clarity. Some new

goals and objectives were also added either to address new topics or understandings (e.g., climate), or specific important research questions that should be answered to better define management actions needed. For example, in the Reducing Toxic Pollution in the objective relating to contaminants of emerging concern, we specifically call out per- and polyfluoroalkyl substances (PFAS) and microplastics. Appendix A provides a line-by-line summary of changes of action plan titles, goals, or objectives and each Action Plan introduction summarizes key changes from the 2013 version.

The Buzzards Bay Steering Committee, the BBAC, and the Buzzards Bay Science Advisory Committee, and various agency staff reviewed this document.

Action Plan 1. Managing Nitrogen Pollution

Problem

Excessive nitrogen inputs to coastal waters, often called coastal eutrophication or nitrogen loading, can dramatically increase the growth and abundance of algae. Increased abundance of macroalgae ("seaweeds") and microalgae (phytoplankton in the water; periphyton growing on surfaces) can have many adverse effects and contribute to water quality degradation and the loss of habitat and living resources (Figure 21). Excessive algal growth causes the loss of eelgrass beds through shading, and there has been a widespread loss of eelgrass in Buzzards Bay during the past 40 years (Figure 22). Dense layers of macroalgae can also accumulate on the bottom of some shallow bays, which destroys habitat for shellfish and other invertebrates. Algae consume more oxygen than they produce at night and during cloudy periods. This effect, combined with the decay of macroalgae on the bottom depletes oxygen in the water which can kill fish and shellfish and release unpleasant odors. Excess nitrogen promotes coliform bacteria, contributing to closures of shellfish areas. Algae blooms and accumulation of seaweed are aesthetically displeasing and can discourage recreational use of water such as swimming and boating. Eutrophication exacerbates the effects of ocean acidification which may cause thin brittle shells in shellfish (Rheuban et al. 2019).

The response of coastal ecosystems to excessive anthropogenic nitrogen inputs is complex but is most adverse where the amount of nitrogen added is large compared to the volume of the receiving water, especially in estuaries with restricted tidal flushing. These nitrogen sensitive embayments [10] are most likely to show the impacts described above. In embayments receiving river discharges high in tannins and humic material (brown river water), the effects of nutrient inputs are exacerbated by the reduced light penetration and water warming caused by the receiving water characteristics. Overall, the addition of excess nitrogen is one of the most serious long-term problems threatening many embayments around Buzzards Bay. Excess nitrogen inputs can also degrade offshore areas as well as drinking water supplies in the watershed.

The relative importance of nitrogen sources varies greatly among Buzzards Bay watersheds. In Apponagansett Bay, the watershed is mostly sewered so other sources like stormwater are the largest nitrogen source from land. In Westport, agricultural sources

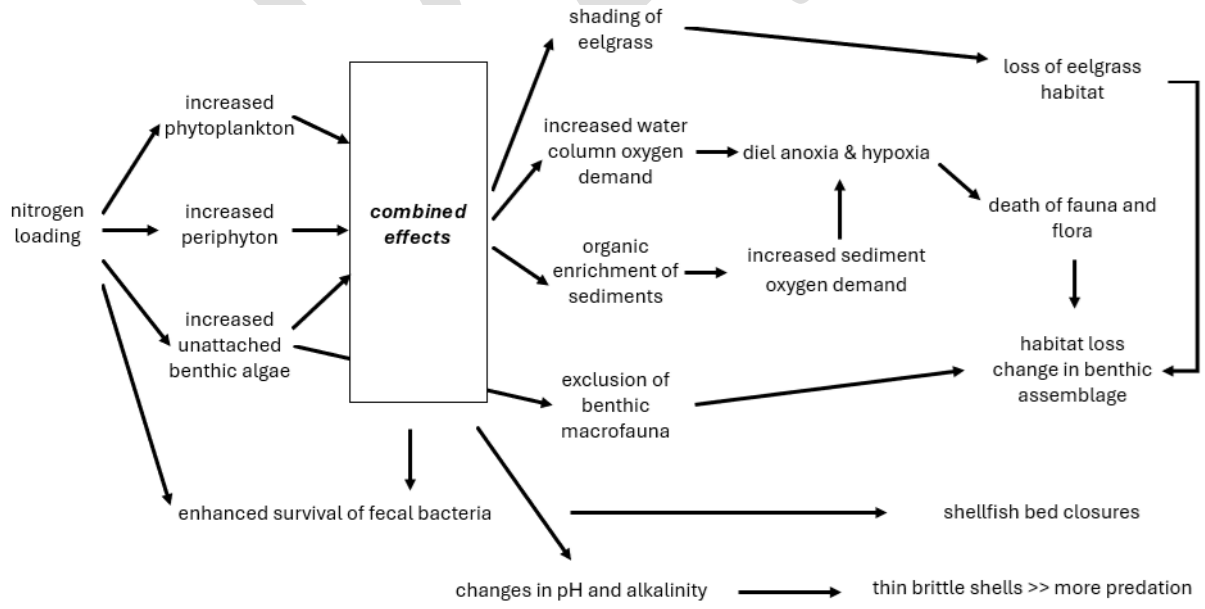


Figure 21. Generalized ecosystem response of a shallow embayment to nitrogen loading.

Modified from Costa et al., 1992.

[10] "Nitrogen sensitive embayments" were a major focus of the 1991 Buzzards Bay CCMP and 2013 update. We have broadened the scope of this action plan to accommodate DEP's 2023 expanded designations of "nitrogen sensitive areas" and nitrogen impaired water bodies.

(farm animals and agricultural fertilizer) are the largest source of nitrogen. Over time, nitrogen sources can vary greatly. Changes may be due to new developments served by onsite systems, expansion of sewering, or introduction of new sources, like the creation of composting facilities on agricultural sites that may discharge large nitrogen loads to groundwater. In 2024, Massachusetts passed a new law that allows accessory housing units on lots zoned for single family use. Where this occurs in unsewered areas it may result in unanticipated watershed nitrogen loads. The dynamic nature of watershed nitrogen loading requires adapted management approaches, and municipal boards of health and other town boards must take action to ensure they meet water quality goals.

As required by the Clean Water Act, the Massachusetts Department of Environmental Protection (MassDEP) prepares an Integrated List of Waters that reports water bodies adversely affected by human activities including nitrogen pollution [11] (Figure 16). For these nitrogen impaired water bodies, federal regulations require the development of watershed nitrogen total maximum daily load (TMDL) studies to quantify nitrogen sources and prescribe load reductions needed to restore water bodies. Between 2005 and 2020, through the Massachusetts Estuaries Project[12], MassDEP completed many studies that resulted in dozens of watershed nitrogen TMDLs for embayments on Cape Cod and Buzzards Bay. However, MassDEP has not completed TMDL technical reports for 13 Buzzards Bay embayments identified as nitrogen impaired Table 5).

The primary sources of anthropogenic nitrogen causing this degradation are wastewater disposal, fertilizer use, and atmospheric deposition. Important fertilizer sources include lawns, golf courses, and agricultural land. Nitrogen from watershed sources enters the bay via streams, groundwater, stormwater runoff, and wastewater discharges. Direct atmospheric deposition of nitrogen from fossil fuel combustion can also be a large nitrogen source.

The relative importance of each nitrogen source varies with the embayment watershed. In the Westport

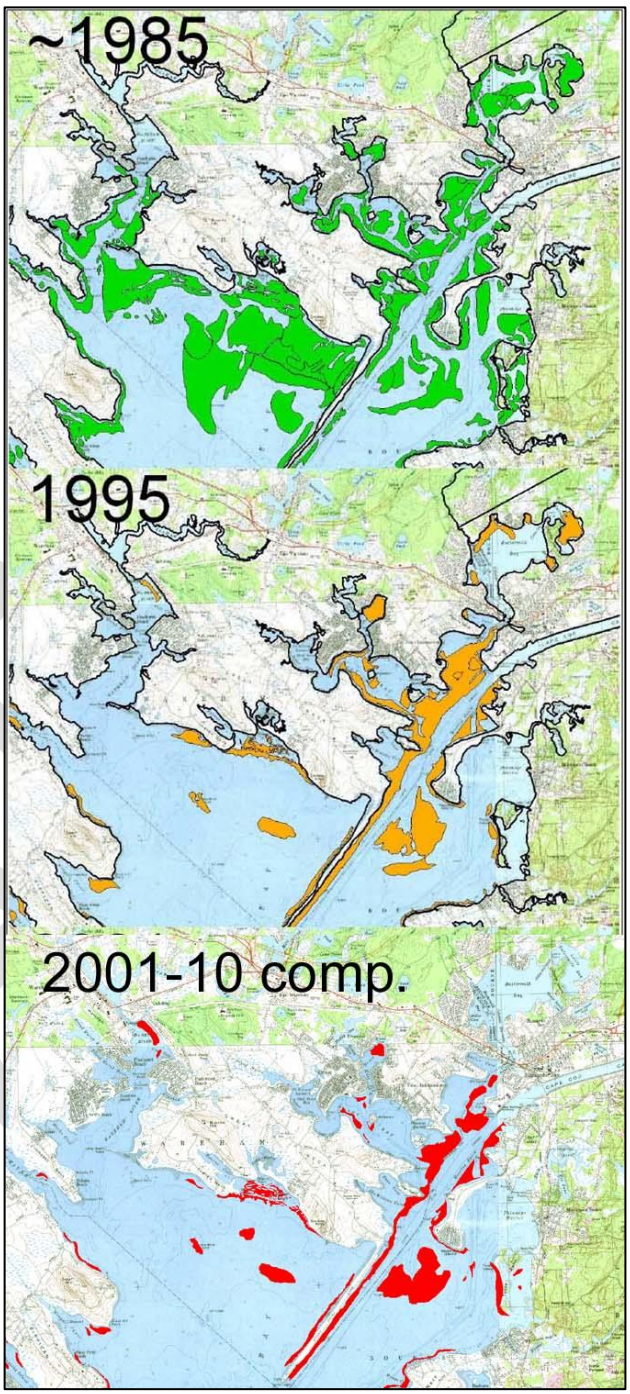


Figure 22. Losses of eelgrass in northern Buzzards Bay between 1985 and 2010.

Top panel from data in Costa 1988a,b from NEP eelgrass web page, middle panel from MassDEP eelgrass surveys, data posted at MassGIS, bottom from MassDEP 2001, 2006, and 2010 maps.

[11] Section 303(d) of the federal Clean Water Act requires states to prepare reports called "Integrated Lists of Waters" to identify impaired water bodies with lost or impaired beneficial uses, including those waterbodies they do not expect to meet surface water quality standards after permitted discharges are treated.

[12] MassDEP created the Massachusetts Estuaries Project in 2001 to assess 89 embayments on Cape Cod and in Buzzards Bay.

River, dairy farms and other farm animal waste accounted for 57% of the controllable unattenuated watershed nitrogen loading (Howes et al., 2012). In the sewered Apponagansett Bay watershed, animal waste from a zoo, stormwater, and atmospheric deposition on the estuary were the important nitrogen sources. In Wareham and Carver, fertilizer used on cranberry bogs is the largest nitrogen source in some estuary subwatersheds.

However, in most embayment watersheds, the largest locally controllable [13] watershed nitrogen source is wastewater discharged either from sewage treatment facilities or onsite septic systems, primarily serving homes. All conventional septic systems release appreciable amounts of nitrogen which discharges to groundwater, eventually reaching the ocean [14]. Nitrate in groundwater flows great distances without attenuation and often with little chance of uptake by plants.

[13] DEP includes septic systems, wastewater treatment facilities, fertilizers, stormwater runoff, and landfills as locally controllable.

[14] Septic systems discharge nitrogen as ammonia and organic nitrogen. This nitrogen converted to nitrate and nitrogen gas in aerated soils above the water table. Nitrate reaching groundwater can travel great distances with little loss. Cesspools and leaching fields in the water table or close to waterbodies can have an anaerobic effluent plume and contribute more nitrogen to the receiving waters.

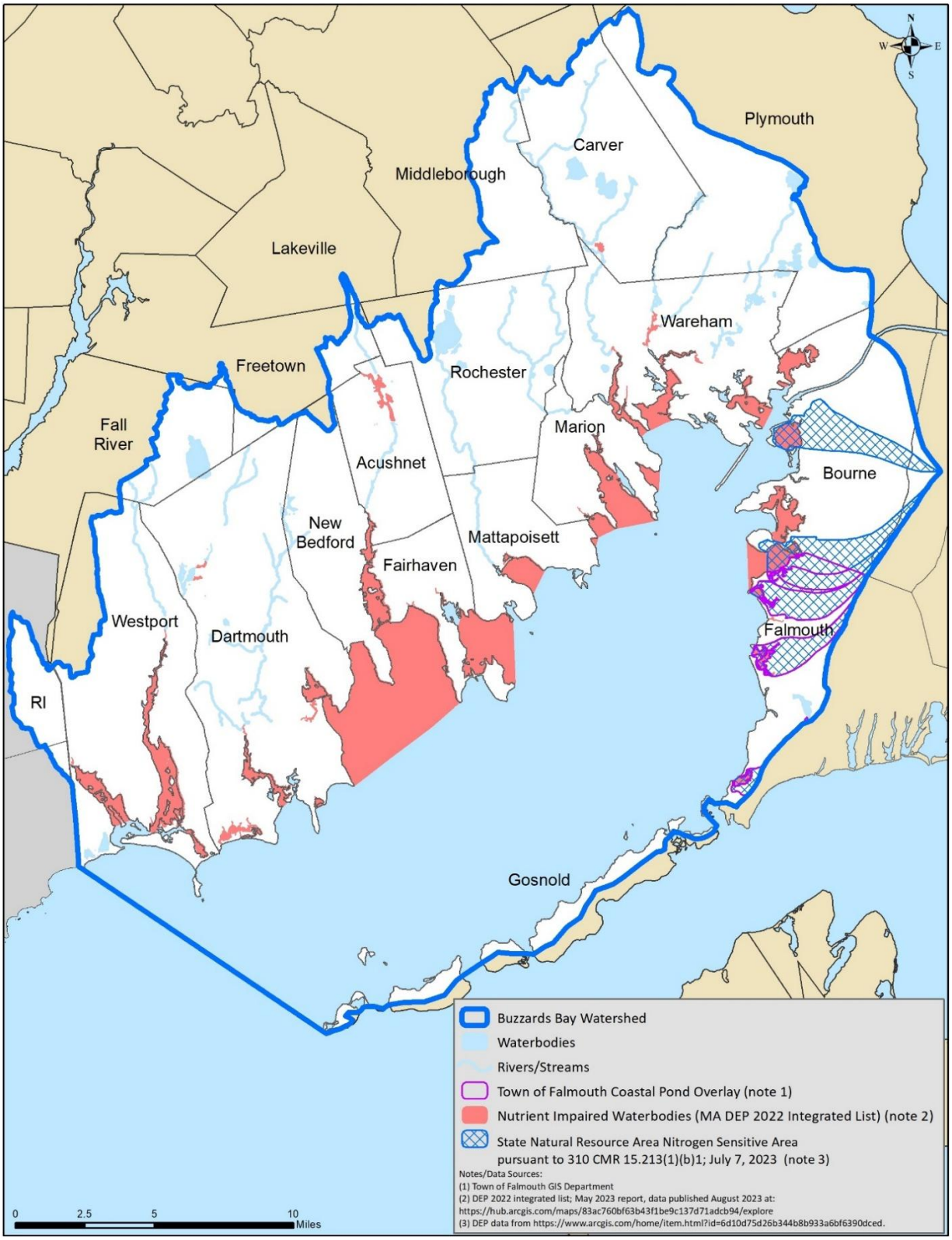


Figure 23. Coastal embayments impaired for nitrogen in Buzzards Bay.

Based on DEP's *Massachusetts Year 2022 Integrated List of Waters, Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act,* and a companion MassGIS coverage. In the future, MassDEP may add or remove impaired embayments as new information becomes available.

Table 5. Status of technical reports and TMDLs for nitrogen impaired Buzzards Bay embayments defined as impaired in MassDEP's 2022 Integrated Report[a] (shown in Figure 16). The listed estuaries may incorporate more than one "segment" on the state list of waters.

Town	Estuary (ies)	Technical Report	EPA TMDL Approval
Bourne/ Wareham	Buttermilk Bay	none	
Bourne	Red Brook Harbor & Hen Cove	BBC study underway	
Bourne	Pocasset Harbor	BBC study underway	
Bourne	Megansett/Squeteague Harbors	2015 final	Approved 2020
Bourne	Pocasset River	none	
Bourne	Phinneys Harbor/Eel Pond/ Back River System	final 2006	Approved 2008
Dartmouth	Allens Pond	none	
Dartmouth	Salters Pond	none	
Dartmouth	Slocums River	revised final 2012*	Approved 2019
Dartmouth	Little River	revised final 2012*	Approved 2019, Preventative TMDL
Dartmouth	Apponagansett Bay	Massachusetts Estuaries Project, draft 2013, new BBC study underway	
Fairhaven	Nasketucket River	None, category 5	
Fairhaven	Little Bay/Nasketucket Bay	Nasketucket Bay final 2013	Loss of eelgrass, MassDEP lists as estuarine bioassessment Impairment for nitrogen related causes and additional study is needed
Falmouth	Herring Brook	none	
Falmouth	West Falmouth Harbor	final 2006	Approved 2008
Falmouth	Megansett & Squeteague Harbors	final 2015	Approved 2020
Falmouth	Fiddlers Cove	final 2013	Approved 2018
Falmouth	Rands Harbor	final 2013	Approved 2018
Falmouth	Quissett Harbor	final 2013	Approved 2018
Marion/Mattapoisett	Aucoot Cove	none	
Marion	Sippican Harbor	none	
Marion	Wings Cove	none	
Mattapoisett	Eel Pond	none	
Mattapoisett	Hiller Cover	none	
Mattapoisett	Mattapoisett Harbor	none	
New Bedford	Acushnet River/ New Bedford Inner Harbor	final 2015*	Approved 2024
Wareham	Agawam/Wareham/Broad Marsh Rivers/Marks Cove	final 2014*	Approved 2024
Wareham	Onset Bay	none	
Wareham/ Marion	Weweantic River	none	
Westport	East & West Branches Westport Rivers	final 2013	Approved 2017

[a]Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle (2022 Integrated Report; MassDEP, 2023)Approval dates from EPA list of approved TMDLs in Massachusetts.

Only in two Buzzards Bay embayment studies were municipal wastewater facility discharges identified as the largest nitrogen source (West Falmouth Harbor and New Bedford Harbor, which receives inputs from the Fairhaven facility and New Bedford CSO discharges). In most TMDL studies on Cape Cod, onsite septic systems average 57% of controllable estuary watershed nitrogen loading.

State and federal agencies regulate permitted discharges like wastewater facility outfall pipes and can set limits on the volume and concentration of pollutants released to meet water quality standards. For example, in the 1990s MassDEP used Buzzards Bay NEP nitrogen loading recommendations for the Wareham River estuary to set a 4ppm total nitrogen discharge concentration limit for the Wareham wastewater treatment facility. Similarly, EPA used the 2015 New Bedford Inner Harbor technical memo to set the most recent Fairhaven NPDES permit. However, controlling nitrogen from non-point sources like onsite septic systems and stormwater discharges is more challenging, and requires the development and implementation of local watershed plans. Local watershed plans typically focus on municipal sewer expansion, improved nitrogen removal at municipal wastewater facilities, or requiring nitrogen removing onsite septic systems. As described in the Costs and Financing section below,

the cost of implementing these plans will total billions of dollars.

Goals

Goal 1.1. Prevent degradation of water quality and loss of habitat and living resources caused by excessive nitrogen inputs.

Goal 1.2. Restore water quality and losses of habitat and living resources caused by excessive nitrogen inputs.

Objectives

Objective 1.1. Promote the development and execution of local nitrogen management plans to manage nitrogen sources to meet Total Maximum Daily Load limits and waste load allocations.

Objective 1.2. State and federal agencies must support Buzzards Bay municipal efforts to adopt and implement watershed permits, watershed management plans, and comprehensive wastewater management plans to reduce nitrogen loading to state-designated Nitrogen Sensitive Areas and other impaired waters.

Objective 1.3 By 2035, MassDEP completes science-based watershed nitrogen loading studies for all impaired Buzzards Bay embayments. Ensure that resulting EPA-approved Total Maximum Daily Loads include required margin of safety calculations that account for climate stressors like temperature, precipitation, and acidification that may worsen effects of coastal eutrophication.

Objective 1.4. Reduce nitrogen loads to nitrogen-impaired embayments to meet EPA-approved watershed nitrogen Total Maximum Daily Load limits and waste load allocations.

Objective 1.5. Regulators should ensure new additions of nitrogen to coastal waters do not cause, or contribute to, a violation of state surface water quality standards, or exceed EPA-approved watershed nitrogen Total Maximum Daily Load limits.

Objective 1.6. Regulators should ensure that federal surface water and state groundwater discharge permits set limits that meet nitrogen loading limits and waste load allocations specified in approved Total Maximum Daily Load limits.

Objective 1.7. Promote the continued development and use of new or improved nitrogen-reducing wastewater treatment technologies at all scales of flow (from onsite systems to municipal scale).

Objective 1.8. Monitor water quality and natural resources (e.g. eelgrass beds, algae, dissolved oxygen), at a sufficient frequency to document management needs, assess the effectiveness of actions taken, and to document ongoing changes and variability in water quality and ecosystems health.

Objective 1.9 Support studies of how changing water temperature and clarity relate to eelgrass loss and incorporate this information along with macroalgal and periphyton cover into an eelgrass health index.

Objective 1.10. Support studies that advance the understanding of the relationship between changing water temperature, influence of increased stormwater volumes, changing precipitation patterns, and acidification, on amounts and chemical forms of nitrogen conveyed to coastal waters and how the changes may affect achieving Total Maximum Daily Load limits.

Objective 1.11. Continue to collect and analyze water temperature and nutrient levels in Buzzards Bay to monitor long-term water quality changes and effectiveness of management action taken.

Objective 1.12. Collect and analyze stream temperature, flow, and nutrient loads to better document seasonal and yearly weather variability on receiving water body quality.

Objective 1.13. Collect and analyze treated and untreated stormwater samples for nutrient loads.

Objective 1.14. Support development of improved groundwater flow and nutrient loading models, including those that account for climate change impacts.

Objective 1.15. Support studies that advance the understanding of nitrogen cycling in sediments of state-designated Nitrogen Sensitive Areas.

Objective 1.16. Encourage adaptive management and performance checkpoints in watershed management planning to address new sources of nitrogen in waterseds to ensure continue progress toward meeting state-designated Total Maximum Daily Loads.

Objective 1.17. Address regulatory gaps in nitrogen management like the control of nitrogen discharges from unlined composting sites on agricultural lands.

Management Approaches

Municipalities will be the lead for many actions to reduce nitrogen, and MassDEP is the lead regulator that requires municipalities and other dischargers to reduce nitrogen. This framework is imperfect, and some sources of nitrogen are poorly regulated. Other agencies and organizations must help and participate in adopting strategies, and towns may need to adopt bylaws or regulations to address gaps in state or federal regulations. This approach can be costly or challenging for municipal government. The Clean Water Act and state and federal regulations define the process for regulatory agencies to show nitrogen pollution impairments and prescribe watershed nitrogen loading limits. While MassDEP has not assessed some small freshwater systems and river segments, they have characterized all estuary and marine segments in Buzzards Bay in the Massachusetts Integrated Lists of Waters. While and Table 4 identify 28 estuary systems as impaired because of nitrogen pollution, other freshwater segments, coastal embayments, or the entirety of Buzzards Bay may be identified as impaired as new information and assessments become available.

After MassDEP identifies a water body as impaired by nitrogen pollution, they must develop a TMDL or an equivalent restoration plan must be undertaken by MassDEP. These technical reports will identify all nitrogen sources to the estuary, estimate the estuary's loading capacity for nitrogen (the maximum amount of nitrogen it can receive without violating water quality standards), and assign nitrogen load reduction targets to different sources ("load allocations"). Watershed nitrogen TMDLs are based on nitrogen loading, water circulation, and water quality models that are approximations of natural ecosystems and their response to reductions in nitrogen loading. Meeting watershed nitrogen TMDL loading targets is required to restore estuaries and achieve narrative or numeric criteria in the Massachusetts Surface Water Quality Standards.

To date, most of these models have used total nitrogen at sentinel stations as the basis for establishing watershed nitrogen loading limits. These total nitrogen targets are meant to be predictive of habitat condition or dissolved oxygen concentrations. In fact, managers consider the disappearance of eelgrass beds in Buzzards Bay as a key indicator of impairments caused by coastal eutrophication (), and the restoration of eelgrass is typically the management goal for these models and for most approved TMDLs in Massachusetts. Thirteen estuaries still require these technical reports (Table 4). MassDEP has developed a TMDL Strategy that prioritizes impaired waterbodies. In the 2024 report Massachusetts Vision 2.0: Clean Water Act Section 303(d) and Total Maximum Daily Load (TMDL) Development[15] MassDEP's describes its approach to TMDL prioritization including a number of estuaries in Buzzards Bay as noted in the vision statement, "the feasibility of TMDL and Advance Restoration Plan creation will depend on staffing levels, financial resources, policy initiatives, and stakeholder and public support." At the same time, state efforts to expand housing can conflict with nitrogen management goals. However, the law allows for local health regulations to override requirement for increased housing density where nitrogen sensitive areas or TMDLs have been adopted. It is essential that Boards of Health avail themselves of these regulatory provisions.

After MassDEP prepares or funds a technical report, and reviews it, MassDEP prepares and submits a TMDL to EPA Region I for approval. Once EPA approves the TMDL, to restore water quality and living resources, the TMDL must be implemented. This responsibility generally falls to municipalities because they have the greatest authority to manage and regulate most of the controllable nitrogen sources. Implementation of a TMDL or an alternative plan might include more stringent NPDES discharge limits in permits for point sources, restoration strategies like planned expansion of sewer networks, and implementation of stormwater management systems for other non-point sources like agriculture or stormwater. Municipalities can use implementation plans like Comprehensive Wastewater Management Plans (CWMPs), Targeted Water Resources Management Plans (TWMPs) and nine-element watershed-based plans to guide their nitrogen pollution reduction efforts. Continued monitoring of the water body is essential to track progress toward meeting water quality standards and to revise the TMDL nitrogen loading targets if needed.

[15] MassDEP 2024; see also MassDEP's web page The Basics of TMDLs." The vision statement designates the "Onset Bay & Buttermilk Bay System" and Weweantic River Estuary System high priority for TMDL studies, Mattapoisett Harbor Embayment System, Sippican Harbor Embayment System, and Clarks Cove as medium priority. The remaining embayments are currently low priority. This includes Apponagansett Harbor and Pocasset Harbor because of the work already in progress by Buzzards Bay Coalition.

State and federal laws and regulations increasingly require municipal action to reduce nitrogen pollution to impaired waters. Nonetheless, despite 15 of the 28 estuary systems in Buzzards Bay having TMDLs, no municipality has implemented a plan to meet the TMDL. To address this problem, in 2023, MassDEP amended Title 5 onsite wastewater disposal regulations to require municipalities on Cape Cod (Bourne and Falmouth in the Buzzards Bay watershed) to develop and begin implementing local watershed management plans to meet watershed TMDLs in designated "Nitrogen Sensitive Areas.". Municipalities can implement these plans over 20 years. If municipalities do not develop watershed management plans, MassDEP will require replacement of existing onsite septic systems with the best available nitrogen removing alternative wastewater treatment technologies within five years in the watersheds of Nitrogen Sensitive Areas.

At some time in the future Title 5 regulations will similarly designate non-Cape Buzzards Bay embayments with EPA approved watershed nitrogen TMDLs as Nitrogen Sensitive Areas under Title 5. Buzzards Bay embayments on the western shore with TMDLs include the East and West branches of the Westport River, Slocums River, Acushnet River, and the Wareham River. The watersheds of these estuaries include most of Westport, Dartmouth, Acushnet, and portions of Fall River, New Bedford, Wareham, Plymouth, Rochester, and Carver.

In most watersheds, sewering and wastewater treatment at centralized or satellite wastewater treatment plants with nitrogen removal will be the most practical solution to meet watershed TMDL loading targets and restore estuaries and achieve narrative or numeric criteria in the Massachusetts Surface Water Quality Standards. In less developed areas, individual advanced nitrogen removal onsite septic systems and small community scale systems may be part of a solution to treat wastewater.

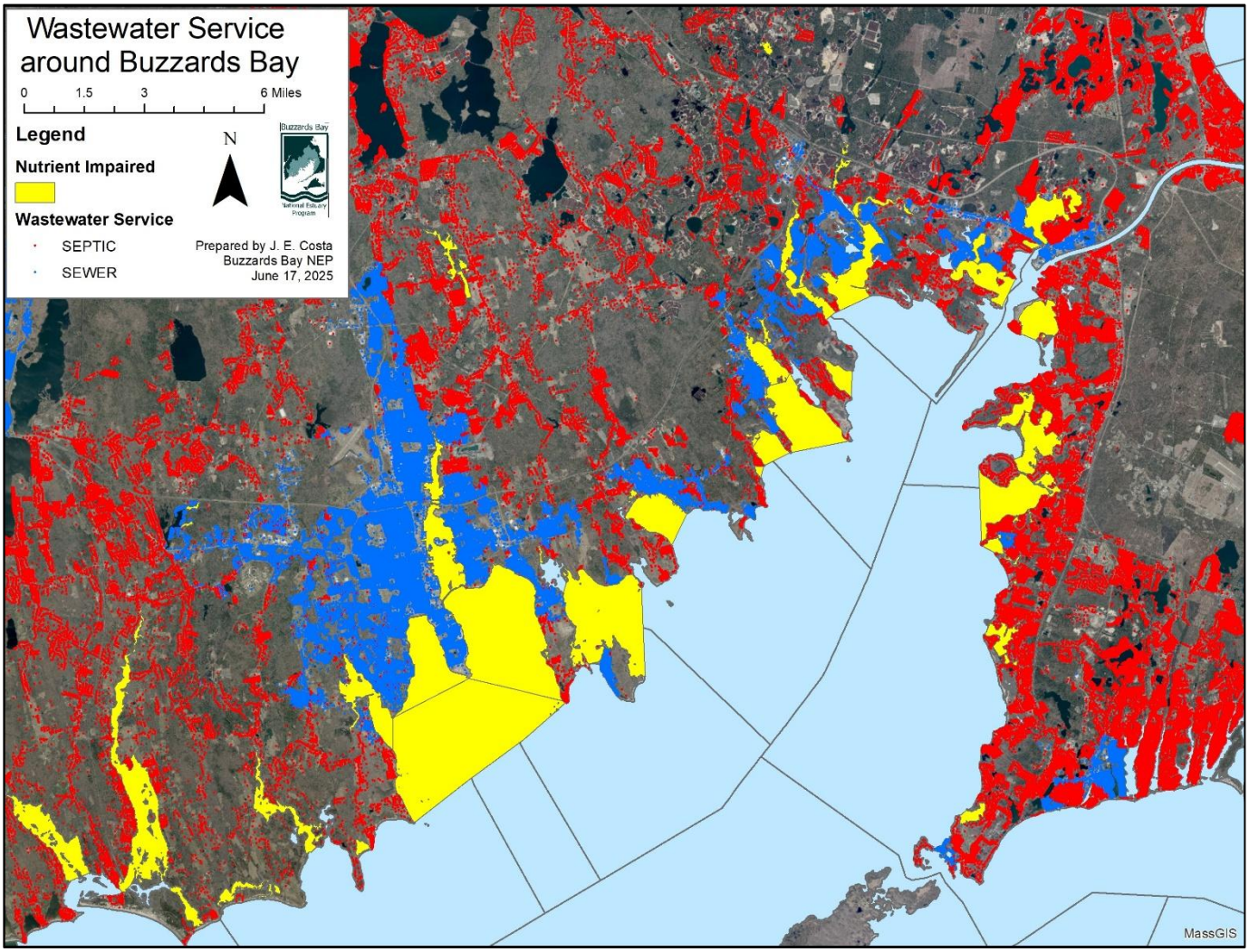


Figure 24. Parcel wastewater service by sewer (blue dots) or onsite systems (red dots) around Buzzards Bay.
Prepared by Joe Costa from Buzzards Bay NEP sewering coverage maps intersected with assessor's parcel data.

Costs and Financing

Technical reports that evaluate estuaries and support TMDL development depend on the size and complexity of the estuary and the quantity and types of nitrogen sources in the watershed. Generally, these technical reports cost $100,000 to $300,000. Costs to meet watershed nitrogen TMDLs are town- and watershed-specific. Costs are site specific and can be volatile, paralleling the volatile costs of material. While municipalities have the greatest regulatory authority to manage non-point sources of nitrogen pollution, they often do not have the practical financial ability to take quick action.

Among the estimated 113,126 residential units in the Buzzards Bay watershed, septic systems serve the wastewater disposal needs of 44,500[16]. Of these, 37,676 residential units with onsite systems are in the watersheds of nutrient impaired embayments (Figure 24). If three-quarters of these were sewered to meet TMDL loading limits[17], the cost to municipalities and homeowners for wastewater facility upgrades and

[16] Based on a Buzzards Bay NEP analysis using assessors data intersected with NEP Sewer history maps. More information in Action Plan 5.

[17] This totals 28,257. In the Westport, New Bedford Harbor, and Wareham River TMDL reports alone, nearly 20,000 homes will need to be sewered.

betterments, system removals, and house tie-ins could total two billion dollars [18].

Homeowner costs include connection fees and septic system decommissioning costs ($4,000 to $8,000 per home), household plumbing retrofit costs if the septic is located behind the home ($1,000 to $2,000 per home), and sewer fees ($400 to $800 per year in Buzzards Bay communities). These costs do not include the costs to upgrade or build municipal wastewater treatment facilities, which might cost hundreds of millions or a billion dollars or more. For comparison, the cost to sewer Cape Cod to meet watershed nitrogen TMDLs will total four to eight billion dollars [19].

Alternative strategies to meet watershed nitrogen TMDLs like replacing conventional septic systems with nitrogen removing onsite systems may not offer savings to homeowners [20], plus the municipality or another responsible management entity needs to oversee and monitor these alternative design systems.

MassDEP funds municipal sewage treatment facility upgrades and sewer expansion through the federally funded Clean Water State Revolving Fund (SRF) program [21]. The program provides municipalities low interest loans spread over twenty or thirty years. Municipalities meet added wastewater facility operation costs through ratepayer fees, and property owners cover sewer connection fees by property assessment betterments. Currently, municipalities have oversubscribed to the SRF loan program with requests to fund wastewater infrastructure, so implementation will likely take decades unless the state and federal government provide more funding [22]. Because of the costs and scale of the needed effort, restoring estuaries will remain one of the most politically and financially formidable challenges to local government.

In a few embayments on Cape Cod, the Massachusetts Estuaries Project recommended the simpler and less costly solution of dredging harbor entrances to increase flushing rates to improve water quality. The Massachusetts Estuaries Project did not find that solution practical for any Buzzards Bay embayment.

Measuring Success

To track progress on this action plan, the Buzzards Bay NEP should track whether MassDEP has assessed, and where needed, developed TMDLs for all of Buzzards Bay. MassDEP should complete this task by 2030. MassDEP tracks whether municipalities have adopted implemented wastewater and watershed plans and supporting regulations, and the Buzzards Bay NEP should monitor the reported progress. The long-term ultimate measure of success of this action plan is the delisting of embayments impaired by nitrogen loading on the state's Integrated List of Impaired Waters, but this may take decades because of the pace of municipal action and the long travel time of nitrogen in groundwater.

To understand embayment health and long-term trends it will be essential to continue several long-term monitoring efforts. Ongoing support of the BBC's Baywatchers Program should continue as this data is the primary mechanism for tracking the effectiveness of this management action and the consequences of inaction. In addition, MassDEP should continue to track eelgrass distribution and abundance every five years. The joint Woodwell Climate Research Center-BBC effort to monitor annual loading of nitrogen in Buzzards Bay streams should also continue to both evaluate the effectiveness of management action, and to better understand nutrient cycling in the watershed.

[18] Calculation: 28,257 systems x $70,000 average total cost per unit; cost includes betterment ties (hundreds to $10,000), facility construction costs and upgrades, sewer line betterment costs (tens of thousands of dollars over decades) homeowner tie costs, system removal and plumbing expenses. 20 years of sewer fees may add an added $15,000 to homeowner costs, or $424 million more. Costs are greater for areas with large parcel size and for municipalities like Westport with no existing wastewater facility and little sewering.

[19] Cape Cod Times, February 27, 2011, Wastewater: Cape Faces Costly Cleanup.

[20] Alternative design nitrogen removing onsite systems typically cost $20,000 to $75,000, with costs usually borne exclusively by the property owner,

[21] DEP Division of Municipal Services and the Massachusetts Water Pollution Abatement Trust jointly administer the program.

[22] The Infrastructure Investment and Jobs Act (IIJA) provides Massachusetts with$1.1 billion over five years for both the Clean Water SRF and the Drinking Water SRF.

Action Plan 2. Protecting and Enhancing Shellfish Resources

Problem

Commercial and recreational harvesting of shellfish (mollusks and crustaceans) has been important in the history of Buzzards Bay, and a focus of the original CCMP. In 2003, DMF estimated [23] the annual value of shellfish harvested from Buzzards Bay was $4 million. Using an economic multiplier effect of 4.5, this catch contributed $18 million to the local economy. While shellfish are an important resource, residents are concerned about increasing water quality closures, diminishing populations, and reductions in public access to those resources. This action plan focuses on two distinct issues: declines in shellfish populations and reduced access primarily caused by regulatory closures.

The decline of some populations of shellfish species is a result of species collapse. Lobster (*Homarus americanus*) catch in Buzzards Bay was significant at the time the 1991 CCMP but rapidly declined through the 1990s. Fisheries scientists have not seen young-of-year (juvenile) lobsters in monitoring programs since 2015. The collapse of the lobster fishery in southern New England is largely due to factors related to warming water temperatures and may be irreversible. Some mollusk species like soft-shell-clam (*Mya arenaria*) have similarly declined in part because warmer waters favor increased predation by invasive and endemic crabs. Declines in bay scallop (*Argopecten irradians*) may in part be related to the loss of eelgrass habitat which is an important settling ground for spat.

Declines of catch of other species simply relate to expanded shellfish closures caused by elevated concentrations of indicator fecal bacteria. Elevated fecal coliform bacteria in the water are both a human health risk and cause economic loss. DMF classifies shellfish beds based on if shellfish are safe for human consumption if eaten raw. DMF classifications are "approved", "conditionally approved", "restricted", "conditionally restricted", and "prohibited". These classifications are based on concentrations of indicator bacteria (fecal coliforms) in the waters over shellfish beds, and other factors that affect shellfish safety. The allowable safe standard is 14 colony forming bacteria units per 100ml. DMF automatically classifies a buffer zone around wastewater outfalls as prohibited to the taking of shellfish. Water circulation models or dye studies define the size of these wastewater outfall prohibited closures. DMF also enacts emergency closures such as when a wastewater facility fails and discharges untreated effluent or when a CSO discharges. These untreated wastewater discharges require a 21-day closure. DMF may also enact emergency closures because of extreme rain events, petroleum spills, or red tides.

DMF closes many designated shellfish growing areas during the summer because average summertime concentrations of fecal bacteria become elevated over the standard. Warmer waters in the summer increase bacteria survival from sources like stormwater inputs. Because of added pollutant loads and increasing elevation and duration of elevated bacteria concentrations during the past two decades, DMF has expanded the area and duration of summer seasonal closures. More broadly, DMF has expanded the size of both permanent and seasonal shellfish bed closures because of many factors including added stormwater discharges from new development, changes to existing development, stricter standards required by the federal government, and more frequent and improved testing procedures. Between 1960 and the early 1990s, the area of shellfish beds closed due to fecal coliform contamination increased dramatically. In 1970, the state closed slightly more than 4,000 acres of shellfish beds in Buzzards Bay; mostly near large wastewater discharges. By 1990, the state had closed more than 16,000 acres (Figure 18).

To offset these trends, some towns [24] developed conditional area management plans with DMF and implemented rainfall conditional programs where shellfish growing areas stay open except for several days following a rain event that exceeds a certain threshold (typically between 0.2 and 0.5 inches). During the 1990s and early 2000s municipalities undertook efforts to reduce discharges including eliminating CSOs, expanding sewer service to densely developed areas and areas with large numbers of old and failing onsite wastewater disposal systems and implementing stormwater treatment programs. After 1991, work by the towns and DMF reduced some pollution sources,

[23] Reported in DMF 2003 newsletter; more recent Buzzards Bay estimates are unavailable.

[24] Westport, Dartmouth, New Bedford, Fairhaven, and Wareham.

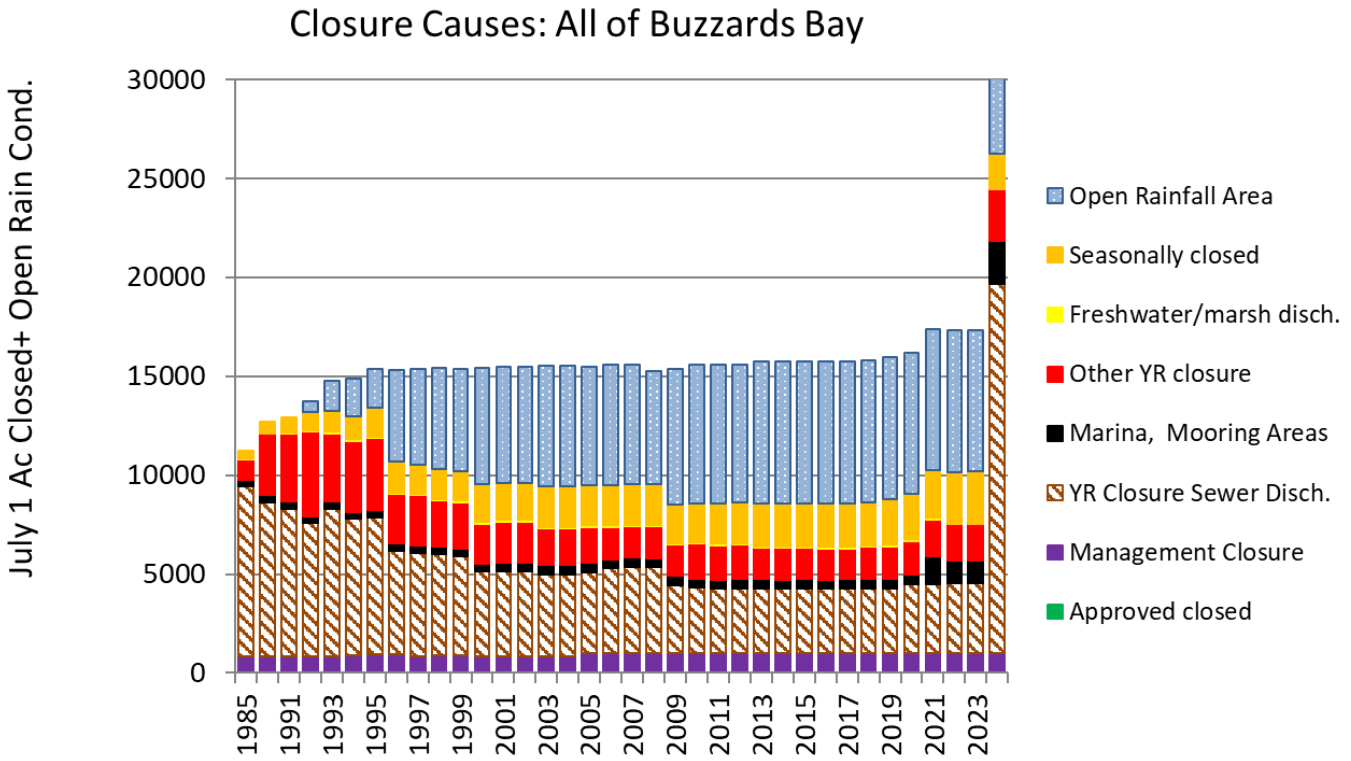


Figure 25. Acres of permanent and rainfall or seasonally conditionally closed shellfish bed acreage in Buzzards Bay on July 1 of each year.

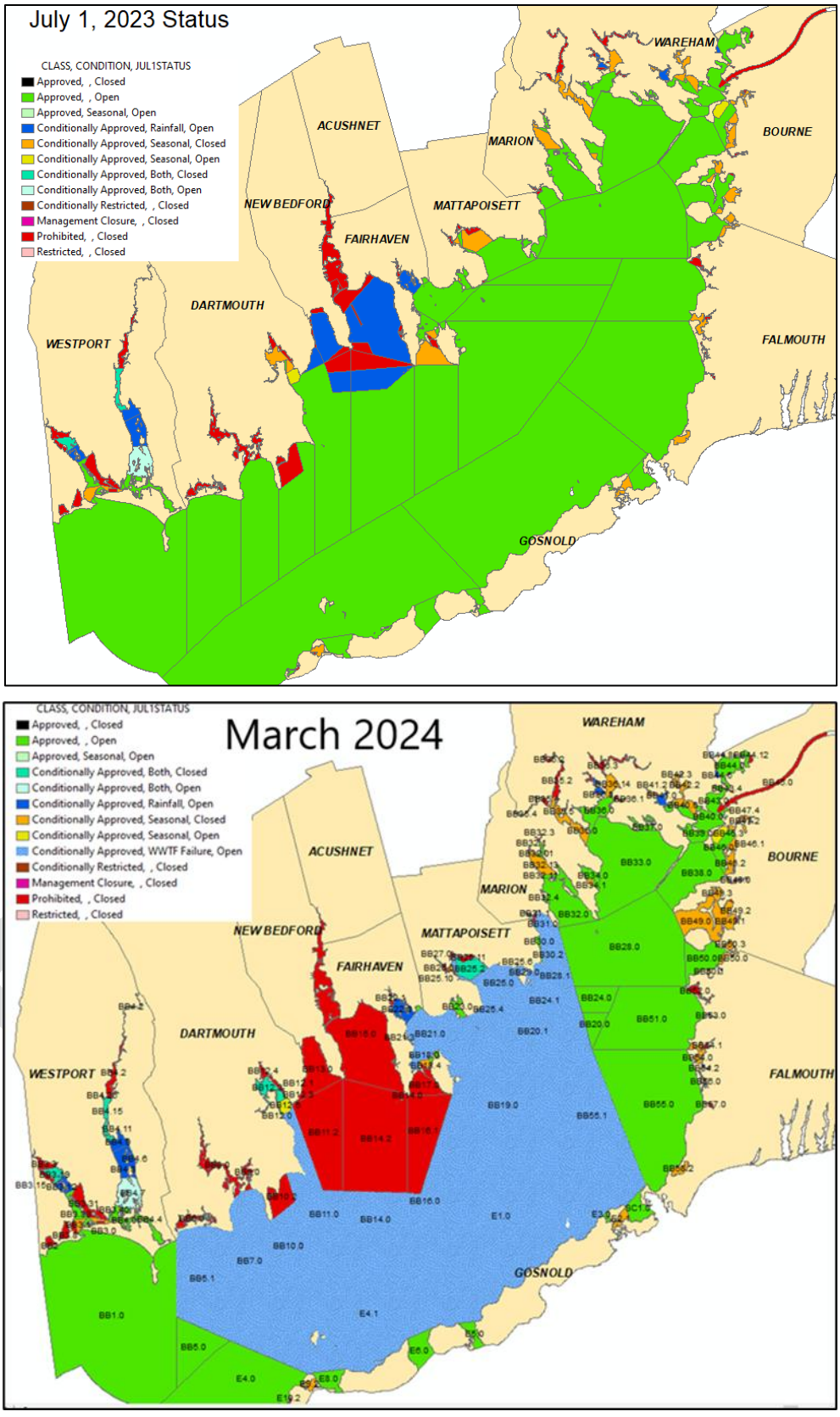
and the acreage of closed shellfish beds on July 1 declined through about 2015 then remained steady to about 2018 when closures began increasing (Figure 18).

The size and duration of seasonal, and mandated prohibited classified shellfish closures in this record have changed both because of changes in water quality, rule changes, improvements of modeling, and a better understanding of risks. National Shellfish Sanitation Program rules [25] adopted by DMF in 2018 require DMF to enact mandatory reclassification around marinas and mooring fields which could no longer have an Approved classification. Additional National Shellfish Sanitation Program rules based on federal Food and Drug Administration (FDA) recommendations require a 1:1,000 Prohibited area dilution zone around wastewater facility outfalls, and even larger Conditionally Approved zones (a 1:100,000 dilution zone) based on discharge volumes. This affected the size and duration of emergency closures.

To implement these rules, DMF needs studies or models of wastewater plumes and ocean circulation. In 2024, after UMass Dartmouth [26] completed a hydrodynamic study of the Fairhaven and New Bedford wastewater facility discharges, DMF expanded the New Bedford outfall closure and permanently closed an additional tens of thousands of acres including all New Bedford waters and large portions of Dartmouth and Fairhaven, adding greatly to the total area closed to shellfishing in Buzzards Bay (Figure 19; 2023 top versus 2024 bottom).

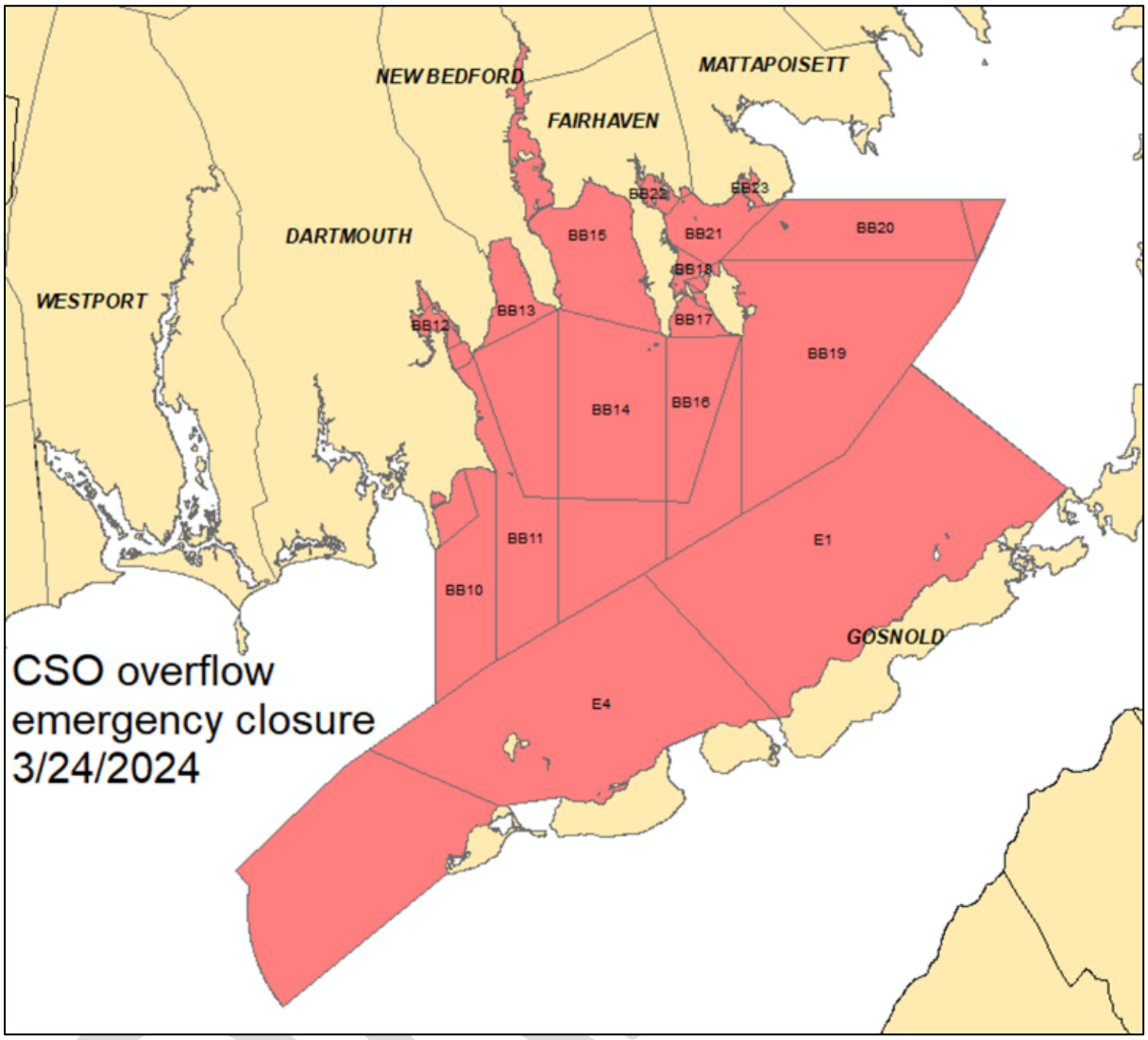
[25] The Interstate Shellfish Sanitation Conference sets those standards through parliamentary procedure as a cooperative organization of states, federal agencies and industry. The FDA audits state programs for compliance with National Shellfish Sanitation Program requirements.

[26] Chen et al. 2023. Estimation of Sewage Water Dilution from Wastewater Treatment Plants in New Bedford and Fairhaven.



Data courtesy of DMF

Figure 26. Top: Map of permanent, rainfall, or seasonal conditionally closed shellfish beds in Buzzards Bay as of July 1, 2023. Bottom: After enactment of new NSPP guidance in March 2024 after expanding the mandatory prohibited closures around the New Bedford wastewater outfall.



Data courtesy of DMF

Figure 27. CSO discharge emergency closures, March 2024.

The new closure ended all recreational shellfishing areas in New Bedford and reduced shellfish areas in Dartmouth and Fairhaven. As DMF evaluates other wastewater treatment plant outfalls (Dartmouth, Marion, Wareham, and Bourne) using the same pollution dilution modeling approach, DMF may expand buffer zones around these other outfalls, closing more of Buzzards Bay to shellfishing. Because these expanded year-round closures near wastewater treatment facilities and CSOs may be permanent and irreversible, most of the management actions contained in this Action Plan will not reopen these areas. DMF will only alter these mandatory outfall closures if there is a better understanding of health risks or the elimination or relocation of outfalls.

Confounding public perception of the expanded New Bedford outfall prohibited closure area in 2024, also in early 2024, DMF enacted recurring emergency closures over months of more than 60,000 acres of Buzzards Bay from Dartmouth to Mattapoisett because repeated heavy rains triggered CSO discharges in New Bedford (Figure 20).

The increased closures of large shellfishing areas in some municipalities has created a corresponding loss of public access sites to the remaining shellfishing areas still available. In the last ten years the percentage of Buzzards Bay coastline closed to shellfishing has increased from 45% to 55%, with some towns having more than 65% of their coastline closed to shellfishing,

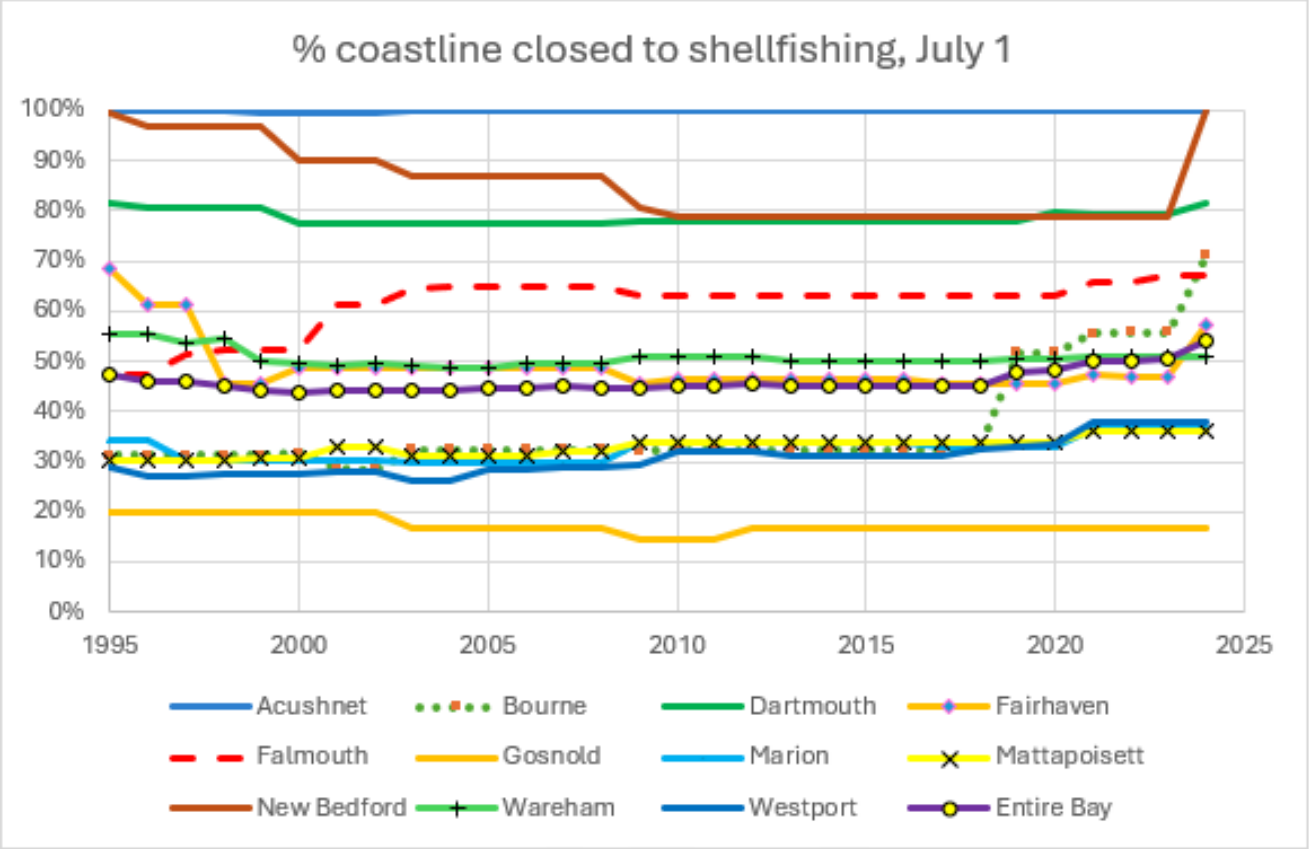


Figure 28. Percent of town coastline closed to shellfishing based on shellfish classifications on July 1 of each year.

and in the case of New Bedford, 100% of the coastline was closed in 2023 (Figure 21).

The sale of commercial and recreational shellfish permits has been an important source of revenue for Buzzards Bay municipalities for decades. Some towns place fees from commercial licenses and occasionally from recreational licenses in a fund to finance local shellfish restoration and propagation efforts. The loss of shellfish resources due to either overfishing, loss of shellfish habitat, disease, predation, competition by invasives, or other unknown variables have diminished overall harvest amounts in Massachusetts. This decline has resulted in a reduction in permit sales. While the number of recreational shellfishing permits has declined somewhat since the 1970s and 1980s, declines in commercial licenses have been greater.

State funding for local seeding, relay, and propagation programs has continued to decline, but to ensure sustainable shellfish fisheries in Buzzards Bay requires more state funding. Some municipalities have met some of their shellfish propagation needs through the establishment of municipal aquaculture programs. These efforts require the purchase of upwellers [27] to raise larval shellfish to a size necessary for transplant and require adequate local funding of staff to manage such efforts. Municipalities have started some of these programs with grant funds, but long-term implementation of these efforts requires sustained local funding for staff, an expenditure often difficult to justify and obtain within stressed town budgets.

In some municipalities there are many private aquaculture enterprises. Most aquaculture businesses obtain shellfish grants from municipalities, with approval by DMF. These grants legally designate an area of tidelands leased to individuals or companies for the purpose of cultivating shellfish, primarily oysters, scallops, and clams in Buzzards Bay (e.g., Figure 29). These businesses contribute to local economies, but pollution-related shellfish closures threaten these sites like public shellfish growing areas around Buzzards Bay.

[27] An upweller is a floating shellfish seed culturing-device that consists of seed containers, called silos, attached to a float-like apparatus attached to a pier or raft. The young shellfish are placed in the silos, and a wave driven pump system brings a continual flow of water over the shellfish.

Figure 29. Top: Aquaculture sites and shellfish grants in Buzzards Bay; bottom: aquaculture rafts and cages on Wareham tidelands at Broad Cove.

MassGIS 2023 ortho imagery.

This action plan narrowly addresses steps to enhance the availability and productivity of shellfish resources, and to enhance the shellfish stock availability to commercial and recreational fishers. It compliments other action plans that target specific pollutants and impacts, or loss of habitat, especially Action Plan 1 Managing Nitrogen Pollution. We discuss the benefits to benthic habitat by using conservation boat moorings in Action Plan 6 Managing Impacts from Boating, Marinas, and Moorings.

Goals

Goal 2.1. Increase availability of shellfish resources for recreational and commercial use.

Goal 2.2. Restore habitat to increase the abundance and distribution of shellfish resources.

Objectives

Objective 2.1. Support efforts to prevent new shellfish resource area closures and open priority resource areas.

Objective 2.2. The state should increase the Massachusetts Division of Marine Fisheries ability to carry out the sanitary survey program, comply with the National Shellfish Sanitation Program, and DMF should also continue to provide technical assistance to municipalities improve local management of shellfish resources.

Objective 2.3. The state and federal agencies should increase grant opportunities to help municipalities remediate pollution sources contributing to shellfish bed closures, and to meet watershed bacterial TMDL limits.

Objective 2.4. Where justified and supported locally, Division of Marine Fisheries and municipalities should expand the use of the rainfall conditionally approved classification to reduce seasonally closed or prohibited shellfish areas.

Objective 2.5. Municipalities, working with the Division of Marine Fisheries should eliminate pollution sources and disturbances contributing to the permanent loss of shellfish habitat.

Objective 2.6 Grant awarding entities, in concert with the Division of Marine Fisheries and municipalities, should support pollution studies using sound hydrodynamic models to evaluate the adequacy and minimum size necessary for effective buffer zones around wastewater treatment plant outfalls.

Objective 2.7. The Division of Marine Fisheries and municipalities should expand programs to propagate, seed, and relay shellfish.

Objective 2.8. Investigate and develop strategies to help make shellfish resources more resilient to changes in habitat caused by coastal eutrophication and climate stressors.

Objective 2.9. The BBNEP should assist and support municipal efforts to track recreational shellfish catch and resource abundance.

Objective 2.10. Promote research to better define the relationship between temperature and precipitation and shellfish water quality indicators and associated habitat (e.g., eelgrass beds).

Objective 2.11. Support efforts to monitor water pH and carbonate and related impacts to shellfish and other living resources.

Management Approaches

While DMF and municipalities are the lead for many actions, other agencies and organizations must help and support activities that achieve the goals of this Action Plan. Efforts to increase shellfish abundance or reopen closed shellfish beds require different approaches. In both cases, DMF or the municipalities must take these needed actions. Specific actions include expanding propagation and relay efforts and collecting more water quality data to better manage the resources and find upstream pollution sources.

The decline or collapse of specific species is often related to water temperature increases, shifts in predator populations, and loss of habitat. Where nitrogen pollution causes habitat loss, sewering or other nitrogen reduction solutions are imperative, but expensive to implement. Shellfish managers can restore some species like the soft-shell clam by seeding, but the loss of mobile species like lobster is likely irreversible.

To address population loss in the short term, state and municipal managers should focus on shellfish seeding and restocking efforts. For some species, improving habitat can also help populations recover. One example is adding bivalve shells to the bottom to restore oyster populations. Other strategies are for towns to buy shellfish stock from closed areas and transplant it to their town to help natural reseeding, and construct

shellfish upwellers to grow their own shellfish from seed bought from private enterprises. Increased shellfish abundance can improve water quality because of the water filtering abilities of shellfish, so these programs can complement source reduction efforts like sewering.

Reopening shellfish growing areas closed due to bacterial pollution is more costly and difficult because it requires pollution source reduction efforts and improved treatment of discharges. In many embayments, stormwater discharges are the leading contributor to elevated bacteria levels and shellfish bed closures. Treating stormwater discharges to reduce bacteria is expensive, particularly if multiple discharges need to be treated or eliminated to see results within an embayment. The posting of sanitary survey reports online could help increase awareness of problem discharges and help towns prioritize treatment sites and build support for local funding.

To reduce the size and duration of shellfish bed closures, water quality monitoring can better define the duration of elevated bacteria levels after rainfall. However, since the 1990s, there has been little interest in Buzzards Bay towns to implement new rainfall conditionally approved shellfish areas.

Broader actions that meet the goals of restoring habitat and water quality by reducing stormwater discharges and nitrogen loading are in Action Plan 1 Managing Nitrogen Pollution.

To reassess buffer zones around outfalls is difficult and requires water circulation modeling or dye studies. Male-specific Coliphage (MSC) testing can reduce a mandatory 21-day emergency CSO closure to as low as 8 days if the results show the shellfish are at or below the MSC standard.

With respect to emergency closures, DMF can reduce the size and duration of the CSO emergency closure zones through ongoing MSC testing. DMF will need more funding for increased MSC testing and personnel to undertake the added sampling, and the agency is working with the legislature to increase funding. DMF must also complete pollution dilution modeling, which must be based on sound model designs and assumptions and supported by dye studies. Municipalities must eliminate some discharges, and it is a long-term high priority that New Bedford eliminate its CSO system.

Costs and Financing

Towns typically fund shellfish propagation, seeding (including upwellers), relay efforts, and habitat restoration programs. However, state and federal grants can supplement local funding. The key to securing these government grants is for towns to incorporate their shellfish propagation efforts into their overall nitrogen reduction strategies for their coastal waters. Towns should also closely coordinate their shellfish propagation strategies and implementation with DMF.

Costs associated with redefining mandatory closures related to wastewater outfalls, CSOs, and other precautionary closures require additional funding to DMF. Funds must cover the cost of dye studies, flushing models and MSC testing of shellfish meats.

A municipal and NEP watershed-scale effort to map upstream pollution sources, together with ongoing municipal stormwater illicit discharge investigations required by federal stormwater permits (MS4), can help reduce pollution discharges contributing to closures. Programs like DEP's EPA-funded 604(b) program can help fund needed watershed assessments.

The costs of tackling nitrogen pollution and stormwater discharge are addressed in Action Plan 1 Managing Nitrogen Pollution and Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

Measuring Success

Acres of shellfish beds permanently closed, and commercial shellfish catch will remain the principal long-term tracking measures to evaluate progress toward the goals of this action plan. However, the Buzzards Bay NEP can track and quantify ongoing propagation and relay efforts in terms of number of sites and number of seed or transplants.

Action Plan 3. Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure

Problem

Forests and other natural land covers are extremely effective in recharging groundwater. In these areas, most of the rainfall infiltrates into the ground, absorbed by vegetation, or evaporates to the atmosphere with very little stormwater runoff generated (Figure 30). Development activities that clear forests and other natural areas and replace them with impervious surfaces and storm drainpipes alter natural hydrology. These "hard" surfaces no longer allow rainfall to soak into the ground resulting in an increase in surface runoff. This precipitation runoff carries natural and human-derived pollutants into wetlands, lakes, streams, estuaries, and groundwater, which can affect water quality, habitat, and living resources.

Most past development used conventional approaches to define subdivision layouts which encouraged sprawl, indiscriminate clearing and promoted impervious surfaces. The increase in impervious cover combined with soil compaction and removal of protective vegetation causes stormwater runoff to accelerate over land rather than infiltrate into the ground. The outcomes reduce groundwater recharge, increase flooding, increase downstream erosion, and adversely affect water resources, wetlands, and habitat. Cumulatively, these activities contribute to all the impacts described in this action plan.

Stormwater enters wetlands and waterways through pipes (Figure 31) and overland flow including "road cuts" in berms to direct runoff. These discharges often receive stormwater from networks of drains, catch basins, and interconnected pipes. Pollutants associated with stormwater runoff may include bacteria, road salt, nutrients, pesticides, metals, detergents, and organic contaminants such as hydrocarbons. Stormwater also conveys sediments, atmospheric particulates, manufactured products, and organic matter. Conveyed sediment particles are carriers of metals and organic contaminants adsorbed to particles on the stormwater [28]. Stormwater also contributes to floatable debris, resulting in littered shorelines and impacts on marine animals due to ingestion and entanglement. Collectively these discharges pollute, cause siltation, increase turbidity, and cause declining water and habitat quality in surface waters, wetlands, and contribute to the loss of habitat and natural resources and can change species composition and diversity.

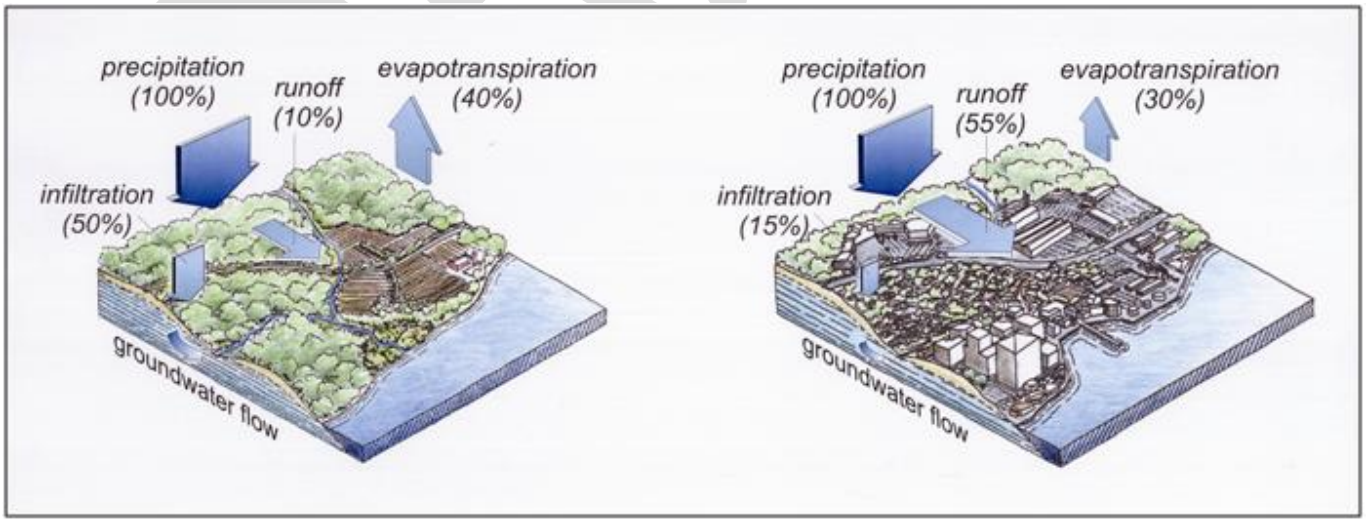


Figure 30. Graphical representation of degree of runoff in lightly developed watersheds as compared to urbanized watersheds.

[28] Additional information on stormwater practices and effectiveness are available at EPA's website National Menu of Best Management Practices for Stormwater (last accessed 12/10/24).

The Massachusetts Integrated List of Waters (under sections 305(b) and 303(d) of the Clean Water Act) define all known impairments to Massachusetts waters. With respect to impairments caused by bacteria and nutrients (Figure 32), regulators consider stormwater one of the primary sources of bacteria pollution and a secondary source of nitrogen pollution to coastal waters.

Studies in Massachusetts and nationwide have consistently pointed to stormwater as a major source of fecal coliform bacteria contributing to closures of swimming beaches (see Action Plan 19 Protecting Public Health at Swimming Beaches) and shellfish areas (see Action Plan 2). Stormwater conveys phosphorus and nitrogen pollution, especially from lawn runoff. Chronic runoff of polluted stormwater to sensitive resources can result in aesthetic as well as economic impacts, such as those associated with the loss of commercial and recreational fisheries.

The sources of bacteria in stormwater varies. Illicit sanitary hookups from septic systems to stormwater pipes are a rare occurrence today. More typically other "nonpoint" sources contribute to elevated fecal indicator bacteria concentrations. These nonpoint sources include wildlife droppings, pet waste, overland run-off of manure from farms, and breakout from failed septic systems.

The Buzzards Bay NEP has mapped more than 5,900 stormwater discharges in the Massachusetts part of the Buzzards Bay watershed (Figure 26). This total includes 4,143 discharge pipes and 1,729 road cuts. The piped discharges connect to more than 31,000 catch basins and other inlet structures tied to 328 miles of pipes. Many stormwater networks discharge contaminated runoff to wetlands, fresh surface waters, or marine waters. Among Buzzards Bay coastal towns, approximately 45% of stormwater outfalls discharge within U.S. Census urbanized areas and regulated by EPA under municipal, state, or commercial MS4 stormwater permits (Figure 33). Table 6 shows the number of private, municipal, and state owned stormwater discharges in each municipality. Any stormwater pipe near a swimming beach is a potential health risk and often contributes to floatable debris on beaches, therefore, these discharges should be ranked as high management priorities for treatment or elimination.

Photo by Joe Costa.

Figure 31. A stormwater discharge pipe in Onset Bay, one of 5,900 mapped by the Buzzards Bay NEP as a discharge to marine waters around Buzzards Bay.

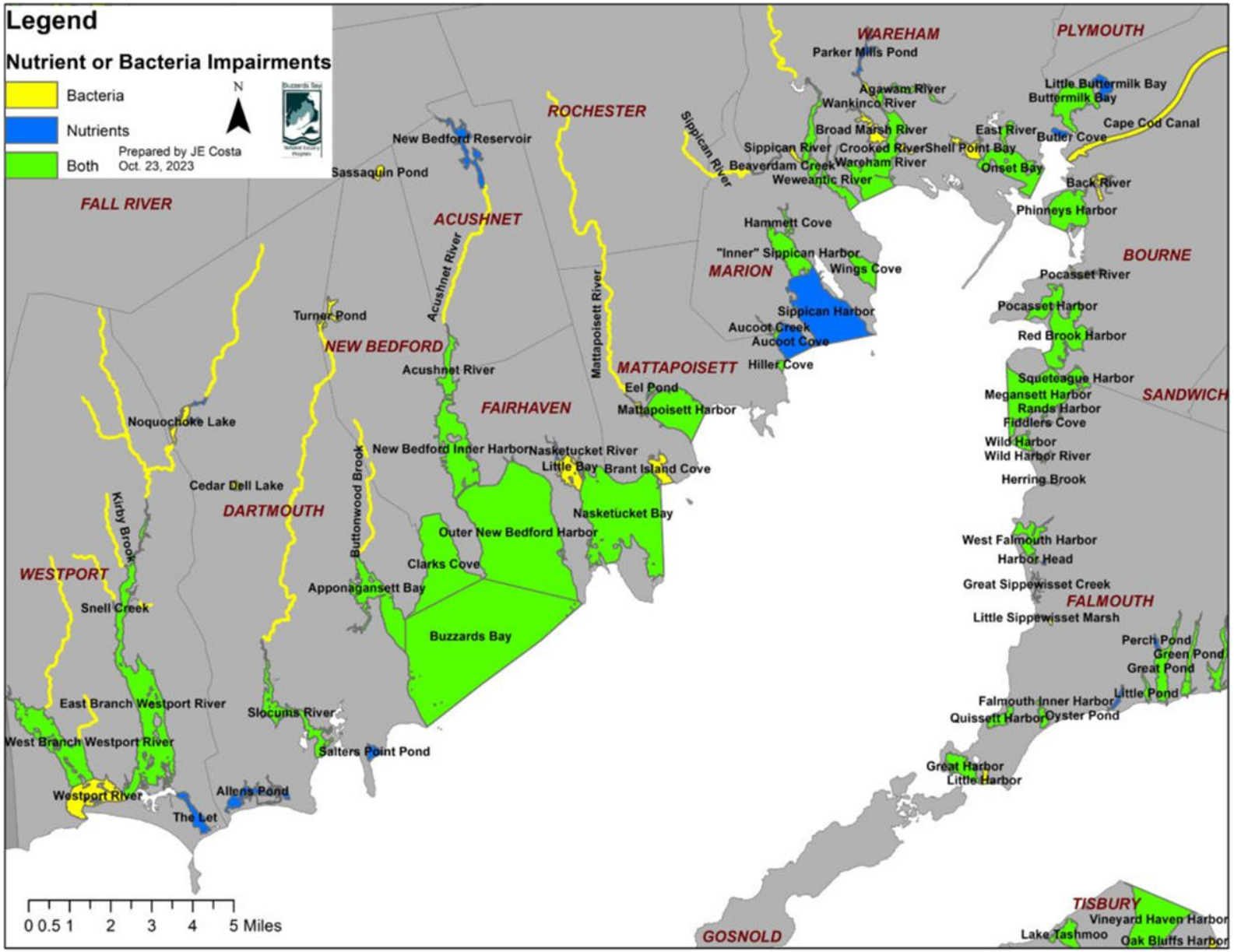


Figure 32. Nutrient and pathogen impaired waters of Buzzards Bay from Massachusetts DEP's 2022 integrated list.

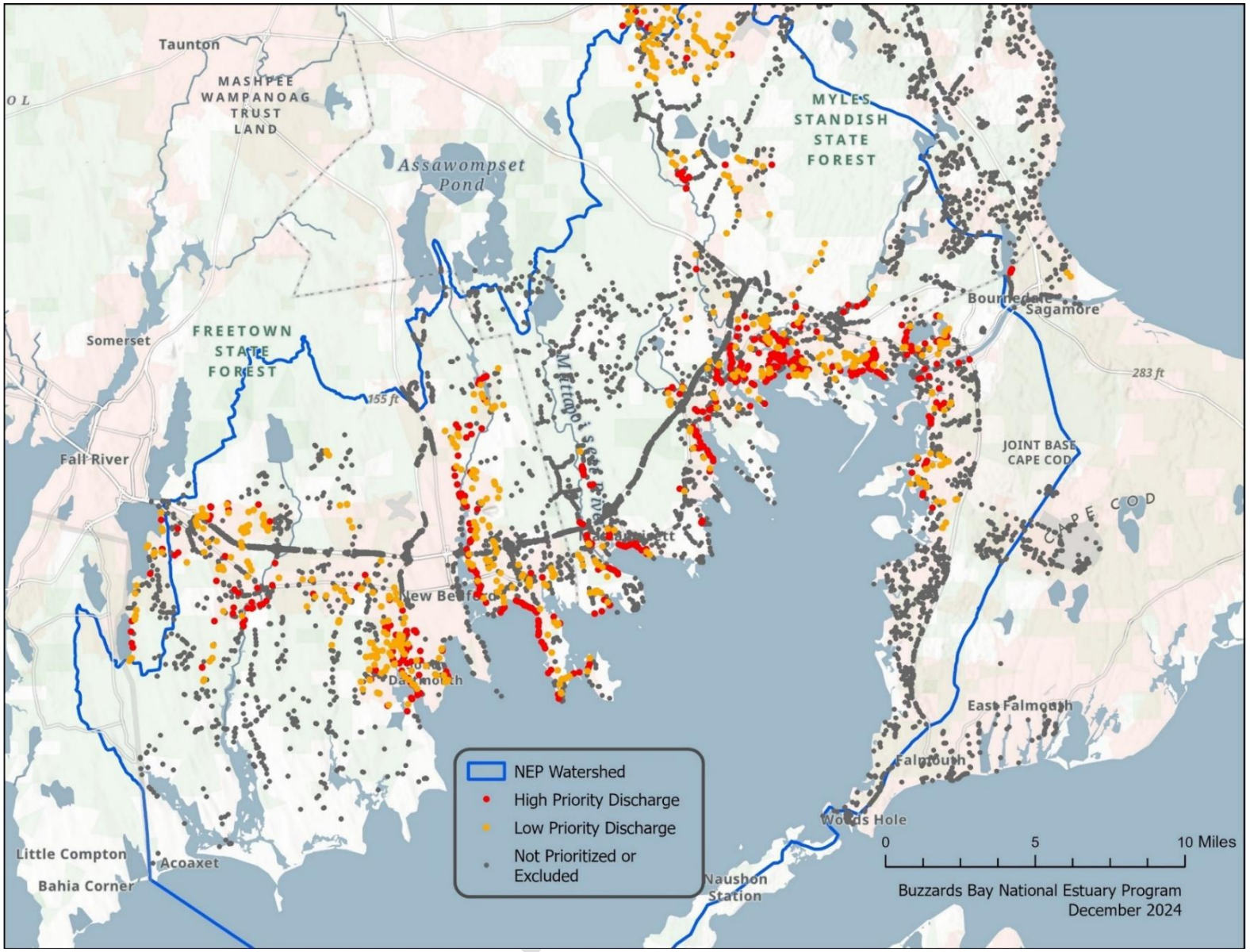


Figure 33. Overview map of stormwater discharges documented by the Buzzards Bay NEP and Buzzards Bay Stormwater Collaboratoive through 2024.

Table 6. Summary of discharges by municipality[1].

Municipality	MS4 Urbanized			Not MS4 Urbanized			Total
	Private	State	Town	Private	State	Town	
Acushnet	11	5	110	3	0	27	**156**
Bourne	56	145	290	3	0	13	**507**
Dartmouth	62	280	339	35	9	141	**866**
Fairhaven	68	119	299	6	41	12	**545**
Falmouth	0	142	339	0	0	0	**481**
Marion	60	84	114	16	70	22	**366**
Mattapoisett	81	86	182	33	94	102	**578**
New Bedford	1	218	118	0	0	0	**337**
Wareham	92	335	458	3	50	29	**967**
Westport	6	167	206	15	0	198	**592**
Total	437	1,581	2,455	114	264	544	**5,395**

(1) 2024 data from Buzzards Bay Stormwater Collaborative interactive map. Counts in Bourne, Falmouth, and Westport include areas outside the Buzzards Bay NEP study area watershed (compare to Figure 26).

Goals

Goal 3.1. Prevent new or increased untreated stormwater discharges to Buzzards Bay and its watershed that would adversely affect water quality and habitat.

Goal 3.2. Remediate stormwater discharges contributing to degradation or impairments of water quality, resources, or beneficial uses.

Goal 3.3. Manage stormwater infiltration to help maintain and restore natural hydrologic conditions, recharge groundwater, and provide improved base flow conditions to streams and wetlands.

Goal 3.4. Encourage low impact development and green infrastructure approaches to minimize stormwater impacts from new development and redevelopment.

Goal 3.5 Eliminate combined sewer overflow discharges to New Bedford waters.

Objectives

Objective 3.1. Build local capacity to adopt and implement local and state low impact development and green stormwater infrastructure laws and regulations.

Objective 3.2. Implement effective stormwater pollution remediation projects that include proper design, construction, operation, and maintenance.

Objective 3.3. State agencies should provide guidance and incentives to promote municipal adoption of low impact development techniques that reduces stormwater runoff and the need for structural practices.

Objective 3.4. Regulators should ensure that federal stormwater discharge permits meet all watershed total maximum daily waste load allocations.

Objective 3.5. By 2030, municipalities should complete illicit discharge detection and elimination investigations on all stormwater discharges identified as high priority by the municipality.

Objective 3.6. Strengthen state and local stormwater treatment performance standards, and designs that accommodate system maintenance to best address climate driven degradation and better meet pollution reduction targets.

Objective 3.7. MassDEP should update the 2008 Stormwater Handbook to reflect MS4 and watershed total maximum daily load requirements and other updated regulations, priorities, and understandings.

Objective 3.8. Evaluate new cost-effective monitoring methods to identify intermittent illicit discharges to stormwater networks.

Objective 3.9. Support efforts to eliminate combined sewer overflow discharges in the City of New Bedford.

Objective 3.10. The legislature and state regulators, must ensure that laws and regulations to increase housing stock do not limit the ability of municipal government to manage stormwater.

Management Approaches

While municipalities, EPA, MassDEP, and property owners are the lead for many actions, other agencies and organizations must help and participate. To achieve the goals of this action plan, municipalities and property owners must remediate existing stormwater discharges that are impairing surface waters. Municipalities must better manage and minimize stormwater from the development and redevelopment of land to minimize new impacts and mitigate existing stormwater related impairments. Municipalities will remediate existing stormwater discharges through local MS4-guided stormwater management plans for municipal infrastructure. State and federal regulators will manage discharges from commercial, industrial, and institutional sources directly through federal stormwater permits. Compliance with the federal permits will be a primary mechanism to achieve the goals of this action plan. Municipalities can minimize or eliminate water quality impairments through municipal laws and regulations that encourage principals of green infrastructure and low impact development for new development and redevelopment. Collectively, better stormwater management restores recharge to groundwater, streams, and wetlands. Municipalities can effectively implement green infrastructure and low impact development approaches are best implemented through local bylaws and ordinances that regulate subdivisions, and commercial development. Other tools like municipal stormwater permit programs will require adoption by town meeting or city councils can help fund local programs but will require training of regulatory and technical assistance staff.

Proposed 2024 revisions to municipal small MS4 permits and bacterial TMDLs in Massachusetts will for the first time define a comprehensive regulatory approach for managing and eliminating impairments caused by stormwater discharges. The proposed permit changes address the inadequacies of the existing state and federal framework articulated in the 2013 update of the Buzzards Bay CCMP.

Besides better enforcement of MS4 requirements by EPA, MassDEP must upgrade state stormwater policies and the 2008 handbook to include treatment standards for nitrogen and bacteria and support the current regulatory landscape. EEA must continue to promote policies and regulations that foster green infrastructure in their climate resilience grant programs. These efforts can result in meeting the goals of this action plan and the goals of the Clean Water Act.

Costs and Financing

The elimination of water quality impairments caused by existing stormwater discharges is a major undertaking that will require actions and expenditures by all levels of government. Recommendations that call for changes to government regulations, laws, and policies generally have negligible costs to government, but some regulatory requirements can add financial burdens to property owners and developers. Other regulatory changes, like reducing the minimum road width of new subdivisions, reduces costs to developers, homeowners, and the municipality because of reduced costs to build, maintain, and repair roads. On average, green infrastructure and low impact development approaches have lower costs for government bodies to implement, and some approaches can even reduce development and long-term maintenance costs borne by residents.

More comprehensive and effective municipal stormwater infrastructure maintenance programs will add cost to public works department budgets. The remediation of existing municipal discharges to meet bacteria TMDLs and stormwater MS4 permits is the greatest cost Buzzards Bay towns face. The cost to treat thousands of discharges may exceed $1-$2 billion dollars and take decades to achieve. These efforts, while costly and politically challenging, have the potential to reduce shellfish bed and beach closures in Buzzards Bay, and any resulting nitrogen reductions will result in estuary habitat improvements. [29].

Municipalities will fund the costs for stormwater treatment and management through federal and state SRF loan programs, property tax funded local appropriations, or through fees from stormwater utilities. Municipalities can establish a stormwater authority under the MGL Chapter 40, Section 1A and Chapter 83, Section 16. Alternatively, they could just expand existing programs and finance such efforts out of the general tax revenue base.

[29] The success of improved habitat quality because of nutrient reductions will also depend on actions contained in Action Plan 1 Managing Nitrogen , because other sources like onsite septic system are much larger contributors of nitrogen loading.

The Massachusetts SRF program is oversubscribed with projects to upgrade wastewater facilities, so Congress needs to expand funding for the program. Congress added funding through the five-year 2020 Infrastructure Investment and Jobs Act, but even that additional funding was insufficient to meet all current municipal needs in Massachusetts, and SRF funding needs to be expanded many-fold.

Education and outreach are essential to secure local funding as taxpayer cost concerns hinder action. A significant obstacle to the acceptance of green infrastructure and low impact development principles is the belief that conventional development costs less than green infrastructure and low impact development. According to the Natural Resources Defense Council (www.nrdc.org/water), green infrastructure and low impact development can often cost less than conventional stormwater management systems for both installation and maintenance. Green infrastructure and low impact development design promotes reduced road surfaces and encourages less infrastructure underground (storm drainpipes, catch basins, manholes). In addition, the associated vegetation also offers human quality of life benefits by greening the neighborhood, contributing to livability and aesthetics. This "greening" can enhance property values and marketability and provide wildlife habitat along with benefits of pollution reduction and decreased flooding. These messages can be conveyed cost-effectively to residents through billing inserts, posting on websites, and local news articles, and social media.

Measuring Success

The Buzzards Bay NEP can measure progress by programmatic tracking and water quality monitoring. Water quality information is contained in DMF sanitary survey program reports for shellfish resources, Board of Health swimming beach monitoring, and stormwater discharge monitoring by municipalities through the Buzzards Bay Stormwater Collaborative. Each of these help document declines or improvements to water quality. Reductions in the extent or duration of shellfish closures, beach closures, and delisting of impaired waters are the definitive measure of success.

The Buzzards Bay NEP can track local government programmatic actions like their compliance with MS4 permits, adoption of plans to meet TMDLs, and adoption of green infrastructure and low impact development bylaws and regulations. The NEP can track green infrastructure and low impact development practices principally by tracking the adoption of necessary local laws and regulations. Municipal compliance with MS4 permits, including constructing stormwater treatment systems, and implementing good housekeeping programs are useful other actions to track, and municipalities report this information in their MS4 stormwater plans which are posted on EPA's MA municipal MS4 communities website. DMF should post its sanitary survey reports online.

Additional Information

Stormwater Management

Prior to the late 1990s, municipalities regulated stormwater discharges largely through subdivision regulations and occasionally by bylaws. These local regulations were inconsistent from one community to the next, and generally did not adequately address management of the rate, volume, and quality of stormwater discharges which is essential to improve or protect water quality. In 1996, MassDEP adopted stormwater standards and a new policy for the implementation of the state Wetland Protection Act (310 CMR 10.00). The new policy prohibited untreated stormwater discharges to waters of the Commonwealth, required water quality treatment for runoff of up to one inch from impervious surfaces, identified appropriate best management practices, required recharge of stormwater to balance the hydrologic budget and required operation and maintenance plans for stormwater facilities. In 2008, MassDEP supported the new wetland regulations with the Massachusetts Stormwater Handbook and new stormwater standards. This 2008 handbook did not adequately address water quality limits to waters that have bacteria or nitrogen TMDLs. In 2014, MassDEP again amended the Wetlands Protection Act and regulations to further expand the jurisdiction of MassDEP and local conservation commissions to more comprehensively regulate stormwater discharges to wetlands and surface waters. In 2020, MassDEP established a Massachusetts Stormwater Management Updates Advisory Committee. Draft updates to the handbook have not yet been released.

Since 2003, EPA's National Pollution Discharge Elimination System program, which regulates discharges to wetlands and waterways, has largely driven stormwater management in Massachusetts. In 1990, imple-

mentation of Phase I of the National Pollution Discharge Elimination System (NPDES) program required the permitting of stormwater discharges from medium and large municipalities with a population of 100,000 or more to waters of the U.S. (this only affected the City of New Bedford). EPA Region 1 directly issues stormwater discharge permits because Massachusetts is only one of two states not delegated to implement the NPDES program.

In December 1999, EPA published the "Phase II Final Rule" for the NPDES program in the Federal Register. This rule expanded the coverage of the stormwater permit program to include stormwater discharges from, "certain regulated small municipal separate storm sewer systems (small MS4s); and construction activities disturbing between 1 and 5 acres of land (i.e., small construction activities)." The rule also revised the "no exposure" exclusion and the temporary exemption for certain industrial activities. In plain English, the rule required municipalities with stormwater infrastructure within "urbanized areas", as defined by the U.S. Census Bureau, to submit permit applications (Notices of Intent) by 2003 for their municipally owned stormwater discharges ("MS4s"), as well as "industrial facilities", waste transfer stations, landfills, and sewage treatment plants (separate from the wastewater discharge permit). The permit requires management of municipal discharges within the Urbanized Areas and encompasses the catchments to those discharges. Equally important, the U.S. Census Bureau redefined urbanized areas for the 2000 Census (and updated in 2010, Figure 34). The redefinition of urbanized areas expanded the geographic scope of the program.

Since 2003, EPA has expanded the requirements for municipal small MS4 permits in Massachusetts with each permit renewal, which municipalities must address in their stormwater management plans. The current final Massachusetts MS4 General Permit was issued on April 4, 2016, revised on December 7, 2020, and is set to expire in 2025. Because the changes to the state's stormwater standards in the wetland regulations coincided with implementation and expansion of the small MS4 permit program, other municipal boards like Planning Boards adopt the state wetland program stormwater standards to ensure consistency in local permitting and to meet MS4 requirements. This common approach elevates the importance of updating the 2008 Massachusetts Stormwater Handbook to not only meet new requirements under the state Wetlands Protection Act. but supports municipal MS4 permits and stormwater management plans.

In 2024, EPA Region 1 issued a Draft MA MS4 General Permit for comment. The new permit includes added requirements for watershed TMDLs, and EPA expects to finalize it in 2025. Concurrently, EPA Region 1 provided notice using its "residual designation authority" under the Clean Water Act to regulate stormwater discharges from certain private commercial, industrial, and institutional properties under the NPDES permit program, with certain requirements like MS4 and nitrogen and phosphorus management. EPA issued these conditions for certain watersheds north of Boston, but they may require them in the Buzzards Bay watershed under future permits.

Stormwater TMDLs

In May 2009, the EPA Region 1 approved pathogen TMDLs for 52 areas in the Buzzards Bay watershed. These TMDLs set concentration-based loading limits in 45 estuaries (covering 38.4 square miles) and seven river areas (extending 17.4 river miles). The TMDL set a bacteria discharge concentration equal to the impairment threshold of the receiving waters. Thus, if a stormwater pipe discharged to a shellfish bed, the discharge limit was to be set to the limit for shellfish beds (14 fecal coliform colony units per 100 ml of seawater). Neither MassDEP nor EPA enforced this permit.

The 2013 update of the Buzzards Bay CCMP noted that the existing MS4 permits did not comprehensively address cumulative loading of nitrogen or bacteria from stormwater. The 2020 update of the small MS4 general permit, and 2014 state stormwater amendments to the Wetlands Protection Act, improved the stormwater management framework, but still did not fully integrate TMDLs into the MS4 permits,

In March 2024, Massachusetts MassDEP proposed a new TMDL for Pathogen-Impaired Waterbodies for all of Massachusetts, including Buzzards Bay. The new approach places more emphasis on load-based mass loadings calculations for setting Waste Load Allocations (point sources) and Load Allocations (non-point sources) loading limits for river systems. However, the state permit also supports concentration-based approaches to define limits individual stormwater discharges to coastal waters.

Complementing the TMDL changes, Appendix F of EPA's proposed 2024 draft MS4 permit (Requirements for Discharges to Impaired Waters with an Approved

TMDL) defines standards and schedules to meet stormwater discharge limits to water bodies with existing TMDLs. The changes define a clear pathway to meet bacteria and nitrogen TMDLs.

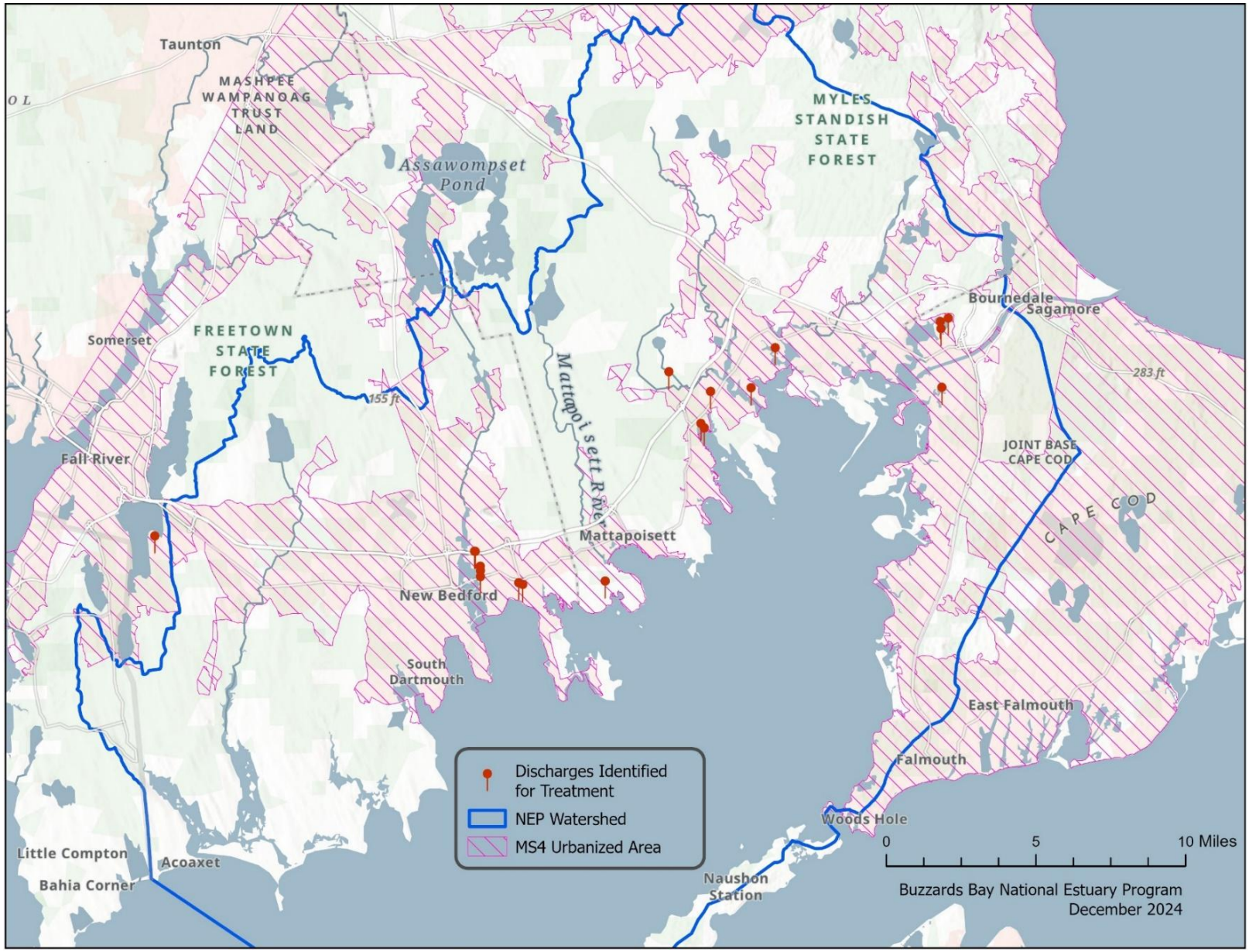


Figure 34. U.S. Census urbanized areas around Buzzards Bay, with selected discharges identified as priorities for treatment.

Stormwater monitoring

Since the 1980s, every three years the Massachusetts DMF completes sanitary surveys for shellfish areas in Buzzards Bay. These surveys discuss recorded fecal coliform bacteria concentrations of the receiving waters (the regulatory standard for shellfish beds) and are a wealth of information on existing stormwater drains and potential pollution sources that may be contributing to shellfish bed closures. While DMF sometimes monitors and reports stream discharge bacteria concentrations, generally stormwater discharges are not routinely monitored in the program. DMF provides these sanitary survey reports to municipal select boards and shellfish wardens, but neither the state nor municipalities post the reports online. Municipalities may undertake stormwater studies to address concerns about specific stormwater networks. Generally, routine monitoring of stormwater discharges for pollutant loads was deficient in Buzzards Bay until expansion of the MS4 permit requirements and creation of the Buzzards Bay Stormwater Collaborative by the Buzzards Bay NEP.

Buzzards Bay Stormwater Collaborative

The Buzzards Bay Stormwater Collaborative launched in 2016, as a partnership between the Buzzards NEP and the BBAC and originally consisted of five municipal public works departments (Dartmouth, Acushnet, Fairhaven, Mattapoisett, and Wareham). The EPA funded the startup with an EPA Region I Healthy Communities grant. The purpose of the collaborative was to map stormwater infrastructure and monitor both wet and stormwater network dry weather flows (if present).

The initial goal of the program was to identify and precisely locate all stormwater discharges along the coast (both in and out of MS4 areas) and define the stormwater network connections to those discharge pipes and structures. During field investigations, failed structures such as catch basins filled with sand, damaged structures, or areas that flood during storms were identified. The monitoring of the discharges under an EPA-approved Quality Assurance Program Plan provided essentially information finding which stormwater discharges were the most important contributors to water quality degradation. By 2016, MS4 requirements made clear that stormwater must be evaluated for the specific impairments identified in the waterbody in the state's Integrated List of Water Bodies. The BBAC completed work under this grant in 2018, and the Buzzards Bay NEP wrote discharge report for each municipality.

In 2018, with Southeast New England Program (SNEP) funding from EPA, the Stormwater Collaborative expanded through a new partnership with the Massachusetts Maritime Academy. This new initiative added three municipalities (Westport, Marion, and Bourne). Under this partnership, the Massachusetts Maritime Academy provided staff support and co-op students to work with Buzzards Bay municipalities and the Buzzards Bay NEP to continue the monitoring and mapping tasks. The Buzzards Bay NEP updated the municipal discharge reports based on the new data collected.

In January 2020, the Massachusetts Maritime Academy also began entering into new agreements with Buzzards Bay municipalities for added work beyond the scope of the SNEP grant. In 2020, the Massachusetts Maritime Academy also received a $46,000 grant from the Massachusetts MassDEP to buy a trailer and equipment to set up an Illicit Discharge Detection and Elimination (IDDE) field investigation trailer. IDDE investigations are essential to decide if pipes with high pollutant loads were receiving illicit discharges or just accumulating non-point sources of pollution, and whether pollutant source reduction or end of the pipe treatment was the best strategy to reduce pollution.

The Massachusetts Maritime Academy outfitted the IDDE trailer under the guidance of the Buzzards Bay NEP. The MassDEP renewed the grant for two more years to expand IDDE efforts in Buzzards Bay and funded the Collaborative's production of training videos on YouTube and hands-on workshops for stormwater managers throughout the state. The MMA keeps the IDDE trailer on campus, and Stormwater Collaborative municipalities can borrowed it.

In 2024, the Buzzards Bay NEP added four new interactive maps in support of the Buzzards Bay Stormwater Collaborative. The maps help to evaluate stormwater outfalls, show the status of IDDE investigations, and provide strategies for Municipal Separate Storm Sewer System (MS4) initiatives. The Buzzards Bay NEP designed the Sampling Dashboard for use on smart phones and supports field investigations. The new mapping products are available on the Buzzards Bay Stormwater Collaborative website. Data and GIS products are also available through the Stormwater Collaborative data page.

Management Practices

Green Infrastructure & Low Impact Development

Here we define green infrastructure as an approach to capture or divert stormwater directly into groundwater or to vegetated areas using practices like green roofs, rain gardens, and biofilters. This contrasts with past conventional strategies hasten stormwater flow to storm sewers ("grey infrastructure"). A complimentary approach to green infrastructure is low impact development. We define low impact development as the site level practices to limit impervious surfaces or maintain the pre-development hydrology of the site. Low impact development strategies include limiting the width of subdivision roads, setting limits on percent impervious area of a parcel, and requiring that no stormwater leaves a property. Low impact development principles include the idea that stormwater is not a waste product that towns must dispose of, but rather that rainwater is a resource that municipalities must manage. At many sites, green infrastructure can meet low impact development requirements. These techniques are elements of Smart Growth as defined in Action Plan 4.

Green infrastructure and low impact development minimize impacts and create a greener, more natural environment (Figure 35). These approaches require the adoption of performance standards in regulations and thoughtful site planning. The goal is to minimize the creation of stormwater, and any stormwater generated is detained, stored, evaporated, filtered, and infiltrated close to its origin. This strategy helps to achieve the goals of mimicking a site's pre-development hydrology, protecting native vegetation, maintaining natural water budgets capable of sustaining sensitive water resources, and keeping pollutants out of the stormwater stream before they can negatively affect downstream water resources. Minimizing or reducing impervious surfaces is also an important strategy to make municipal infrastructure become more resilient to climate impacts like increasing intensity and volumes of stormwater. Green infrastructure and low impact development is based on the premise that natural landscapes and infiltration are the best management approach.

The MS4 permit program and compliance with TMDLs will define how existing discharges causing impairments will be managed. Principals of green infrastructure will define the selection of treatment options. Municipalities can adopt local laws and regulations to manage stormwater impacts from new development and redevelopment. Municipalities can adopt standards in these laws and regulations that are based on principles of green infrastructure and low impact development.

Site planning using the green infrastructure and low impact development starts with defining critical environmental resource areas on, next to, and down gradient of the site. Such resource areas can include drinking water protection areas, sensitive wildlife habitats, wetlands, streams, and estuaries. Designs for house sites and roads maximize buffers to these resource areas. The site design reflects the site's natural runoff patterns, soil types, sensitive areas, and other key features and relies on those features to dictate the development pattern, rather than forcing a pre-conceived design upon the landscape.

In green infrastructure and low impact development developments, buildings are often clustered to protect natural areas by preserving open space. Green infrastructure and low impact development designs incorporate narrower roads and use permeable pavement for parking lots, driveways, and other impervious surfaces. Environmental engineers develop plans that direct runoff from impervious surfaces, such as rooftops, to vegetated areas with porous soils. Roof gardens use soil and plants to absorb and evaporate water and slow runoff. Stormwater systems can collect rooftop runoff for storage and reuse. The proximity of the development to other developed areas (including village centers) can provide reduced costs associated with shared (neighborhood) wastewater treatment systems.

Minimizing impervious areas supports green infrastructure and low impact development goals of maintaining natural site hydrology. This strategy reduces development costs and thus has economic benefits. Other successful techniques to minimize impervious include:

- integrating stormwater management early in site planning activities;
- mimic the natural hydrologic functions;
- focus on prevention rather than mitigation;
- emphasize simple, nonstructural, low technology, and low cost methods;
- manage stormwater as close to the source as possible;

Photo credit: Modified from the Low Impact Development Center.

Figure 35. Conventional versus low impact development.

- distribute small-scale practices throughout the landscape;
- use native vegetation in landscaping to reduce the need for irrigation and fertilizing;
- rely on natural features and processes; and
- creating a multifunctional landscape.

An integration of green infrastructure and low impact development principles and management practices in treatment designs slows the transfer of stormwater (increases "time of concentration") and increases infiltration onsite, thereby reducing runoff volume and downstream flood damage (peak runoff control) thus improving downstream water quality. The infiltration of stormwater provided by green infrastructure and low impact development practices can result in more groundwater recharge than may have occurred under pre-development conditions, which in turn can help offset increasing water supply demand from other locations in the watershed. Finally, the hydrologic benefits of green infrastructure and low impact development also provide aesthetically pleasing landscape and neighborhood layout that manages stormwater more economically and with lower maintenance requirements than is generally the case with traditional stormwater management practices.

Stormwater Management Design

We can summarize the four key principles of stormwater management as: "Reduce Runoff, Slow It Down, Spread It Out, Soak It In". Managers can implement this stormwater management approach as part of a holistic, integrated water management with a goal to recharge stormwater to approximate predevelopment hydrologic conditions and mimicking natural conditions and pathways.

Regulations should preferentially require the discharge of treated stormwater runoff to groundwater wherever practical. Infiltrating stormwater recharges groundwater to restore drinking water supplies in some watersheds, maintain groundwater levels, and help sustain freshwater base flow to streams and wetlands. Infiltration of stormwater greatly reduces pollution discharge to surface waters and minimizes or reverses water quality degradation downgradient. At a river watershed level, stormwater recharge can offset some "consumptive" drinking water used by residents.

Property owners can collect stormwater runoff from rooftops into rain barrels or cisterns and use that water for irrigation of gardens and landscaped areas, thus reducing their need purchase municipal drinking water for these purposes. Practitioners should recognize that the volume of rain collected by barrels is a small percentage of roof runoff volumes, and property owners need large underground cisterns to eliminate most roof runoff.

Managers have developed a broad range of best management practices (BMPs) for treating stormwater runoff. While some of these BMPs are effective at removing at least 80% of the total suspended solids (a minimum state and federal standard), only certain management practices are effective at treating fecal coliforms and nitrogen (two of the critical pollutants of concern for Buzzards Bay). BMPs that treat both nitrogen and fecal coliforms include filtration practices (sand filters, organic filters and infiltration systems with proper pre-treatment that trap bacteria) and

treatment practices that include vegetation (bioretention areas, rain gardens, vegetated swales, and constructed wetlands that provide for nutrient uptake and/or nitrification-denitrification processes).

The proper design, construction, operation, and maintenance of all new stormwater BMPs are critical to their successful functioning. Without these elements, stormwater facilities provide only a false sense of security--they may appear to work because there is no flooding, but they may reduce little pollutant load in the stormwater that passes through them. Effective stormwater management also means that existing stormwater Property owners should repair, rebuild, or retrofit BMPs observed to be malfunctioning, improperly sized, or otherwise not meeting the objectives of stormwater management. Sometimes towns must test stormwater discharges from treatment systems to evaluate their effectiveness.

Other Issues

There appears to be a general lack of public knowledge and recognition of the importance of stormwater management and the impacts of stormwater management on surrounding properties and downstream resources. This together with stormwater management costs makes it difficult to implement local regulatory changes. In addition, stormwater management design for permitting purposes requires engineering skills and more recently, site planning skills. Therefore, it is becoming increasingly necessary to incorporate technical review and expertise on behalf of the local boards and commissions into the local permit process. Education of the public, local boards and commissions, municipal employees, as well as engineers and site planners, on matters of stormwater management, treatment designs, and pollutant loading calculations help stormwater management programs improve water quality.

Local stormwater management regulations and standards, MS4 permitting, and the MassDEP Stormwater Policy generally focus on new development and redevelopment, but do not focus on stormwater impacts from existing developments. Implementation of management measures to address water quality improvements through retrofits to existing development receives less attention. The proposed 2025 Updates to the small MS4 and statewide pathogen TMDL will put in place needed tools for MassDEP and EPA to ensure progress is made to achieve the goals of the Clean Water Act.

The implementation of an effective and comprehensive municipal stormwater management program can be expensive. Communities need to consider innovative mechanisms and models to fund a stormwater program, such as stormwater utilities.

The management solutions for controlling stormwater discharges range from simple to complex, inexpensive to costly, and can involve different levels of government as well as private landowners. In developed areas, structural controls may be expensive to implement and land for large stormwater basins may be either prohibitively expensive or not available at all. Municipalities and their residents must bear the costs of installing stormwater BMPs, but benefits are accrued to all users of the municipality's water resources. These benefits can include restored recreational opportunities, maintenance of land values due to the aesthetic appearance of receiving waters, and, of greatest relevance here, restored or continued shellfishing opportunities.

Any town that is contemplating the construction of stormwater treatment facilities must consider land acquisition, installation techniques, cost, treatment effectiveness, and maintenance requirements. Sampling data is required to establish priorities and identify treatment needs. Before targeting a particular storm drain for action, the town must ensure that an illicit connection or sewer line cross-connection is not the cause of the degradation.

The NPDES MS4 Program requires that communities prepare and implement a stormwater management plan according to a five-year schedule. While EPA and MassDEP require that each MS4 file an annual report to provide an update on progress, there is insufficient agency staff to adequately review as to the appropriateness of effectiveness of municipal actions or timelines. At the same time, most communities are understaffed to meet all the responsibilities outlined in their plans and permits. Communities need technical assistance to work efficiently and effectively to meet the MS4 permit requirements, and to address other water quality efforts such as the need for municipalities to implement programs to meet the pathogen TMDL for Buzzards Bay.

The primary focus of the Massachusetts Department of Transportation (MassDOT) is the construction and maintenance of safe roads. In January 2006 MassDOT released an updated manual for the design of state

roads. This manual, entitled *Project Development and Design Guidebook* features more emphasis on design flexibility, streamlined procedures, and improved collaboration between MassDOT and the cities and towns it serves. MassDOT also developed a *Stormwater Handbook for Roads and Bridges* (May 2004) to meet MS4 permit requirements for the storm sewer systems from the roads and facilities operated by MassDOT.

Transportation planners should avoid siting new traffic corridors or hubs near sensitive receiving waters, and an alternatives analysis should identify sites that pose minimal or least impact due to stormwater runoff. Existing corridors/hubs near sensitive resources should be remediated.

Most stormwater outfalls in Buzzards Bay are primarily wet weather discharges only. Those that have continuous dry weather flows might be a sign of illegal cross connections with sewer lines or septic systems. More likely, these stormwater network dry weather flows reflect outdated and decrepit pipe systems that allow groundwater infiltration. In some communities, the discharge of sump pumps from basements can contribute to dry weather flows. These sump pump connections can be a source of illicit discharges like basement washing machines.

MS4 permits regulate municipal infrastructure stormwater discharges from urbanized areas to wetlands and waterways. Municipalities do not regulate existing private commercial, institutional, or industrial discharges, unless stormwater from those entities discharge to the municipal stormwater network. The MassDEP Stormwater Policy, regulations and handbook were developed to implement the Wetlands Protection Act. Wetland regulations effectively capture stormwater activities in the wetland buffer zone or a regulated wetland resource area. However, inland activities (outside the jurisdiction of the Wetlands Protection Act (WPA) can generate sediments or contaminants that discharge to stormwater networks via surface runoff. The cumulative effect of these unregulated flows can have significant impact on downstream resources. Municipalities can implement their stormwater program across the entire municipal limits following the state stormwater guidance.

Currently, the state's stormwater management policy requires 80% TSS removal. MassDEP needs to require other performance standards and discharge limits in watersheds where they have issued a TMDL to address bacteria and nutrient pollution.

Climate Resilience

Increased precipitation and intensity of storms will challenge programs to manage stormwater pollution. For the northeast U.S., models predict a 7-14% increase of annual precipitation by the year 2100, mostly the result of increased rainfall in cooler months (EEA, 2011, Frumhoff et al., 2007). Furthermore, the frequency of larger rainfall events may also increase, as may storm intensity. Because stormwater collection and treatment systems may have lifespans over many decades, towns may wish to employ or require treatment designs to accommodate higher and more intense rainfall events. For stormwater treatment systems very close to shore, groundwater levels may rise as sea level rises. Infiltration systems nearshore should be designed to accommodate at least a 1-foot rise in sea level.

State Responsibilities

MassDEP should update its 2008 Stormwater Handbook to reflect the new regulatory landscape. Under the Massachusetts environmental Protection Act (MEPA) the state should require the submission of a green infrastructure and low impact development alternatives analysis for commercial and residential projects that meet MEPA thresholds (for land, rare species, wetlands, water, wastewater, transportation, and ACEC) for EIRs. These green infrastructure and low impact development principles need to be more formally incorporated into the MEPA Regulations at 301 CMR 11.00.

Agricultural Runoff

The U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS) should continue their ongoing program to assist farmers to implement best management practices on agricultural lands in the Buzzards Bay area. In many Buzzards Bay watersheds, stormwater runoff from agricultural lands is still an important contributor to water quality and habitat degradation, and these impacts can be overcome. Farmers may need ongoing support and guidance to implement their farm plans. Specifically, recommendations should focus on minimizing nitrogen and phosphorous loading from fertilizers and fecal coliform where manure is used as a fertilizer. A more recent need is guidance for farmers that accept food waste streams for agricultural composting. NRCS

should continue to work with MassDEP to provide guidance to farmers to incorporate stormwater management into farm plans.

Road Work Exemptions

The state legislature should avoid exempting road and bridge projects from state wetlands permitting. The legislature continues this practice in the belief that it will streamline the permitting process, but it does nothing to streamline the federal permit process, and large projects often take considerable time, many times exempt from any local appeal process. Denying conservation commission involvement may just alienate the town. Although in these cases MassDOT will still voluntarily meet with Conservation Commissions to resolve wetland issues, this does not always occur for exempted projects. Elimination of these exemptions will help Buzzards Bay communities to better protect sensitive wetlands from stormwater runoff from roads and ensure that local needs are addressed.

Education and Training

Effective outreach and information about green infrastructure and low impact development techniques and approaches need to be provided to a wide audience. The recipients of this training include municipal staff and boards involved in policy and permitting of development. This includes planning boards, building inspectors, conservation commissions, zoning boards, boards of health, and others. Outreach and information should be available to interested non-governmental entities, developers, builders, engineering firms, homeowners and trade associations, and the public.

The U.S. EPA should continue to promote green infrastructure and low impact development through funding and partnership building, as part of nation-wide smart growth initiatives, and to encourage green infrastructure and low impact development principles through in their regulatory programs. In Massachusetts, green infrastructure and low impact development techniques should be encouraged through EPA's MS4 stormwater permit program.

Another avenue for education and outreach is directly to homeowners and residents. Simple changes in everyday behavior such as picking up dog waste and reducing lawn fertilizers can make a significant impact on pollution sources. This approach is also cost effective when compared to the installation and maintenance of a stormwater treatment structure.

Action Plan 4. Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience

Problem

Since 1970, the population in the Buzzards Bay watershed increased from approximately 193,000 to 260,000, or nearly a 35% increase in the past fifty years (see Figure 3 in Chapter 1). During this period, population declined in urban areas (such as New Bedford), with development sprawling into the countryside and outside of town village centers. Developers converted large areas of forest and farmlands into low density residential development. This pattern of development also increased lot size for residential units, from small fractions of an acre in urban areas and village centers to 1-, 2-, or even 5-acre minimum lot sizes for residential subdivisions, sometimes with excessive minimum road widths. This change is clear among Buzzards Bay coastal towns, where between 1950 and 2000, the average lot size for a single-family home increased more than three-fold, from 0.44 to 1.37 acres (Figure 36). Municipalities implemented these requirements in part to help preserve the rural appearance of the countryside, and to slow the pace of development by making it costly.

While municipal adoption of large minimum lot size helped keep a rural appearance, these and other municipal policies of the 1980s and 1990s encouraged sprawl. Expansion of the second-home market and the increasing willingness of homebuyers to pay higher prices to live near the coast created economic pressure to convert rural or agricultural land to residential development. In addition, homeowners increasing converted summer seasonal homes to year-round residences.

There were many adverse environmental and social consequences of large lot size and suburban sprawl. The widespread destruction of habitat, wetlands, wetland buffers and declining water quality accompanied this expansion of development. Municipal roads cost money to maintain, repave, and plow, with the taxpayer bearing these costs. Where there might be 100 residential units or more along a 1000-foot road length in a village center with a small lot size, there might be only 20 residential units along the same stretch of road with 1-acre zoning. Longer and wider residential roads resulted in increased road maintenance costs per capita, greater commutes, and the expansion of school bussing programs. Sprawling development also contributes to a disproportionally high pollutant load per housing unit because the road surface area per house is greater. Collectively, these past building and development practices, increased pavement area per capita, increased pollution discharges, and caused many unintentional injurious effects to the environment.

While municipalities could expand sewer lines in the town village centers easily and cost-effectively, the costs to expand sewers to the new sprawling subdivisions were cost prohibitive for the town and residents, making the sewering unaffordable in areas of sprawl. Consequently, wastewater disposal in this new development was by septic systems. Later, when municipalities and the state recognized the cumulative impact of all these septic systems on marine ecosystems, the cost to sewer these areas to meet TMDLs has grown substantially.

The need to provide affordable local housing affects municipal state decisions about proposed development. To address a shortage of affordable housing, the Massachusetts Legislature approved in 2021 the MBTA Communities Law. This law requires 177 Massachusetts cities and towns with access to MBTA service, to create at least one zoning district where multifamily housing is permitted as of right. Buzzards Bay watershed MBTA municipalities are Bourne, Carver, Fall River, Freetown, Lakeville, Middleborough, New Bedford, Plymouth, Rochester. Similarly in August 2024, the Massachusetts Legislature passed the Affordable Homes Act, Massachusetts. The new law permits residential property owners to build accessory dwelling units less than 900 SF in single-family zoning districts in all communities. One of the intents of this provision is to encourage greater density development in areas zoned for single-family homes and reduce the pressure to build upon undeveloped lands. Village centers may be particularly attractive areas for accessory dwelling units given the existence of municipal infrastructure. The effects of these laws on development patterns and the environment will be better understood over time.

Whereas the preceding Action Plan 3 promotion of green infrastructure and low impact development focuses principally on development-related stormwater management by reducing impervious, and restoring

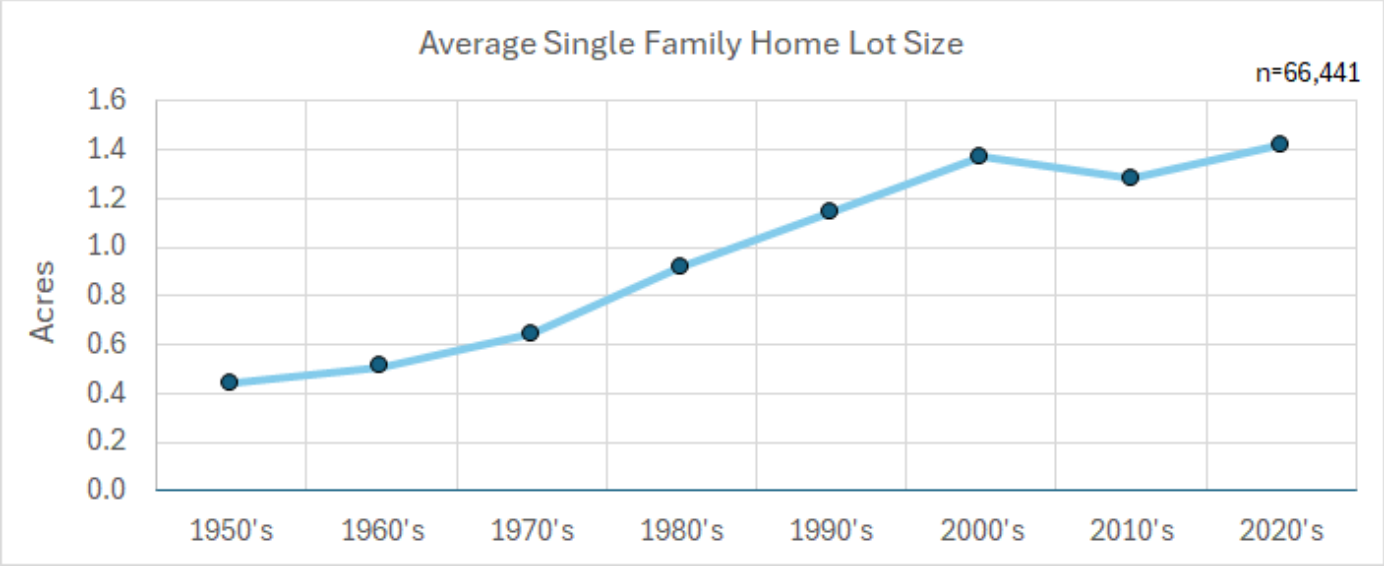


Figure 36. Average single family lot size over time for all Buzzards Bay coastal municipalities, excluding New Bedford.

Calculated from MassGIS parcel data joined to the assessors databases with year-built circa FY 2021 to 2025 for 66,441 properties among Buzzards Bay watershed coastal communities, excluding New Bedford. Data summarizes structure year built for property, parcel size, for use code type 101 (single family homes) properties. This approach captures when a structure was built or rebuilt, and not when the land was subdivided, and does not capture all types of cluster developments. Prepared by Joe Costa, Buzzards Bay NEP.

the natural hydrology, this action plan addresses growth management strategies to help manage nitrogen pollution and other indirect environmental impacts of growth and sprawl. This action plan addresses other land management practices that negatively affect the environment, strains municipal finances, and makes communities less resilient to climate change. Poor planning for growth will add to municipal expenses needed to meet federal stormwater permits and TMDLs for nitrogen and bacteria.

This action plan also addresses the recent replacement of large agricultural and forested land areas with solar farms. Deforestation caused by solar farm construction has raised concerns with many. Since 2011, nearly 800 acres of undeveloped land in the Buzzards Bay watershed has been converted to photovoltaic installations (Figure 37). In November 2024, the Governor of Massachusetts signed into law "An Act Promoting a Clean Energy Grid, Advancing Energy Equity, and Protecting Ratepayers." The stated primary goals of the legislation are to expedite and simplify the permitting process for solar farms, wind farms, and energy infrastructure. The law does include provisions to mitigate the potential negative impacts of solar fields, but it is too soon to tell how the new law will affect the construction of solar farms in undeveloped areas.

The biggest challenge to municipalities achieving the goals of this action plan is overcoming local resistance to rewriting local bylaws and imposing regulatory burdens on developers.

Changes to Title 5 regulations during the 1990s and 2000's focused on protecting public health and the environment and the allowance of alternative design systems removed an element that towns used to control growth on marginal sites. These regulatory changes allowed the installation of septic systems on lots that towns previously characterized as unbuildable. These changes forced towns to address growth more directly through zoning and planning,

Goal

Goal 4.1. Improve land use management and increase protection of natural resources through smart growth, climate resilience development, and strategies to offset impacts of new development.

Objectives

Objective 4.1. Encourage municipalities to adopt smart growth and climate resilience approaches through local zoning, subdivision, health, and wetlands laws and regulations to protect natural resource areas.

Objective 4.2 Encourage municipalities to focus redevelopment and cluster development in village centers and existing urbanized growth centers and couple with rule changes to encourage greater protection of open spaces, endangered species, and natural resources.

Objective 4.3 Promote sustainable agriculture and forest management practices that do not adversely affect water quality.

Objective 4.4 Avoid the placement of large scale solar developments on undeveloped lands.

Management Approaches

While municipalities are the lead for many actions, other agencies and organizations must help and participate. Managing environmental impacts from growth is essential to protecting natural resources and water quality. Municipalities have the greatest capacity and responsibility for regulating and managing the impacts of future growth to minimize potential environmental impacts from that growth. Good planning and regulations that promote smart and resilient growth are the basis for effective management approaches. Regulatory strategies may include revisions to zoning bylaws, general bylaws, and local wetland regulations. Zoning tools include economic incentive zones, zoning, clustering of development, road width and parking requirements, and transfer of development rights. Cluster zoning and transfer of development rights are underutilized and municipalities should adopt these approaches more widely. Each municipality must decide which smart growth techniques work best for them and implement those that best protect their critical resources and minimize growth impacts on water quality and habitats special to their community.

Adoption of regulatory approaches should be based on sound comprehensive planning. Municipal long-term planning documents that address growth include municipal master plans, open space plans, housing plans, comprehensive wastewater management plans, and municipal stormwater plans [30]. These planning documents must consider the placement of public infrastructure and public facilities.

Goal setting is an essential first step to these planning efforts, and municipalities, together with their partners, need to educate the public of the benefits of smart growth techniques to help them encourage these ideas. Outreach should target developers as well. Public involvement is essential because residents must often vote to support these changes. Where resources cross municipal boundaries (e.g., water supply areas), municipalities must think of creative ways of collaborating with neighboring towns.

Other levels of government need to support municipalities with technical and financial aid programs, and where appropriate, must also change regulations and laws regulating new growth and redevelopment to both support smart growth principles, and to lead by example.

The Commonwealth of Massachusetts has advocated for municipal adoption of green infrastructure and smart growth practices to offset these impacts. We define smart growth as well-planned development that helps the community, protects open space and farmland, keeps housing affordable, provides more transportation choices, and preserves the natural environment. Smart growth includes common sense planning strategies like clustering of development on new subdivisions, transfer of development rights, and polices and regulations to encourage development and redevelopment of village centers. These incentive approaches concurrently require offsets that improve protection of open space and preservation of natural landscapes. Implementation of smart growth practices and policies will not only help the environment but also have the potential to save government infrastructure construction and maintenance costs and ultimately reduce government tax burdens on residents. Smart development approaches are not at odds with affordable housing goals. However, municipalities must evaluate any proposed policy and regulatory incentives to promote affordable housing in the context of environmental impacts.

[30] All Buzzards Bay municipalities have been issued a stormwater management permit by the U.S. EPA that requires the development and implementation of 5-year stormwater management plans as part of the NPDES MS4 stormwater discharge permit. See Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

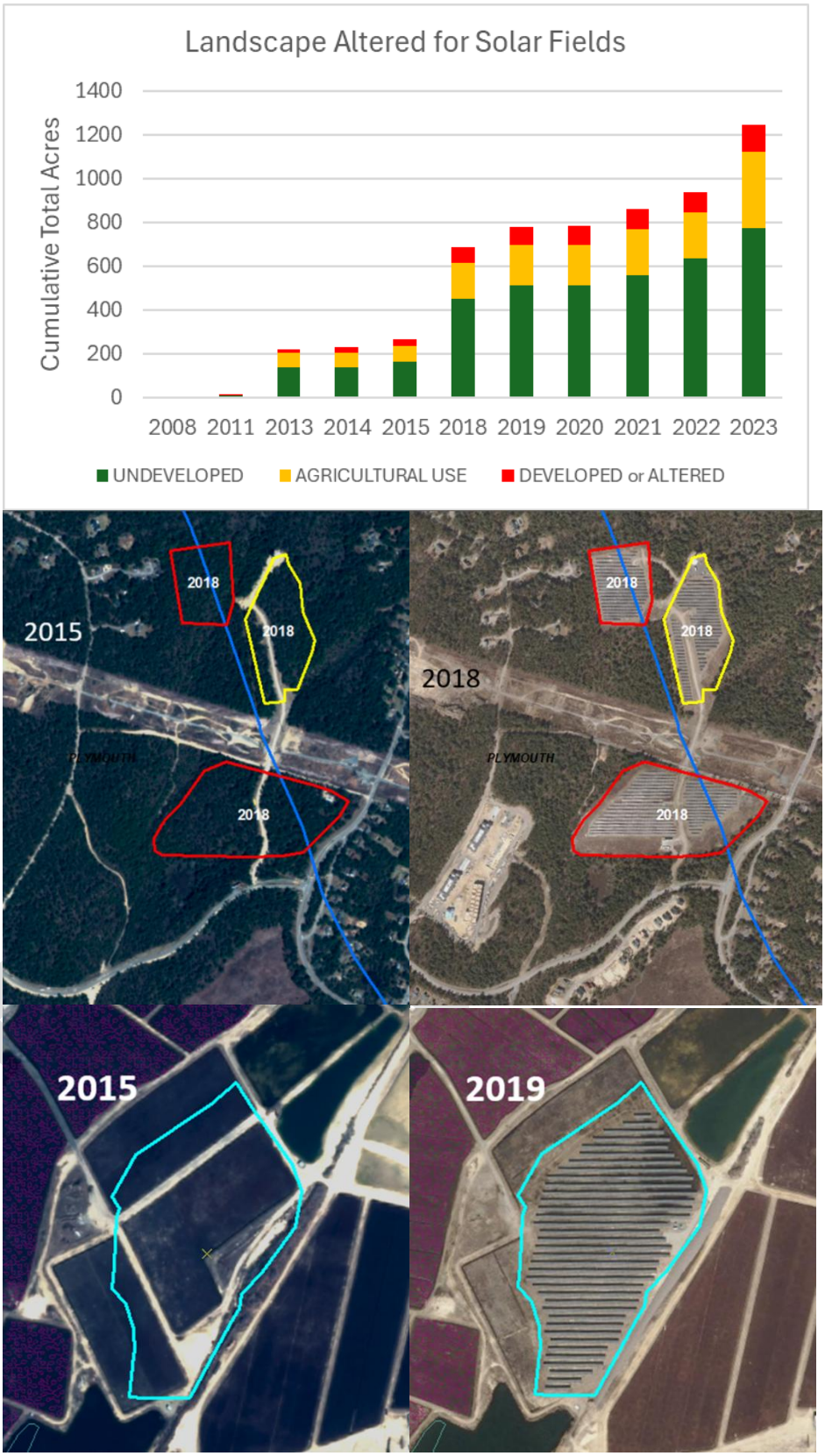


Figure 37. Top: Total acres in the Buzzards Bay watershed altered by large solar fields over time (excludes residential development). Middle: conversion of forested areas in Plymouth. Bottom: conversion of cranberry bogs in Wareham.
Buzzards Bay NEP data from *A preliminary assessment of land types used for photovoltaic fields in the Buzzards Bay watershed*, JE Costa, in preparation.

Regional planning agencies (Southeast Regional Planning and Economic Development District and the Cape Cod Commission) should continue to provide help communities in promoting smart growth incentives and help communities in the development of regulatory amendments. Regional planning agencies, the Buzzards Bay NEP, and state agencies all have important roles to play through training, education, and review of projects under the jurisdiction of MEPA. New state requirements will either force towns to sewer watersheds around nitrogen sensitive embayments or require advanced nitrogen removal onsite systems. Municipalities must include these strategies in their long-term planning.

Industry groups, like the Massachusetts and Cape Cod Homebuilders Association, should also promote smart growth techniques through training and other education programs. These associations appreciate and understand the benefits of green infrastructure and low impact development and smart growth techniques, including the potential financial savings they provide. They need to promote these concepts more actively to their membership and in support of local law and regulation change.

Costs and Financing

Many of the necessary regulatory changes to implement this action plan have negligible cost to government and primarily relate to adopting and enforcing laws and regulations. There is a cost to hire professionals to review the large and complex projects to ensure conformance with state and local laws, but municipal boards already have authority to pass these costs on to the developer. While developers often carry the burden of smart growth strategies, some approaches (like clustering of development) reduce costs to developers and taxpayer burdens because of reduced infrastructure maintenance costs. State and federal grants could help with the development of planning needs and bylaw development.

Measuring Success

Over the short and medium term, it will be difficult to document whether environmental degradation is occurring at a slower rate than without smart growth measures in place. Consequently, this action plan requires the Buzzards Bay NEP to track programmatic measures such as adoption of laws and regulations that achieve the goals of this action plan. Because the goal of this action plan is to lessen the many adverse effects of new development; no single environmental outcome can define success.

Synopsis of Management Tools

Other action plans in this Buzzards Bay CCMP address specific types of pollution sources or sensitive habitats or have specific recommendations for reducing pollutant loads and protecting areas of special concern. These individual action plan recommendations alone are not sufficiently protective; inherent in each set of recommendations is an understanding that municipalities and the state must adopt a holistic approach to protect water quality and natural resources.

Smart growth and green infrastructure approaches offer an opportunity to foster quality development that provide both economic and environmental benefits to a community and a region. It directs growth into village centers that have wastewater treatment infrastructure, broader transportation choices, and more diverse (and affordable) housing opportunities. It also preserves and protects critical environmental resources, agricultural areas, and open space. The first step in implementing smart growth is defining goals and strategies in municipal planning documents.

Developing a Local Land-Use Plan

Municipal master plans, open space plans, comprehensive wastewater management plans, and housing plans are the key documents for municipalities to define their long terms goals and strategies for development. The underlying assumption of growth management is that there are limits to the amount of unmanaged growth that an area can withstand without serious harm to public health, safety, regional economy, or the environment. Environmental systems, and specifically coastal embayments, reach limits at which they can no longer absorb the impacts from added development without degradation or impairment of uses. This carrying capacity is clear by the degradation of embayment living resources from excessive inputs of nitrogen and bacteria. Municipalities can protect water quality of an embayment by managing land use effectively through planning and by well-defined regulations that require treating pollutants onsite as property owners build upon or redevelop the land.

Local land use planning begins with defining critical resource areas for protection (drinking water supplies, receiving surface waters, important habitat, etc.). Unmanaged development stresses these critical resource

areas proportional to growth. Identifying resource areas and impacts of concern defines the types of needed planning and regulatory tools.

Equally important, municipalities must specify areas that can accommodate growth (growth centers), where they can easily and economically provide infrastructure (including wastewater treatment), and where the town can meet more stringent environmentally sensitive design standards. These growth centers can then absorb the vested rights of landowners in the region by re-directing (or transferring) them from more critically sensitive areas. They can also provide a better diversity of housing types (including affordable), a range of transportation options (transit, cycling, and pedestrian) and a good quality lifestyle. The resulting form of development (more compact village centers surrounded by protected open spaces) can also provide opportunities for the reduction of carbon emissions.

Important agriculture areas must also be designated and protected. Cranberry and other agriculture have been an important part of the landscape in southeastern Massachusetts and Cape Cod for well over one hundred years. This unique environment plays an increasingly important role in the preservation of open space, in providing opportunities for water conservation and in providing wildlife habitat. Although 13,000 acres are in actual production (U. S. Department of Agriculture NASS 2012 statistics), cranberry growers own and manage nearly 62,000 acres of related ponds, bogs, wetlands, and upland forest. As the region becomes more developed, this land takes on increased importance. Some cranberry bog owners have already converted bogs and accessory lands to solar panel farms or residential development.

Tools and Techniques

The Home Rule clauses of the Massachusetts constitution authorize local government regulations predicated on the broad concept of police power: the power of government to regulate for the advancement and protection of the health, safety, economy, and welfare of the inhabitants of the community.

Historically, municipal authority has been limited to zoning techniques to dimensional requirements including lot size, setbacks, and lot coverage. In more recent years, communities have expanded their zoning regulations to help protect water quality and living resources and adopted other regulatory and non-regulatory tools like those described below.

Overlay Ground/Surface Water Protection Districts

A groundwater or surface water overlay protection district clearly identifies and recognizes critical water resources and protects these resources through regulatory restrictions. These ordinances (cities) and bylaws (towns), while varying in their approach toward resource protection (i.e., prohibition of various uses versus special permitting and/or performance criteria), are similar in their goals of defining a resource by mapping boundaries and enacting specific legislation for land uses and development within these boundaries. Whenever possible, treatment designs should capture and treat stormwater on-site.

Overlay Smart Growth Zoning District

Many communities in Massachusetts face a shortage of affordable housing units. Communities that do not meet the minimum requirements for availability of affordable housing can be faced with proposed affordable housing projects that are allowed to bypass certain local zoning regulations through a comprehensive permit application process, under MGL Chapter 40B. As a result, applicants may propose high-density projects in unsuitable areas.

One mechanism to pre-plan and provide incentives for creation of affordable housing and open-market housing is to develop a Smart Growth Overlay Zoning District (authorized by MGL Chapter 40R). Within the district, development must meet a set of design standards created by the municipality. However, development can occur by right, easing the comprehensive permitting requirements for the developer in comparison to Chapter 40B developments (which are often contentious and may result in litigation). Chapter 40R allows a municipality to designate areas where mixed use and residential growth should occur in the town following a land use plan and then provide an incentive in the form of a simpler permit process. Such a district can relieve development pressures in more environmentally constrained areas through a transfer of development rights process (described below).

In addition, and perhaps its biggest selling point to the public, state approval of a Chapter 40R Overlay District provides incentive payments to the community's general fund, equal with the number of units the district allows. The municipality may receive added payments

of $3,000 per unit as each new residential unit receives a building permit, as long the developer builds one unit within three years. This program has only been employed by a handful of communities in the Buzzards Bay watershed to date; for example, Plymouth recently passed a Chapter 40R district at Cordage Park, (although this is outside the Buzzards Bay watershed) and Dartmouth adopted a 40R district at Lincoln Park.

Surface Water Buffer

Stormwater runoff holds pathogens, nutrients, vehicle related pollutants that are a major contributor of non-point-source pollution in surface water. Studies have shown that undisturbed lands are generally more permeable and allow higher levels of stormwater percolation and natural treatment of associated contaminants. Municipalities can require that undisturbed vegetative upland buffers be maintained next to and within a defined buffer area (e.g. 100 feet or more) of surface waters to promote natural stormwater treatment.

Performance Standards

Performance standards in regulations can assume that any given resource has a critical limit (carrying capacity) beyond which the resource deteriorates to unacceptable levels. Sometimes regulations define these limits as TMDLs. Performance controls assume that most uses are allowable within a designated area--if the use or uses will not overload natural or manmade resources. To apply this concept to Buzzards Bay, the critical limits of nitrogen sensitive embayments must be defined. Once determined, towns would limit nitrogen inputs from development in a plan that meets embayment TMDL limits.

Because many estuaries currently exceed TMDLs for nitrogen, municipalities must reduce existing nitrogen sources and hold loading from new development to a de facto net zero standard. Municipalities can achieve net zero wastewater nitrogen loading for new development through sewering, by offsetting new development on septic systems by sewering other parts of the same watershed, or by installing advanced nitrogen removal systems in a sufficient number of systems to offset new inputs. Reducing existing nitrogen sources will generally require sewering, but in some cases, decentralized treatment options may be an alternative.

Cluster Design

Cluster zoning is an alternative to the standard grid-style subdivision. In a cluster submissions development, towns may allow the same number of allowed units on smaller building lots within the parcel, resulting in a set aside protected open space. Cluster development allows shorter streets and reduces construction and maintenance costs. It provides tremendous flexibility for both the developer and municipality and allows greater creativity in the division of large land parcels.

Open Space Residential Design

Open Space Residential Design is like cluster design but generally it is a partnership process between the developer and the town. It requires a larger part of land to be set aside as open space, offers more flexible incentives, and establishes a design process to be followed. Open Space Residential Design process starts with identifying areas of the site with conservation value, such as water resources, wetlands, and habitat areas. Placing residential units on the site to avoid these areas, aligning roads and walkways to conform to the natural topography of the site, and drawing lot lines around the units allows residents the best opportunity to enjoy these resource areas. The conservation value of the open space conserved through this technique is often greater than through traditional cluster subdivisions.

Transfer of Development Rights

Transfer of Development Rights is a regulatory strategy that harnesses private market forces to carry out two smart growth objectives. First, towns permanently protect open space by the transfer of some or all the development that would otherwise have occurred in sensitive places to locations that are more suitable but may not meet minimum zoning requirements. Second, other locations, such as city and town centers or vacant and underutilized properties, become more vibrant and successful as the town transfers development rights to them from the protected resource areas. For the transfer of development rights process to help the environment, municipalities must define sensitive resource areas (sending areas) and growth centers (receiving areas). Municipalities can define the sending and receiving areas by considering well-recharge areas and inventories of natural resources like NHESP maps. Assigning sending and receiving areas will require municipal boards to consider

political and economic considerations factors. In essence, development rights are "transferred" from one district (the "sending district") to another (the "receiving district"). Communities using Transfer of Development Rights are shifting development densities within the community to achieve both open space and economic goals.

It can be challenging for municipalities to develop support Transfer of Development Rights bylaws, and municipalities must communicate clearly how this approach helps the community and offers opportunities to link to and solve other problems such as managing nitrogen loading through trading. Municipalities can build public support for programs that compensate landowners by building community support before voting at town meeting.

Traditional Neighborhood Development

Traditional Neighborhood Development, also known as "new urbanism", "neo-traditional" or village-style development, includes a variety of housing types, a mix of land uses, an active center, a walkable design, and often a transit option within a compact neighborhood scale area either as infill in an existing developed area or as a district scale project.

Transit Oriented Development

Transit Oriented Development creates mixed-use, higher density communities that encourage people to live, work and shop near transit services and decrease their dependence on driving.

Green Infrastructure and Low Impact Development

Green infrastructure and low impact development are more sustainable land development approaches. They are based on a site planning process that identifies critical natural resources, and then determines appropriate building envelopes, structures, and landscaping. Green infrastructure and low impact development also incorporates a range of BMPs that preserve the natural hydrology of the land. Green infrastructure and low impact development are described in much more detail in Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

Subdivision Control

Subdivision regulations, as described in Massachusetts General Laws Chapter 41 Sections 81K- GG (the "Subdivision Control Law"), differ from zoning bylaws in that they focus less on land use and more on engineering concerns such as street design (grade, width, intersection angles), utility placement, and traffic patterns. Protecting water resources via subdivision control can help limit the degree of imperviousness of the watershed, thereby controlling stormwater runoff.

Stormwater Management Requirements

Municipalities can regulate stormwater from subdivisions and commercial developments using local stormwater bylaws and regulations that specify stormwater treatment performance standards and design criteria. Municipalities can incorporate design standards in local subdivision regulations, local wetlands protection bylaws, or the site plan review process. Many agencies have developed model stormwater bylaws that towns can consider. More details are provided in Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

Nitrogen Management Overlay Districts

Municipalities can zone for nitrogen management overlay districts and enact supporting regulations, and these approaches are addressed in Action Plan 1 Managing Nitrogen Pollution.

Board of Health Review

Section 81-U of the Subdivision Control Law requires that boards of health review all subdivision plans to ensure that they do not pose any public health concerns. When used appropriately, the Board of Health can minimize threats to water quality with these reviews. Regulations prevent planning boards from approving subdivision plans that the board of health stipulates are not suitable for construction because of public health issues. This review authority vests considerable power in the board of health and has the effect of encouraging planning boards to work cooperatively with local health boards to ensure adequate protection of public health.

Board of Health Regulations

Board of health regulations, as provided for in the various sections of Massachusetts General Laws, Chapter 111, can be effective to manage land use particularly methods of wastewater disposal and requiring tie-ins to sewer systems.

Non-Regulatory Techniques

District Improvement Financing / Tax Increment Financing

District Improvement Financing and Tax Increment Financing are economic tools that promote redevelopment using public/private partnerships. TIF offers tax breaks to developers, while DIF channels tax dollars into targeted redevelopment districts. These incentives encourage redevelopment efforts in targeted areas instead of new development. Both programs can indirectly help to preserve open space and reduce the pattern of sprawl.

Protecting Open Space

Many communities are committed to the acquisition of selected parcels of land considered so significant to the town's future that it may be willing to buy them outright at market prices. These acquisition priorities include large tracts of undeveloped land, land within defined water resource areas, land holding rare and endangered wildlife, and land with unique ecological character. Action Plan 12 Protecting Open Space describes these approaches in.

Conservation Commission Policies and Regulations

Local conservation commissions, in their role of implementing the Wetlands Protection Act, have significant land use responsibility. For example, they have the authority to protect critical wetland areas through local initiatives that assert their jurisdiction within the 100-foot buffer zone around wetlands. Conservation commissions can protect sensitive coastal wetlands by requiring strict standards within buffer areas. A buffer zone is extremely important for the protection of both wetland functions and wildlife habitat.

Neither state nor federal government has a setback requirement in its wetland regulations, but the state allows towns to adopt construction setbacks from wetlands. Some towns have adopted wetland setbacks of 25-50 feet and, in the case of Areas of Critical Environmental Concern, 100 ft. Others, such as Falmouth, have adopted regulations requiring new construction to provide at least 25 feet of vegetated buffer to the wetland. Most towns on Buzzards Bay, however, do not have standard wetland setbacks, and thus must negotiate buffer zones on a case-by-case basis, and no automatic protection buffer exists. Some town Open Space Residential Development zoning regulations mandate setbacks from wetlands.

Agricultural land protection

When properly managed, agricultural lands can have less impact on the environment than the same land used for residential or commercial development. For these reasons, the government should help preserve existing farms in areas with good agricultural soil. Government can help preserve existing farms for continued agriculture through tax policies and regulations. In those areas with prime farmland soils, or soils of statewide importance (determined by USDA-NRCS), the property owner can protect the property for future generations through the state's Agricultural Preservation Restriction program. This approach is important because areas with good agricultural soils are in limited supply, and it would be unwise to direct growth to these areas through transfer of development rights or other smart growth approaches. Municipalities should include maps of prime farmland soil in their open space plans. Towns and the USDA should work with farmers to enact Agricultural Protection Restrictions (APRs) on these properties.

Open Space Residential Development zoning regulations can include protection of agricultural lands. The Town of Dartmouth requires a 200-foot setback for residential structures from active cranberry bogs. Agricultural buffer zones also have health benefits as they minimize exposure to sprayed pesticides and conversely minimize the discharge of pollutants from development onto agricultural lands (e.g. runoff of pollutants or residential pesticides affecting pollinators).

Action Plan 5. Managing Onsite Wastewater Disposal Systems

Problem

While sewering has expanded in Buzzards Bay in recent decades (Figure 38), the high cost of municipal sewer system expansion, particularly in the less densely developed areas, ensures that property owners will use onsite wastewater disposal systems of various designs for years to come. Among the estimated 113,126 residential units in the Buzzards Bay watershed, 44,500 (39.3%; Table 7) of the residences have onsite wastewater treatment systems [31]. Most of these have a conventional gravity design called a septic system that conforms to the state Title 5 sanitary code (310 CMR 15.00), first promulgated by the state in 1975. Before that time, most homes had a single leaching-pit commonly called a cesspool. Modern conventional Title 5 wastewater systems, as depicted in Figure 39, infiltrate wastewater through soil into groundwater to remove bacteria and other pollutants, but not all. Septic systems are an important controllable nitrogen source reaching estuaries. A conventional septic system removes less than a third of the nitrogen contained in wastewater through processes in the tank and under the leaching field. In unsewered areas sensitive to nitrogen inputs, towns may require property owners to convert septic systems to nitrogen removing alternative designs.

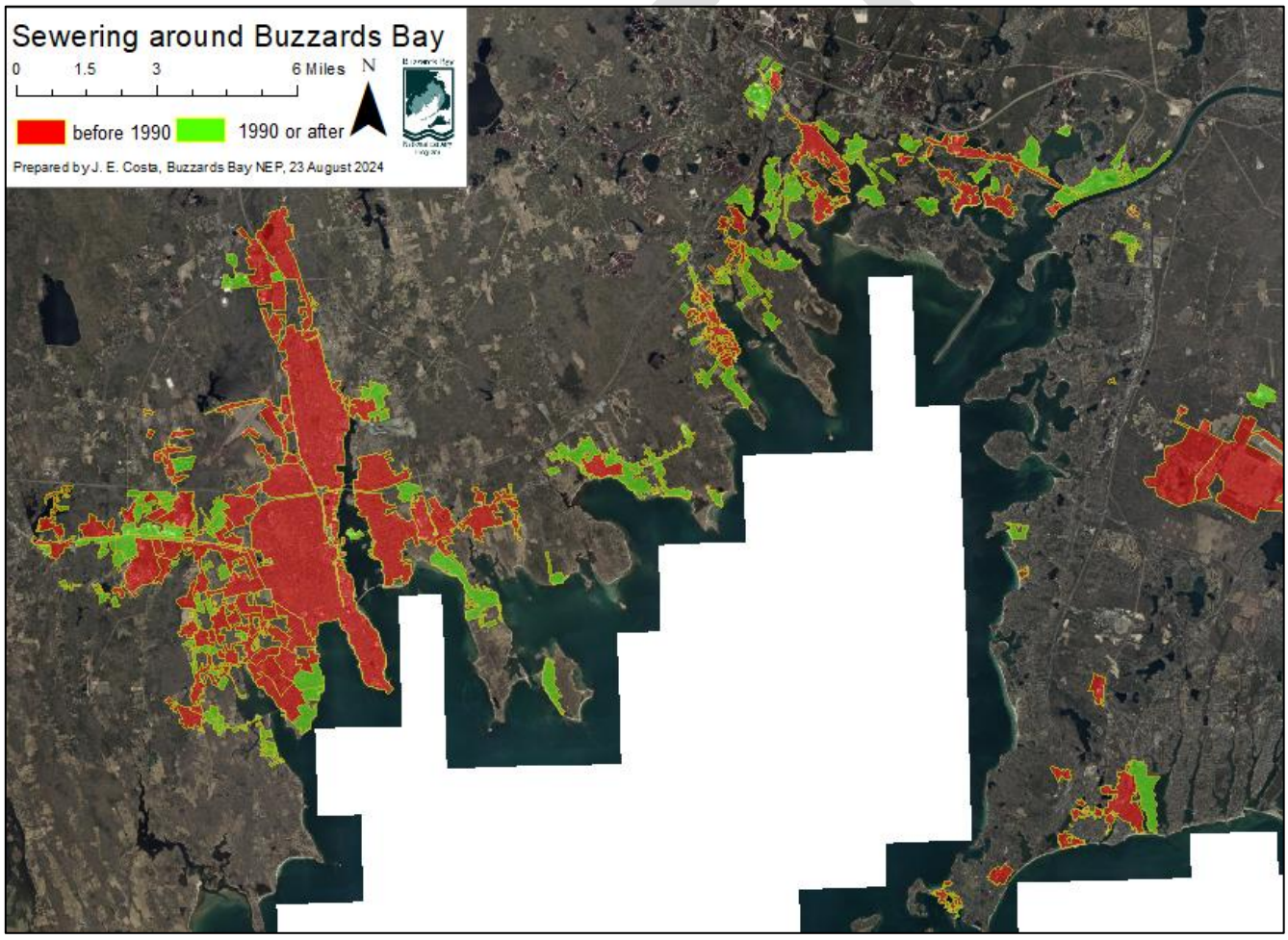


Figure 38. Buzzards Bay sewered areas, before and after 1990, clipped to the watershed boundary.

2019 basemap from MassGIS, sewer coverage developed by the Buzzards Bay NEP. This sewer map coverage was used to estimate units tied to sewer and septic systems as described by the methodology described in Action Plan 1 Managing Nitrogen.

[31] Calculation based on 2021-2025 MassGIS assessor's data intersected with sewer map posted on the NEP's website Wastewater Disposal page. This is an underestimate because not all homes are connected to sewer in recently sewered areas.

Changes to the state's Title 5 sanitary code in 1995 met many of the original recommendations of this action plan in the 1991 CCMP including requiring a 4-ft separation to groundwater, the use of licensed inspectors and soil evaluators, permitting of alternative design septic systems, and inspections for system failure at property transfer, change of use, or for expansions. Nonetheless, many challenges remain, and at least 8% of the existing onsite systems in the Buzzards Bay watershed are cesspools [32].

Repair and installation of conventional systems typically range from $20,000 to $50,000 per system. These conventional systems are not effective at removing nutrients like nitrogen and phosphorus, which can degrade surface waters, and in the case of nitrates, can affect human health. Alternative design nitrogen removal onsite systems may have double the costs of conventional systems.

Septic systems may contribute to phosphorus pollution in freshwater systems, especially where the septic systems are located near shorelines. This action plan also addresses tools to manage phosphorus pollution from onsite wastewater disposal. Action Plan 13 Protecting and Restoring Lakes, Ponds, and Streams has some actions that address phosphorus pollution.

This action plan primarily focusses on outstanding issues related to the permitting, construction, use, and maintenance of existing and new onsite wastewater disposal systems of all types, tracking the operation and maintenance of alternative design systems, and enforcement and compliance with the state Title 5 sanitary code and meeting broader goals of protecting public health and the environment. Action Plan 1 Managing Nitrogen Pollution addresses the broader need to replace conventional onsite wastewater disposal systems with either innovative alternative design nitrogen removal onsite systems or eliminating them and connecting into sewers to meet coastal watershed nitrogen TMDLs.

Table 7. Wastewater disposal in each municipality for residential units within the Buzzards Bay watershed, summarized by municipality.

TOWN	GWP	Onsite	Sewer	Total	% onsite
Acushnet	0	3,152	1,015	4,167	75.6%
Bourne	448	6,272	347	7,067	88.8%
Carver	0	2,934	0	2,934	100.0%
Dartmouth	0	3,910	7,531	11,441	34.2%
Fairhaven	0	650	6,764	7,414	8.8%
Fall River	0	160	0	160	100.0%
Falmouth	0	6,240	462	6,702	93.1%
Freetown	0	624	0	624	100.0%
Gosnold	0	151	0	151	100.0%
Lakeville	0	28	0	28	100.0%
Marion	0	890	1,667	2,557	34.8%
Mattapoisett	0	1,877	1,484	3,361	55.8%
Middleborough	0	739	0	739	100.0%
New Bedford	0	375	42,772	43,147	0.9%
Plymouth	119	3,577	0	3,696	96.8%
Rochester	0	2,045	0	2,045	100.0%
Wareham	0	4,839	6,017	10,856	44.6%
Westport	0	6,037	0	6,037	100.0%
Total	567	44,500	68,059	113,126	39.3%

GWP= ground water permit systems are those with treatment capacity over 10,000 gpd and may service many homes. Data prepared by Joe Costa from 2021 to 2024 assessor's parcel data combined with NEP sewer history maps.

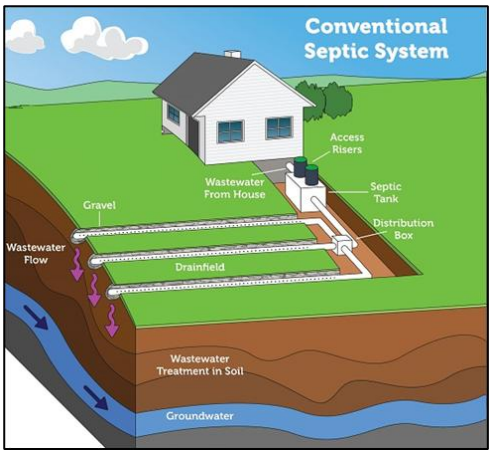


Figure 39. Typical conventional onsite wastewater disposal septic system installed in Massachusetts.
Illustration modified from an EPA types of onsite disposal systems webpage (last accessed 12/19/2024)

[32] This 8% estimate was calculated from the number of homes in unsewered areas built before 1965, when cesspools were still acceptable, and have also not been sold since 1995, when requirements for system inspections were added to Title 5. Some homeowners likely upgraded their cesspool to a Title 5 system because of hydraulic failures. However, cesspools may pass inspection if they do not show evidence of hydraulic failure, so the number of units served by cesspools likely exceeds 8% of all onsite systems.

Photo by Joe Costa.

Figure 40. The Massachusetts Alternative Septic System Test Center.

The construction of the Massachusetts Alternative Septic System Test Center at the Massachusetts Military Reservation by the Buzzards Bay National Estuary Program, in partnership with Barnstable County Department of Health and the Environment and Massachusetts Department of Environmental Protection, was an important achievement toward implementing key goals and objectives contained in the 1991 Buzzards Bay CCMP onsite wastewater management action plan, including "to promote innovative technology that will reduce nitrogen." Today the facility is operated by Barnstable County Department of Health and the Environment.

Additional Information

The 1991 Buzzards Bay CCMP identified on-site wastewater disposal systems (commonly referred to as "septic systems") as a concern to human health and the environment for three primary reasons. First, failed systems (especially cesspools) were contributing to elevated fecal coliforms in surface waters, and high densities of functioning systems threatened the quality of nearby public and private drinking water supplies. Second, nitrogen from these wastewater disposal systems was unregulated and was often the principal source of eutrophication to many embayments around Buzzards Bay. Third, many towns were using the permitting of Title 5 systems as a de facto growth control and land protection instead use zoning districts and master planning tools. Since 1991, state and local government have addressed many of these issues. The allowance of alternative design onsite systems led the Buzzards Bay NEP to collaborate with Barnstable County and MassDEP to construct the Massachusetts Alternative Septic System Test Center with funding from EPA (Figure 40). Despite these successes, many problems remain.

Until 2023, Title 5 code updates did not address nitrogen loading to coastal embayments, and these new amendments are now being implemented. This lack of a state mandate did not prevent the towns of Wareham and Westport from eventually requiring innovative alternative design nitrogen removal systems for new construction and expansions in unsewered areas (2015 and 2019, respectively).

Between 2000 and 2020, EPA approved dozens of watershed nitrogen TMDLs for Cape Cod and Buzzards Bay embayments. In most of the studies, onsite nitrogen systems were the primary source of nitrogen contributing to coastal eutrophication. In July 2023, MassDEP amended Title 5 to require within seven

years the upgrade of all onsite systems in the watersheds of nitrogen sensitive areas on Cape Cod to best available nitrogen reducing technology if the municipality does file a Notice of Intent to apply for a Watershed Permit stating the municipalities' intention to adopt a local watershed plan to meet EPA approved coastal watershed nitrogen TMDLs. Each of those communities with a Nitrogen TMDL and covered under an area-wide 208 plan filed a Notice of Intent, thereby tolling the Title 5 requirement to upgrade onsite septic systems. MassDEP has not yet issued a nitrogen TMDL to any of the watersheds on the western shores of Buzzards Bay. Excluding Bourne, none of the watersheds on the western shores of Buzzards Bay are covered by an approved area wide 208 plan. As a result, Nitrogen Sensitive Areas have not been designated in those communities, therefore the Nitrogen Sensitive Area provisions of Title 5 do not yet apply in those communities. Whether towns choose to replace conventional onsite systems with sewer or nitrogen removal technologies, both strategies pose financial and administrative challenges to homeowners and municipal governments, and we address the problem in Action Plan 1 . After 1990, many communities expanded sewering to densely developed former seasonal village areas (Figure 31). However, the number of homes converted to sewer has rarely outpaced the construction of new septic systems (Figure 41).

The contamination of surface waters from on-site wastewater disposal systems can occur in at least three ways. Perhaps the most obvious public health threat occurs when a system experiences overt failure. Failure occurs when soils under the leaching system can no longer accept septic tank effluent. Sewage levels rise in the septic tank and back up into the home or break out onto the surface of the lawn or ground. This process is most noticeable during wet periods or after heavy rains. When a failed system is near shore, this breakout of sewage, which may hold bacterial and viral pathogens, can be transported to surface waters via stormwater drainage systems or overland flow. In general, homeowners will pump out their septic tanks when they observe overt failures like the pooling of sewage on their lawn. However, there will be no municipal enforcement against the property owner unless someone complains. In some towns, because of the availability of septic system tracking programs, frequent pumpouts have triggered inspections by municipal health agents and resulted in boards of health requiring septic system repair or replacement.

Covert failures may play a more significant role in the pathogen contamination of some embayments surrounding Buzzards Bay. Many on-site systems installed before 1978 had little or no separation from groundwater. Sewage from these systems discharges directly to the groundwater, without the benefit of filtration through unsaturated soil. Property owners may assume these systems are functioning effectively because no visible wastewater appears on the ground surface, but they are adding pathogens directly to groundwater. Depending on the horizontal distance this contaminated groundwater flows before reaching surface waters, the potential for pathogens to reach coastal waters can be significant.

Another type of covert failure is the problem of overflow pipes. Before the enactment of Title 5, some property owners used these pipes as backups to prevent overt failure of systems. After Title 5 was enacted, these overflow pipes were sometimes illegally installed. These overflow pipes discharged wastewater directly into surface waters, connecting ditches, streams, or wetlands. Through health agent participation in sanitary surveys with the Division of Marine Fisheries, and through other local field evaluations, many of these illegal discharges have been identified and eliminated.

A similar problem has occurred in some municipalities with sewer systems. In some municipalities (Acushnet, Dartmouth, Fairhaven, and New Bedford), household sewer pipes were attached to stormwater pipes instead of municipal sewer lines. During the late 1990s and 2000s, these communities rented, purchased, or borrowed pipe "creeper cameras" to conduct surveys to identify these illicit connections. Dozens of illicit connections have been identified and eliminated because of these efforts. Today, some illicit connections undoubtedly still exist, and they need to be eliminated.

The possibility of viral pathogens entering Buzzards Bay from properly designed and installed on-site systems remains a concern but is the subject of much debate. Research suggests that, although fecal indicator organisms are filtered out adequately in the leaching

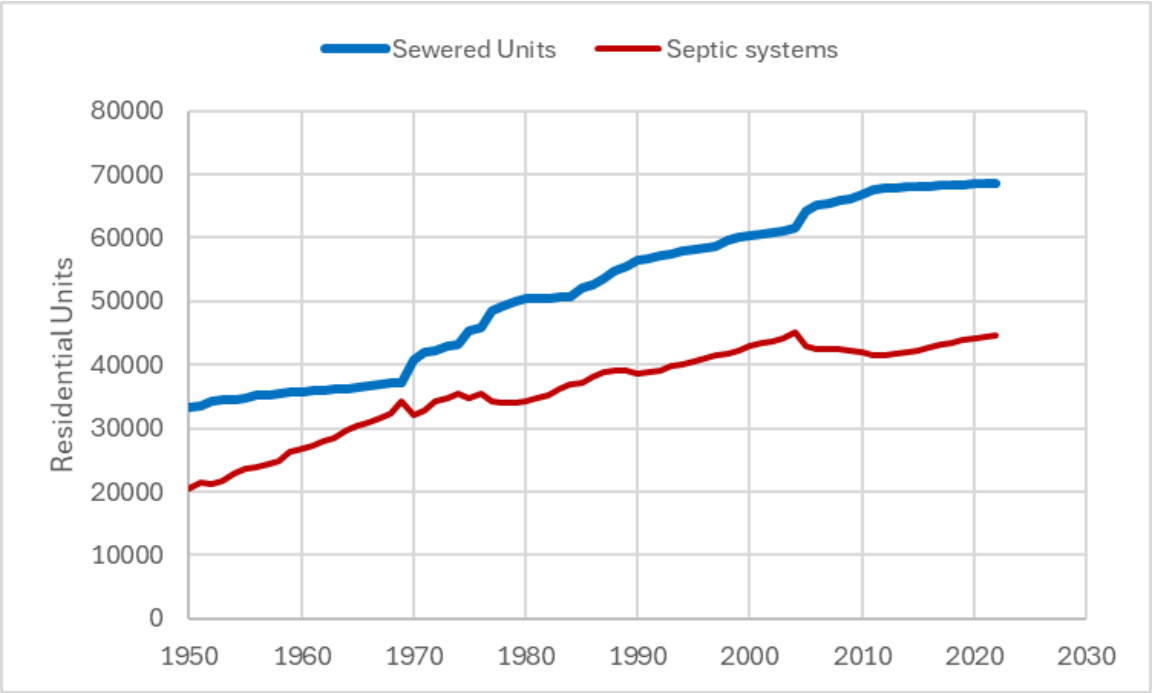


Figure 41. Numbers of septic systems and sewer to residential units in the Buzzards Bay watershed.

component of on-site wastewater disposal systems, viruses may pass through the unsaturated soil layer, reach groundwater, and travel great distances. These viruses may be a public health threat to resource areas (aquifer, shellfish area, swimming beach). The presumption remains that the existing Title 5 setback requirements from on-site wastewater disposal systems to private wells, surface water bodies, and other areas are inadequate to provide protection against virus transport.

With respect to phosphorus discharges from septic systems, these discharges primarily affect freshwater systems. Moreover, because of the nature of the iron-rich soils in the region, most phosphorus in septic effluent tends to be bound to soil particles within a hundred or few hundred feet of discharges where the treatment layer has aerobic (well oxygenated) conditions. Most regulations for onsite systems that limit phosphorus generally require a specific setback distance from surface waters or vegetated wetlands, and some managers have promoted a 300 feet setback rule of thumb [33]. Only a limited amount of research has been undertaken to evaluate the time to saturate soils with reactive phosphorus from septic plumes.

Goal

Goal 5.1. Prevent public health threats and reduce environmental degradation from on-site wastewater disposal systems.

Objectives

Objective 5.1. DEP and Boards of Health must ensure compliance with and enforcement of Title 5 regulations.

Objective 5.2. Support development of local watershed plans and encourage boards of health to adopt local regulations to improve environmental and public health protection and to meet local needs.

Objective 5.3. Improve management and oversight by municipalities of onsite wastewater disposal systems.

Objective 5.4. In areas where the state requires advanced nutrient removal, evaluate and compare the benefits and costs of centralized sewering, community

[33] See, for example, the Barnstable County septic system training module 3 at: www.learntitle5.org/Module3.PDF.

scale satellite treatment systems, and individual alternative systems.

Objective 5.5. Encourage towns to track septic tank pumping frequencies and to remind homeowners to pump their septic tanks at MassDEP recommended frequencies.

Objective 5.6. Encourage and promote ongoing research on new alternative onsite wastewater disposal systems that more effectively remove nutrients.

Objective 5.7. In areas around freshwater ponds, where excess phosphorus is causing reductions in surface water quality, promote technology and setback strategies to reduce the phosphorus loading from septic systems reaching the pond.

Management Approaches

While municipalities and MassDEP are the lead for many actions, other agencies and organizations must help and participate. Boards of health administer most elements of Title 5 regulations. Massachusetts Home Rule and Chapter 111, Section 31 of the Massachusetts General Laws, to meet local needs and better protect public health and the environment [34]. Consequently, MassDEP wrote the Title 5 regulations as minimum standards of protection, and some health boards have adopted more stringent regulations that offer extra protection to public health, enhance environmental protection, or other special needs. However, the MassDEP must approve any locally approved variances from the regulations. Some coastal communities have been quite aggressive in formulating local regulation supplements to Title 5. Some, like Title 5 setbacks (distance to wetlands or wetlands buffer zone for example) vary. While there have been challenges to boards of health, the Massachusetts Supreme Court upheld the rights of the boards of health to enact more stringent local regulations. [35]

To meet the goals of this action plan, municipal boards of health must ensure that all onsite systems must meet all state and local regulations, including any new requirements to meet TMDLs. Boards of Health should avoid providing hardship variances, and instead municipalities should provide betterment programs to spread costs over decades or subsidize some part of tie-in costs. For new construction and onsite wastewater upgrades, municipalities must adopt local regulations to meet special local needs to protect public health, safety, and the environment. Local requirements should not only support plans to meet coastal watershed nutrient TMDLs but could include more stringent setbacks from surface waters or requiring greater separation to groundwater near the coast to account for sea level rise. Where local government mandates the use of nitrogen removal septic systems, requirements should include the best available technology rather than the state's 19 ppm minimum standard.

Because phosphorus does not travel great distances in groundwater, local setback requirements from surface waters can address phosphorus pollution from septic systems.

Costs and Financing

Most of the strategies described in this action plan have negligible costs to government, although some initiatives would increase the workload for staff, or require new staff. Costs though of alternative onsite technology are highly variable and volatile and will depend on housing density, lot size, soil characteristics, and separation of groundwater among other factors. Monitoring alternative design onsite systems may cost property owners hundreds of dollars annually and require more municipal staff. On Cape Cod, municipalities are considering using a regional responsible authority to oversee all alternative septic systems on

[34] Chapter 111, Section 31, states, “Boards of health may make reasonable health regulations” and adopt local regulations for subsurface disposal of sanitary sewage as specified in the state environmental code, 310 CMR 11.00 and 310 CMR 15.00 (“Title 5”). The purpose of 310 CMR 15.00 is to “Protect Public Health and Safety and the Environment.” Section 303, allows local boards of health to determine if wastewater disposal systems are failing and order an upgrade of any system the system "threatens public health, safety, welfare or the environment or causes or threatens to cause damage to property or creates a nuisance.” Moreover, boards of health can adopt more stringent standards than 310 CMR 15.00. The powers and authorities of the boards of health can be found in the Manual of Laws and Regulations Relating to Boards of Health.

[35] Decision was in the case Tortorella versus the Board of Health of Bourne 39 Massachusetts Appeals Court 277. Retrieved from Mass Cases website.

Cape Cod [36]. Compliance with Title 5 is a financial challenge to property owners, and towns must provide betterment programs to spread upgrade costs over decades. Innovative alternative designs may double those costs. Some initiatives, like a regional online innovative system tracking system would likely cost less than $10,000 to create and may cost $10,000 per town to annually staff thereafter.

Measuring Success

For this action plan, programmatic actions are the chief measure to track progress toward the goals of this action plan. Tracking individual system compliance and performance through inspection, annual performance reports, and pumpout frequency are metrics municipalities can easily track. Evaluating the effectiveness of local regulations is subjective, but tracking the adoption of local regulations, like setbacks to fresh surface waters or requirements for repairs when nitrogen removal systems are not meeting state-approved limits, are actions easily tracked.

[36] The Town of Falmouth uses Barnstable County Department of Health and Environment.

Action Plan 6. Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging

Problem [37]

Many thousands of recreational boaters and commercial vessel operators use Buzzards Bay (Figure 35 and Figure 36). These vessels, plus supporting infrastructure and operations may adversely affect water quality and habitat. Supporting infrastructure and operations include constructions and maintenance of docks and piers, mooring-related impacts, channel dredging, vessel launch impacts, propeller wash and boat wake, fuel spills, transport of invasives in bilge water and on boat and trailer surfaces, noise, release of trash, and disposal of sanitary waste, among others.

During the summer, Buzzards Bay is home to more than 12,000 docked or moored boats (2004-2006 summary by embayment in Table 7) [38]. During a peak summer holiday or boat event, with the addition of day launches, more than 15,000 vessels are in the bay. Based on boat registration data (Table 9), about 1,850 of these are commercial or government-operated vessels (principally coastal or nearshore fishing boats, ferries and municipal craft), with the rest being recreation vessels. More than 33 public and private marinas, 58 public boat ramps, 6,340 moorings, and nearly 1,300 public and private docks serve these vessels. The number of docks, moorings, and boats in Buzzards Bay continues to grow. In some harbors, mooring fields cover large areas and may exceed 1,000 anchorages. The demand for boat moorings is great. For example, in 2024, 777 boaters were waiting for an available mooring in a Falmouth Buzzards Bay embayment, with some on the waitlist for more than 30 years.

Impacts from the construction of new docks is a concern for managers at all levels of government (Figure 44). Docks are a potential source of user conflicts, since they tend to restrict access along and to the shore for shellfish harvesters, anglers, and the public.

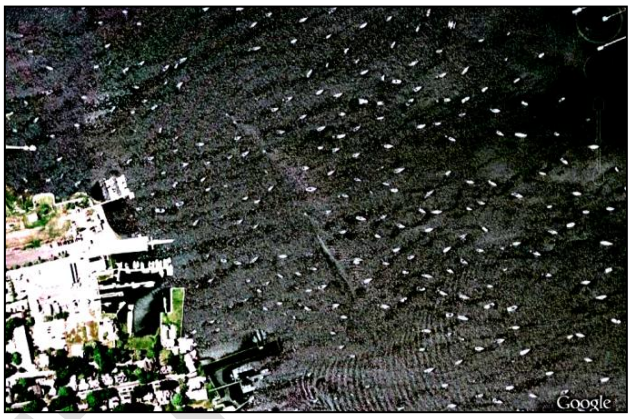


Figure 42. Oblique aerial photograph of a portion of a mooring field in Sippican Harbor, Marion, MA.

This harbor has one of the largest mooring fields in Buzzards Bay

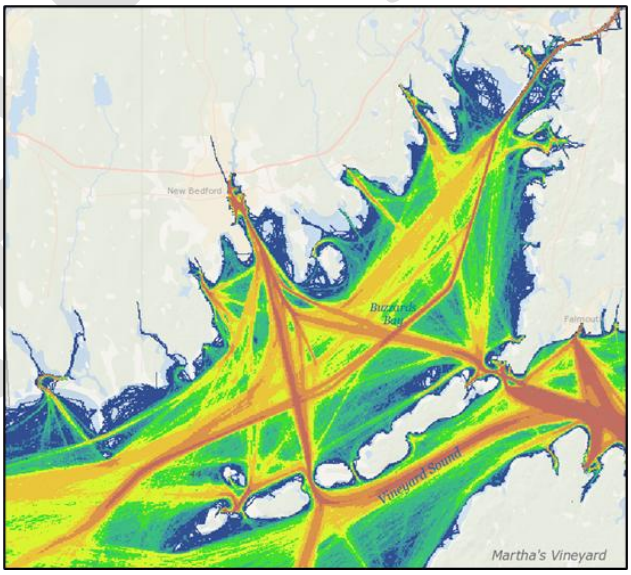


Figure 43. 2023 Commercial Vessel transects in Buzzards Bay.

From the Northeast Ocean Data Explorer website.

[37] This action plan primarily addresses physical impacts and pollutant discharges associated with boats, marinas, and mooring fields. Impacts of development of the waterfront, managing usages of the watersheet (like defining the extent of moorings) are addressed in Action Plan 15 Managing Coastal Watersheets, Tidelands, and the Waterfront. We address fueling spill impacts in Action Plan 17 Preventing Petroleum Products Pollution.

[38] Based on mooring and slip numbers provided by the towns. In 2006, the DMF reported that there were 23,231 boats registered to residents of Buzzards Bay watershed municipalities. Of these, 1,769 of these registered vessels are commercial vessels. These registrations do not include all boating on Buzzards Bay. Recreational boat owners outside the watershed may also trailer boats to Buzzards Bay. Owners of larger recreational vessels register their boats in other states (like Delaware) for tax purposes.

Long docks can impede or hinder nearshore navigation. The environmental impacts of poorly sited docks and piers and associated motorized boating activities, can include damage to salt marsh, shellfish habitat, eelgrass beds, and water quality due to resuspended sediments. The visual and aesthetic impacts of a single small dock are arguable, but dense clustering or proliferation of docks and piers ("dock sprawl") or large dock systems may have such visual impacts. Measures to mitigate a single issue may end up affecting something else (e.g., siting a dock to avoid salt marsh impacts may result in an increased impact to navigation or aesthetics).

Perhaps 1,000 or more of the moored boats in Buzzards Bay have installed marine heads (toilets), today mostly using holding tanks. Some smaller vessels use portable heads. The illicit discharge of sanitary waste was a concern described in the 1991 Buzzards Bay CCMP. This led to the designation of Buzzards Bay as a No Discharge Area (NDA) for boat sewage in 2000, the first large area to be designated in Massachusetts. The designation required the availability of an adequate number of boat sanitary waste pump-outs (Figure 39).

Environmental impacts from boats are most pronounced where boat density is greatest or where there are sensitive resources. Boat use and maintenance, and the infrastructure to support those activities, all have potential impacts associated with the release of contaminants, and through physical alterations like propeller wash, anchor chain scour, decreased water transparency, and shading of eelgrass from boats, docks, and sediment resuspension. Some harbors in Buzzards Bay have more than 1,000 moorings. Mooring chains scour the bottom, remove eelgrass, directly kill benthic fauna and destroy its habitat. Anchor chains, bouncing on the bottom with waves, resuspend bottom sediments greatly reducing water clarity that can shade out eelgrass beds over large areas and elevate bacteria levels.

There are several potential pollution issues associated with marinas [39]. Impervious surfaces (roofs, driveways and parking lots) convey stormwater to surface waters. Such discharges require a stormwater NPDES permit from EPA under the multi-sector general permit (MSGP) program. This permit requires marina operators to implement best management practices to minimize stormwater volume and contaminants. Less than half of marinas in Massachusetts comply with this EPA permit program. Marinas with boat cleaning operations including pressure washing Figure 38), must capture all wash waters. The wash water and chemicals in bottom paint scrapings can contaminate surface water and groundwater and adversely affect marine life.

Figure 44. Docks constructed across a salt marsh in the Town of Westport;

MassGIS 2023 ortho imagery.

The potential impact of docks on Buzzards Bay coastal wetlands, particularly salt marshes, eelgrass beds, and shellfish habitat is often a focus of mangers and the public. The permitting of dock falls under local wetland protection bylaws, Massachusetts Wetlands Protection Act, Army Corps of Engineers, and possibly MEPA and CZM depending upon the scope of the project.

[39] EPA defines a marina as any facility that contains 10 or more slips, piers where 10 or more boats may tie up, or any facility where a boat for hire is docked; boat maintenance or repair yards that are adjacent to the water; any federal, state, or local facility that involves recreational boat maintenance or repair that is on or adjacent to the water; public or commercial boat ramps; any residential or planned community marina with 10 or more slips; and any mooring field where 10 or more boats are moored.

Table 8. Moorings and slips in Buzzards Bay embayments (data from various source circa 2004-2006).

Town	Bay	Moorings	Slips	Combined
Bourne	Buttermilk Bay	162	299	461
	Canal: Gray Gables	29	3	32
	Hen Cove	232	6	238
	Phinneys Harbor	327	70	397
	Pocasset Harbor	201	8	209
	Pocasset River	88	63	151
	Red Brook Harbor	546	278	824
	Squeteague Harbor	70	11	81
	Wings Cove	23	1	24
Bourne Summary		1,678	739	2,417
Dartmouth	Apponagansett Bay	810	270	1,080
	Clarks Cove	30	30	60
	Little River	10	0	10
	Slocums River	30	0	30
Dartmouth Summary		880	300	1,180
Fairhaven	East Cove, West Island	22	0	22
	Little Bay	10	0	10
	Nasketucket Bay	60	85	145
	Nasketucket Bay-Seaview Ave	13	0	13
	New Bedford Inner Harbor	213	409	622
Fairhaven Summary		318	494	812
Falmouth	Fiddlers Cove	0	120	120
	Megansett	138	0	138
	Quissett Harbor	240	0	240
	Rands Canal	15	0	15
	West Falmouth Harbor	348	0	348
	Wild Harbor	109	0	109
Falmouth Summary		850	120	970
Gosnold	Cuttyhunk Harbor	135	46	181
	Cuttyhunk Pond	61	0	61
	Hadley Harbor	18	0	18
	Robinson's Hole/Nash. Harbor	4	0	4
Gosnold Summary		218	46	264
Marion	Aucoot Cove	17	0	17
	Blankenship Cove	48	0	48
	Hammets Cove	85	0	85
	Planting Island Cove	90	0	90
	Sippican Harbor	260	56	316
	Sippican Harbor- Old Landing	0	100	100
	Sippican Harbor-Inner Harbor	732	0	732
	Sippican Harbor-Jobs Cove	24	0	24
	Weweantic River	71	0	71
	Wings Cove	90	0	90
Marion Summary		1417	156	1,573
Mattapoisett	Aucoot Cove	100	0	100
	Brandt Island Cove	12	75	87
	Mattapoisett Harbor	694	9	703
	Pt. Connett	45	0	45
Mattapoisett Summary		851	84	935
New Bedford	Clarks Cove	90	30	120
	New Bedford Inner Harbor	105	995	1,100
	New Bedford Outer Harbor	90	10	100
New Bedford Summary		285	1,035	1,320
Wareham	Butlers Cove	35	0	35
	Buttermilk	0	86	86
	Buttermilk Bay	30	0	30
	Onset Bay	370	350	720
	Onset Bay-Broad Cove	35	0	35
	Onset Bay-Stonebridge	0	60	60
	Onset Bay-Sunset Cove	40	0	40
	Wareham River	376	116	492
	Weweantic River	30	28	58
Wareham Summary		916	640	1,556
Westport	East Branch	100	130	230
	West Branch	30	30	60
	Westport Harbor	500	440	940
Westport Summary		630	600	1230
Total Bay Summary		8043	4,214	12,257

In 2000, EPA approved all of Buzzards Bay as an NO DISCHARGE AREA for boat sewage. This designation helped keep shellfish beds open near marinas and mooring areas unless closures were justified by water quality data. As described in Action Plan 2 Protecting and Enhancing Shellfish Resources, new FDA rules in 2018 require precautionary closures near marinas and mooring areas even in the presence of a no discharge designation or lack or adverse water quality data.

Figure 45. Pressure washing at a marina with a water collection and treatment system.

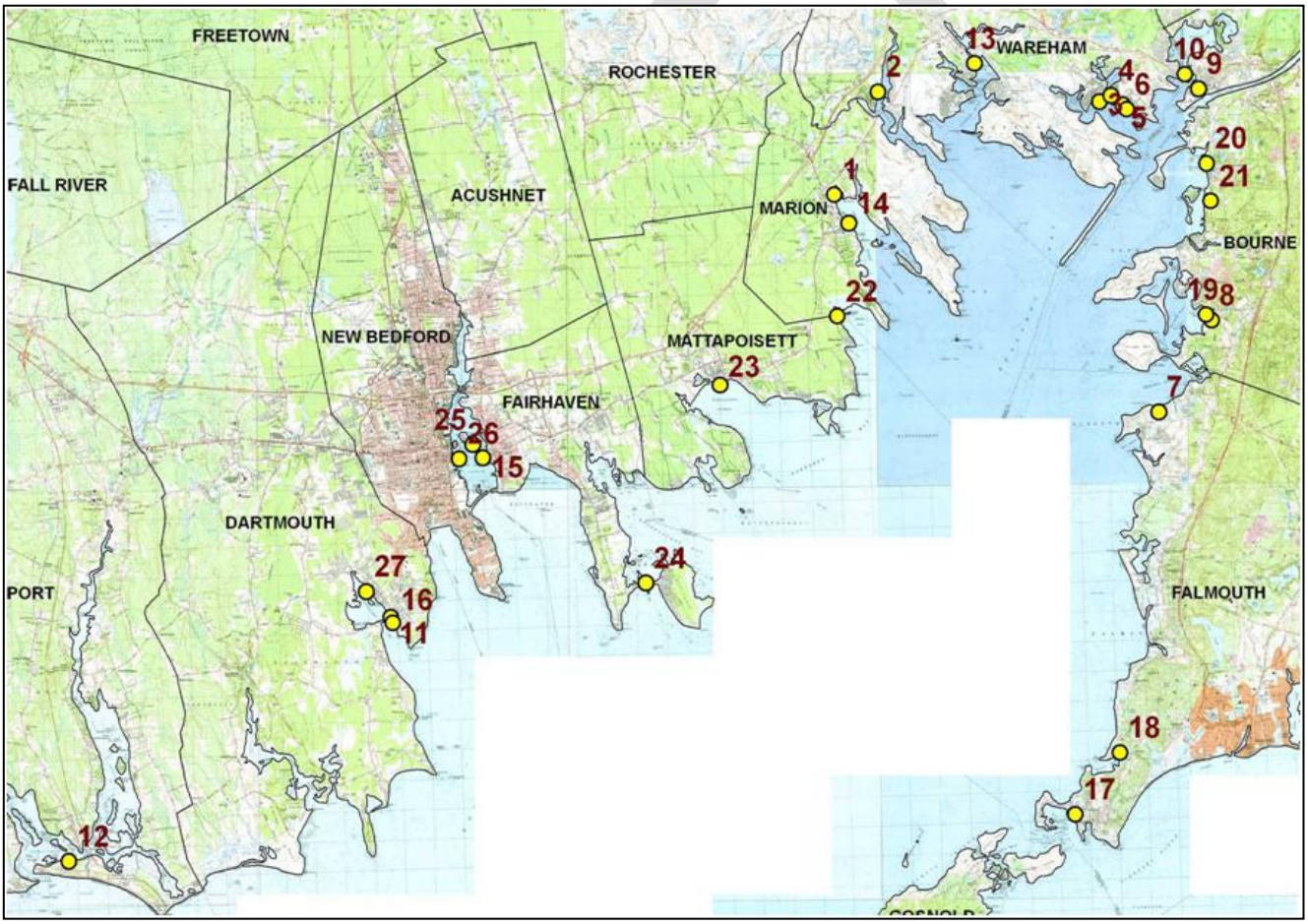


Figure 46. Location of boat pumpouts in Buzzards Bay.

Key: 1: Burr Brothers, 2 Wareham Boat Yard, 3: Onset Town Pier, 4: Stonebridge Marina, 5: Pt. Independence Yacht Club, 6: Onset Bay Marina, 7: Brewers Fiddler Cove, 8: Parker's Boat Yard, 9: Taylors Point Marina, 10: Continental Marina, 11: North Side Bridge Town Dock, 12: Westport Point-Town Dock, 13: Town Facility at Warr's, 14: Island Wharf, 15: Fairhaven Pumpout, 16: Davis and Tripps, 17: Woods Hole Marine, 18: Quisset Harbor Boatyard, 19: Kingman Marine, 2: Wareham Boat Yard, 20: Pocasset River - town op, 21: Monument Beach Marina, 22: Mattapoisett Boat Yard, 23: Mattapoisett Town Dock, 24: Earl's Marina, 25: Popes Island Marina, 26: State Pier Facility, 27: Padanaram Harbor Boat. Not shown: Coalition Bay Keeper serves Cuttyhunk Harbor on Gosnold.

Table 9. Motorboat registration in Buzzards Bay municipalities[1]
Unverified data from online sources.

Municipality	Recreational	Commercial Fishing	Freight Barge	Passenger	Other	Total
Acushnet	23	10	0	4	1	38
Bourne	253	6	0	10	6	275
Carver	28	4	0	0	0	32
Dartmouth	273	25	0	6	3	307
Fairhaven	129	74	3	10	4	220
Falmouth[2]	254	15	0	29	9	307
Gosnold	3	1	0	2	1	7
Marion	188	8	0	5	4	205
Mattapoisett	200	24	0	2	10	236
Middleboro	43	3	0	0	0	46
New Bedford	108	254	6	5	22	395
Rochester	39	6	0	0	0	45
Wareham	96	7	0	5	0	108
Westport	83	24	1	0	1	109
Grand Total	**1,720**	**461**	**10**	**78**	**61**	**2,330**

[1] Many more vessels are moored in Buzzards Bay than registered in Buzzards Bay watershed towns. Only boats with engines (primary or secondary propulsion) must be registered in Massachusetts. Moreover, larger vessels (over 5-ton drafts) are exempt and instead are registered with the USCG National Vessel Documentation Center, and many of these are registered in other states (e.g., Delaware) for tax purposes.
[2] For Falmouth, only address listed as North Falmouth, West Falmouth, and Woods Hole Included, For Bourne, only Pocasset, Monument Beach, and Buzzards Bay addresses included.

Besides this action plan, we address problems associated with docks and piers in Action Plan 7. Protecting and Restoring Wetlands. We also address boating fuel spills and the discharge of oily bilge in Action Plan 17 Preventing Petroleum Products Pollution.

Goals

Goal 6.1. Enforce the Buzzards Bay No Discharge Area to ensure there are no illegal wastewater discharges from boats.

Goal 6.2. Eliminate or minimize impacts of pollutant discharges from marina operations and from maintenance and repair activities performed directly by boaters.

Goal 6.3. Eliminate adverse environmental impacts associated with mooring fields.

Goal 6.4. Minimize negative impacts of dredging activities on water quality, physical processes, marine productivity, and public health.

Objectives

Objective 6.1. Municipalities should ensure that each embayment has at least one boat waste pumpout facility. Granting agencies should support this action.

Objective 6.2. Promote the use of pumpout facilities by educating boaters, making facilities more accessible, and enforcing the regulations.

Objective 6.3. EPA should ensure that marinas, boat building, and boat maintenance facilities are in full compliance with industrial site stormwater discharge permits.

Objective 6.4. Regulators and municipalities should ensure compliance of marina power washing activities with applicable state and federal laws and encourage the use of products that meet the EPA Safer Choice Standard.

Objective 6.5. State and federal agencies should encourage and support municipal efforts to pilot, demonstrate, and require conservation moorings for boat mooring fields.

Objective 6.6 Encourage municipalities and marinas to educate boaters about how to reduce fuel spills and minimize impacts and require best management practices around fueling facilities.

Objective 6.7. Encourage the use of the least environmentally damaging cleaners, and bottom paints by marinas and do-it-yourself boaters.

Objective 6.8. Maximize the beneficial use of dredged sediments on land rather than disposing at sea.

Objective 6.9 Municipalities should encourage the adoption of shared docks to reduce the number of future docks.

Objective 6.10. Municipalities should adopt with public input local harbor and watersheet plans and policies to better manage coastal watersheet uses, structures, natural resources, and tidelands habitats. Strategies should help increase shoreline resilience to storms and rising sea level, ensure dredging is protective of natural resources and habitats, and designate areas appropriate for sustainable uses including aquaculture and alternative energy. Towns must provide plans and policies to the MassDEP Waterways Program.

Management Approaches

While municipalities, boaters, marina operators, and MassDEP are the lead for many actions, other agencies and organizations must help and participate. Municipalities and other government entities can achieve the goals in this action plan through education, regulatory compliance, and new local regulations. Government and environmental non-profits can help minimize environmental impacts associated with boats, moorings, and marinas by educating boaters and the public. Communication can include newsletters, factsheets distributed to boaters, videos, social media, and signage at launch areas and marinas. To reduce fuel spills from boats, towns can require absorbent pads around fueling points and bilge socks in bilge tanks or similar collection points. Boaters must recognize the importance of looking for fuel leaks, not overfilling tanks, using vent capture overflow devices, and cleaning up spills at once with absorbent materials.

Each town should decide whether it has sufficient pumpout facilities. Towns should keep and review sewage pumpout facility records of boats, and query boat owners to decide whether they need to provide more pumpout facilities. State and federal funds can help meet local needs. If compliance with the No Discharge Area is a concern, harbormasters could implement programs such as sealing heads of tank valves while in harbor, or placing dye tablets in the heads, and using criminal fines for actual discharges.

Conservation commissions are the primary municipal board reviewing docks and other coastal structures under the Massachusetts Wetland Protection Act and under any local wetland bylaws and regulations. MassDEP generally will overrule dock denial decisions made by conservation commissions under the state regulations if the denial is based on non-mitigatable or cumulative impacts to shellfish or fisheries habitat [40]. Consequently, it is vital that local zoning and non-zoning bylaws address cumulative impacts not adequately addressed by the state Wetland Protection Act.

Strategies for managing impacts of docks include, limiting length to minimize footprint impacts, limiting the boat draught to control prop dredging, limiting the types of dock materials to prevent pollution by pressure-treated wood or other substances, specifying the degree of light transmission between deck planks to minimize impacts on salt marsh growth, avoiding productive shellfish areas, limiting dredging or fill activities to times when shellfish larval settling or fish breeding activities are not occurring, minimizing the piling footprint area to minimize permanent loss of habitat, and minimizing dock width to reduce shading of salt marsh vegetation.

Improved compliance by marinas with the MSGP stormwater permit program will require notification and enforcement by the U.S. EPA, with supporting technical assistance from MassDEP and CZM. Marina operators must also cease discharges associated with bottom cleaning operations on their properties that result in direct discharges. Most marinas have opted to construct closed loop wash systems as they do not need discharge permits.

Eventually municipalities should require replacement of conventional mooring anchors with conservation moorings, such as helical anchors and elastic rodes. Municipalities can require boat owners to replace mooring gear with more environmentally friendly types through regulations or policies phased in over time to minimize hardships. Conservation moorings have an added benefit of increased boat densities; the

[40] DEP can overrule decisions based on state regulations but cannot overrule decisions based on municipal wetland laws and regulations.

same number of boats can be confined to a smaller area of the estuary. Municipalities can lead by example by replacing all municipal owned moorings with these environmentally beneficial mooring systems.

To reduce the number of future potential docks in an embayment, municipal regulations should encourage community or shared docks. A community dock is one that serves a neighborhood or several coastal property owners, while a shared dock may serve two adjacent owners. Frontage, maximum dock length, and MLW depth standards can reduce the number of docks along the waterfront and can also promote shared docks to overcome performance standards. For example, wetland regulations in the Town of Barnstable limits dock length by frontage, channel distance, and depth, excluding many properties [41].However, to meet these standards, owners of two adjoining lots may "combine frontage and erect a shared pier, provided that such agreement is registered in perpetuity at the Registry of Deeds."

Harbor and embayment plans

Municipalities may develop state-approved harbor plans, or they may adopt locally approved plans or policies for their embayments. In Buzzards Bay, only the City of New Bedford and Town of Fairhaven have jointly developed a CZM-approved harbor management plan for part of New Bedford Harbor and its waterfront. This plan does not address the construction of private and commercial docks and piers. The Town of Wareham has adopted a locally approved (by select boards) Dock Exclusion Zone. Below we discuss the differences between state-approved and local-approved embayment plans.

Locally approved embayment management plans can become the foundation of local management programs. In 2009, the town of Falmouth drafted a Green Pond Harbor Management Plan (Urban Harbors Institute, 2009). The management plan proposed mooring tackle restrictions, activity use areas, dock requirements and restrictions, and identification of marine spatial planning zones. While the town did not formally incorporate the plan in regulations, the planning effort helped guide some local decision-making. As noted earlier, municipalities can control dock and pier construction through the Chapter 91 permitting process if they adopt a formal local (non-state-approved) harbor or embayment plan or policy as per 310 CMR 9.34(2) (b). DEP's Waterways Program will enforce local harbor and embayment plan or adopted policy if there was a public hearing process as part of the policy or plan adoption.

Special area management plans can also serve this purpose if they address activities and areas subject to Chapter 91 jurisdiction (filled and flowed tidelands). One example of a special area management plan that includes dock management for the purpose of shellfish habitat protection is the Pleasant Bay Area of Critical Environmental Concern (ACEC) Management Plan developed for the Towns of Orleans, Eastham, and Chatham. This ACEC management plan addresses dock sprawl through designation of different zones within Pleasant Bay, based on shellfish habitat value and uses. The different zones specify whether docks are allowed or not. The wetland regulations of the towns located within the Pleasant Bay ACEC are consistent with and help to implement the Management Plan.

Watersheet zoning and non-regulatory approaches

Municipalities can use marine watersheet zoning to efficiently address cumulative impacts of activities on the water and along waterfront. Towns can use watersheet zoning to allow or disallow dock exclusion zones. The town must clearly delineate district boundaries, and the planning board or zoning board would administer it. A disadvantage of this approach is that these boards lack experience and expertise with marine and coastal environmental issues, but these boards can request input from the conservation commission or a subject matter expert.

Protection can be achieved without passage of zoning or general bylaws or ordinances. For example, towns can exclude motorboats from swimming areas, family shellfishing areas, and even eelgrass habitat areas.

Dredging and Dredged Material Disposal

Boat channels around Buzzards Bay continue to require periodic maintenance. In addition, regulators

[41] In 2003, the Massachusetts Appeals Court upheld this regulation in Dubuque v. Conservation Commission of Barnstable No.01-P-1152.

sometimes allow dredging for better access to private non-commercial docks. After the Massachusetts Legislature passed the 2006 law banning dredged material disposal in Buzzards Bay, municipalities and government agencies mostly dispose of dredged sediments on land sites or offshore out of Buzzards Bay. Only occasionally are the dredged materials used beneficially, like for beach nourishment. Municipalities and state and federal agencies should encourage and work toward coordinating dredging and beach nourishment work.

Costs and Financing

Many elements of this action plan require modest or negligible expenditures of public funds, as most relate to education, adoption of regulations, or better enforcement of existing regulations. Most of the necessary flyers and notices can be produced in-house by towns and distributed with mooring permits and through marinas.

The most expensive element of this action plan is born by boat owners, and that is the cost of new mooring systems. While conservation mooring systems are somewhat higher in price than a conventional mooring system ($4-$7,000), unless the mooring is new, this is an added cost. Municipalities can phase in mooring upgrades over a period of years. Municipalities should pursue funding for municipal owned mooring replacements from habitat restoration programs.

Measuring Success

The NEP will document the success of this action plan with programmatic actions, including the volume of boat waste collected, marina compliance with multi-sector general permits, the number of fuel spills reported, the extent of use of conservation moorings, and the adoption of strategies to limit dock density and impacts.

Additional Information [42]

Operators of marine sanitary waste collection facilities cannot dump this waste into septic systems because of the chemicals it holds. Instead, operators of boat pump-out facilities must haul sanitary waste to municipal wastewater treatment facilities. When traveling in No Discharge Area waters, boaters with Type I or Type

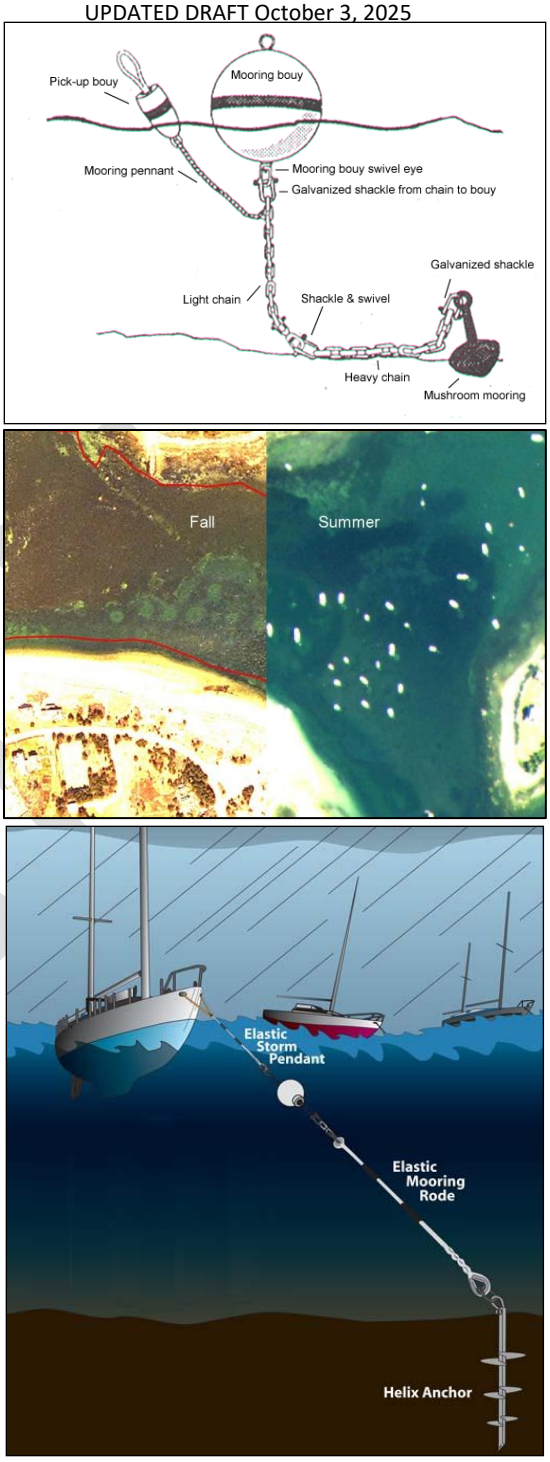


Figure 47. Conventional mooring system (top), bottom scouring and eelgrass loss from convential mooring (middle, West Falmouth Harbor), and a conservation mooring system (bottom).

Graphic courtesy of boatmoorings.com.

[42] Some text and information in the Action Plan was taken from the CZM *Massachusetts Clean Marina Guide*.

II marine sanitary devices (MSD) (macerators with disinfectants) must do one of the following: 1) close the seacock and remove the handle, 2) fix the seacock in the closed position with a padlock or non-releasable wire-tie, and 3) lock the door to the space enclosing the toilet with a padlock or door handle key lock. Those with Type III MSDs (holding tanks) must secure these in one of the following ways: 1) close each valve leading to an overboard discharge, 2) padlock each valve in the closed position, and 3) use a non-releasable wire-tie to hold each valve leading to an overboard discharge in the closed position. In 2008, the Massachusetts legislature amended Chapters 21A and 90B of the General Laws to allow for fines of up to $2,000 for discharge violations in No Discharge Areas [43]. These amendments broadened the authority to the Massachusetts Environmental Police, harbormasters, fish and game wardens, and police officers to enforce the law. Nonetheless, boater compliance is uncertain, and the ability of government to enforce these rules is also a concern.

Dense and expansive mooring fields degrade water quality and bottom habitat of Buzzards Bay. Some harbors, like Apponagansett Bay and Sippican Harbor have more than 1,500 boats on moorings and slips. Conventional moorings (Figure 42) often use large concrete blocks (16 square feet or more) for anchors(Figure 47 top). Chains attached to mooring weights scour eelgrass and animals from the bottom. These chains also bounce up and down off the bottom resuspending bottom sediments, greatly reducing water clarity that in turn can shade out eelgrass beds and elevate bacterial levels. Chain scour impacts are often visible in aerial photographs (Figure 40 middle). Conservation moorings, that use elastic rodes and helical anchors, have less environmental impacts (Figure 40 bottom). This mooring system is pragmatic for Buzzards Bay because the tidal range is less than 4 feet. The Town of Marion already requires helical anchors. [44]

Other conspicuous boating impacts include propeller wash from boat operation at too high a speed in shallow water. Other impacts, such as marsh bank erosion, may occur in an estuary from the cumulative operation of thousands of boats and the impact of their wakes.

[43] See Chapter 495 of the Acts of 2008.

[44] Owners of vessels longer than 25 feet must meet the 2002-approved requirement to install helical anchors. As of 2011 there were 1570 moorings in the Town of Marion of which approximately 1200 had helical moorings. Elastic rodes are not required by the Marion regulations.

Action Plan 7. Protecting and Restoring Wetlands

Problem

Since colonial times, Massachusetts has lost a third of all its wetlands [45]. There are no good loss estimates for the Buzzards Bay watershed, but historic maps suggest the greatest wetland losses in the watershed occurred around New Bedford Harbor, along urbanized waterfronts, near the south entrance of the Cape Cod Canal, during construction of interstate highways, along built-up roads, and in rural areas as the result of agricultural expansion, including cranberry bog construction in wetlands.

Since 1972, the Wetlands Protection Act (Massachusetts General Laws (MGL) Chapter 131, Section 40), and its supporting regulations (310 CMR 10.0) protect wetlands and the interests they serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fisheries, land containing shellfish, and wildlife habitat. Today the Buzzards Bay watershed has more than 51,000 acres of fresh and salt vegetated and emergent wetlands (Figure 41).

A study conducted for the 1991 CCMP estimated that between 1977 and 1986, southeastern Massachusetts lost over 1300 acres of freshwater wetlands. In 2013, using aerial imagery, the MassDEP Wetland Conservancy Program documented the loss of 280 acres of wetlands at hundreds of sites in the Buzzards Bay watershed since 1991. Many of these documented losses were illegal alterations. The study did not identify alterations less than 1/3 acre, and environmental managers consider these losses much more widespread via wetland encroachment on developed lots. These smaller encroachments may be cumulatively large, but no one has well characterized these losses. Although the rate of loss has diminished in recent years, slow incremental wetland losses and degradation continue, the result from poor enforcement of state and local regulations, together with losses allowed under existing regulations.

There is no estimate of acres of vegetated wetlands degraded by pollution of other perturbations, except those water bodies listed in the state's integrated list, where 3,487 of 4,688 acres of ponds in the watershed are listed as impaired (category 4 and category 5 waters).

The 1996, 2008, and 2014 amendments to the Wetlands Protection Act and their supporting regulations expanded the jurisdiction of MassDEP and local conservation commissions to regulate stormwater discharges to wetlands and surface waters. With the 1996 changes to the state wetland regulations MassDEP issued a Stormwater Handbook with management standards implemented under the 310 CMR 10.05(6)(k) and the Water Quality Certification Regulations, 314 CMR 9.06(6)(a). The changes strengthened municipal and state authorities to manage stormwater discharges to wetlands and waterways and became the primary tools for municipalities to manage stormwater and meet MS4 permit requirements as described in Action Plan 3. However, the review of stormwater designs is often beyond the capability of most conservation commission members and conservation agents. The state amended the wetland laws to allow conservation commissions to hire experts to review plans and pass these costs on to the applicant. Not all conservation commissions use this provision to hire the necessary consultants.

Confounding stormwater management is the fact that the Stormwater Handbook, last updated in 2008, does not fully address cumulative loading control necessary to meet bacteria and nutrient TMDLs (Action Plans 1 and 3) and MS4 permit requirements [46].

Another challenge is the protection of isolated wetlands, including isolated vernal pools, which are important for threatened amphibian species, and among the most threatened wetland habitats. Vernal pools have not been adequately inventoried and certified contributing to their loss.

[45] From MassDEP's webpage Protecting Wetlands in Massachusetts.

[46] According to the MassDEP Stormwater Handbook webpage, in 2020, MassDEP convened an advisory committee to align the Act's Stormwater Management Standards with the requirements of the federal Municipal Separate Storm Sewer System Permit

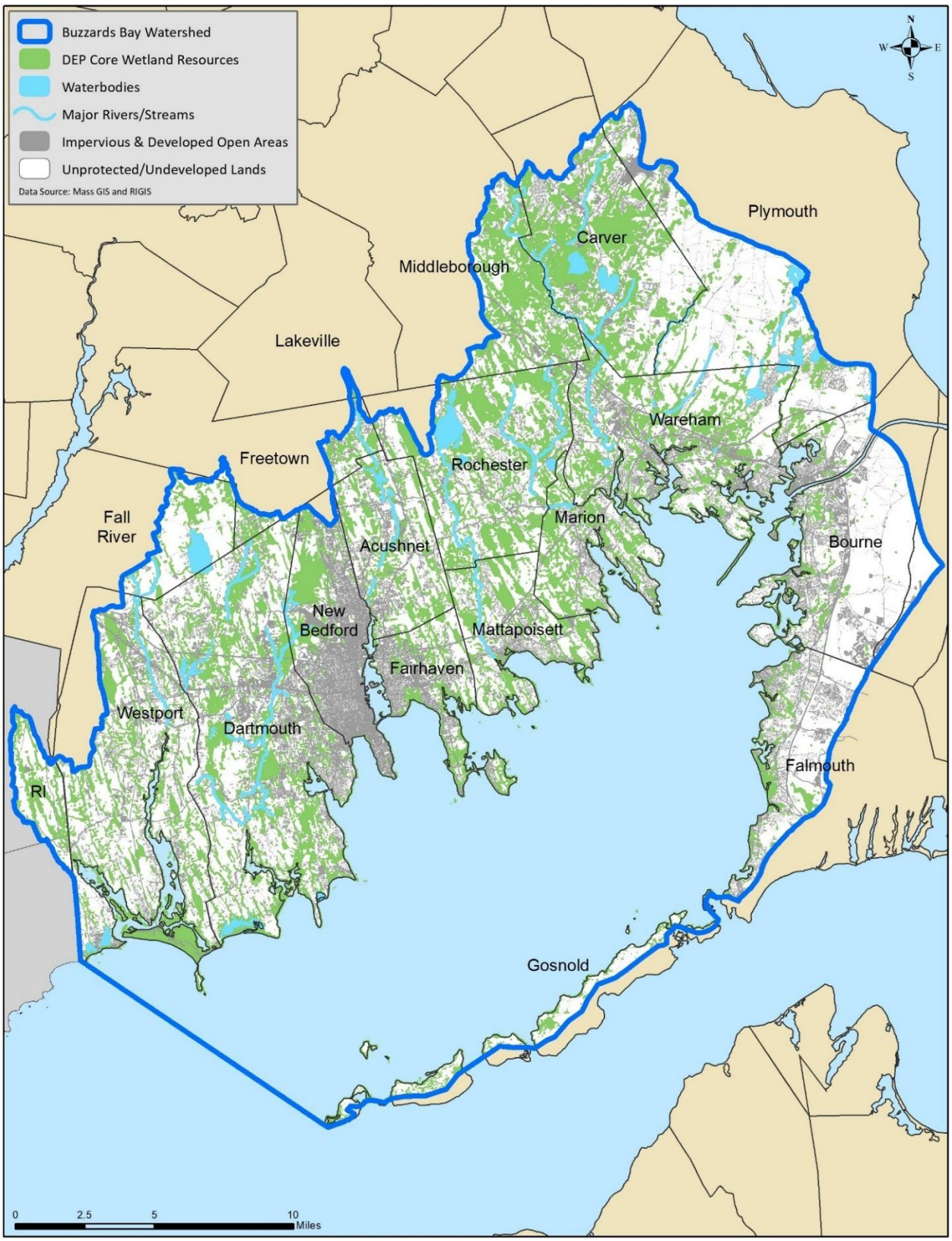


Figure 48. Core vegetated wetlands in the Buzzards Bay watershed.

(Wetland Conservancy Program data from MassGIS.)

The accurate delineation of wetland boundaries is one of the most challenging skills needed to protect wetlands. Although certified plans submitted to a municipality by an applicant's engineer may accurately show the location of wetland flags and the presumed wetland boundary, the accuracy of the placement of the wetland flags is only as good as the skill of the wetlands biologist that placed them. Because there is no certification of wetland biologists to flag wetlands, and because the regulations define wetland boundary by complex criteria of soils, species composition, and cover of wetland plants, it is vital that conservation agents and commission members have adequate training in wetland delineation and to review the data sheets provided by applicants. This is especially important in the Buzzards Bay watershed because large areas of the watershed have flat areas that slowly transition from wetland to non-wetland habitat. Applicants may underestimate these wetland areas, and if the error is not identified by the municipality, the error may go unchecked as state regulators have can only find egregious errors using state-mapped core wetlands documented from aerial surveys.

Similarly, correctly defining the mean high-water mark is essential for properly enforcing the state Wetlands Protection Act, Chapter 91, and various federal permits. The high tide line is also known as the king tide or the highest predicted tide of the year. The high tide line defines salt marsh boundaries and is the jurisdictional boundary of federal wetlands permits. Because of confusion about these terms, and because tidal datums may not explicitly defined in engineering plans, Conservation Commissions may inadvertently allow certain prohibited activities within resource areas. Adding to the confusion, applicants may incorrectly omit plants like Phragmites from salt marsh delineations. Such omissions are important if, for example, docks are prohibited within salt marshes under local regulations. Training and dissemination of information on websites like the Buzzards Bay NEP's tidal datum viewer can help municipal boards. Strategies to manage the individual and cumulative impact of docks are described in Action Plan 6 Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging.

Complaints by abutters or other concerned parties often drive municipal and state regulators to take enforcement action against violators of state and local wetland laws. MassDEP and the U.S. Army Corps of Engineers may also take enforcement action against the largest violators upon their review of wetland change observed in aerial surveys. Local conservation commissions must develop strategies to find and act against smaller violations and incremental wetlands filling.

The 2013 CCMP noted that conservation commissions in Buzzards Bay communities at the time cumulatively processed approximately 1,458 permit actions and issued 24 enforcement orders. Successful wetlands protection by conservation commissions requires a good understanding of wetland laws and regulations, and the state and federal definitions of wetland boundaries, which is based on interpretation of vegetation, hydrology, and soil features. The turnover of municipal conservation agents (often part-time) and volunteer conservation commission members is an ongoing challenge to ensure these regulators have the needed training to implement the law. Training of commission members is not compulsory, and many commission members have never received formal training in wetland delineation or how to interpret and enforce the provisions of the law and regulations.

Besides protecting existing wetlands, municipalities need to increase efforts to restore existing degraded wetlands and remedy past wetland violations or historic losses. Such an effort requires a more robust enforcement approach and state and federal grant funds for restoration projects.

As noted previously, the state regulations allow applicants to destroy bordering vegetated wetlands if replaced at a 1:1 ratio. However, the quality of these wetlands is often poor, and conservation groups have suggested a replication ratio of 2:1 or higher, though municipal or state regulators rarely impose such conditions.

Conservation commissions periodically review aerial surveys to determine whether their properties or any MassDEP core wetlands have been subject to any incursions from adjacent properties.

This action plan principally relates to the enforcement of existing wetland laws and regulations, and the need to adopt municipal wetland bylaws and regulations that meet local needs and conditions. Other actions related to wetlands protection are contained in Action Plan 6 Managing Impacts from Boating, Marinas, and

Moorings, Action Plan 8 Restoring Migratory Fish Passage and Populations, Action Plan 9 Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species Action Plan 10 Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies, Action Plan 12 Protecting Open Space, Action Plan 13 Protecting and Restoring Lakes, Ponds, and Streams, and Action Plan 17 Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms.

Goal

Goal 7.1 Protect existing wetlands to ensure no unpermitted losses.

Goal 7.2 Promote the long-term increase of high-quality wetlands in Buzzards Bay and its surrounding watershed.

Objectives

Objective 7.1. Improve the protection of existing wetlands through laws, regulations, and government policies.

Objective 7.2. Municipalities and DEP should strengthen enforcement of state wetlands laws and municipalities adopt local wetland bylaws and regulations to meet their needs.

Objective 7.3. Enhance the effectiveness of local conservation commissions to protect wetlands by adequately staffing municipal commissions and reinitiating DEP-developed and sponsored training programs for conservation commissions and staff.

Objective 7.4. Encourage restoration of degraded and filled wetlands.

Objective 7.5 Create new wetlands habitat, and enhance existing wetland habitat, especially habitat directly supporting threatened, rare and endangered coastal species and anadromous and catadromous fish.

Objective 7.6. Ensure that adopted coastline climate resilience strategies are compatible with the migration of wetlands and barrier beaches.

Objective 7.7. Restore hydrology to tidally restricted salt marshes.

Objective 7.8. Promote land management, land protection, and restoration that supports potential marsh migration.

Objective 7.9. State and federal agencies should assist municipalities to identify and map marsh migration areas, and barriers to marsh migration and expansion.

Objective 7.10. Prioritize management actions for wetlands of rare or threatened species most vulnerable to climate impacts (with US endangered roseate tern habitat prioritized; see related recommendations in Action Plan 11).

Objective 7.11. State and federal agencies should support research to better understand how climate stressors adversely affect essential wetland habitat and threatened species.

Objective 7.12. Support efforts to increase in eelgrass bed acreage by 15% by 2035 (to 7,000 acres as documented in the MassDEP long-term monitoring program) through water quality and habitat improvements, such as use of conservation moorings.

Management Approaches

While MassDEP and municipalities are the lead for many actions, other agencies and organizations must help and participate. Municipalities are responsible for most of the action needed to achieve the goals of this action plan. These actions include improved municipal enforcement of existing regulations and adopting new laws and regulations that supplement the minimum standards imposed by state and federal laws.

Municipalities must adopt local wetland bylaws or regulations that address local needs. Local regulations should always require notification to abutters for filings of requests for determination of applicability (not required under the state Wetland Protection Act) and should include specific performance standards (e.g. require no-build setback distances).

Reducing future wetland losses requires increased local training, better enforcement, education of property owners, adequate staffing, and the adoption of local wetland regulations to meet local needs and address shortcomings of state and federal laws. Improved enforcement, monitoring wetland loss using aerial photography, and implementation of new local wetlands laws and regulations are the key actions. Wetlands regulations are among the most complex

that are enforced locally, and there is a steep learning curve for municipal officials in their successful implementation. Continued training of municipal staff (conservation agents) and municipal conservation commission members will support the action plan goals.

The two most challenging aspects of enforcing wetlands regulations are the accurate delineation of wetland boundaries and the adequacy of stormwater treatment designs (which has a primary benefit to water quality). Municipal boards must carefully review these elements for accuracy and adequateness. This goal can be met through improved training of commissioners and staff, use of free technical services, and for complex projects, hiring consultants paid for by the applicant, as provided under state laws and local bylaws.

Municipalities can reduce future threats to wetlands by promoting open space acquisition and conservation restrictions on lands with appreciable wetland habitat or those lands identified as areas for potential salt marsh migration in the face of sea level rise, encouraging certification of vernal pools, and by helping restore filled or impaired wetlands.

To more effectively address water quality and wetlands habitat degradation caused by stormwater discharges, conservation commissions must better coordinate with other boards on municipal MS4 Stormwater Advisory Committees to ensure consistent town-wide stormwater management requirements.

Conservation commissions and the state should periodically review the wetland loss maps prepared by MassDEP, and recent aerial imagery to find illicit fillings of wetlands.

Writing decisions is somewhat of an art, and permit writers need training. If there is a denial, the basis of a decision must be clear with the proper justification. Where applicable, a conservation commission should approve a project under the state regulations but deny it under the local regulations which may have stricter standards than the state regulation. In other situations, Conservation Commissions can and should be deny an application under both the state and local regulations when they do not meet applicable standards.

To ensure that approved projects adhere to the permit orders of conditions, it is important that conservation commissions require the recording of plans, wetland boundaries, and the order of conditions itself at county deeds offices. The Wetlands Protection Act and regulations require this, but applicants sometimes ignore this requirement. Consequently, municipalities must implement a tracking system to ensure that applicant records permit orders.

The conservation commission should work with the municipality's open space committees to identify large wetland systems within their town and make these properties a priority for acquisition (see Action Plan 12 Protecting Open Space). Funding sources include Community Preservation Act funds, town meeting articles, and the USDA Wetlands Reserve Program. Municipalities (select boards, conservation commissions, land trusts, etc.) should also use non-regulatory wetlands protection techniques. These techniques include encouraging or purchasing conservation restrictions and using tax incentive strategies that encourage land to be kept as forest, farmland, and recreational/open space (MGL Chapter 61, 61A, and 61B), as well as using differential taxation policies allowing for open space to be taxed at a rate significantly lower than for residential or commercial property (MGL Chapter 54, Special Act 797 of 1979).

Public agencies owning barrier beaches (principally municipalities, but also the Massachusetts Department of Conservation and Recreation) should develop management plans for barrier beaches. Municipalities can address this problem through coastal and beach committees. These barrier beach management plans should define beach protection and restoration strategies, public acquisition goals, and site-specific issues to address wetland and habitat protection, and to address issues related to sea level rise and minimizing storm damage impacts.

Costs and Financing

The cost of adoption of regulations is negligible to government, but the staff to implement and enforce additional regulations is an added cost. Wetland restoration funding is available through a number of websites including CZM's Coastal Habitat & Water Quality Program, DER's Grants for Priority Projects, DER's Partnerships Program, and MVP, among others,. Federal programs like USDA NRCS are very involved in funding salt marsh restoration projects in Massachusetts. Most of the training courses are available at no or little cost.

Existing grant programs do not currently meet all wetland restoration interest and more government funding is needed.

Measuring Success

The Buzzards Bay NEP can track progress toward the goals of this action plan by tracking programmatic actions, like the adoption or update of bylaws and regulations. Some actions, like numbers of vernal pools certified, and wetland acres lost, restored, or protected are useful metrics, and MassDEP is already tracking these metrics.

Additional Information

There are many state programs and local strategies that relate to wetland protection, including programs and regulations that regulate the placement of docks and activities on tidelands. The section below provides an overview of these programs and regulations.

Chapter 91 and other needed permits

The permitting of dock and filled pier construction also falls under local wetland protection bylaws, Massachusetts Wetlands Protection Act, Army Corps of Engineers, and possibly MEPA and CZM. The level of review depends on the size of the project and the issues. The construction of new filled piers is difficult under existing laws and are now rarely built. Local building departments do not issue dock construction permits, unless there is a local zoning bylaw requiring such permits. Local zoning bylaws regulating dock construction exist in some, but not all, Buzzards Bay towns. Regulations generally address dock structure and construction method, dock length, or water depth at the end of the dock. Most local bylaws do not address associated activities. Jurisdiction of bylaws typically extends either seaward from mean high water, the boundary of the most inland coastal resource area, or the FEMA floodplain boundary (land subject to coastal storm flowage).

Municipalities can control dock and pier construction through the Chapter 91 permitting process if they adopt a formal local (non-state-approved) harbor or embayment plan or policy as per 310 CMR 9.34(2)(b) [47]. Such a plan could include spacing requirements between docks, exclusion zones, or construction standards. If a municipality holds public hearings, then adopt these local plans or policies, the town must send the written policy or plan to the MassDEP Waterways Program so that it is on file. Such plans or policies could cover just one bay, or the entire coastal area of the municipality. In 2001, the Town of Wareham adopted such a policy [48] with maps specifying dock exclusion zones. DEP's Waterways Program enforced this policy in their issuance of Chapter 91 permits.

In practice, the presence of eelgrass beds and depth of water at the end of the dock [49] are the primary siting criteria under local bylaws. For example, a municipality may adopt a zoning bylaw that limits the length of docks (as is the case in Fairhaven). A dock greater than the limit would then require ZBA approval and a review by the building inspector. If building inspectors are involved in the review of dock applications under some local authority, it will be for structural and safety issues only, and not environmental or aesthetic issues.

Shellfish and herring wardens may have added authority in dock placement and construction. For example, in the Falmouth Wetland Regulations, docks are prohibited where "there are significant quantities of shell-

[47] This section states that "No project shall include a private recreational boating facility with fewer than ten berths on Commonwealth tidelands or Great Ponds, if the Department (i.e., DEP Waterways Program) receives written certification from the municipal official or planning board of the municipality in which the project is located that such facility does not confirm to a formal, area-wide policy or plan which establishes municipal priorities among competing uses of the waterway, unless the Department determines that such certification: is arbitrary, capricious, or an abuse of discretion; or conflicts with an overriding state, regional, or federal interest."

[48] "It is a policy of the Town of Wareham (Policy 1-01) to maintain those areas designated as Recreational Shellfish Areas and Shellfish Grants, as indicated on the enclosed map, open and unobstructed for the purpose of shellfishing related activities as these activities are considered priority uses for these areas. These designated areas are valuable natural resources of the Town and represent productive shellfish beds that are utilized by recreational shell fishermen and commercial shell fishermen respectively. It is important that these areas remain accessible for the purpose of shell fishing and free of additional projects that may adversely affect the quality and productivity of the shellfish habitat. Therefore under 310 CMR 9.38(2)(b) the Town of Wareham requests that no further Chapter 91 Licenses be issued by the MA DEP Waterways Section for dock or pier projects within these designated areas."

[49] For example, under the Falmouth Wetland Regulations, "the water depth at the end of the dock shall be a minimum of four (4) feet at the time of mean low water or three (3) feet greater than the draft of vessels served by the dock or pier whichever is the greatest depth."

fish... and the area has been historically used for shellfishing or has potential for shellfishing, and the sediment provides a viable shellfish habitat." [50] Shellfish wardens typically ensure that shellfish are relayed out of the site to be disturbed by dock construction or associated dredging.

Falmouth is the only Massachusetts municipality where the select boards review docks and coastal projects under a separate, older wetlands zoning bylaw (which has no performance standards). Falmouth is also the only example of a watershed town having two wetlands bylaws.

Under state law, MassDEP reviews the construction of docks in the Waterways Program, primarily ensuring compliance with the licensing requirements of Chapter 91 of the Massachusetts General Laws, which primarily relates to public access, navigation, and public trust issues and not environmental impacts. At the federal level, dock construction and dredging to docks requires Army Corps permits and Water Quality Certificates (issued by DEP). These permits require avoidance of certain habitat (e.g. eelgrass beds), and if habitat loss cannot be avoided, mitigation must be provided.

While community docks are a potential solution to minimize future dock expansion, few municipalities offer incentives to encourage community or common docks. Objections to community docks include the need to have deed restrictions or covenants, and the need to define rules on the number of users and allowable activities that all property owners can agree to.

Indirect and Cumulative Impacts of Docks

Wetland laws and regulations typically focus on regulating individual docks and piers on a lot-by-lot basis but generally do not address cumulative impacts. Moreover, the cumulative impacts of dock structures are not the only concern. There can be many other indirect consequences of increased boating and other recreational and commercial uses of the waterfront associated with docks.

Conservation commissions can limit boat size or boat draft to ensure that vessels do not rest at the bottom at low tide and affect benthic habitat. Conservation Commissions write the specifications into permit orders of conditions, which the applicant records on the property deed.

The spacing and placement of docks can affect navigation and public access. MassDEP Chapter 91 licenses are the principal mechanism for addressing these issues, especially if no local requirements exist. Spacing between docks can be set through local zoning bylaws or ordinances, and these can be more protective than any minimum requirements for navigation or resource protection established by state and federal laws.

Houseboat Prohibitions and Floating Dock Expansions

State and local wetland laws require permits for the construction of docks and piers, but a wetlands permit is not needed for a vessel, barge, or floating device tied to that dock, irrespective of its use. This situation has led to temporary and permanent structures being tied to docks including houseboats, floating restaurants, docks storage areas, floating dock attachments, and recreational platforms.

These expansions, however, may conflict with the state's Chapter 91 license for those docks and piers. In fact, Chapter 91 Waterways regulations (310 CMR 9.00) include a number of categorical restrictions on these structures and add-ons, and for others require an amendment to the Chapter 91 permit. Existing Chapter 91 licenses may also hold additional limitations on uses and activities specific to that site.

Because of concerns about the impact of these expansions on water dependent uses and the environment, the lack of past comprehensive enforcement of the Chapter 91 law, and to better assert local control, many cities and towns have adopted harbor regulations or laws addressing issues like these relating to houseboat. Examples include:

- Section 5.5 (Harbor Pollution Control) of New Bedford's Code 4(d) states: "Houseboats used as residences shall not dock in waters covered by this section unless approved by the board of health."

[50] FWR 10.16 (1) (h) 2, although in practice, this provision appears to have been rarely invoked to prohibit the construction of a dock.

- The Town of Barnstable adopted a waterways General Bylaw regulating boats with this provision in section 40-12, Docking and mooring of houseboats restricted to licensed slips: "No person shall moor or dock a houseboat in the waters of the Town except at a pier, slip or dock for which a valid current marina license has been issued under Section 59B of Chapter 91 of the General Laws.
- The Town of Chatham adopted a "Protective [General] Bylaw" which states: "4. Prohibited Uses d. No person shall construct a residential dwelling unit, or use a houseboat or barge designed or used as a dwelling unit in the Conservancy District."

Wetlands Protection Act and Regulatory Framework

In 1963, with the adoption of the Jones Act, Massachusetts became the first state in the nation to protect coastal wetlands, preceding even the efforts of the federal government. This law, in conjunction with the "Hatch Act," passed in 1965 to protect inland wetlands, eventually evolved into the Massachusetts Wetlands Protection Act (General Law Chapter 131, section 40, passed in 1972). Significant revisions of the Act regulations were promulgated in 1978 for coastal wetlands, in 1983 for inland wetlands, in 1997 for river front areas, and in 2005 to bolster state no-net-loss policies. The law and supporting regulations establish the current system of resource areas, presumption of significance, and performance standards. In permitted alterations, the law and supporting regulations support a three-tiered approach of avoidance, minimization, and mitigation. The primary responsibility for implementing the Wetlands Protection Act regulations rests with local conservation commissions, which consist of three to seven appointed members. The state wetlands law is a minimum state standard, and most Buzzards Bay municipalities have adopted stricter bylaws under home rule (Figure 40).

The Wetlands Protection Act recognizes specific wetland resource areas (Table 9) crucial to the following interests:

- Protection of public and private water supply
- Protection of groundwater supply
- Flood control
- Prevention of storm damage
- Prevention of pollution
- Protection of land containing shellfish
- Protection of fisheries
- Protection of wildlife habitat

Massachusetts provides a higher level of protection for its salt marshes through the Wetlands Protection Act regulations and the Wetlands Restriction Program. The regulations are less protective of subtidal wetlands and habitat. The state regulations provide an intermediate level of protection for bordering vegetated wetlands, but state regulations allow applicants to alter or fill up to 5,000 square feet of wetlands for many different reasons. Moreover, state and federal regulations offer limited protection to isolated wetlands.

Because the Wetlands Protection Act provides a statewide minimum level of protection, many communities have adopted zoning or non-zoning bylaws to further protect the interests of the Massachusetts Wetlands Protection Act. While nearly all Massachusetts coastal communities have adopted local non-zoning wetland bylaws, five municipalities along the coast of Buzzards Bay have not (Acushnet, Marion, Mattapoisett, Westport, and City of New Bedford; Figure 49). Local wetland bylaws typically add other wetland resource values like sedimentation control, recreation, agricultural and historical values, aesthetics,

Table 10. Wetland Protection Act Resource Areas

Inland Resource Areas:
Banks and beaches
Bordering vegetated wetlands
Land under water bodies and waterways
Land subject to flooding
Riverfront areas
Coastal Resource Areas:
Land under the ocean
Designated port areas
Coastal beaches
Coastal dunes
Barrier beaches
Coastal banks
Rocky intertidal shores
Salt marshes
Land under salt ponds
Land containing shellfish
Anadromous/Catadromous fish runs

and aquaculture. They may also include other performance standards like required setbacks from certain resource areas, technical review fees for complex projects, or extra performance standards for stormwater treatment.

The MassDEP Southeast Regional Office oversees and reviews the appeal of municipal decisions. MassDEP also aids conservation commissions with training and regulatory guidance. The Massachusetts Association of Conservation Commissions (MACC), a non-profit advocacy organization, also helps Conservation Commissions.

In Massachusetts, wetlands delineation is primarily based on the occurrence of specific vegetation, with confirmation of wetland hydrology by some other feature. The Wetlands Protection Act specifies that boundaries of vegetated wetlands be delineated based on the occurrence of vegetation that is indicative of saturated conditions for a significant portion of the year. Regulators typically delineate non-vegetated wetlands, such as coastal banks and coastal dunes based on geological features.

The Wetlands Protection Act regulations require that property owners (or their representative) apply for a permit from the local conservation commission before proposed activities occur within 100 feet of wetlands, floodplains, riverfront areas, and land subject to coastal storm flowage. Projects within this 100 ft. buffer zone as decided by the Conservation Commission not to adversely affect resource areas (Table 10) are issued a "negative determination" on the applicability of the wetland Protection Act. If there are potential impacts that the applicant must mitigate, the commission issues a permit called an Order of Conditions, that includes the conditions and actions during the proposed work that are necessary to protect the interests of the Wetlands Protection Act.

Wetlands Restriction Program

The Coastal and Inland Wetlands Restriction Acts, enacted by laws in 1965 and 1968, placed permanent deed restrictions on selected wetlands. In the 1970s, the Wetlands Restriction Program expanded deed restrictions to salt marshes, tidal flats, barrier beaches, sea cliffs, dunes, and salt ponds. These permanent wetland restriction orders were placed in 53 municipalities and restricted activities on approximately

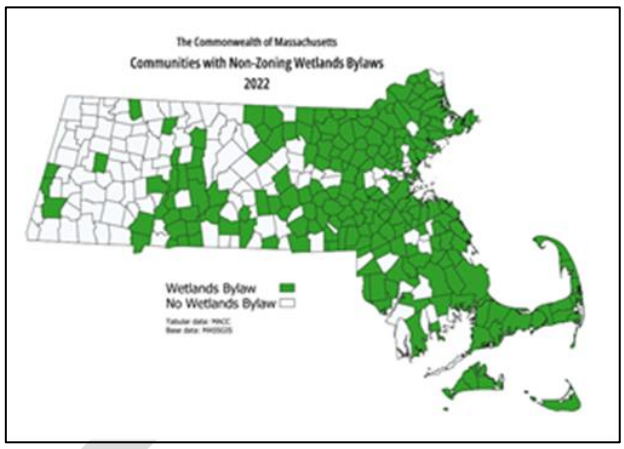


Figure 49. Communities with non-zoning wetland bylaws as of 2022.

46,000 acres of coastal wetlands and 8,000 acres of inland wetlands. In the Buzzards Bay watershed, 6 out of 10 coastal towns have deeded wetland restrictions (Bourne, Falmouth, Marion, Plymouth, Wareham, and Westport), but MassDEP did not restrict significant amounts of inland wetlands. Many of these deed restrictions can now be searched and viewed online in databases posted by county deeds offices. Violations of the deed restrictions are enforced by MassDEP pursuant to 310 CMR 13.00 (Adopting Inland Wetland Orders) and 310 CMR 12.00. (Adopting Coastal Wetland orders).

Some property owners may not be aware of deed restrictions applied to their property under this program, and some conservation commissioners seem unaware of the program. Because the MassDEP has not posted digital versions of these maps, complying with the Deed Restriction Program can be challenging for both the property owner and municipal conservation commissions.

Wetland Conservancy and Wetland Loss Programs

The Wetlands Conservancy Program was the successor of the Wetlands Restriction program with a goal to map and track core wetlands 1/4 acre or larger in the state that could be identified on aerial photographs. Wetland conservancy program delineations are based on photo interpretation and do not substitute for the delineation information required under the wetland regulations. In 2003, the Conservancy Program began systematically analyzing discrepancies between the original wetland mapping performed in 1993 and updated aerial photos from 2001 (Figure 50 and Table 11). In 2003, the program began using these maps to pursue criminal violations of the state's Wetland Protection Act. The aerial survey method did not capture losses of less than about 4,000 square feet.

Under state law, there is a two-year statute of limitation for violation of the Wetlands Protection Act. However, in the case of filled wetlands, every day after the filling is a new violation. Aerial photographs, taken as early as 1990 (the date of key changes in the state wetlands regulations) and field evidence, are used by regulators to take enforcement action on decades-old, filled areas.

Local Implementation of the WPA

The Act empowers municipal conservation commissions to oversee and implement most of the key components of the state Wetlands Protection Act. If an applicant, abutter, or concerned parties feels a conservation commission is being too strict or lenient in their interpretation of the state Wetlands Protection Act, they can appeal the decisions to DEP. Through the MassDEP appeals and adjudicatory process, MassDEP will decide a case. Applicants and interested parties can appeal DEP's decisions to Superior Court.

The Massachusetts Home Rule Amendments to the state constitution enable municipalities to adopt wetland protection bylaws and regulations that are more stringent than the Wetlands Protection Act regulatory requirements. Some local wetlands bylaws spell out standards like setback distances of construction from wetlands. Other bylaws provide added authority to the conservation commission to promulgate regulations without further town meeting approval. Some local bylaws include limits on docks, setback requirements, abutter notification, requiring wetland replication at a ratio of at least 2:1, "no activity zones" and eliminating "limited projects" allowances.

Select boards and city mayors play an essential role in protecting wetlands by appointing conservation commission members able to apply a strict but fair interpretation of the law. Appointing members that have no desire to implement the law is a violation of the public trust.

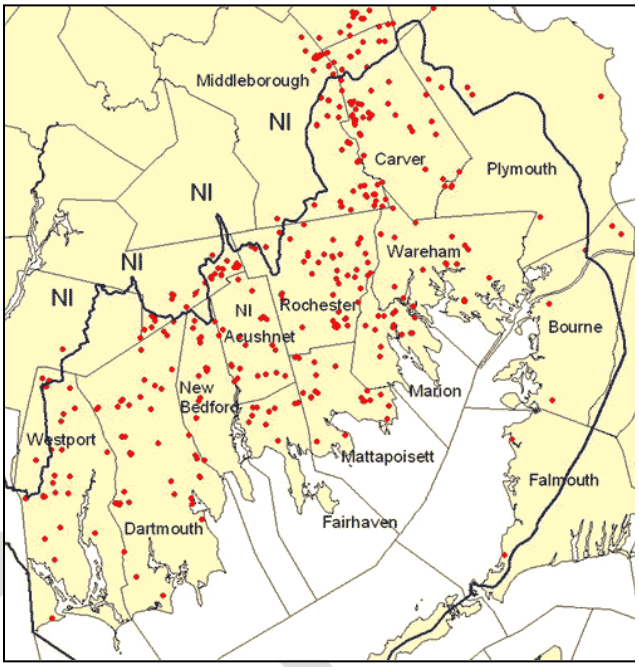


Figure 50. Sites of wetland loss in the Buzzards Bay watershed, 1994-2003.

Table 11. Wetland loss sites by town shown in Figure 50.

Town	No. of Sites	Acres Lost
Carver	48	36.4
Middleborough	52	33.7
Rochester	56	26.8
Dartmouth	42	11.5
Mattapoisett	22	11.3
Wareham	18	10.8
New Bedford	14	8.2
Marion	14	6.9
Fairhaven	10	5.2
Westport	28	4.9
Plymouth	15	4.5
Acushnet	20	4.0
Bourne	5	2.4
Falmouth	2	0.2
Gosnold	0	0.0
Total	346	166.8

To protect wetlands more effectively, conservation commissions in the Buzzards Bay watershed have adopted a wide array of enforcement and implementation tools. One local tool is the use of non-criminal dispositions to levy fines for small violations. This technique used in the bylaws of Fairhaven, Falmouth, and Wareham. Quite simply, the town's enforcement officer (the conservation agent or department of natural resource officer) can write a citation, much like a parking ticket. The amount of the fines can be scaled to the severity of the offense (e.g. $10 for certain minor or first offenses) and escalate in fine value. Municipalities can issue citations for each day of violation. Like parking tickets, the applicant can appeal a wetland enforcement citation in District Court.

This use of non-criminal citations for minor offenses (like mowing of wetlands adjoining lawns) can be a simpler and less costly mechanism to ensure compliance with a town's wetland bylaw, than the issuance of enforcement orders and paying for attorney fees. If towns adopt this technique, they should keep in mind that the purpose of the citations is to encourage compliance with the law, not to raise revenues for the town.

Other strategies include:

- Confiscation of heavy equipment used in illegal operations (Falmouth).
- Bringing of criminal charges against chronic violators (Falmouth).
- Use of local Department of Natural Resource police to gain access to private property to investigate suspected wetland violations (Falmouth).
- Detailed filing requirements (Bourne, Rochester, Falmouth, Carver).
- Restrictive policy on new dock and pier construction (Bourne, Falmouth, Wareham).
- Designation of sensitive wetlands as Areas of Critical Environmental Concern (ACEC) or as a District of Critical Planning Concern (Bourne, Falmouth).
- No-build setback (in law or regulations) from wetlands for all structures (Bourne, Carver, Falmouth).
- Recording enforcement orders on deeds until mitigation activities are satisfactorily accomplished (Rochester).

Chapter 91 Waterways Program

Chapter 91 of the Massachusetts General Laws regulates waterways in Massachusetts and enables the Commonwealth to both protect and promote public use of its tidelands and other waterways. The legislature passed the law in 1866, but the basis of the law originated with the Colonial Ordinances of 1641-1647 and led to what is known today as the "public trust doctrine." This doctrine holds that the air, the sea, and the shore belong not to any single person, but rather to the public at large.

Chapter 91 regulates activities on both coastal and inland waterways, including construction, dredging and filling in tidelands, great ponds, and certain rivers and streams. An important component of the law is that the Commonwealth owns land below the low water mark, and privately owned land between the high water and low water marks is subject to public rights, namely fishing, fowling, and navigation.

While we discuss Chapter 91 more fully in Action Plan 6 Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging, from a wetlands protection point of view, the Chapter 91 program is an important mechanism to address wetland alterations caused by illegal structures. In addition, filled tidelands, even those filled 100 years ago or more, are still subject to the law, and the state can take wetland enforcement actions if the applicant did not receive a Chapter 91 permit.

Clean Water Act and Federal Wetlands Permits

The federal Clean Water Act requires permits for fill in wetlands (Section 404), for excavation and construction in navigable waters (Section 10), discharges to wetlands and surface waters (section 402), and in the case of discharges (which includes fill), require that the discharge meets state water quality standards (section 401).

The Army Corps of Engineers implements Section 404 of the Clean Water Act which regulates discharges of dredged and fill material into wetlands and other waters of the United States. Under Section 10 of the Rivers and Harbors Act, the Corps regulates any excavation or construction in traditionally navigable waters. Section 10 permits often involve the construction of piers.

In Massachusetts, the issuance of NPDES permits lies with the U.S. EPA Region 1 office in Boston, However, Section 401 permits (Water Quality Certificates) are issued by DEP's Division of Water Pollution Control, which must certify that any activities requiring federal permits, e.g. NPDES or Section 404, are consistent with state water quality standards.

Water quality certification enables the state to protect wetlands from a broad range of activities potentially affecting physical and biological integrity of the wetlands in addition to the chemical integrity of the water column. The DEP's Water Quality Certification program ensures that proposed activities do not violate the state's water quality standards. MassDEP could strengthen this program by defining water quality standards for wetlands.

Each of these programs adds a layer of protection for wetlands and waterways, but they may not be as protective as local and state regulations. On the other hand, if a local permit was issued for a project within wetlands, and the appeal period has lapsed (that is, the project is protected under state law), enforcement action can still be taken if a federal permit was not obtained. Generally, however, federal, state, and local wetland laws are viewed as complimentary permitting pathways. In general, no one level of government can override the decision of another level of government if the decision was based on the laws of that jurisdiction. Thus, each jurisdictional level can prohibit or limit a project, but approval does not limit the rights of different jurisdictions to further modify, limit, or deny a project. This reality means that projects constructed in wetlands or surface waters must meet the most stringent performance standard of any of the jurisdictions issuing a permit.

As a result of the U.S. Supreme Court's 2001 decision in Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers, 531 U.S. 159 ("SWANCC decision"), federal jurisdiction over isolated inland wetlands has been severely limited. More recent executive orders have further curtailed the jurisdiction of the Clean Water Act. Because these wetlands are not identified as resource areas in the state's Wetland Protection Act, and because state jurisdiction for these areas was provided only through the Water Quality Certification process, which was tied to the federal definition of "waters of the United States," only local regulatory efforts can protect isolated wetlands.

Planning and Preemption

Managers should not rely too heavily on the wetlands regulatory process as the principal tool to protect wetlands. By their nature, wetlands permits are a piecemeal decision-making approach where it is difficult to achieve strategic goals. Planning and preemption achieve these wetlands protection goals effectively. Planning involves the identification of sensitive resources and the justification of their significance and creates a framework to justify preemption techniques and permitting decisions. Relevant local plans that can achieve wetland protection goals include development or updates of master plans, open space and recreational plans, watershed management plans, shellfish habitat maps, harbor watersheet zoning, dock exclusion zoning, management for ACECs and for those towns in Barnstable County, Districts of Critical Planning Concern and local comprehensive plans. Using these plans and strategies, a town can prioritize wetlands for acquisition or define uses and activities that are least likely to degrade sensitive wetland resources.

Preemption is the foreclosing of opportunities for use of wetlands by not allowing the applicant to propose certain activities for permitting. Preemption tools include zoning bylaws and regulations, conservation restrictions, land acquisition, temporary moratoriums, and, if effectively managed, ACECs (although this program is now considered toothless as implemented). To the greatest practical extent, the plans described above should explicitly identify wetlands and habitat areas that should be the target of preemption strategies.

Many conservationists believe the best way to protect land is to own it. Vigorous municipal land-acquisition programs and the blossoming of the nonprofit land-trust movement in the 1980s have led to the acquisition of many wetlands through purchase and donation. Ownership by public conservation agencies or private conservation organizations may offer the best preemption situation because these groups have neither the philosophy nor the financial incentive to propose development in or near wetlands. State agencies can support these efforts by allowing land donations or conservation restrictions in lieu of fines in enforce-

ment cases. This approach and related recommendations are addressed in Action Plan 12 Protecting Open Space where there is a fuller discussion of non-regulatory techniques for protecting critical areas, including using tax incentives.

Wetland Replication

Wetland regulations allow the discretionary destruction of up to 5,000 sq ft, if the applicant replicates the destroyed wetlands following seven general conditions. Agencies may also require wetland replication under other circumstances. Many scientists and managers are concerned with the use of wetlands replication as a routine management tool for two reasons. First, wetlands replication projects have a high failure rate. In New England, wetland regulators estimate that 50% of all replication efforts fail because of inadequate design or maintenance. Second, many functions performed by natural wetlands may not be performed by artificial or replicated wetlands. Although it may be possible to replicate the flood control, sediment trapping, and waterfowl values of some wetlands, scientists have found at least 75 complex ecological relationships among soils, hydrology, water quality, vegetation, and wildlife, many of which take centuries to develop that are difficult or impossible to replicate. Many of these relationships play significant or yet undetermined roles in the protection of the eight wetland interests listed in the Wetlands Protection Act or of other interests included in local wetland bylaws. Many wetland replication projects have difficulty recreating even the typical vegetative community of a wetland, much less these other complex relationships that make a natural wetland.

For these reasons, wetland destruction should be avoided except in extreme cases or on projects with an overriding public purpose. When wetland destruction is the last resort, a genuine effort must be made to recapture the lost values of the destroyed wetlands. Given the high failure rate of replicated wetlands, a ratio of replicated wetlands to destroyed wetlands of much greater than 1:1 must be required to achieve a true no net loss.

Adequate Local Staffing and Resources

In the 1991 CCMP, inadequate staffing to conservation commissions was an important problem limiting the effectiveness of local conservation commissions. Irrespective of staff levels, all conservation commissions should adopt a policy of requiring the attendance of at least one commission member on site visits, particularly for any project involving the construction of buildings, roads, or land clearing. Such a policy helps ensure that the commission members are directly engaged in evaluating sites and the potential impacts of proposed projects.

Local Authority and Legal challenges

Through the Wetlands Protection Act, conservation commissions have the authority to review projects on land under the ocean, land under salt ponds, fish runs, and tidal lands containing shellfish. Conservation Commissions can use this authority to protect valuable marine habitats such as DMF-designated productive shellfish areas, town-designated resource areas, habitat in ACECs, fish runs, and eelgrass beds, by prohibiting or limiting the number of new docks, piers, and their associated dredging activities, as well as reducing or mitigating the impact of approved projects.

To reduce the likelihood that a court ruling overturns a decision by a conservation commission, commissions should develop, and towns adopt, an explicit management plan regarding the location and construction of projects in the critical habitat areas previously discussed. The plans should clearly define and delineate the sensitive habitats to protect, the reason for protecting these areas, the type of projects that harm the habitats, and how the adverse effects is manifested. Conservation Commissions adopt regulations that support the plan for these special areas.

A house construction project will be reviewed for construction impacts to an adjacent wetland but not for the subsequent activity associated with the house being occupied. Studies have shown that a 25-foot setback from wetlands is inadequate to prevent future wetland impacts from homeowner activity. A 50-foot setback has appeared to be more effective at protecting wetlands. Towns are allowed to adopt construction setbacks from wetlands, just as they adopt setbacks under local zoning.

The Town of Carver has adopted a 65-foot no structure zone around wetlands under their local bylaw, and Falmouth and Bourne have adopted varying no-touch or no-construction zones that vary from 25 to 50 feet depending upon the resources. Some towns have adopted a policy of encouraging applicants to keep a specific setback distance, but without a local bylaw or

regulation in place, such a setback requirement is unenforceable under the state regulations. Municipalities should be explicit in the local bylaws, ordinances, or regulations whether setbacks are "no-build" or "no structure" or if they are "no-work" or "no alteration" areas.

River Protection Act Compliance

The implementation of the 1997 amendments to the Wetland Protection Act, known as the Rivers Protection Act (and the later supporting regulations), have been subject to litigation and caused confusion at the local level. The River Protection Act created a new resource area 200 feet from the riverfront area that, in many respects, was treated like other resources areas such as bordering vegetated wetlands and dunes. This new resource area is not provided with a jurisdictional buffer. For the purposes of the Act, rivers were defined as any stream or brook that flowed year-round [51]. In some respects, the first 100 feet from these rivers are considered no-build zones for structures and septic systems, but the law and regulations provide many exceptions for preexisting and small lots. Because of the various case decisions relating to the River Protection Act, there is a need for a simplified summary of regulations for commission members and the public.

Conservation Lands and Article 97 Land Protection

An important part of wetland protection at the local level involves acquisition by local government of the most important wetland and habitat areas (discussed further in Action Plan 12 Protecting Open Space). Sometimes, land municipal officials thought was protected as open space because it is owned by a conservation commission, is not protected. For example, in 2005, Massachusetts Supreme Judicial Court [52] found that land acquired for conservation purposes by a town meeting vote, can in fact be disposed of for other purposes, if the conservation commission never placed a conservation restriction (also known as a conservation easement) on the deed. For these reasons, it is important that conservation commissions review the deed of each property they own (deeds are now available online) to ensure the owner of the property or restriction recorded the appropriate conservation or use restrictions as per the intent of town meeting. Sometimes conservation commissions jointly hold conservation restrictions with an area lands trust.

Certain public and private lands may also have other deed restrictions. Many are held in perpetuity, but some deed restrictions expire after 30 years, so mechanisms must be in place to ensure that these deed restrictions are renewed.

Like conservation restrictions, certain public lands voted for open space protection at town meeting are considered Article 97 lands. Article 97 of the Massachusetts Constitution requires that public land acquired for natural resource purposes not be used for other purposes, or otherwise disposed of, without a two-thirds vote of the legislature. To support Article 97 lands, in 1998, EEA (then EOEA) adopted an Article 97 Disposition Policy to help ensure that state agencies "shall not sell, transfer, lease, relinquish, release, alienate, or change the control or use of any right or interest of the Commonwealth in and to Article 97 land."

Despite these protections, municipalities have converted some Article 97 lands to other uses. To address this problem, An Act Preserving Open Space in the Commonwealth, also known as the Public Lands Preservation Act, became law in 2022. The Act codifies the state's "No Net Loss" policy into law and requires that any public open space converted to another use must be replaced with land of equivalent value.

Isolated Vegetated Wetlands

So-called "Isolated Vegetated Wetlands" (e.g., wetland areas that are not hydrologically connected by some surface channel to a river, stream, estuary, pond, or ocean) are not now recognized as a resource area in the Wetland Regulations. To be recognized under the WPA, wetlands must border a water body, the smallest of which is a 10,000-sq-ft pond or fit the definition of isolated land subject to flooding, in which case only limited interests may be protected. Isolated Vegetated Wetlands contribute to the same eight interests listed in the Wetlands Protection Act and hence Conservation Commissions and the state should

[51] Streams indicated by solid blue lines on 7.5-minute scale topographic maps are presumed to conform to this definition.

[52] Massachusetts Supreme Judicial Court (June 2005 Town of Hanson v. Lindsay) found that land acquired for conservation purposes as stipulated in the Town Meeting Vote, but not subsequently reflected in the deed, can be “disposed” (see summary fact sheet at caselaw.findlaw.com/ma-supreme-judicial-court/1222292.html.

protect them. The term "isolated" has a different meaning in the Wetlands Protection Act than the U.S. ACOE Section 404 program, but the distinction is often lost on local conservation commissions and DEP.

A special problem in protecting isolated wetlands is the fact that, if a municipality lacks regulations or by-laws to protect isolated wetlands, their conservation commissions may not require the applicant to identify these wetland areas on site plans submitted for a Notice of Intent wetlands permit application. Consequently, MassDEP would be unaware of the existence of these isolated wetlands and may incorrectly determine that a Water Quality Certificate is not needed. To solve this problem, conservation commissions should require the applicant to delineate isolated wetlands on wetlands permit site plans.

Some isolated wetlands may be classified as vernal pools, which may offer them some added protection if certified by the state. Nonetheless, it is important that conservation commissions adopt local wetland bylaws or regulations to protect isolated wetlands more effectively. Problems with mapping and protecting vernal pools are detailed in Action Plan 9 Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species.

USDA Wetlands Reserve Program

The Wetlands Reserve Program is a voluntary program established by the NRCS that offers landowners the opportunity to protect, restore, and enhance wetlands on their property. NRCS provides technical and financial support for these efforts, as noted on the NRCS website, NRCS's goal "is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program" and offer landowners "an opportunity to establish long-term conservation and wildlife practices and protection."

In practical terms, this program allows farmers to sell a permanent conservation easement on unproductive wetland portions of their land and restore wetlands and permanently protect those areas. The program is especially important for lands owned by cranberry growers because it provides an incentive for the growers to sell smaller unproductive or underutilized cranberry bogs.

Action Plan 8. Restoring Migratory Fish Passage and Populations

Problem

In the Buzzards Bay watershed, there are more than 9,000 acres of ponds and deep marsh and hundreds of stream miles (see details in Action Plan 13). Prior to colonial settlement, most of these ponds and streams were likely important habitats for fish species that spent portions of their life cycle in both fresh and marine waters. These fish were historically important to the coastal economy and ecosystem of Buzzards Bay, and in some cases were an important food source for humans. Most of these species, including alewife, blueback herring (Figure 44, white perch, brook trout, tomcod, shad and rainbow smelt are called anadromous species because adults come from the sea to lay their eggs in fresh or brackish water. The American eel is a catadromous species because the adults lay eggs in salt water and the young mature in freshwater streams and connected ponds. Collectively, scientists call anadromous and catadromous species diadromous species.

These diadromous species likely inhabited most Buzzards Bay ponds and streams before development. All these species have declined dramatically in the Buzzards Bay watershed during the past 250 years. Historically, river obstructions, particularly the widespread construction of mill dams during the 19th century, largely caused the declines observed by the early twentieth century. Other contributing factors include culvert installation, channelization of streams, loss of bordering tree and shrub vegetation, and pollution and sediment discharges. Accidental release of pesticides from agricultural lands has resulted in fish kills. Shoaling at pond outlets and encroachment of vegetation has affected some sites. Water diversion and pumping for agricultural purposes without intake screens can kill thousands of juvenile fish. Agricultural from surface waters and drinking water withdrawals from groundwater can also reduce stream levels, impeding fish migration and stranding fish, especially of juvenile fish in the fall during drought years.

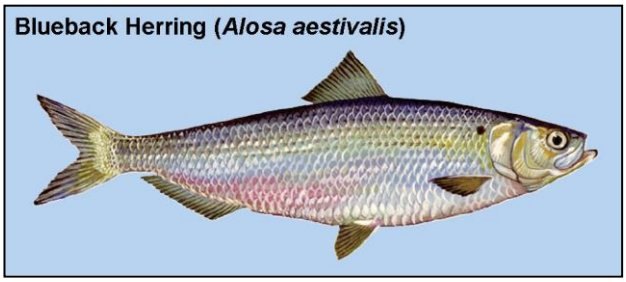


Figure 51. The blueback herring, *Alosa aestivalis*.

Figure 45 shows existing diadromous fish habitat, and impairments in Buzzards Bay. According to DMF scoring for water use conflicts on Buzzards Bay streams, the Mattapoisett, Weweantic, Wankinco, Wareham, and Agawam Rivers and Red and Herring Brook have some level of water use conflict for diadromous species. Water withdrawal issues are discussed in this action plan, and other impacts of water withdrawals on wetlands are also discussed in Action Plan 10 Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies.

In recent decades, most managers agree that offshore commercial fishing pressures including sea herring bycatch are now a fundamental factor affecting river herring abundance [53]. The decline of river herring across the eastern seaboard has resulted in many lawsuits, and petitions to change trawler regulations. In 2011, the Natural Resources Defense Council petitioned the National Oceanic and Atmospheric Administration (NOAA) Fisheries Council to list river herring on the endangered species list. None of the efforts have succeeded. River herring counts conducted by DMF, Alewives Anonymous, and BBC in Buzzards Bay show these population declines (Figure 46).

The loss of suitable river spawning habitat like gravel bottom streams with fast moving cool water, has affected other species. Many of the impairments causing diadromous species declines also resulted in reductions of coldwater stream species like brown and brook trout. Little is known about human impacts to white perch, rainbow smelt, and tomcod populations in the Commonwealth.

[53] Atlantic States Marine Fisheries Commission River Herring Benchmark Stock Assessment and Peer Review Report, August 7, 2024.

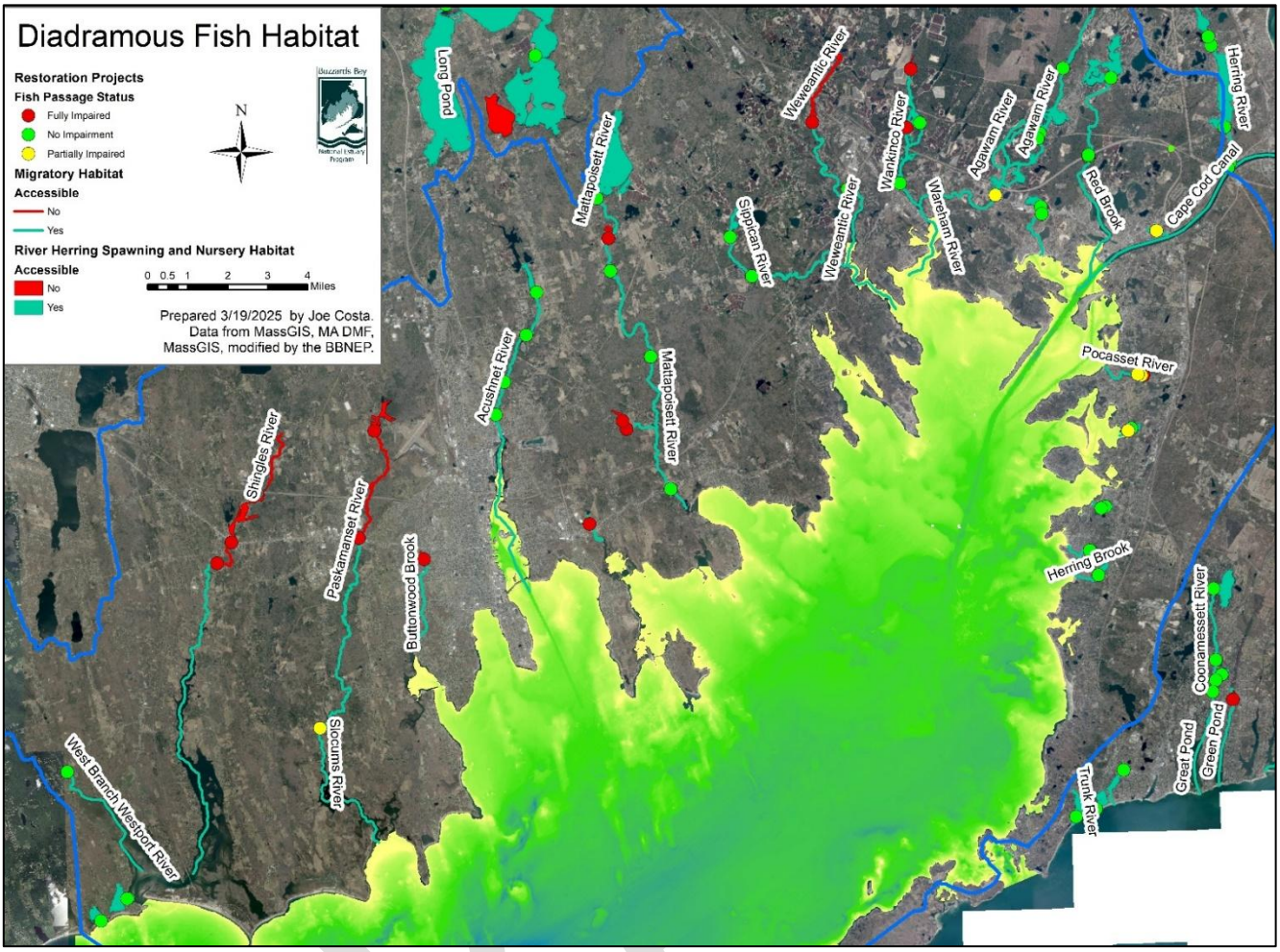


Figure 52. Diadromous fish habitat around Buzzards Bay.

While managing offshore commercial fishing bycatch should remain a national priority, improvement and restoration of diadromous habitat in the Buzzards Bay watershed is still a CCMP priority. We call out the Weweantic River watershed as having the greatest restoration potential in the Buzzards Bay watershed.

Historical Information and restoration

Town records, local historical texts, and state reports document well the historical loss of anadromous fisheries because they were so important to local economies and municipal revenues. With the disappearance of the American shad from most Massachusetts rivers during the 1800s, river herring became the most abundant and economically important diadromous species (Belding, 1921). Even today, blueback herring and alewife remain one of the most abundant of the diadromous fish. There are roughly 8,000 acres of open pond and lake systems in the Buzzards Bay watershed, but probably less than 40% of this area is accessible to river herring. Table 12 shows a list of the ponds and major existing herring runs and habitat. DMF herring surveys (Reback et al., 2004a-b) have good summaries of anadromous fish runs and impairments in the Buzzards Bay watershed. The 2013 CCMP has other historical details, including the potential role in the loss of beaver in the Buzzards Bay watershed.

Because river herring were state-wide importance for centuries, Belding wrote several fishery reports about them in the early twentieth century. In many rivers, the most dramatic herring declines largely occurred between 1800 and 1900. Many declines were related primarily to changes in the natural flow regime of rivers and streams, although he believed sewage and "trade wastes" from sawmills and iron works contributed to some population declines (Belding 1921). More alterations in stream flows during the 20th century left most anadromous fish populations a small

fraction of colonial times. Changes in the river flows is also documented in maps and historical texts.

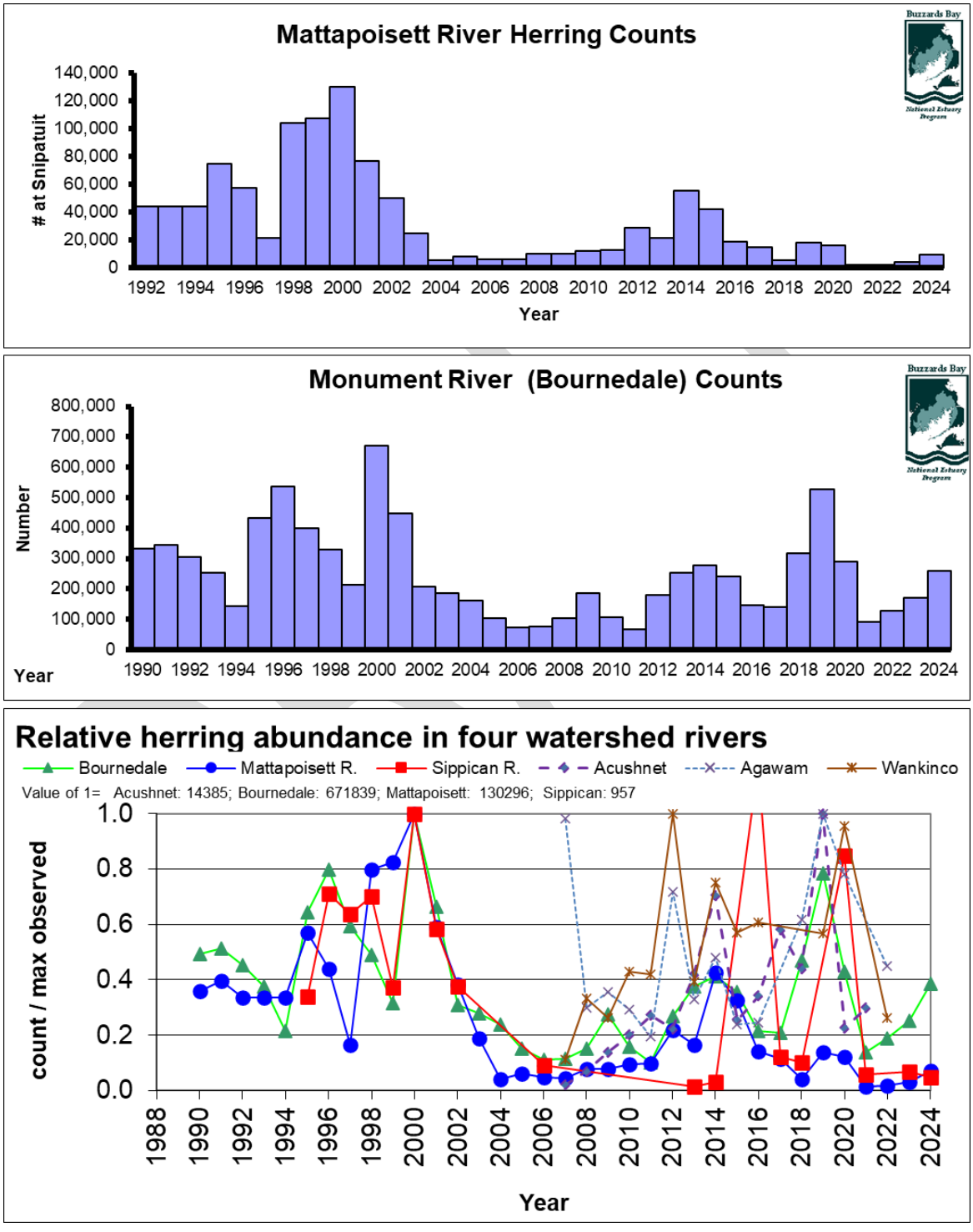


Figure 53. Counts of herring passing upstream as measured at Mattapoisett River, Monument River, and relative abundance on six rivers.

Counts were not available for the Sippican River from 2003 to 2005 and 2007 to 2012 because of various equipment issues. Data courtesy of Massachusetts DMF, Alewives Anonymous and Buzzards Bay Coalition.

Belding (1921) and others document both successful and failed attempts to restore fish passage past milldams. Some local efforts created artificial connections to ponds to bypass mills. In the case of Snipatuit Pond, flow formerly flowed out of the pond north to wetlands feeding into Quittacas Pond. This flow was redirected into the Mattapoisett River.

Until the 1990s, commercial and recreational herring fisheries remained relevant. Smoked or kippered herring and egg roe (served for example in omelets) were local delicacies. Recreational fisherman captured more as bait for fishing or in lobster traps.

The 1991 CCMP identified physical obstructions to migration of diadromous fish as a primary cause of then recent declines. Other impairments included impediments to spawning migration, escapement of adults or juveniles, overfishing, poor water quality, and habitat degradation (e.g., channelization of streams). Improvements to the fish ladder and removal of obstructions to fish passage in the Mattapoisett River was a focus of the 1991 CCMP because it was the largest and most historically prolific herring run in Buzzards Bay [54]. At the turn of the twentieth century, the Mattapoisett River had an estimated annual sustainable yield of approximately 1.4 million fish with the total fish stock estimated at 1.8 to 1.9 million fish per year and was one of the best herring runs in the state (Belding, 1921).

The Mattapoisett River begins at the 731-acre Snipatuit Pond in Rochester and flows 20 miles south to its discharge into Mattapoisett Harbor. Following efforts to improve fish passage, river herring counts in the Mattapoisett River showed generally increasing return of river herring through the 1990s, with the highest fish count seen in 2000, with 130,000 fish (Figure 53). However, after 2000, river herring in the Mattapoisett and other rivers began new unprecedented and precipitous declines, with the lowest count occurring in 2021 with less than 1,900 fish. Fisheries managers saw similar river herring declines elsewhere in Massachusetts and throughout the U.S. eastern seaboard. Herring runs that might have once had hundreds of thousands of returning fish, now were reported to have declines of 90% or more of the population. These new declines appeared to be independent of river-specific habitat impairments or declines in water quality as the declines occurred in all rivers, even where conditions in the river had not changed.

Table 12. Acreage of existing Buzzards Bay alewife pond habitat.

River	Pond	Acres	Primary Location
Acushnet River	Acushnet Sawmill Pond	8	Acushnet
Acushnet River	Hamlin Street	5	Acushnet
Acushnet River	New Bedford Reservoir	233	Acushnet
Agawam River	Halfway Pond	229	Plymouth
Agawam River	Pond above Glen Charlie	34	Plymouth
Agawam River	Glen Charlie Pond	168	Wareham
Agawam River	Maple Park	20	Wareham
Agawam River	Mill Pond	138	Wareham
Agawam River	Besse Bog Reservoir	34	Wareham
Agawam River	Kennard Bog	19	Wareham
Cedar Lake Ditch	Cedar Lake	21	Falmouth
Cockeast Pond Stream	Cockeast Pond	101	Westport
Gibbs Brook	Dicks Pond	47	Wareham
Herring Brook	Wings Pond	26	Falmouth
Mattapoisett River	Rochester Fish Hatchery	32	Rochester
Mattapoisett River	Snipatuit Pond	731	Rochester
Monument (Herring) River	Great Herring Pond	413	Plymouth
Monument (Herring) River	Little Herring Pond	81	Plymouth
Red Brook (Buttermilk)	White Island Pond	322	Plymouth
Red Brook Conrail Run	Red Brook Pond	19	Bourne
Richmond Pond	Richmond Pond	54	Westport
Russells Mills Pond	Paskamanset/Slocum	4	Dartmouth
Sippican River	Leonards Pond	53	Rochester
Sippican River	Hathaway Pond	19	Rochester
Wankinco River	Tihonet Pond	93	Wareham
Wankinco River	Parker Mills Pond	82	Wareham
Westport West Branch	Grays Mill Pond	3	Little Compton
Weweantic River	Horseshoe Pond	45	Wareham
Wild Harbor River	Dam Pond	7	Falmouth
Total		2,943	

Areas as reported in Reback (2004a) or as calculated by the Buzzards Bay NEP from apparent water surface boundaries, including some deep marsh area, as defined in 2009 MassDEP wetland conservancy maps and 2009 MassGIS aerial photographs. The area of some ponds has been variable.

Selecting sites for dam removal requires careful assessment of approach, costs, environmental benefits, environmental risks, public and private liabilities, costs of maintaining dams that may be unsafe, whether any rare or endangered species would be affected by the loss of adjoining surface waters and bordering vegetated wetlands, and other factors. Many ponds in the

[54] Snipatuit Pond originally was connected to Quittacas Pond, but about 1755, colonists of Rochester dug a ditch to connect the Pond to the Mattapoisett River to establish a new run on that river.

Buzzards Bay watershed are agricultural impoundments, used for cranberry production. Removal or alteration of these dams may involve complex water rights issues.

Prior to 2005, herring could only be caught during spawning runs with hand-held dip nets, with various scenarios of daily bag limits and days closed to harvest implemented. However, in 2005, in response to sharp population declines following droughts during 2000-2002, DMF implemented what a three-year moratorium on the catch of herring in rivers and inshore areas. By the end of 2007, Rhode Island, Connecticut, and North Carolina also banned herring fishing. In 2008, the ban on river herring catch was extended in Massachusetts, and other states also enacted bans. Today in Massachusetts, spawning run harvest can only occur under an ASMFC-approved Sustainable Fishery Management Plan (3 approved in Massachusetts) or by Federally recognized, indigenous tribe members who have aboriginal rights to take river herring for personal use.

The harvest closure in 2006 may have contributed to a regional improving trend in herring runs through 2019 (excluding the Mattapoisett River), however, most runs in the region have declined since (Figure 53). Environmental groups asserted these actions were ineffective because overfishing by ocean mid-water trawling and river herring bycatch were the primary cause of these river herring declines. During the past two decades there have been repeated legal attempts by environmental groups to ban certain kinds of trawling, or change trawler fisheries rules, all of which have been unsuccessful.

Potential new diadromous fish habitat

In Belding's 1921 treatise on the alewife fishery of Massachusetts, he summarizes obstacles facing many of the runs in Buzzards Bay, including the need to construct fishways at several dams, or to enable passageways through certain bog systems. Many of the obstacles identified by Belding's report remain a problem over 100 years later, notably including the need for fishways at Lake Noquochoke, Russells Mills, and Smith Mills dams in Dartmouth, and Tremont Pond dam in Wareham. Because of elevations at these sites, they need considerable funding for, perhaps totaling hundreds of thousands of dollars.

Table 13. List and acreage of potential alewife pond habitat and acreage in the Buzzards Bay watershed.

River	Pond System	Acres	Primary Location of Pond
Agawam River	Halfway Pond	229	Plymouth
Bourne Pond Brook	Bourne Pond	11	Bourne
Buttonwood Brook	Buttonwood Park Pond	10	New Bedford
East Branch Westport	Copicut Reservoir	621	Dartmouth
East Branch Westport	Cornell Pond	16	Dartmouth
East Branch Westport	Lake Noquochoke	181	Dartmouth
East Branch Westport	Forge Pond Dam	4	Dartmouth
Mattapoisett River	Tinkham Pond	22	Mattapoisett
Paskamanset/Slocum	Smith Mills Dam	5	Dartmouth
Paskamanset/Slocum	Turner Pond	95	Dartmouth
Pocasset River	Mill Pond	1	Bourne
Pocasset River	Shop Pond	2	Bourne
Pocasset River	The Basin	2	Bourne
Pocasset River	Freeman & Upper Pond	4	Bourne
Wankinco	East Head Pond	85	Plymouth
Weweantic River	Sampson Pond	302	Carver
Weweantic River	Federal Pond	126	Plymouth
Weweantic River	Crane Brook Bog Pond	38	Carver
Weweantic River	Dunham Pond	49	Carver
Weweantic River	Wenham Pond	48	Carver
Weweantic River	Tremont Mill Pond	36	Wareham
Total		1,717	

The Buzzards Bay NEP calculated areas based on water surface boundaries, including some deep marsh area, as defined in 2007 MassDEP wetland conservancy maps. Some of these ponds, like those on the Weweantic River and Westport East Branch would never become accessible without overcoming the first dam on each system (Tremont Pond and Lake Noquochoke dams respectively), and even then, each subsequent pond may pose its own special set of obstacles. The value of pond habitat, and the biomass of fish it can sustain, is a function of pond depth (volume) and other factors.

Altogether, there is the potential to increase diadromous fish habitat in Buzzards Bay by 1,700 acres (Table 13). In most cases, fisheries managers can restore fish passage by removing obstructions, including dams. Many of the smaller ponds on this list have been ignored because they are considered "minor" habitat. Cumulatively, restoring fish passage to these minor ponds is still beneficial to Buzzards Bay. While ignoring minor ponds is practical for distributing state resources, it is desirable to restore passage to these small ponds, especially when the cost of repair or restoration is modest. Neither Table 12 nor Table 13 list some of these smaller ponds. River herring will try to navigate any stream with unimpeded passage to a small pond. Some of these smaller ponds function well for their size; others have various degrees of impairments.

MGL Chapter 130 Sections 19, 93, and 94, states that private property owners have the responsibility to provide fish passage if required by the Director of

DMF. In recent years, repair mandates and enforcement actions against dam owners have been rare. In some New England states in the 2010s, road washouts and dam failures resulted from some extreme nor'easters and hurricanes. In Massachusetts, this prompted a review of regulations related to culvert replacement, and a focus on dam safety. In 2017, Massachusetts dam safety regulations became more stringent for owners of dams with significant hazard potential. This prompted some property owners to seek relief through state programs to fund dam removal, including grants to restore river habitat. The cost of removing old milldams varies greatly and is site specific.

The Weweantic River watershed has important potential to create new diadromous fish habitat in the Buzzards Bay. Work on the river would pose challenges to water use management, would involve water use conflicts, and a significant financial challenge.

The Weweantic River

Until the late 1800s, river herring passed all the way up the Weweantic River to Federal Pond (36 acres), Crane Brook Pond (today 38 acres), and Sampson Pond (302 acres), and along another tributary all the way to Wenham Pond (48 acres) near the Middleborough border [55] (Figure 54. However, this run eventually was destroyed by modifications to the Tremont Pond dam [56]. In 2020, the BBC removed the old mill dam that was the first obstruction on the river that formed Horseshoe Pond, freeing the first three miles of the river to fish passage. The Weweantic River has the state's only rainbow smelt run with a spring taking allowed with net fishing (Reback, 2004a). Prior to the Horseshoe Mill dam removal, smelt, which must lay eggs in brackish water, were only able to use a small area below the old Horseshoe Pond dam.

Any anadromous fish restoration strategy for the upper Weweantic River will be defined by the restoration approach taken at Tremont Pond. Tremont Pond [57] is 24 feet above stream level and an insurmountable barrier to anadromous fish, cutting off hundreds of acres

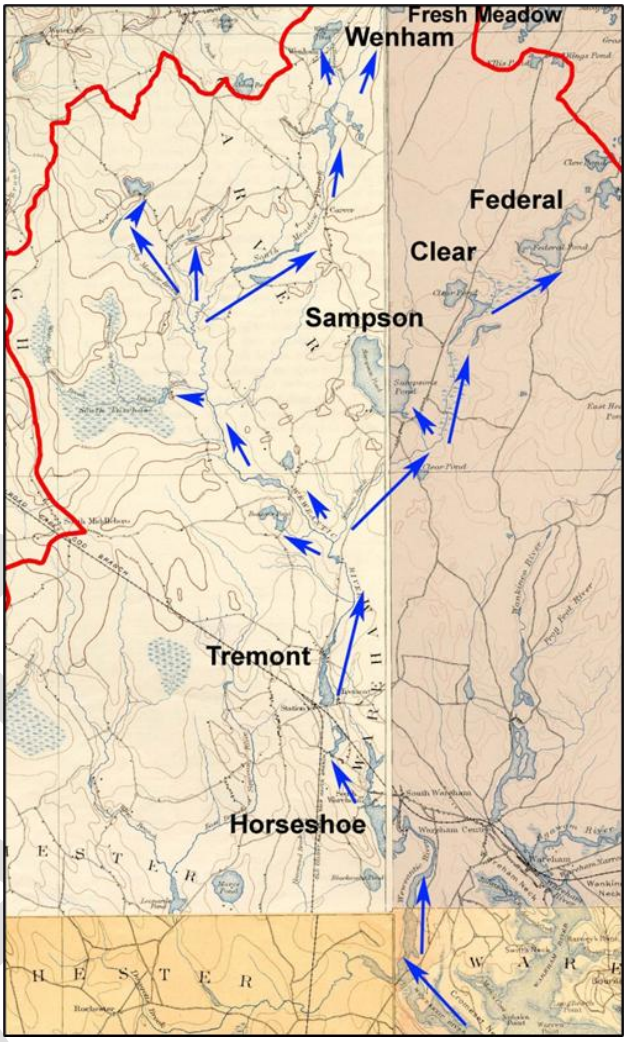


Figure 54. Likely Weweantic River diadromous fish passage prior to the 1890s.

More information at NEP's herring information webs page.

of ponds and dozens of miles of upstream habitat. Either a fish elevator, or an expensive series of ladders are needed if the pond is preserved. Dam removal would only be viable if the town, abutters, and various agencies develop a consensus on the approach, and adequate financing available. Because Tremont Pond (31 acres) and upgradient ponds total 550 acres, anadromous fish restoration effort would greatly increase

[55] See maps and sources at the NEP's Historical Weweantic Herring page. Historical documents like Bliss (1888), Griffith (1913), and an 1815 description of the Town of Carver touch upon these historic pathways and ponds.

[56] There may have been a poorly function bypass up until the 1890s, but Belding (1921) suggested the vibrant historical Weweantic River run was all but destroyed by the creation of the first dam in the 1860s.

[57] The dam is owned by the Town of Wareham and was once a functioning hydroelectric dam.

anadromous fish habitat appreciably in the Buzzards Bay watershed.

Water Management Issues and Bog Operations

As noted in the DMF herring reports, "large numbers of young herring are killed each year due to cranberry bog operations" (Reback, 2004a-c). Some of the past impacts could have been avoided by simple and inexpensive screening systems on water intakes and flumes. This led DMF to recommend that state-issued water withdrawal permits issued by the state not only ensure that there is adequate flow in rivers during juvenile fall downstream migrations, but that permittees use proper screening of water withdrawal intakes. Because of these concerns, in 2004 the Cape Cod Cranberry Growers Association worked with DMF and issued a grower advisory on protecting anadromous fish [58]. The advisory includes recommended practices for ensuring the springtime passage of adults and the fall passage of juveniles. Included in the advisory is a formula for sizing screens to prevent juveniles from being injured by the screen, and how to remove fry that have entered a bog.

A related problem is that of strandings or cessation of stream flows that may be caused by heavy summer and fall withdrawals by municipal water suppliers and/or cranberry growers that cause the cessation of stream flow or drops water levels in ponds that prevent juvenile migration. The issue is becoming increasingly problematic on the Mattapoisett River where continuing large municipal withdrawals during drought years, coupled with water diversions for cranberry operations have caused the river to run dry during critical herring migration periods. In Massachusetts, among 39 fish kills investigated in 2011, four were caused by "human-induced low-water conditions." [59] This topic is also found in Action Plan 10 Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies.

Goals

Goal 8.1. Remove barriers that prevent fish from migrating between salt and fresh water habitats.

Goal 8.2. Restore degraded stream habitat and functions to ensure the diversity and abundance of fish species in Buzzards Bay streams.

Goal 8.3. Manage fishing impacts on anadromous fish populations to ensure fish harvest and bycatch are sustainable.

Objectives

Objective 8.1. The legislature and DMF should ensure adequate funding of state fisheries restoration programs.

Objective 8.2. Local, state, and federal fisheries regulators should continue to monitor and improve the management of the catch and bycatch of river herring and other diadromous fish to promote their recovery and population sustainability.

Objective 8.3. DMF, DER, municipalities, and property owners should improve passageways and remove impediments and obstructions to fish migration.

Objective 8.4. Ensure adequate stream flow for fish migration.

Objective 8.5. Regulators should strengthen drinking water and agriculture withdrawal regulations to ensure adequate flow for the passage of adult migratory fish in the spring and juveniles in the fall, especially during drought conditions.

8.6. Support monitoring and assessments of stressors affecting anadromous fish populations including stream flow, temperature, and mapping of obstructions and reproductive habitat.

Objective 8.7. Promote measures for nutrient control in freshwater habitats to ensure adequate water quality for diadromous fish spawning and recruitment.

Objective 8.8. Support efforts to restore historic fish passage to the Weweantic River above Tremont Dam, and the other major biologically disconnected streams and rivers in the watershed.

Objective 8.9 Encourage and aid conservation commissions to aggressively protect stream wetland habitat to protect flow volumes, prevent sediment inputs and reduce thermal warming of the streams.

[58] Cape Cod Cranberry Growers' Association. Grower advisory. Anadromous Fish.

[59] Annual Report 2011. Massachusetts Division of Fisheries & Wildlife, 94pp.

Objective 8.10. Regulatory agencies should ensure dredging methods are acceptable and are completed at a time of year to minimize adverse impacts to migrating fish populations and other natural resources. Where needed, require relocation of shellfish from the planned dredge area.

Management Approaches

DMF regulates marine fish populations in coastal Massachusetts including passage and harvest of diadromous species. DFW manages diadromous fish in inland waters. This duality requires good coordination between agency missions to avoid redundancy or inconsistent prioritization. DMF coordinates with coastal towns to manage fish passage and coordinate interstate efforts with Atlantic States Marine Fisheries Commission to improve fish passage.

While DFW, DMF and municipalities are the lead for many actions, other agencies and organizations must help and participate. State and local managers must restore priority fish habitat sites and remove obstructions to fish migration. They should also evaluate many smaller herring runs for restoration potential because of their cumulative benefits. Removal of migration barriers helps diadromous species, and in many cases. Dam removal is the best management strategy. In other cases, new fish ladder installations may be the only practical solution. Improved water management practices by cranberry growers and preventing excessive drawdowns by municipal water suppliers during drought years is important to avoid placing adult and juvenile populations at risk (see Action Plan 10 Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies).

While inland river restoration efforts are underway, the National Marine Fisheries Service, Regional Fisheries Management Councils, and the Atlantic States Marine Fisheries Commission (ASFMC) should further strengthen and enforce rules to limit the catch and bycatch of river herring in offshore waters. Potential added measures could include MassDEP requiring that adequate flow maintained in rivers and streams during adult and juvenile migration periods as a condition of state water withdrawal permits. Permittees should also be required to use screening of water withdrawal intakes to prevent stranding, mutilation, entrainment, or impingement of young herring.

Figure 55. The Horsehoe Mill bridge before (top) and after (bottom) dam removal.

Images courtesy of the BBC, with more information at the Horseshoe Mill website.

Early diadromous fish restoration activities in the Buzzards Bay watershed spearheaded by DMF largely focused on the construction and restoration of fish ladders. However, dam removal is the most effective strategy to increase anadromous fish spawning habitat upstream of the obstruction. Some dams are very old and in disrepair and are a flood risk to downstream property if they fail, which is another reason for removal. Dams not only impede the migration of diadromous fish, but they create environments that favor warm water and pond (lotic) spawning species, over species that prefer cool flowing water stream (lentic) habitats. As noted by ASFMC (2009), "wherever practical, tributary blockages should be removed. Full dam removal will likely offer the best chance for restoration; however, it is not always practical to remove large dams along mainstream rivers." Whether or not dam removal is practical also depends in part on a variety of social, political, flooding, water rights, aes-

thetic, and other values associated with the water impoundment created by the dam (Lane, 2006). The discussion of these costs and benefits often becomes emotionally charged (Stanley and Doyle, 2003). Where dam removal is not an option, resource managers should use fish ladders.

Dam removals on the Acushnet and Weweantic Rivers (Figure 48) by the BBC illustrate that while sometimes complex, these more ambitious projects can succeed. In 2007, BBC and other partners partially removed the dam at the former Acushnet Sawmill using New Bedford Superfund Natural Resources Damage Assessment (NRDA) funds. At Hamlin Street, a series of step-pool weirs were created with granite blocks to form a fish passage system. These changes allowed river herring and American eel to better access the entire 8-mile length of the Acushnet River. In 2019, the BBC and other partners removed the Horseshoe Dam at the mouth of the Weweantic River. Both BBC dam removal projects began with the outright purchase of properties having dams, followed by coordination with municipalities and state granting agencies. Municipalities, Buzzards Bay NEP, BBC, and the state should coordinate on a similar restoration effort for other dams and obstructions along the entire length of the Weweantic River because of the great restoration potential for that system (additional information at the NEP's Historical Weweantic River herring webpage).

The citizens group Alewives Anonymous has long been a leader managing, promoting, and enhancing the herring runs in Marion, Mattapoisett, and Rochester. Their actions have included volunteer efforts to clean debris and trash from fish runs and to enact other stream restoration efforts. The Massachusetts River Herring Network, a collaboration of herring wardens, town river herring committee members, town natural resources officers, community science river herring count volunteers, watershed organizations, state, county, and federal agencies provides a forum to exchange information and successes. Similarly, to better evaluate stream condition and the success of restoration efforts, the BBC has organized volunteers to monitor herring runs, assist with herring counts, track the condition of herring runs, and monitor stream flows. The BBC has also added electronic fish counters to the Agawam, Wankinco, Acushnet, Sippican, and Weweantic Rivers. DMF has embraced these and similar efforts and has held workshops and produced guides for the collection of data by these volunteers.

Most municipalities in Buzzards Bay have a herring inspector or natural resource officer who handle enforcing herring catch limits, permit compliance, monitoring the condition of herring runs, and sometimes maintenance of water control structures. In most instances, the demands of herring management far exceed the time availability of these municipal officers.

Costs and Financing

Developing and implementing designs to repair fish passageway structures in the watershed and to remove dams and other obstacles, may cost millions. Federal grants can cover some of these costs, but state and local government may need to provide more funding for project designs and implementation and natural resource staff. Passage of new laws and regulations have negligible costs to government, but property owners may need to pay restoration costs. Monitoring efforts such as the installation of a fish counter on a particular stream may initially cost about $10,000, with follow-up maintenance costs being much lower.

Measuring Success

To track progress on this action plan, the Buzzards Bay NEP should monitor the number of restoration efforts undertaken or quantifying the number of upstream river miles or pond acres newly accessible or restored are easily tracked. Different management actions may help some species and not others. The best measure of success will be herring counts with automated fish counters and observations by volunteers, direct capture, or through catch, mark, and release programs.

Action Plan 9. Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species

Problem

Buzzards Bay and its watershed provides habitat for many species that are locally rare, threatened, or endangered (Figure 56). Populations of these species are vulnerable to habitat loss, alteration, pollution, and stresses caused by human activity.

The Massachusetts Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program's (NHESP) Priority Habitats are mapped areas of known occurrences of habitat for state-listed plant and animal species. Habitat alterations in these areas are subject to regulatory review by NHESP under the Massachusetts Endangered Species Act (MESA) Regulations. NHESP Estimated Habitats are a sub-set of Priority Habitats and only include rare wetlands wildlife habitats. These areas are protected under the MESA and the rare species provisions of the WPA Regulations.

NHESP also produces maps of natural communities of biodiversity conservation interest. These include BioMap Core Habitats, which identify habitats critical for the long-term persistence of rare species, exemplary natural communities, and resilient ecosystems, and Critical Supporting Habitats/Natural Landscapes, which identify large landscapes minimally impacted by development and buffers to Core Habitats and coastal areas, both of which enhance connectivity and resilience (Figure 56). Many areas of BioMap are not mapped as Priority Habitat or Estimated Habitats and do not require regulatory review under MESA or the rare species provisions of the WPA. The designation of these habitats is best used by municipalities, land trusts and other conservation partners as planning tools for selecting the highest priority land for local protection, conservation, and restoration.

Conservation of these areas can be achieved by municipalities strictly enforcing existing laws, adopting new laws to create buffers around these habitats, educating the public and government officials about their importance, and encouraging more environmentally sensitive developments, such as those using Open Space Residential Design principals.

The adoption of municipal conservation plans may be another approach to go beyond project permit review and to achieve more comprehensive and effective strategies to protect key wildlife habitat, and to build necessary public support. Past efforts to protect open space have increasingly focused on protecting lands that have core habitat for endangered or threatened species (compare Figure 56 to BioMap 3 Core Habitats and wetlands protected in Figure 66 in Action Plan 12 Protecting Open Space).

Recommendations and discussions related to this action plan are included in Action Plan 7 Protecting and Restoring Wetlands (including vernal pools); Action Plan 8 Restoring Migratory Fish Passage; Action Plan 11 Managing Invasive Species; and Action Plan 12 Protecting Open Space. This action plan addresses problems not discussed in those action plans, especially those issues relating to the Massachusetts Natural Heritage and Endangered Species Program.

Additional Information [60]

Natural Heritage & Endangered Species Program

NHESP conserves and protects Massachusetts' biodiversity. A primary responsibility of the NHESP is the regulatory protection of rare species and their habitats as codified under MESA [61] and the rare wildlife species provisions of the Wetlands Protection Act (MGL Chapter131, Section 40). Additional protection is offered under the Massachusetts Forest Cutting Practices Act (MGL Chapter 132, Section 40-46) and supporting regulations (304 CMR 11.00), which require the review of certain forest cutting plans for potential impacts to rare species.

[60] Some of the information and text in this action plan was taken from information prepared by the NHESP website and the MassGIS website.

[61] The MESA was enacted in December 1990 (MGL c.131A). Implementing regulations were promulgated in 1992 and last updated in 2010 (321 CMR 10.00). The 2010 MESA revisions clarified filing requirements, specified timelines for the review process NHESP must meet, and implemented fees to help ensure prompt reviews and consultations with project proponents.

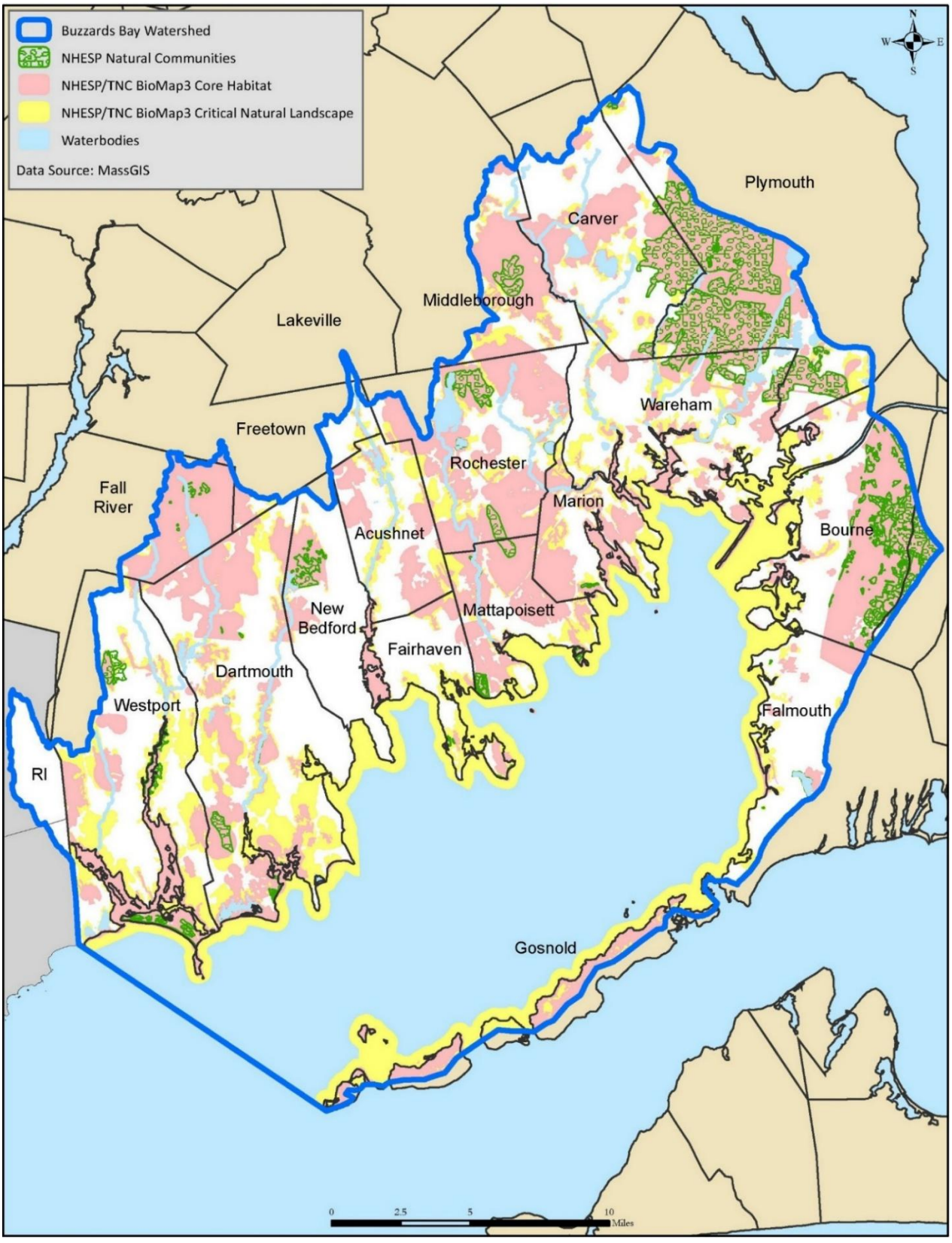


Figure 56. Important habitat types mapped in support of Natural Heritage and Endangered Species Program's mission (MassGIS data retrieved 2025).

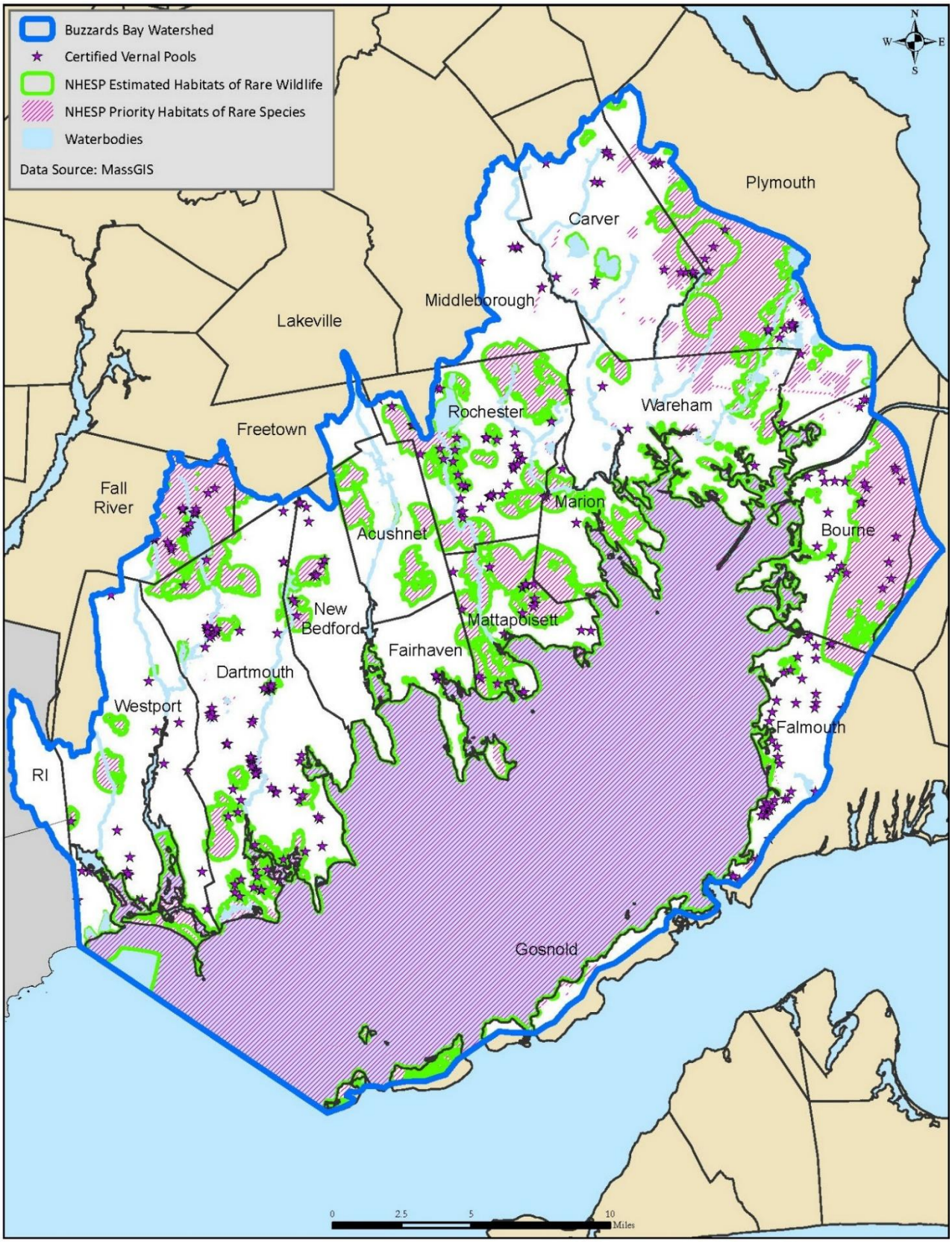


Figure 57. Location of certified vernal pools and rare and endangered species wildlife (purple hatching) and plant species only (green) in the Buzzards Bay watershed (MassGIS data retrieved 2025).

Table 14. Total number of occurrences of MESA listed species reported since 1990 in Buzzards Bay watershed municipalities (data as of 2025).

Municipality	Amphibian	Bee	Beetle	Bird	Butterfly/Moth	Crustacean	Dragonfly/ Damselfly	Fish	Mammal	Mussel	Reptile	Vascular Plant	Total
Acushnet						1				1	2		4
Bourne	1		1	11	16	2	2	1	2	2	4	14	56
Carver		1	1	7	1		1	1		2	4	7	25
Dartmouth	1		1	9	9	1	2				2	14	39
Fairhaven				20							2	6	28
Falmouth		1	1	10	13	1	2			1	2	20	51
Marion				3	1						2	3	9
Mattapoisett		1		6	1		1		1		2		12
Middleborough	1			8	1		2	1		3	5	12	33
New Bedford	1			3	2	1	3				1	1	12
Plymouth			1	11	19		3	1	1	3	4	19	62
Rochester	2			1	1			1		2	2	6	15
Wareham				5	8					1	4	11	29
Westport	2			6	7				1	1	1	4	22
Total	8	3	5	100	79	6	16	5	5	16	37	117	397

There are 135 separate species in the combined list for these towns reported since 1990 (34 endangered, 54 threatened, 47 of special concern; historic data totals 166). Calculated from NHESP Rare Species Viewer website.

The program focuses on 181 species of vertebrate and invertebrate animals and 273 species of native plants and their habitats that NHESP lists as Endangered, Threatened, or of Special Concern under the MESA. A summary of the 135 MESA listed species (34 endangered, 54 threatened, 47 of special concern) in the Buzzards Bay watershed are shown by municipalities and taxa in Table 14 and a complete federal species list is shown in Table 15. The NHESP, founded in 1978, is part of the Massachusetts Division of Fisheries and Wildlife, and one of the programs forming the Natural Heritage network. The Natural Heritage and Endangered Species Advisory Committee helps guide NHESP activities, especially the regular re-evaluation of the MESA list that occurs at least every 5 years.

NHESP reviews projects within "Priority Habitats of Rare Species" and "Estimated Habitats of Rare Wildlife" published in the Massachusetts Natural Heritage Atlas [62]. The latter category is a subset of the first category, and Conservation Commissions use these maps to review applications under the Wetlands Protection Act. NHESP reviews proposed projects or activities for compliance under MESA and or the rare wildlife species provisions of the WPA. Figure 57 shows these areas, plus another special wetland category, certified vernal pools. In the permitting process, it is the responsibility of the landowner or project proponent to confirm if their project falls within Priority Habitat or Estimated Habitat mapped by the NHESP using published information, submitting an application for review, and receiving written authorization prior to implementing the project.

[62] The atlas is based on observations documented within the last 25 years in the database of the Natural Heritage & Endangered Species Program. Priority Habitat areas are the filing trigger for determining whether or not NHESP must review a proposed project or activity for compliance with the MESA and its implementing regulations. Areas delineated as Priority Habitats can include wetlands, uplands, and marine habitats.

Table 15. Number of Buzzards Bay watershed towns (see Table 14) reporting a species in 1990 or later.

Common Name	Scientific Name	Endangered	Special Con-	Threatened	Total	Fed status
Amphibian						
Blue-spotted Salamander	*Ambystoma laterale pop. 2*			1	1	
Eastern Spadefoot	*Scaphiopus holbrookii*			3	3	
Marbled Salamander	*Ambystoma opacum*			4	4	
Bee						
Walsh's Anthophora	*Anthophora walshii*	1			1	
Yellow-banded Bumble Bee	*Bombus terricola*			2	2	
Beetle						
Purple Tiger Beetle	*Cicindela purpurea*		5		5	
Bird						
American Bittern	*Botaurus lentiginosus*	4			4	
Arctic Tern	*Sterna paradisaea*		2		2	
Bald Eagle	*Haliaeetus leucocephalus*			5	5	
Common Gallinule	*Gallinula galeata*		3		3	
Common Loon	*Gavia immer*		1		1	
Common Tern	*Sterna hirundo*		11		11	
Eastern Meadowlark	*Sturnella magna*		4		4	
Eastern Whip-poor-will	*Antrostomus vociferus*		7		7	
Grasshopper Sparrow	*Ammodramus savannarum*			5	5	
King Rail	*Rallus elegans*			3	3	
Least Bittern	*Ixobrychus exilis*	3			3	
Least Tern	*Sternula antillarum*		8		8	
Northern Harrier	*Circus hudsonius*			1	1	
Northern Parula	*Setophaga americana*			5	5	
Peregrine Falcon	*Falco peregrinus*			2	2	
Pied-billed Grebe	*Podilymbus podiceps*	2			2	
Piping Plover	*Charadrius melodus*			10	10	T
Roseate Tern	*Sterna dougallii*	11			11	E
Saltmarsh Sparrow	*Ammospiza caudacuta*		2		2	
Upland Sandpiper	*Bartramia longicauda*	5			5	
Vesper Sparrow	*Pooecetes gramineus*			6	6	
Butterfly/Moth						
Barrens Dagger Moth	*Acronicta albarufa*			2	2	
Buchholz's Gray	*Hypomecis buchholzaria*	1			1	
Buck Moth	*Hemileuca maia*		4		4	
Chain Dot Geometer	*Cingilia catenaria*		4		4	
Chain Fern Borer	*Papaipema stenocelis*			1	1	
Coastal Heathland Cut-worm	*Abagrotis benjamini*		5		5	
Collared Cycnia	*Cycnia collaris*			1	1	
Drunk Apamea Moth	*Apamea inebriata*		3		3	
Dune Sympistis	*Sympistis riparia*		2		2	
Frosted Elfin	*Callophrys irus*		4		4	
Heath Metarranthis	*Metarranthis pilosaria*		2		2	
Herodias Underwing Moth	*Catocala herodias*		4		4	
Hessel's Hairstreak	*Callophrys hesseli*		2		2	
Imperial Moth	*Eacles imperialis*			1	1	
Melsheimer's Sack Bearer	*Cicinnus melsheimeri*			4	4	
Pale Green Pinion Moth	*Lithophane viridipallens*		5		5	
Pine Barrens Macaria	*Macaria exonerata*		4		4	
Pine Barrens Zale	*Zale lunifera*		3		3	
Pine Barrens Zanclognatha	*Zanclognatha martha*		2		2	
Pink Sallow Moth	*Psectraglaea carnosa*		5		5	
Scrub Euchlaena	*Euchlaena madusaria*		2		2	
Slender Clearwing Sphinx	*Hemaris gracilis*		2		2	
Spartina Borer Moth	*Photedes inops*		2		2	
The Pink Streak	*Dargida rubripennis*			4	4	
Water-willow Stem Borer	*Papaipema sulphurata*			8	8	
Waxed Sallow Moth	*Chaetaglaea cerata*		1		1	
Woolly Gray	*Lycia ypsilon*			1	1	

Common Name	Scientific Name	Endangered	Special Con-	Threatened	Total	Fed status
Crustacean						
Agassiz's Clam Shrimp	*Eulimnadia agassizii*	2			2	
American Clam Shrimp	*Limnadia lenticularis*		1		1	
Coastal Swamp Amphipod	*Sicifera chamberlaini*		3		3	
Dragonfly/Damselfly						
Attenuated Bluet	*Enallagma daeckii*			3	3	
Mocha Emerald	*Somatochlora linearis*		3		3	
Pine Barrens Bluet	*Enallagma recurvatum*			4	4	
Ringed Boghaunter	*Williamsonia lintneri*			1	1	
Scarlet Bluet	*Enallagma pictum*			5	5	
Fish						
Bridle Shiner	*Notropis bifrenatus*		5		5	
Mammal						
Little Brown Bat	*Myotis lucifugus*	1			1	
North Atlantic Right Whale	*Eubalaena glacialis*	2			2	E
Red Bat	*Lasiurus borealis*		1		1	
Silver-haired Bat	*Lasionycteris noctivagans*		1		1	
Mussel						
Creeper	*Strophitus undulatus*		2		2	
Eastern Pondmussel	*Sagittunio nasutus*		7		7	
Tidewater Mucket	*Atlanticoncha ochracea*		7		7	
Reptile						
Blanding's Turtle	*Emydoidea blandingii*			1	1	
Eastern Box Turtle	*Terrapene carolina*		15		15	
Eastern Hog-nosed Snake	*Heterodon platirhinos*		6		6	
Northern Diamond-backed Terrapin	*Malaclemys terrapin*			6	6	
Northern Red-bellied Cooter	*Pseudemys rubriventris*	7			7	E
Wood Turtle	*Glyptemys insculpta*		2		2	
Vascular Plant						
Acadian Quillwort	*Isoetes acadiensis*	1			1	
Adder's Tongue Fern	*Ophioglossum pusillum*			1	1	
American Sea-blite	*Suaeda calceoliformis*		1		1	
Bristly Foxtail	*Setaria parviflora*		5		5	
Broad Tinker's-weed	*Triosteum perfoliatum*	1			1	
Canadian Sanicle	*Sanicula canadensis*			1	1	
Climbing Fern	*Lygodium palmatum*		1		1	
Collared Cycnia	*Cycnia collaris*			1	1	
Cranefly Orchid	*Tipularia discolor*	2			2	
Creeping St. John's-wort	*Hypericum adpressum*			1	1	
Dwarf Bulrush	*Cyperus subsquarrosus*			4	4	
Eastern Prickly Pear	*Opuntia humifusa*	1			1	
Foxtail Clubmoss	*Lycopodiella alopecuroides*	2			2	
Grass-leaved Ladies'-tresses	*Spiranthes vernalis*			2	2	
Inundated Beaksedge	*Rhynchospora inundata*			2	2	
Long-beaked Beaksedge	*Rhynchospora scirpoides*		2		2	
Long-leaved Panic-grass	*Coleataenia longifolia ssp. longifolia*			3	3	
Long's Bittercress	*Cardamine longii*	1			1	
Long's Bulrush	*Scirpus longii*			1	1	
Mattamuskeet Rosette-grass	*Dichanthelium mattamus-keetense*	4			4	
New England Blazing Star	*Liatris novae-angliae*		5		5	
New England Boneset	*Eupatorium novae-angliae*	1			1	
Northern Gama-grass	*Tripsacum dactyloides*	2			2	
Ovate Spike-sedge	*Eleocharis ovata*	1			1	
Pale Green Orchid	*Platanthera flava var. herbi-ola*			1	1	

Common Name	Scientific Name	Endangered	Special Con-	Threatened	Total	Fed status
Papillose Nut Sedge	*Scleria pauciflora*	2			2	
Parker's Pipewort	*Eriocaulon parkeri*	1			1	
Philadelphia Panic-grass	*Panicum philadelphicum ssp. philadelphicum*		3		3	
Pickering's Reedgrass	*Calamagrostis pickeringii*	1			1	
Pinnate Water-milfoil	*Myriophyllum pinnatum*		1		1	
Plymouth Gentian	*Sabatia kennedyana*		8		8	
Pondshore Smartweed	*Persicaria puritanorum*		5		5	
Purple Milkweed	*Asclepias purpurascens*	1			1	
Purple Needlegrass	*Aristida purpurascens*			1	1	
Redroot	*Lachnanthes caroliniana*		2		2	
Resupinate Bladderwort	*Utricularia resupinata*			2	2	
Round-fruited Seedbox	*Ludwigia sphaerocarpa*	2			2	
Salt Reedgrass	*Sporobolus cynosuroides*			1	1	
Saltpond Pennywort	*Hydrocotyle verticillata*			1	1	
Sandplain Gerardia	*Agalinis acuta*	1			1	E
Sea-beach Knotweed	*Polygonum glaucum*		5		5	
Shore Pygmy-weed	*Crassula aquatica*			2	2	
Short-beaked Beaksedge	*Rhynchospora nitens*			2	2	
Slender Bladderwort	*Utricularia subulata*			1	1	
Southern Twayblade	*Neottia bifolia*			1	1	
Stiff Yellow Flax	*Linum medium var. texanum*			4	4	
Swamp Oats	*Sphenopholis pensylvanica*			2	2	
Taperleaf Water-horehound	*Lycopus rubellus*	2			2	
Terete Arrowhead	*Sagittaria teres*		6		6	
Three-angled Spike-sedge	*Eleocharis tricostata*	1			1	
Tiny-fruited Spike-sedge	*Eleocharis microcarpa*	1			1	
Violet Wood-sorrel	*Oxalis violacea*	1			1	
Walter's Sedge	*Carex striata*	2			2	
Weak Rush	*Juncus debilis*	3			3	
Wild Lupine	*Lupinus perennis*		3		3	
Wright's Rosette-grass	*Dichanthelium wrightianum*		2		2	
Grand Total		73	20	12	39	
			1	3	7	

The posting of GIS data and online mapping tools of NHESP habitat areas during the early 2000s helped with compliance with state law. NHESP also has webpages summarizing all species seen in each municipality. The maps do not show the precise location of specific species to protect those populations. The NHESP website has online reporting tools and species identification pages that should help them develop more accurate and comprehensive maps of listed species.

In broader terms, the goal of the NHESP is the protection of the state's wide range of native biological diversity. NHESP achieves this goal through biological field surveys, effective information exchange, research, endangered species regulations, project review, habitat restoration and management, focused land protection efforts, and education.

In 2006, NHESP completed the Natural Communities data layer that consists of mapped areas that show the extent of various natural communities in Massachusetts where agencies have an interest in preserving biodiversity through conservation. NHESP updated the GIS data again in 2024. These polygons are based on records of unique natural communities, field observations, land topography, and observable habitat types from aerial photography. The draft classification lists names and describes 105 natural community types found in Massachusetts [63].

The Natural Communities mapped boundaries do not receive the same legal protection as Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife under state law. They are, however, used by federal, state, and municipal groups to define priorities for awarding grants and technical assistance in efforts to protect open space and restore habitat.

Federal Endangered Species Act

Although this action plan largely focuses on the Massachusetts Endangered Species Act, federal listed species under the Federal Endangered Species Act of 1973 can be relevant for projects around Buzzards Bay [64].

Federal laws and regulations define species as endangered and threatened, and prohibit the unauthorized taking, possession, sale, and transport of endangered species. Section 7 of the Act requires federal agencies to ensure that any action authorized, funded, or carried out by a federal agency will not likely jeopardize the continued existence of listed species or to alter their critical habitat. The U.S. Fish and Wildlife Service administers the Act, and the NOAA National Marine Fisheries Service is the steward federal agency for offshore living marine resources and habitat, especially fish, whales, dolphins, sea turtles and other marine life. Table 15 shows a list of species in the watershed listed under state or federal lists and the number of Buzzards Bay towns reporting them.

Vernal Pools

Vernal pools are small, shallow ponds that exist only during periods of high groundwater and disappear during the driest periods of the year. Typically, they exist only in the winter, spring, and early summer. Their ephemeral nature means they generally lack fish, which in turn means they become ideal nurseries for certain species of amphibians, mollusks, crustaceans, and insects because of the lack of fish predation. Vernal pools are thus extremely important to various wildlife species that may breed exclusively in these habitats. Some species, such as fairy shrimp, spend their entire life cycles confined to vernal pool habitat.

The Massachusetts WPA regulations provided the original legal basis for protecting vernal pool habitat in Massachusetts; vernal pools first received protection in 1987 when MassDEP added "wildlife habitat" as one of the eight interests protected under the WPA regulations. Vernal pools are not a specific recognized wetland type, but rather a distinct wetland function that provides important wildlife habitat functions. Consequently, 310 CMR 10.04 defines "vernal pool habitat" by the wildlife that depends on vernal pools.

Vernal pool certification does not define the habitat as a resource area under the WPA or provide any explicit protection. The designation only acknowledges that

[63] According to NHESP, all sites in the "Natural Communities" mapped areas have been visited by NHESP biologists or by other biologists who have submitted reports on community occurrences that NHESP biologists have reviewed and accepted. Aquatic community types are not included. The natural community types are from Swain and Kearsley (2011). For pre-consultation resource for determining initial species lists, go to the IPaC: website

[64] Past proposals to build offshore turbines, and the 2012 proposed navigation changes for escort tugs in Buzzards Bay, are two examples that triggered a review under the federal regulations.

the habitat functions biologically as a vernal pool. Vernal pools receive no automatic protection unless they already fall under the jurisdiction of the regulations (e.g., the vernal pool is within a bordering vegetated wetland).

Certified vernal pools are protected under the state Water Quality Certification regulations (401 Program), the state Title 5 regulations, and the Forest Cutting Practices Act regulations. The Water Quality certification is particularly significant, because under the Federal Clean Water Act's Section 401 requirements, certified pools are "Outstanding Resource Waters", and state policy does not allow fill or discharges within Outstanding Resource Waters. Table 16 shows the number of vernal pools certified in each Buzzards Bay municipality (as of 2009, when last compiled by NHESP).

Despite the importance of vernal pools, most remain unprotected because they have not been identified, mapped, and certified. Table 16 illustrates this by showing that MassDEP has not certified many vernal pools in some communities, and none in others, even though they likely hold dozens. There are also several regulatory technical limitations as to how vernal pools area protected under state and federal regulations.

In January 2009, NHESP proposed, and then later accepted, changes as to how vernal pools were certified. The report concluded that the Guidelines for the Certification of Vernal Pool Habitat needed to be revised to provide an even more defensible basis for certifications. This resulted in more rigorous data submission requirements and at the same time, made the certification of new pools more challenging, and even created a new appeal process for vernal pool certification. Most vernal pools are on private property and agency staff cannot map these areas in the field without permission of landowners. However, agencies do accept data and supporting information from residents and citizen groups.

Because of limitations of state and federal protections for vernal pools, many Massachusetts municipalities have adopted their own vernal pool regulations. For example, the Town of Falmouth prohibits any construction on or alteration of natural landscapes within 100 feet of a vernal pool.

A similar issue relates to the apparent inconsistent level of mapping efforts of MESA listed species in each municipality. As shown by Table 14, the highly urbanized City of New Bedford has 12 listed species since 1990, while the adjacent more rural Town of Acushnet has only 4. Similarly, Dartmouth has 39 species listed, while Westport, which is comparable in size and habitat has only 22. In this latter case, the discrepancy between species documentation can be largely attributed to the studies of butterflies, moths, plants, and birds in Dartmouth by the Lloyd Center for the Environment.

Table 16. 2013 Certified Vernal Pools versus a 2000 study of potential vernal pools.

Municipality	2013 Certified Vernal Pools	2000 study of potential Vernal Pools
Acushnet	0	48
Bourne	26	51
Carver	19	91
Dartmouth	54	252
Fairhaven	4	48
Fall River	39	151
Falmouth	57	96
Marion	3	22
Mattapoisett	20	58
Middleborough	12	388
New Bedford	6	28
Plymouth	46	392
Rochester	47	131
Wareham	3	100
Westport	14	253

Potential vernal pools were based on an analysis of 1993 and 1999 aerial photographs and wetland coverages. Data available at the MassGIS vernal pool data page.

Funding Issues

Previous state funding cuts have limited the state's efforts to map and protect important wildlife areas. NHESP has been funded by a patchwork of sources, from regulatory review, fees, and federal grants, to voluntary contributions. Voluntary donations on state income tax forms are an important source of funding, with over 15,000 taxpayers contributing to the NHESP Fund each year.

More stable and expanded funding could assist the program in mapping important wildlife areas and help the program meet its goals. Such funding would not only assist the program in better implementing education and regulatory components of the program but also address scientific information shortcomings plaguing most wildlife programs. These needed data include more current distribution and abundance

data, lack of systematic population monitoring, lack of information on diseases and pathogens, and lack of information on invasive species that may be threatening endemic populations.

Goal

Goal 9.1. Conserve, protect, and enhance the native biological diversity of Buzzards Bay and in its surrounding watershed.

Objectives

Objective 9.1. Support implementation of the State Wildlife Action Plan to conserve biodiversity - specifically, Species of Greatest Conservation Need and their habitats.

Objective 9.2. Support implementation of land conservation goals identified in the Clean Energy and Climate Plan for 2050.

Objective 9.3. Support NHESP efforts to identify and map BioMap Core Habitats to help guide state and municipal protection and conservation efforts

Objective 9.4. Improve the awareness of the public and government officials of the importance of protecting species considered endangered, threatened, or of special concern.

Objective 9.5. Support studies that promote a better understanding of how climate change and sea level rise will affect marsh dependent nesting species like the diamondback terrapin, marsh sparrow, and coastal nesting birds.

Objective 9.6. Support efforts to protect and restore island nesting habitat of the federally- and state-listed Endangered roseate tern, as well as the state-listed Special Concern common and least tern populations in Buzzards Bay.

Objective 9.7 Support efforts to protect and restore habitats of all state- and federal-listed species.

Objective 9.8. Support efforts to follow Executive Order No. 618 to conserve biodiversity in Massachusetts.

Management Approaches

While NHESP is the lead for many actions, other agencies and organizations must help and participate. Nonprofits can help with outreach and mapping efforts. Granting agencies can provide much needed financial support. The primary mechanism to permanently protect the most important habitats in the Buzzards Bay watershed is the acquisition of land or conservation restriction for open space protection. Municipal conservation commissions and area land trusts should coordinate to ensure that municipal open space plans are current and have clear goals and priorities targeting the acquisition of critically important habitat. To provide sufficient funds to meet municipal acquisition goals, all municipalities should consider adopting the Community Preservation Act and adopt and continue policies to buy or encourage donation of as much important habitat as possible.

The second most important strategy to protect rare and endangered species habitat is to accurately inventory and map these resources. The variability in the number of species and vernal pools documented in each municipality (Table 14 and Table 15) often reflects past levels of effort to map and report species, rather than habitat availability alone. Municipalities and lands trusts should coordinate with NHESP to report state-listed species observations and certify vernal pools on their properties and encourage other properties owners to take part. NHESP has created the Heritage Hub to enable citizen scientists, landowners, consultants, and researchers to report rare species, natural communities, and vernal pool information. State and federal managers can provide training to volunteers to use this tool. Wetlands and wildlife biologists must map other important habitat types. Nonprofits could improve the effectiveness of the effort by targeting outreach to landowners of large properties or invite trained volunteers and scientists to conduct site investigations using the NHESP reporting tools.

Other important strategies include restoring and managing high quality habitat (see the BioMap's Habitat Restoration Resource Center website) and control and management of invasive species (see Massachusetts Invasive Plant Advisory Group website for information on common invasive plants and how to treat them).

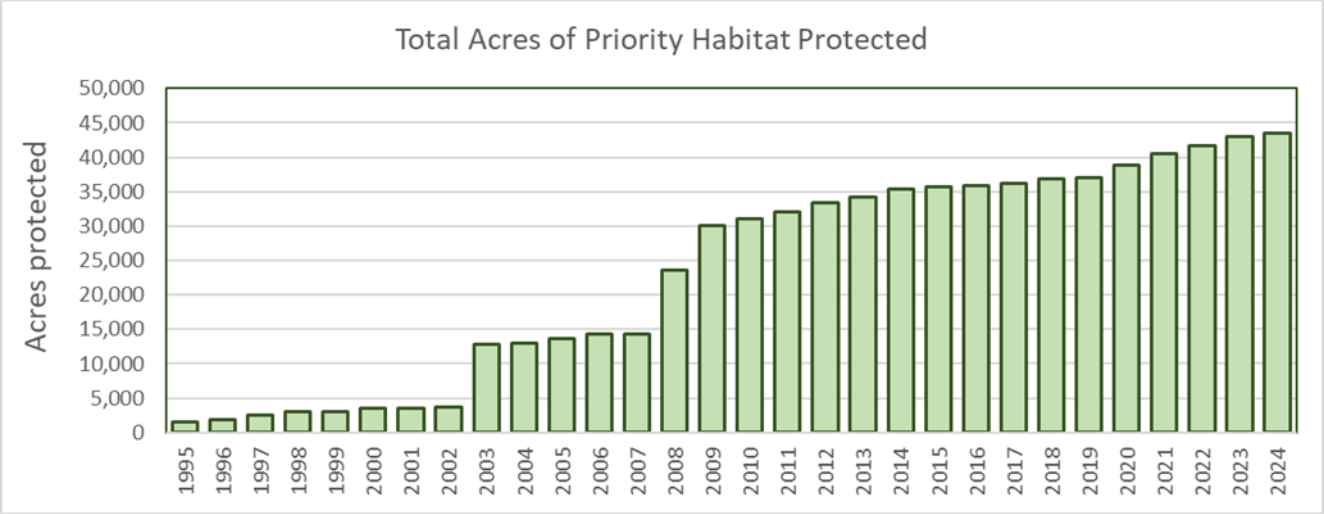


Figure 58. Acres of NHESP Priority Habitats identified by the NHESP and protected through land protection efforts.

To help educate the public, municipalities should post on their website lists and maps of rare and endangered-species habitat[65] and maps of certified vernal pools and include information as to why it is important to protect these habitats in their community. Municipal websites can link to the NHESP online mapping tools [66]. Disseminating this information increases the public's awareness of the important habitat that needs protection in each community.

Local land protection and habitat restoration efforts should focus on sites with NHESP-mapped Priority Habitats of Rare Species and BioMap Core Habitat.

To help improve local protection efforts, NHESP should provide more training to municipal conservation agents and local planners on the use of NHESP maps and resources, and in the adoption of local strategies to complement state protection efforts. Circuit riders could provide local training and support materials necessary for improved local protection.

Costs and Financing

Certain costs, like providing trained staff to help organize efforts to certify vernal pools, or update open space plans are relatively modest, and some free technical assistance could be provided by the Buzzards Bay NEP. However, the real cost associated with this action plan is the acquisition of open space. It would be easy for watershed municipalities to spend several million dollars per year for open space protection. Fortunately, because much of the critically important land holds considerable areas of wetlands and they are often difficult to build upon, they often have the lowest costs per acre of land available for sale.

Measuring Success

The Buzzards Bay NEP can track several direct measures to evaluate progress toward the goals of this action plan. Among these, total acres of priority habitat and BioMap3 Core habitat permanently protected being the most important. Other measures, like the number of vernal pools that the state has certified (Figure 57), or species inventoried, are easy to track programmatically. State agencies already track some species' populations within Buzzards Bay or the watershed, such as the roseate tern and piping plover. Ongoing annual bird counts may provide insights as to changes in habitat and climate.

[65] The state' policy is to identify general areas of rare, threatened, or endangered, but not to release species-specific detailed maps to avoid threats of collection or harm to the protected species.

[66] NHESP Rare Species Viewer web page.

Action Plan 10. Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies[67]

Problem

All freshwater water entering Buzzards Bay originates as precipitation that falls upon the surface of the land and waterbodies in the watershed. About 45% of this annual precipitation evaporates or transpires from vegetation back into the atmosphere as water vapor. Another large proportion of precipitation results in surface flows. The rest of the rain and snowmelt infiltrates into the ground where it replenishes groundwater aquifers and travels slowly through the ground before discharging to rivers, streams, or coastal waters.

Surface flows and groundwater levels define waterbody levels and the extent of vegetated wetlands. River flow and groundwater levels are impacted by annual precipitation, temperature, hydrologic pathways, and water withdrawals. Disposal of wastewater effluent and stormwater discharges to groundwater can recharge aquifers and sustain groundwater water levels and flows. Conversely, precipitation that runs off the land surface or roads as stormwater runoff, into drainage systems that bypass the land and discharge directly to rivers or the ocean worsens river flooding and deprives groundwater recharge. As the area of impervious surfaces in the watershed increases with development, there is an urgent need to revise state and local stormwater regulations to increase groundwater recharge.

Water withdrawals affect the basin water budget and groundwater levels. Environmental impacts of municipal water withdrawals are sometimes underappreciated by residents because of misconceptions about where their water comes from, or a failure to understand that surface water supplies and groundwater supplies are fundamentally connected. When wells withdraw water below confining sediment layers, such water withdrawals can still affect water table levels near the wellhead.

The Massachusetts Water Resources Commission is responsible for "developing, coordinating, and overseeing the Commonwealth's water policy and planning activities to ensure that Massachusetts will have plentiful water to support health, safety, economic development, and ecological vitality". This includes developing water resource policies, advising MassDEP on water management and pollution control, and implementing the Interbasin Transfer Act. However, the entire western part of the Buzzards Bay watershed is a single basin, and documented problems and management issues occur within river subbasins, and smaller pond watersheds. In general, state laws and regulations have difficulty addressing cumulative impacts of withdrawals and development on groundwater resources and wetland habitat, so active municipal management of withdrawals and recharge are essential for effective management.

In recognition of these issues, EEA's 2004 Massachusetts Water Policy stressed the importance of keeping water local and encouraged municipalities to live within their water budgets. In its Water Management Planning guidance document, EEA stressed municipalities develop and maintain Integrated Water Resources Management Plans to address municipal water needs through coordinated management of water supplies, wastewater, and stormwater systems. While some municipalities have included this approach to wastewater facility planning (e.g., in 2017, New Bedford prepared a plan as part of its management of CSOs), and elements of the plans are triggered by MEPA review, only the Town of Westport has developed (in 2020) a standalone plan.

In 2012, EEA completed a Sustainable Water Management Initiative to revise regulations under the Water Management Act to balance water needs with ecological concerns like low stream flows. In 2018, EEA and the Massachusetts Water Resources Commission issued water conservation standards to set statewide goals for water conservation and water use efficiency and provide guidance to municipalities to reduce water consumption and promote efficient water use.

These efforts have paid off, and there have been improvements in per capitata water use and reductions

[67] The Massachusetts Water Resources Commission website provides many resources to implement this action plan.

Table 17. Average 2018-2024 residential gallons per capita day (RGPCD, Massachusetts Standard = 65) and unaccounted for water use for Buzzards Bay public water suppliers compared to 2007 data as reported in the 2013 CCMP update.

PWSID	PWS Name	Town	2007 RGPCD	RGPCD 2018-2024	2007 % UAW	UAW % 2018-2024
4003000	Acushnet Water Department	Acushnet	68	45	22	9.5
4036000	Bourne Water District	Bourne*	69		9	8.8
4036001	Buzzards Bay Water District	Bourne*	54		9	11.7
4072000	Dartmouth Water Department	Dartmouth	72	57	10	7.8
4094000	Fairhaven Water Department	Fairhaven	63	49	9	8.7
4095000	Fall River Water Department	Fall River	65	46	22	29.8
4096000	Falmouth Water Department	Falmouth*	79		20	14.0
4169000	Marion Water Department	Marion	81	57	11	8.7
4173000	Mattapoisett Water & Sewer Department	Mattapoisett	55	51	6	5.2
4182000	Middleborough Water Supply	Middleborough	69	48	9	7.0
4201000	New Bedford Water Department	New Bedford	59	48	14	7.8
4036002	North Sagamore Water District	Bourne	79	75	8	9.0
4310003	Onset Fire District	Wareham	45	62	17	22.8
4239055	Pine Hills LLC	Plymouth	65	50	3	3.5
4239000	Plymouth DPW Water Division	Plymouth	83	61	14	11.3
4239045	Plymouth Water Co	Plymouth	167	97	6	4.8
4310000	Wareham Fire District	Wareham	60	50	13	5.3

* Because residential occupancy is highly seasonal in Bourne and Falmouth, neither the towns nor MassDEP track RGPCD statistics.
PSWID = Public Water Supply ID; PWS Name = Public Water Supply District Name; UAW = Unaccounted for Water Use

in unaccounted water loss since the 2013 CCMP update (Table 17). Nonetheless, and despite the collective changes in state regulations and policies, episodes of drought, increasing population, new development, and increasing water use are continuing to degrade flow and water levels in some Buzzards Bay streams and ponds and creating conflicts among users.

In the Buzzards Bay watershed, there are eight major river subwatersheds on its western shore (the Westport River, Paskamanset River, Acushnet River, Mattapoisett River, Sippican River, Weweantic River, Wankinco River, and Agawam River). This contrasts with the eastern shores on Cape Cod (Bourne and Falmouth), and the Elizabeth Islands, where there are no significant riverine flows and instead watershed precipitation flows to the ocean via small groundwater fed streams and seepage along shore (Figure 59). These surface and groundwater flows are an important natural resource.

Among the 15 communities within the Buzzards Bay watershed, most have public water supply service areas, except Westport and Rochester where properties receive water from private wells or small private water supply districts (Figure 60). Most of these service areas are served by various water supplies within the Buzzards Bay watershed (Figure 61), but notably the City of New Bedford, the largest consumer of water in the watershed, receives its water from outside the watershed (Assawompsett Pond Complex). This water supply also serves the Town of Acushnet and portions of Dartmouth. Wells drawing groundwater account for most of the municipal water supplies within the watershed.

As development in the region has increased, both the quantity and quality of Buzzards Bay surface and groundwater water supplies are threatened. In some cases, public and private water withdrawals are cumulatively affecting wetlands, anadromous fish runs, and other wildlife habitats, particularly during droughts. Buzzards Bay's growing population creates a need for more water supplies, but there is a limited supply of land to site future water supplies, and it is increasingly drawn upon from new development.

It has become increasingly difficult for municipalities to meet summertime water demand. An early study by the Massachusetts Department of Environmental Management's Office of Water Resources found that water withdrawals from the Mattapoisett River sub-

watershed in 1980-1981 amounted to 87% of the estimated base flow in the river, and that withdrawals from the Paskamanset River subwatershed equaled 21% of estimated base flow in the river. In a 1995 study of the hydrology of the Buzzards Bay watershed (Bent, 1995), the USGS found well withdrawals within the Paskamanset River and Mattapoisett River subwatersheds as having significant impacts on the flows of both rivers, particularly during natural low flow periods.

Figure 59. Principal rivers and subbasins of the Buzzards Bay watershed.

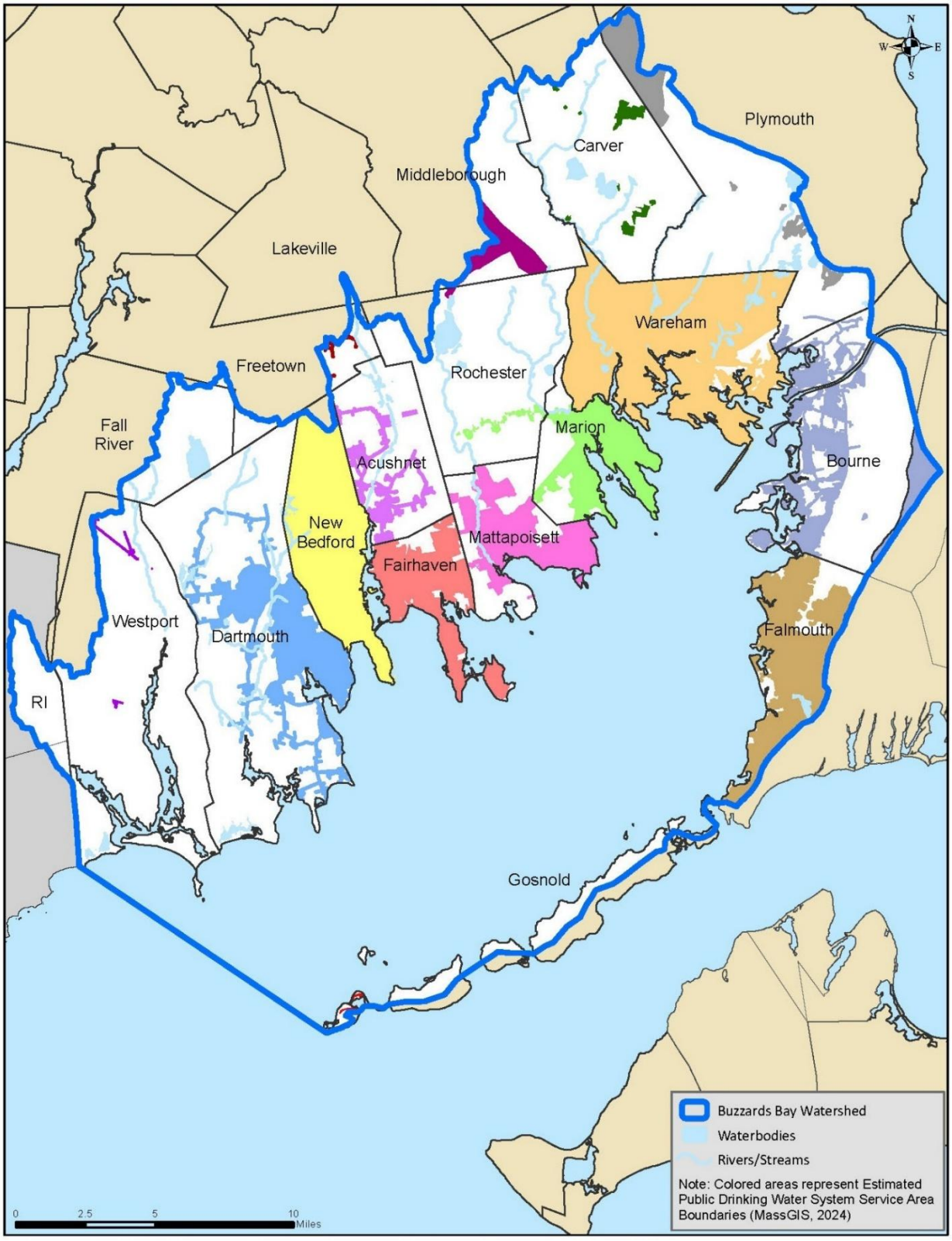


Figure 60. Public water supply service areas of the Buzzards Bay watershed.

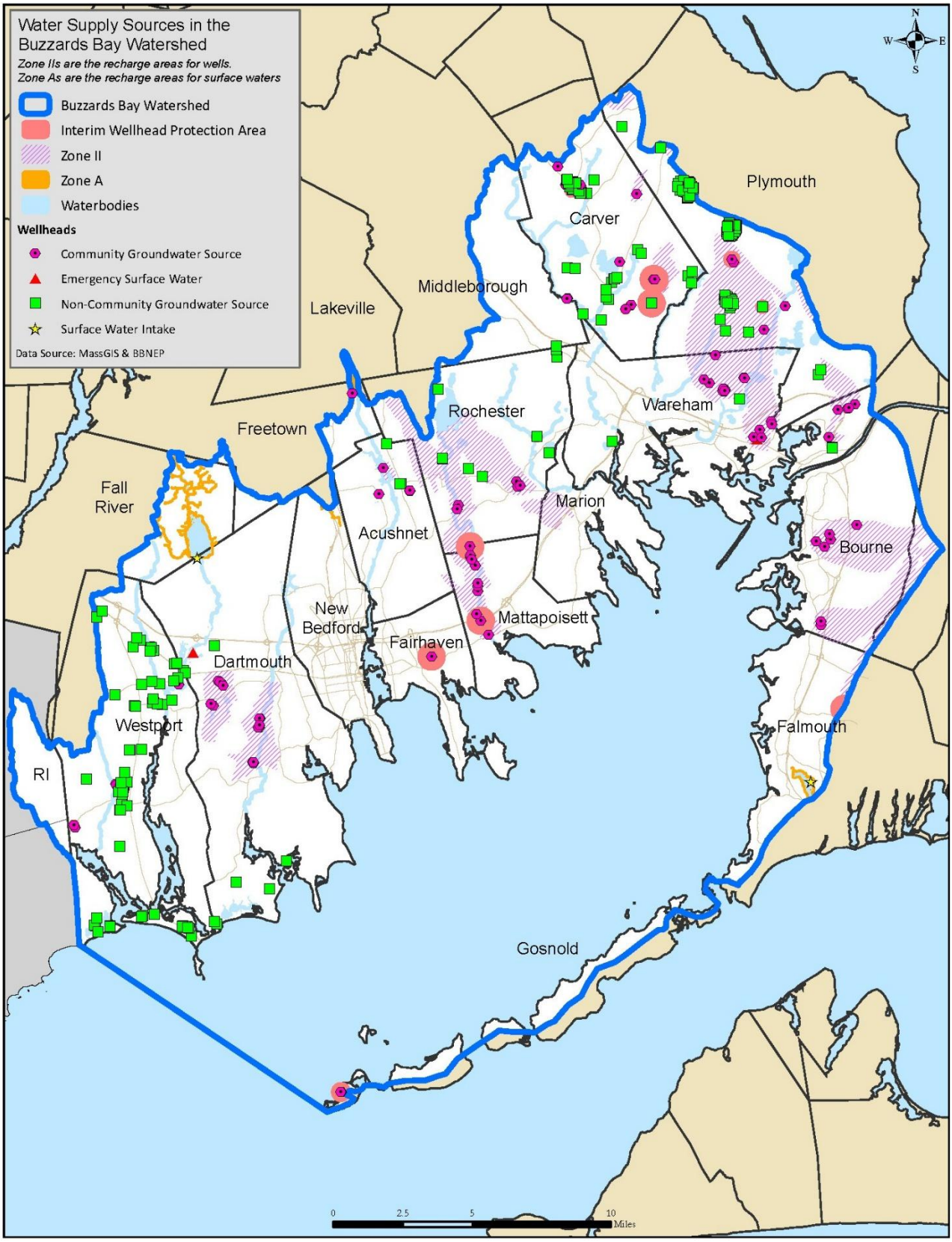
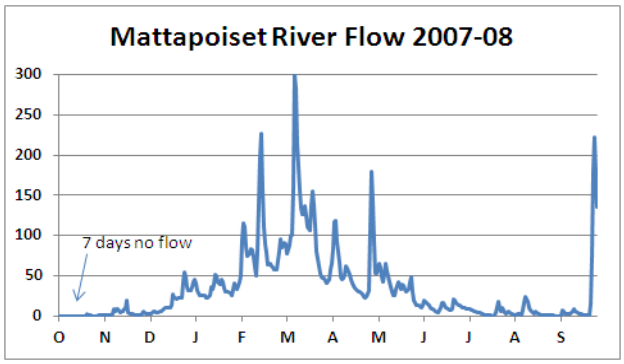


Figure 61. Water supplies in the Buzzards Bay watershed.

Approximately 78% of the groundwater pumped from the Mattapoisett River subwatershed is transported out of the subwatershed to supply other communities. Similarly, most water withdrawn from the Paskamanset River subwatershed by the Town of Dartmouth serves homes outside the subwatershed. In these studies, estimated stream flow deficits for both subwatersheds were of similar size to the water exported out of the subwatersheds for water supply. Furthermore, stream flow measurements in the Paskamanset River subwatershed upstream and downstream from significant groundwater withdrawals proximally to the river showed that the stream flow deficit measured between the two stations was approximately equivalent to the water volume pumped from the adjacent wells.

Since these early studies, the strain on water supplies has worsened. Exacerbating the problem, as the number of homes sewered in the watershed increase, wastewater flows are discharged directly to Buzzards Bay, so there is no recharge of water back to the watershed.

In September 1999, the Mattapoisett River ran dry for the first time. This occurred during drought conditions, and peak water withdrawals exceeding 4.0 MGD, a predicted water withdrawal capacity for the river during drought. The Massachusetts Department of Fish and Game Riverways Program noted, "In September of 1999, a freshwater mussel surveyor for the Massachusetts Natural Heritage and Endangered Species Program found a series of deep pools with little flow between them on the Mattapoisett River at the Route 6 crossing in Mattapoisett. Further upstream just north of Route 195 in Mattapoisett [in the vicinity of public wells], the river was 'bone dry,' and local kids were riding their ATVs up and down the stream banks." This report further notes groundwater withdrawals may cause these low flows. The river again ran dry in 2007, under drought conditions and with water withdrawals exceeding 4.0 MGD (Figure 62). Cranberry grower withdrawals may have worsened conditions near Snipatuit Pond during this period. DMF reports this portion of the river, and the Weweantic, Wankinco, Wareham, and Agawam Rivers and Red and Herring Brooks have some level of water use conflict affecting diadromous fish species passage (see Action Plan 8 Restoring Migratory Fish Passage and Populations).



Data from USGS 2008 Water Data Report for station 0110591.

Photo courtesy of the MAFWS Riverways Program.

Figure 62. Top: period of no flow on the Mattpoisett River In October 2007 from USGS guage data. Bottom: More than 1000 feet of the Mattapoisett River was dry.

While managers believe that the Mattapoisett and Paskamanset Rivers are impacted by water withdrawals, withdrawal problems elsewhere in the watershed have been reported. Between 2004 and 2020, the Town of Dartmouth, to reduce water purchases from the City of New Bedford, began building added wells in the vicinity of Cedar Dell Pond. While MassDEP required the town to monitor flows on the Paskamansett River, MassDEP did not require the town to monitor water levels in Cedar Dell Pond. In the 2010s, residents around the pond reported it was nearly going dry each summer, killing amphibians and turtles. In 2020, MassDEP required the town to begin monitoring water levels in Cedar Dell Pond to better understand the relationship between water levels in the pond and town well water withdrawals.

Goals

Goal 10.1. Manage drinking, irrigation, and industrial water withdrawals to protect groundwater and surface water, ensuring a sustainable, high-quality drinking water supply across the Buzzards Bay Watershed.

Goal 10.2. Protect and restore the natural recharge of the Buzzards Bay watershed, and manage drinking, irrigation, and industrial withdrawals to protect and restore the natural flows of rivers and the natural waters of ponds, lakes, estuaries, and protect the wetlands and habitat that depend on them.

Goal 10.3. Protect and preserve estuarine and brackish surface water habitats in river mixing zones.

Goal 10.4: Promote Water Conservation and Efficiency Across All Sectors - Encourage and support the adoption of water-efficient technologies, practices, and policies in residential, agricultural, commercial, and industrial sectors to reduce overall water demand and mitigate impacts on freshwater sources. Reducing water demand is a cost-effective, immediate way to balance water supply and ecosystem protection.

Goal 10.5: Integrate Climate Change Projections into Water Management Planning - Incorporate current and projected climate data (e.g., precipitation patterns, drought frequency, sea level rise) into water withdrawal and recharge planning to ensure long-term resilience of water resources and dependent ecosystems. Climate change should be integrated into adaptive planning because it will intensify water availability challenges.

Goal 10.6: Enhance Monitoring and Data Collection of Water Withdrawals, Groundwater Levels, and Ecosystem Health - Establish or expand continuous monitoring networks to track the cumulative impacts of water withdrawals, land use changes, and climate metrics on surface and groundwater systems and associated habitats. Robust data on water use and ecosystem conditions will help guide effective decisions and assessment of impacts.

Goal 10.7: Promote Green Infrastructure and Low-Impact Development (LID) to Support Natural Recharge - Encourage municipalities and developers to use green infrastructure (e.g., rain gardens, permeable pavements, bioswales) and low-impact site design to enhance groundwater recharge and reduce stormwater runoff to help maintain the natural hydrologic cycle, especially in developed areas.

Goal 10.8: Collaborate with Municipalities to Align Local Policies and Zoning with Watershed Protection Goals - Work with local planners, conservation commissions, and zoning boards to update bylaws and local water policies that support regional freshwater management objectives and ecosystem protection because local decisions directly affect water withdrawals, land use, and recharge areas.

Objectives

Objective 10.1. Encourage water conservation, reduce water distribution losses, and increase utilization efficiency to minimize environmental impacts from water withdrawals.

Objective 10.2. Encourage water reuse for irrigation, industrial process water, and other non-potable uses within public health constraints.

Objective 10.3. Update state water withdrawal regulations to reduce the potential of affecting wetlands, surface waters, and other public water supplies.

Objective 10.4. Municipalities must develop and implement integrated water resources plans and assess water rate structures, policies, and regulations to encourage conservation of both public and private water withdrawals and maximize local recharge of stormwater and wastewater.

Objective 10.5. Water managers should limit non-essential water use during droughts.

Objective 10.6. Improve the efficiency and resiliency of water supply infrastructure and minimize potential impacts on natural resources.

Objective 10.7. Identify and protect open space to support existing and potential future water supplies

Objective 10.8. Incorporate new information from studies on water budgets, water withdrawals, and sustainable yields into local water resources planning and local and state water withdrawal regulations, and the Massachusetts Interbasin Transfer Act regulations.

Objective 10.9. Encourage accurate tracking of water use by agricultural users and promote agricultural management practices for water conservation.

Objective 10.10. Minimize entrainment and impingement impacts at intakes of any future desalinization facilities, exclude intakes and discharges from brackish water mixing zones of rivers or streams, and preserve the natural salinity of receiving waters.

Objective 10.11. Collect and maintain water use data in support of this action plan and for tracking success.

Objective 10.12. Encourage revisions to the Interbasin Transfer Act to reflect impacts to individual river basins, like the Mattapoisett River basin, rather than addressing only transfers in or out of the Buzzards Bay basin.

Objective 10.13. Promote research to understand drinking water and groundwater availability and impacts of withdrawals.

Management Approaches

EEA, the Massachusetts Water Commission, MassDEP, and municipalities are the lead for many actions, and other agencies and organizations must help and participate. Managing water withdrawals to minimize environmental impacts is complicated and politically challenging and requires long-term strategies. Better management of freshwater recharge and withdrawals are the two key elements to ensure aquifers and surface waters are protected, maintained, and resilient to climate change. Elimination of subsidized rates to large water users can reduce demand. Increased rates can also reduce demand. Continued education of rate payers, enforcing water restrictions during drought, and programs to help fund low flow devices can also reduce demand.

EEA and MassDEP must limit withdrawals from subwatersheds with flow stressed rivers, not just major basins like Buzzards Bay. Other strategies include implementing regulations to allow the reuse of treated wastewater for irrigation and industrial use and encouraging the use of green infrastructure and low impact development management practices to maximize groundwater recharge. When new water supplies are needed, they must be sited to limit adverse impacts to wetlands and surface waters.

While the state only has one municipal desalination facility, more towns will consider them in the future. Desalinization facilities can meet public needs, but these facilities must minimize withdrawal and discharge impacts.

Costs and Financing

The costs to implement this action will vary with each community and the severity of the problems. The cost of educating residents and ratepayers about the importance of water conservation is modest but ongoing. Actions like eliminating water loss in old water distribution systems can be costly because it involves replacing decades-old water mains and road work. Most Buzzards Bay municipalities fund the costs of developing new sources and maintaining existing water supplies by ratepayers through an enterprise fund, but some costs can be supported with Clean Water State Revolving Loan Funds, which offers municipalities savings because of subsidized interest rates as compared to traditional municipal bonds or other financing options. If a town does not yet have an enterprise fund, adopting one becomes a financial solution to meet some needs.

The cost to the NEP to monitor progress on this action plan is modest because only programmatic actions need to be tracked. MassDEP already tracks other metrics like per capita residential water use and unaccounted for losses, although a methodology must be developed for communities with highly seasonal populations like on Cape Cod. The cost to monitor streams and pond levels requires both upfront costs and annual maintenance costs, but automated sensors are reducing both these costs, and some information is being collected by the BBC and Woodwell Climate Center monitoring program partly funded by the NEP.

Measuring Success

To evaluate progress on this action plan, stream flow in stressed stream watersheds, and pond levels in well recharge areas must be monitored to document baseline conditions, and conditions during drought. This information, together with tracking municipal water withdrawals and agricultural withdrawals in those stressed watersheds elucidate where problems are most acute, and the effectiveness of municipal action. In its evaluation of whether water suppliers are meeting state performance standards, MassDEP tracks residential gallons per capita day (except on Cape Cod

towns), and unaccounted-for water lost from public water supplies. Both these measures can be used to evaluate municipal efforts to conserve water use. Local regulatory changes and municipal outreach are programmatic actions to track.

Additional Information

Water managers track consumptive water use which is the portion of water withdrawals not returned to the water source via groundwater. These losses include water evaporated or transpired by irrigated vegetation, and water not returned through wastewater discharges.

Any large wastewater and drinking water project that moves water in or out of the Buzzards Bay basin are reviewed by MassDEP and EEA for inter-basin transfer effects. The Interbasin Transfer Act applies only to transfers between major basins and not between specific subwatersheds (e.g. in and out of the Mattapoisett River watershed). This Act, as well as the Water Management Act, which regulates all significant water withdrawals in the Commonwealth, includes registered or grandfathered water withdrawals that were in place before the state implemented these Acts. Generally, projects must be sufficiently large to potentially lower the water table over a broad area for MassDEP to regulate them.

Less protection is offered to transfers between individual river basins. It is essential that managers recognize that any large water withdrawal near surface freshwater and wetlands can potentially have a more immediate and noticeable impact on nearby wetlands, especially during drought years.

MassDEP permit requirements sometimes impose water use restriction conditions in some communities. Municipal restrictions vary and depend on well maintenance, seasonal demand, or other factors. In 2018, the state issued water conservation standards to establish statewide goals for water conservation and water-use efficiency and provide guidance on effective conservation measures. This document includes both standards and recommendations. The standards are best practices that agencies should adopt and specify in permits and water resources management programs. These recommendations are practices that water suppliers should consider.

Because of increased municipal fees for potable water, property owners are increasingly drilling private wells for lawn irrigation. Often town regulations and watering bans during droughts do not cover these private wells. Because these private wells may cumulatively alter surface and groundwater levels and wetlands, water managers have encouraged water restrictions to be applied to both public and private water withdrawals.

Stormwater Management Practices

Historical stormwater management has emphasized quickly conveying stormwater away from its point of origin to ultimately discharge in wetlands or the ocean, as if stormwater was an undesirable waste product. New stormwater treatment requirements driven by green infrastructure and low impact development goals are reversing this trend. Such practices increase the amount of water available within a watershed to support water resources and can offset impacts of water supply withdrawals on groundwater. These principles are addressed more fully in Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

Agricultural Withdrawals

Another important water use in the Buzzards Bay watershed relates to the cultivation of thousands of acres of cranberry bogs. The majority of Massachusetts' approximately 13,000 acres of cranberry bogs [68] are in the Buzzards Bay watershed. Cranberry farming is a water intensive agricultural activity, with large amounts of water used for frost protection, irrigation, cooling, and harvesting (Bent, 1995). In some systems like the Weweantic River, bog operations have appreciably manipulated stream flow (Masterson et al., 2009, p. 77). Bogs require irrigation through the growing season, whereas growers flood bogs for the fall harvest and winter frost protection. Hansen and Lapham (1992, p. 9) estimated that 84 percent of the water supplied for use on cranberry bogs is from ponds and reservoirs. Cranberry growers return much of the

[68] USDA, NASS New England Field Office Massachusetts Statistics for 2012.

water used in cranberry farming when the flooded bogs are drained back to tributary streams or ponds, with some floodwater infiltrating into groundwater, and some flood and irrigation water lost through evapotranspiration.

Two USGS studies in the Buzzards Bay watershed considered recharge to groundwater from precipitation and flooding of cranberry bogs in their analysis. In the first hydrologic investigation of the Plymouth-Carver Aquifer, Hansen and Lapham (1992) estimated that cranberry bogs contribute to a negative 17 inches per year loss of aquifer recharge per unit surface area. Masterson et al. (2009, p. 9) affirmed this estimate and concluded that precipitation recharge to the aquifer was 27 inches per year, but precipitation recharge in bogs was 10 inches per year. This amount was two inches higher than natural vegetated wetlands and assumed that flooded bogs acted more like ponds (which contribute 20 inches of recharge per year) during those periods when cranberry bogs are flooded. This analysis was based on annual budgets, and during the summer, bogs become net sinks when surface evaporation and plant transpiration exceed precipitation (Masterson et al. 2009, p. 77).

Whether cranberry bog water use recharges to groundwater or is discharged to streams is less important than the potential reduction or cessation of stream flows that may occur during periods when streams are diverted to flood bogs, or when high volumes of groundwater or pond water is withdrawn. Because large water withdrawals (whether for agriculture or municipal water supplies) have the potential to affect the wetlands and aquatic habitat, they are subject to the Water Management Act.

Cranberry growers with less than 4.66 unregistered acres of "old style bogs" in production do not require a WMA permit [69]. Best management practices for "new style bogs" not requiring a permit for a 9.33-acre threshold include bog construction laser leveled (or equivalent) to 6 inches, implementation of a tail water recovery system, and irrigation systems and water control structures (dikes and flumes) that meet USDA NRCS standards. The total cumulative size of cranberry bog consumptive water use in the watershed compared to other water withdrawals is unknown.

As noted in Action Plan 8 Restoring Migratory Fish Passage, MA DMF has identified water use conflicts on the Mattapoisett, Weweantic, Wankinco, Wareham, and Agawam Rivers and Red and Herring Brooks that threaten both stream flow and fish survival. Reback et al. (2004) noted that large numbers of juvenile herring were killed in the past due to cranberry bog withdrawal intakes and suggests that growers employ a simple, inexpensive screening system developed to prevent most of these losses. He recommended that state agencies require, as condition of any water management act permits issued, that growers use proper screening of water withdrawal intakes to prevent stranding, mutilation, entrainment, or impingement of young herring.

[69] According to a 2004 Cape Cod Cranberry Growers' Association grower advisory on the WMA, "the difficulties in metering water usage in cranberry bogs led the Department to agree to issue registrations base on acreage. In 1987, considering water used for harvest or trash flow, for initial winter flood, and for fall frost protection this acreage was calculated to be 4.66 acres."

Action Plan 11. Managing Invasive Species

Problem

Introduced species, which are also called non-native, non-indigenous, alien, or exotic species, are those that have been transported by human activities into a region where they were previously absent and have established self-sustaining reproducing populations (Carlton and Schwindt, 2024). When they alter other populations, affect the natural balance of ecosystems, damage the environment, or harm economies or human health, they are more typically called nuisance, noxious, or invasive species. Once invasive species become established in an ecosystem, they are virtually impossible to eliminate. This has been particularly true of marine aquatic invasive species.

Aquatic and terrestrial invasive species are a threat to healthy natural ecosystems of Buzzards Bay and its surrounding watershed. Invasive species cause economic or environmental harm by developing self-sustaining populations that dominate or eliminate native plant and animal populations and disrupt ecosystems. Costs to control invasive species are difficult to estimate because so many agencies and levels of government are involved. In a 2022 study, quantifiable costs in the U.S. totaled about $20 billion annually during the past decade. The authors of the study estimate economic damage far exceeds these costs. Invasive species management is difficult, costly, and requires regulatory controls and increased public awareness to manage introduction pathways. Monitoring existing invasive species and documenting new bioinvasions as they occur are essential to understand transport pathways, species' range expansions, and the breadth of invasive species impacts. Rapid response plans for eradication of new invasive species are a useful tool to manage terrestrial and aquatic invasive species in the early stages of introduction.

Goals

Goal 11.1. Minimize the potential introduction of new invasive species to Buzzards Bay and its watershed.

Goal 11.2. Reduce the extent and limit the spread of existing invasive species that are degrading habitats of Buzzards Bay and its watershed.

Objectives

Objective 11.1. Adopt and enforce laws, regulations, and policies that will reduce the potential introduction of invasive species.

Objective 11.2. Educate the public, farmers, nursery owners, fisherman, pet-store owners, shipping industry, and other relevant sectors about possible actions to reduce the threat of introducing invasive species to the environment.

Objective 11.3. Fund and promote actions, research, and innovative methods to control and reduce existing populations of invasive and nuisance species.

Objective 11.4. Monitor existing and new invasive species to help discern introduction pathways and to identify species in early stages of introduction to improve the chance for containment.

Objective 11.5. Support studies that aim to understand how climate change influences the establishment of introduced species, facilitates species' range expansions, and worsens invasive species impacts to ecosystems within the Buzzards Bay watershed.

Objective 11.6. Prioritize or support efforts to control invasive species where control is likely to be effective.

Objective 11.7. Support the development and implementation of rapid response plans for invasive species.

Management Approaches

Because of the high costs of invasive species removal, this action plan focuses on preventing new introductions, monitoring existing conditions and trends, and undertaking removal or other management tactics where it is achievable or meets a critical or local need.

Prevention

A major vector that contributes to new marine bioinvasions is introductions from global commercial shipping. Both the 1991 and 2013 CCMP discuss problems associated with the discharge of boat bilge water. After many years of study, in 2024, the EPA defined national performance standards on the discharge of pollutants from ocean vessels under the Vessel Incident Discharge Act (VIDA). As noted in this EPA press release, the new national discharge standards are aimed to control the release of pollutants – which includes

aquatic nuisance species – from approximately 85,000 vessels operating in U.S. waters. Currently, the US Coast Guard is coordinating closely with the States to develop procedures for nationwide implementation of the VIDA standards.

The enforcement of existing laws and regulations is important to minimize invasive species introductions from businesses. In 2006, Massachusetts Department of Agricultural Resources (MDAR) established the Prohibited Plant List [70]. The list included species that the USDA identifies as noxious weeds, or identified as invasive in Massachusetts by the Massachusetts Invasive Plants Advisory Group. Today, the Massachusetts prohibited plant list has 144 plants that should not be sold, transported, or propagated in the Commonwealth. Because nurseries and growers sold some of these as ornamental plants, to reduce economic impacts to sellers, the state phased in the ban. Some notable species on the list include Norway maple, Japanese honeysuckle, oriental bittersweet, common buckthorn, burning bush, multiflora rose, purple loosestrife, and the Bradford pear, added in 2024. MDAR created the Massachusetts Introduced Pests Outreach Project as an educational element of the Cooperative Agricultural Pest Survey Program. The project is a collaborative effort between MDAR and UMass Extension Agriculture and Landscape Program and funded by the USDA Agriculture and Animal and Plant Health Inspection Service. Agencies should review the effectiveness of implementation and enforcement of past efforts and recommend new laws, regulations, and policies to prohibit or regulate the sale of prohibited species.

In addition to regularly enhanced standards, increased awareness by the public, businesses, and educational institutions is essential to minimize future species introductions. To reduce new aquatic bioinvasions, education strategies may include posting signage at common transport sites, like marinas, boat ramps, and fishing sites (Figure 56). These postings and other educational campaigns educate residents about actions they can take to mitigate new bioinvasions – such as cleaning boats and boat trailers prior to leaving a waterway and never releasing live organisms, such as aquarium pets and unused live bait and bait packing materials. Publications like Salem Sound's A Citizen's Guide to Monitoring Marine Invasive Species and CZM's Marine Invasive Species Publications are useful educational tools to communicate invasive species identification tips to the public.

Government, growers, and educational groups should encourage residents to mitigate new terrestrial plant invasions, and landscape with native plants. Many nonprofits (see this Association for the Preservation of Cape Cod Native Plant Initiative) and agencies (see this CZM coastal landscaping plant list) have developed outreach materials on the use of native plantings. Additionally, Mass Audubon's Invasive Plants of Massachusetts website communicates how to identify non-native plants commonly found in Massachusetts. Programs to encourage property owners to voluntarily remove invasives could additionally help mitigate their further spread. Lastly, because of the ease for individuals to order plants online from many sources, there is a special need to provide more education and outreach to the nursery, aquaculture, water garden, bait, and pet trades. National retailers also need to be more proactive in notifying consumers about state bans, such as the Massachusetts prohibited plant list.

Monitoring

Monitoring introduced species by scientists and managers is important to discern whether shifts in endemic species are likely the result of human perturbations like pollution, are possibly caused by predation or competition with introduced species, or related to changing climate. Monitoring also documents trends and helps discern pathways of invasive migrations and help inform policy decisions and devising regulations.

In 2002, CZM developed a Massachusetts Aquatic Invasive Species Management Plan. The objectives of this plan included preventing the introduction and establishment of aquatic invasive species, controlling the growth and spread of aquatic invasive species, and abating the impacts and minimizing the harmful effects of aquatic invasive species. As part of this Plan, CZM established a Marine Invasive Species Program to monitor and reduce the spread of invasive species in coastal waters. The Program includes the recurring

[70] Authority provided under Chapters 128 Section 2 and sections 16 through 31A.

Rapid Assessment Survey, in which CZM coordinates a group of taxonomic experts to sample marinas across

New England to identify new bioinvasions, track the expansion of established invasive species, and document trends through time. The Buzzards Bay NEP should continue to support this effort, which involves monitoring stations in Buzzards Bay every three to five years. In addition to the expert-led Rapid Assessment Survey, CZM also convenes the Marine Invader Monitoring and Information Collaborative (MIMIC), a participatory science program where volunteers learn how to identify and monitor common marine invasive species along the New England coast.

In addition to marine invasive species, MassDEP tracks aquatic invasive species causing impairments to water bodies in the Integrated List of Waters. The agency added to the wetland regulations a permit process for wetland restoration, that can include the removal of invasive species.

Agency staff should encourage the use of existing invasive species reporting tools as a cost-effective strategy to monitor conditions and increase public awareness. Popular phone apps like EDDMapS and iNaturalist enable the public to identify and report invasive species.

Management and Removal

Though managing invasive species can prove difficult or, for marine systems, nearly impossible, there are discrete instances where management, removal, or eradication of invasive species may be possible. At the Federal, State, and local level various funding pathways, management strategies, and response efforts exist to attempt to manage or remove established or emerging introduced species.

The Massachusetts Department of Conservation & Recreation (DCR) has programs in place to manage invasive species in state parks and reserves. DCR's Lakes and Ponds Program has developed invasive species management plans for freshwater aquatic and terrestrial species that threaten DCR watersheds and reservoirs, including specific strategies to manage zebra mussels. The overall goal of the program is to prevent further infestation of Massachusetts' lakes and ponds by exotic invasive aquatic plants, and to work towards controlling and removing existing populations of exotic invasive plants. To meet this goal DCR has implemented a Weed Watchers program where a volunteer teams receive training in the identification and removal of invasive species, signs are posted on boat ramps, and informational materials are made available

Figure 63. Various public education graphics and signs relating to introducing exotic species.

Don't Release A Pest. Film by S. Zaleski, L. Walters, and P. Grifman. USCSG-ME-03-2007(N/C).

Don't move a mussel – now it's the law, AZGFD.gov.

Look for Mussels Here, Minnesota Department of Natural Resources Invasive Species Program.

Stop Aquatic Hitchhikers, protectyourwaters.net.

Don't move firewood, massnrc.org.

for distribution. The volunteers patrol their lake every other week during the summer for the presence of invasive species in key locations. If the Weed Watchers group finds a potential infestation, they will work with DCR to develop and implement a removal plan.

On Cape Cod, Barnstable County has had several initiatives relating to invasive species control. One of these efforts involved AmeriCorps Cape Cod staff, with the help of other volunteers, physically removing invasive plant species. This program only covers Bourne and Falmouth in the Buzzards Bay watershed, and there is no comparable county agency doing similar work in Bristol and Plymouth counties. The Buzzards Bay NEP and it partners could work toward creating similar programs in those counties.

Some funding opportunities are available for efforts to control the spread of invasive species. For example, USDA NRCS offers technical and financial assistance programs that support farmers to manage invasive species and pests that threaten the health of agricultural lands. NRCS's Conservation Innovation Grants can fund evaluation of invasive species impacts and help with detection, inventorying, and monitoring on private land.

State and Federal agencies can offer added guidance on best practices for control or removal of invasive species. Where managers can control invasive populations (e.g. *Phragmites australis*), they should provide better informational materials on best practices to control invasives or restore native species and explain the permitting requirements for these activities. Additionally, agencies should enable a streamlined permitting process for rapid response using approved control methods.

Costs and Financing

The cost of eradicating invasive species is high. For example, the Eurasian watermilfoil (*Myriophyllum spicatum*) affects 14% of the roughly 700 lakes and ponds in Massachusetts, with the affected systems totaling more than 19,000 acres (DCR, 2006). To control the species, DCR estimated costs for three different treatment options: chemical control using herbicides ($550-$750 per acre), biological control using weevils ($3,000 per acre), and mechanical control using diver-assisted, suction harvesting ($10,000 per acre). Total costs for all impacted lakes would range from $7 to $120 million for this one invasive species. Given these immense costs, program managers must prioritize only the most harmful species, and even then, efforts will depend on available financing.

The cost of monitoring compared to managing invasive species is considerably less, especially if the public and volunteers take part. For example, the 2023 Rapid Assessment Survey to monitor marine invasive species, which recur every 3-5 years, minimizes direct costs in part because the participating scientists volunteer their time or their institutions pay for their time spent on the survey. The implementation of more rigorous monitoring and research efforts will require millions of dollars, especially from federal agencies. In some cases, existing agencies' grant programs can provide funding. State and federal agencies must expand funding to evaluate the effectiveness of past abatement and control efforts. Managers can better track, map, and monitor key invasive aquatic and terrestrial species with annual expenditures as little as tens of thousands of dollars using resident volunteers, online reporting, and wildlife scientists and biologists to oversee the work. More comprehensive mapping efforts, together with research into the pathways and impacts of invasives, can cost millions of dollars. There is a cost to the government to enforce compliance with new regulations. The cost to industry can range from negligible (e.g., species import bans) to substantial (e.g., ballast water treatment).

Government agencies must also fund new research because scientists do not fully understand the vectors, pathways of introduction, and the impact to ecosystems and coastal communities of many invasive species. Government must also fund long-term monitoring, as it may take years to fully understand the impacts of species introductions on the biology of native species or understand mechanisms for effective control.

Measuring Success

While property owners, businesses, CZM, and DFW are the lead for many actions, other agencies and organizations must help and participate, particularly in funding monitoring and research. The state's tracking the extent and abundance of introduced species, together with documentation of the rate of new species introductions, will be the measure of the success of this action plan, as well as programmatic measures like the adoption of new regulations.

Monitoring not only helps to evaluate the success of control measures but is also fundamental to better define the extent of the problem and the viability of proposed solutions. State agencies should continue to support the New England Rapid Assessment Surveys repeated every 3-5 years. For any given site or watershed, the extent and abundance of introduced species should be mapped and agencies should make the data publicly available. Managers should track programmatic measures, like the adoption of new regulations.

Additional Information

Aquatic and terrestrial invasive species are a threat to the endemic natural resources and wildlife of Buzzards Bay and its surrounding watershed. Certain species already have affected the bay and watershed. Freshwater emergent wetland plant species, like purple loosestrife (*Lythrum salicaria*) and the common reed (*Phragmites australis),* are among the better known. In freshwater aquatic systems, introduced non-native game fish and non-native weeds like the Eurasian watermilfoil (*Myriophyllum spicatum*) have dramatically changed many freshwater ecosystems. In marine ecosystems, the European green crab (*Carcinus maenas*), Asian shore crab (*Hemigrapsus sanguineus,* Figure 57), and the Pacific green fleece alga (*Codium fragile* subsp. *fragile)* have had profound effects on the coastal ecology and shellfishing economy of Massachusetts. New terrestrial invaders, like the Asian longhorn beetle (*Anoplophora glabripennis*), and spotted lanternfly (*Lycorma delicatula*) have infested trees in some parts of Massachusetts, and their arrival in the Buzzards Bay watershed would have a profound effect on our forests and agricultural fruit trees. Non-native earthworms have become widespread in the northeast, and they are already believed to be causing important changes in forest habitat (UMass Amynthas species website).

Historically, marine invasives have been principally the result of transport via ship ballast water and hulls, or through the introduction of non-native species for aquaculture. In freshwater systems, past practices of stocking ponds with non-native game species have caused dramatic shifts in pond ecosystems. Introductions of certain game fish by agencies and members of the public have endangered endemic species. In terrestrial ecosystems, the escape of non-native ornamental and agricultural species has contributed to the introduction of some species. Climate changes in seasonal temperature and rainfall may help the spread of some invasive species.

The escape of exotics by research institutions and commercial entities may have resulted in some past introductions of marine, freshwater, and terrestrial species. Residents may have contributed to the introduction of some freshwater and terrestrial invasives. For these reasons, education of the public, businesses, and educational institutions is an important part of any strategy to prevent new introductions. Agencies could offer special certifications for businesses that implement certain practices.

If managers perceive a newly introduced species to be an ecological or economic threat, a rapid response is critical for a possible successful eradication. This approach was tried for the Asian Longhorn beetle which is deforesting large tracts of land. In the Worcester area, managers burned infected wood to prevent the spread of the beetle. In the marine environment, agencies have not tried eradication as it is rarely effective. To address marine invasive species, experts focus on methods of monitoring for and advocating for the prevention of new bioinvasions, rather investing significant resources or funding on eradication or education, which have historically been unsuccessful.

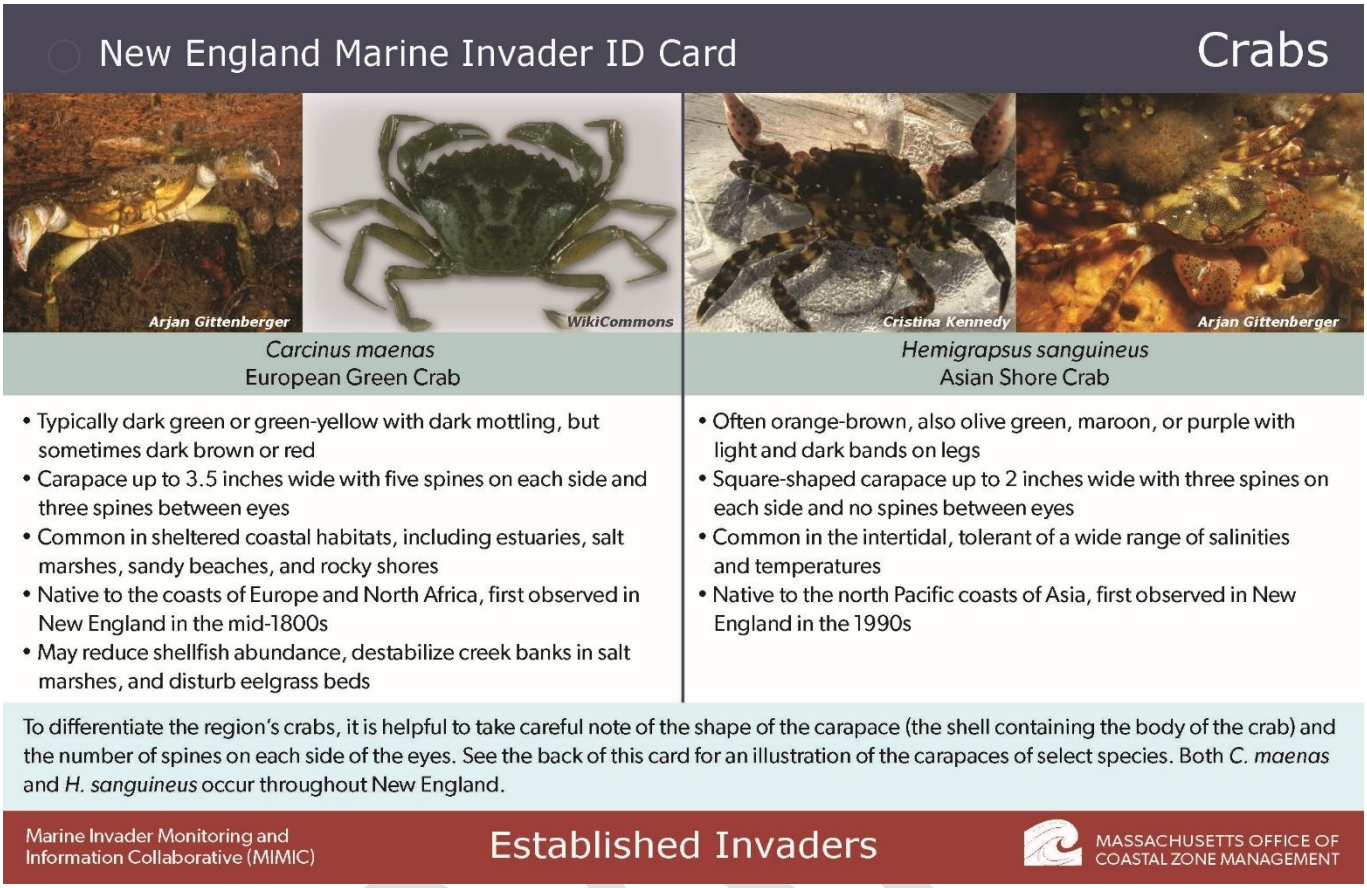


Figure 64. Invasive species identification card for two introduced crabs, *Carcinus maenas* and *Hemigrapsus sanguineus,* developed by Massachusetts CZM.

Action Plan 12. Protecting Open Space

Problem

Development in the Buzzards Bay watershed was rapid after 1950. In 1971, 64.5% of the watershed consisted of open and undisturbed forestlands, with only 12.9% developed. By 1999, open and undisturbed forested lands decreased to 56.5% of the watershed, while developed lands increased to 19.8% [71]. The percentage of developed lands continues to increase, especially in suburban communities.

Because of these trends, as early as the 1970s the first lands trust formed. In the 1990s many more groups began to focus on open space protection, but by 1995, only 5,543 acres were protected. During this time, municipalities generally had insufficient funds to meet land protection needs. With the enactment of the Community Preservation Act (MGL Ch. 44B) in 2000, municipalities could establish a local Community Preservation Fund supported by a surcharge of the real estate tax on real property of up to 3%. Concurrently, the state committed to a matching fund generated by fees charged on certain transactions filed at county registries of deeds. The fund provided municipalities with a new source of funding to buy open space, protect historic sites, or provide affordable housing. As Buzzards Bay municipalities adopted and approved a local Community Preservation Fund in the early 2000's, the rate of acquisitions increased (Figure 58). Of the 19 watershed municipalities 11 adopted the Act by 2013 and 17 adopted the Act by 2024. By 2024, this had grown to 77,013 acres, or approximately 28.7% of the watershed Figure 59 and Figure 60).

There are ecological, cultural, and aesthetic reasons to protect open space. Naturally vegetated landscapes control flooding, protect water supplies, reduce erosion, intercept pollutants, and provide upland and wetland habitat. Figure 67 illustrates that as of 2024, in the Massachusetts part of the Buzzards Bay watershed, permanently protected open space is concurrently protection 30% of National Wetlands Inventory wetlands, 51% of BioMap 3 core habitats, and 59% of endangered and threatened species' priority habitat is permanently protected as open space

Among watershed municipalities, the amount of open space varies considerably (Table 18). The amount of protected acreage within each watershed town varies and is dependent on many factors. Local dedication to land protection, availability of affordable land, eminent threats from development, and socio-economic factors all contribute to the culture of land conservation in each municipality. While many studies describe long-term economic benefits from protecting open space, including reductions in future costs to build and maintain infrastructure, some municipal managers are concerned about the more immediate losses in property tax revenue or costs to manage open space.

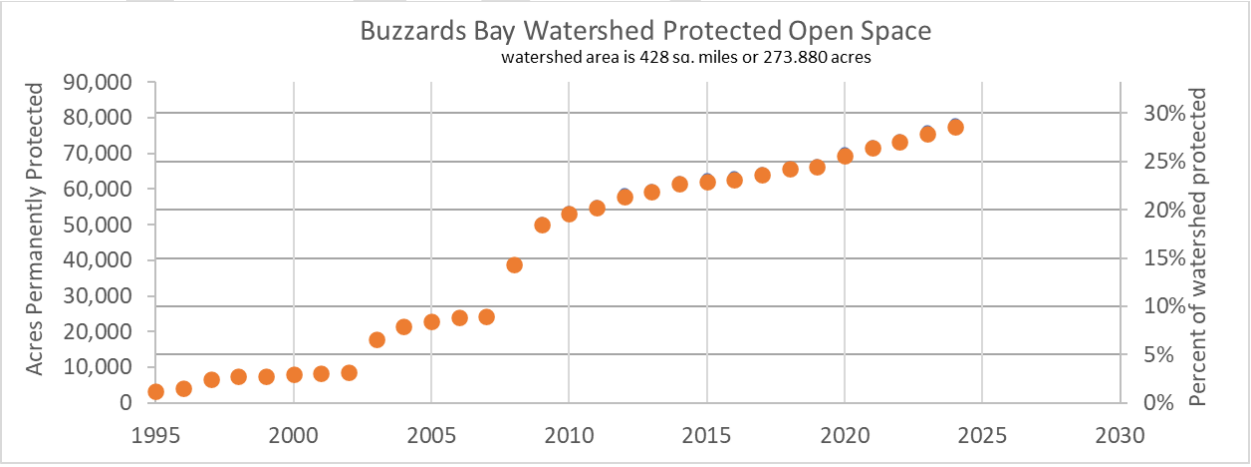


Figure 65. Total Buzzards Bay open space as total acres and % of watershed (includes RI).

[71] Estimated from the MassGIS coverage "Land Use (1951-1999)" using the categories of Mining, Residential, Commercial, Industrial, Transportation, and Waste Disposal land uses for "developed land." Land use for 2005 and 2016 is available using a different method not directly comparable.

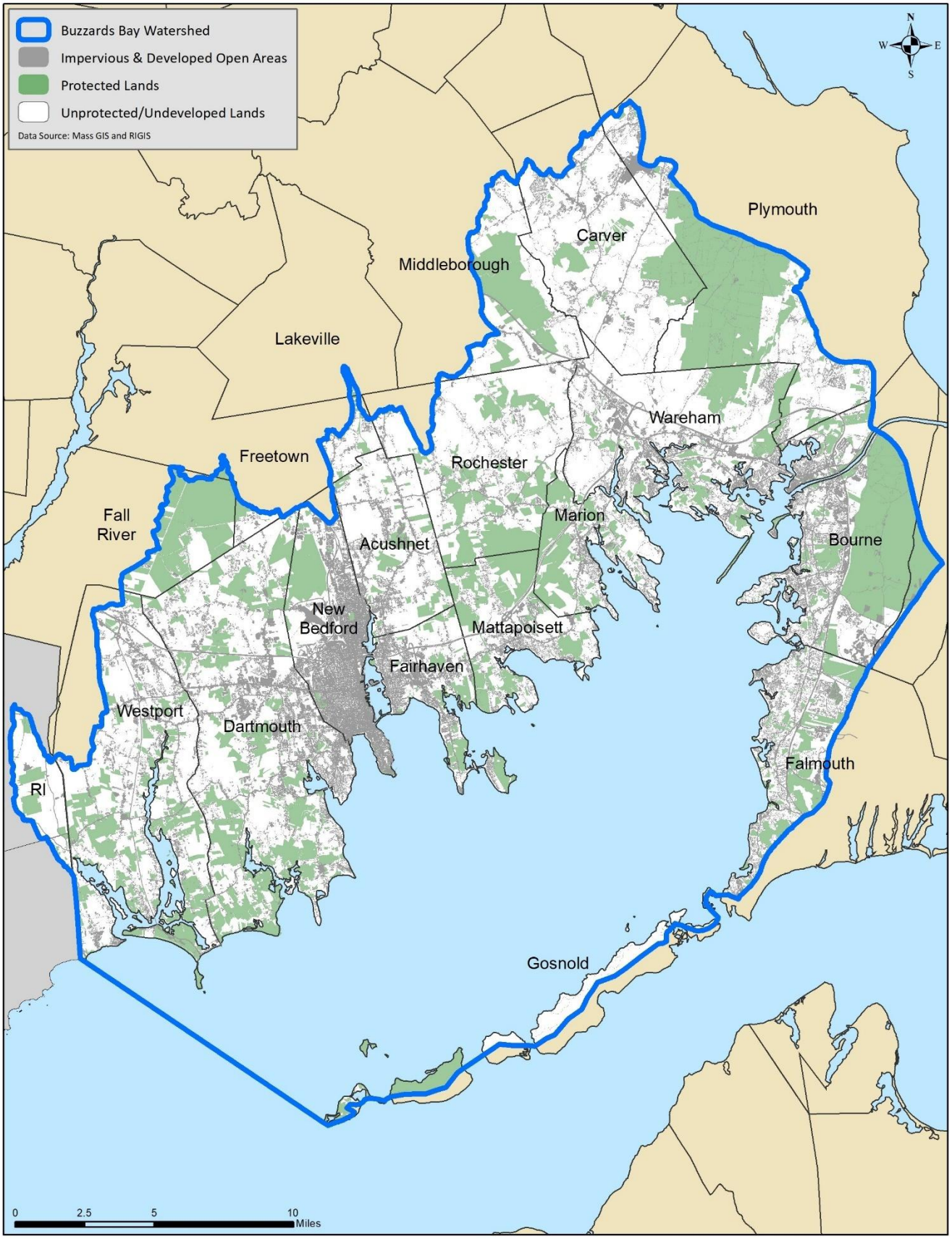


Figure 66. Permanently protected open space in the Buzzards Bay watershed as of 2024.

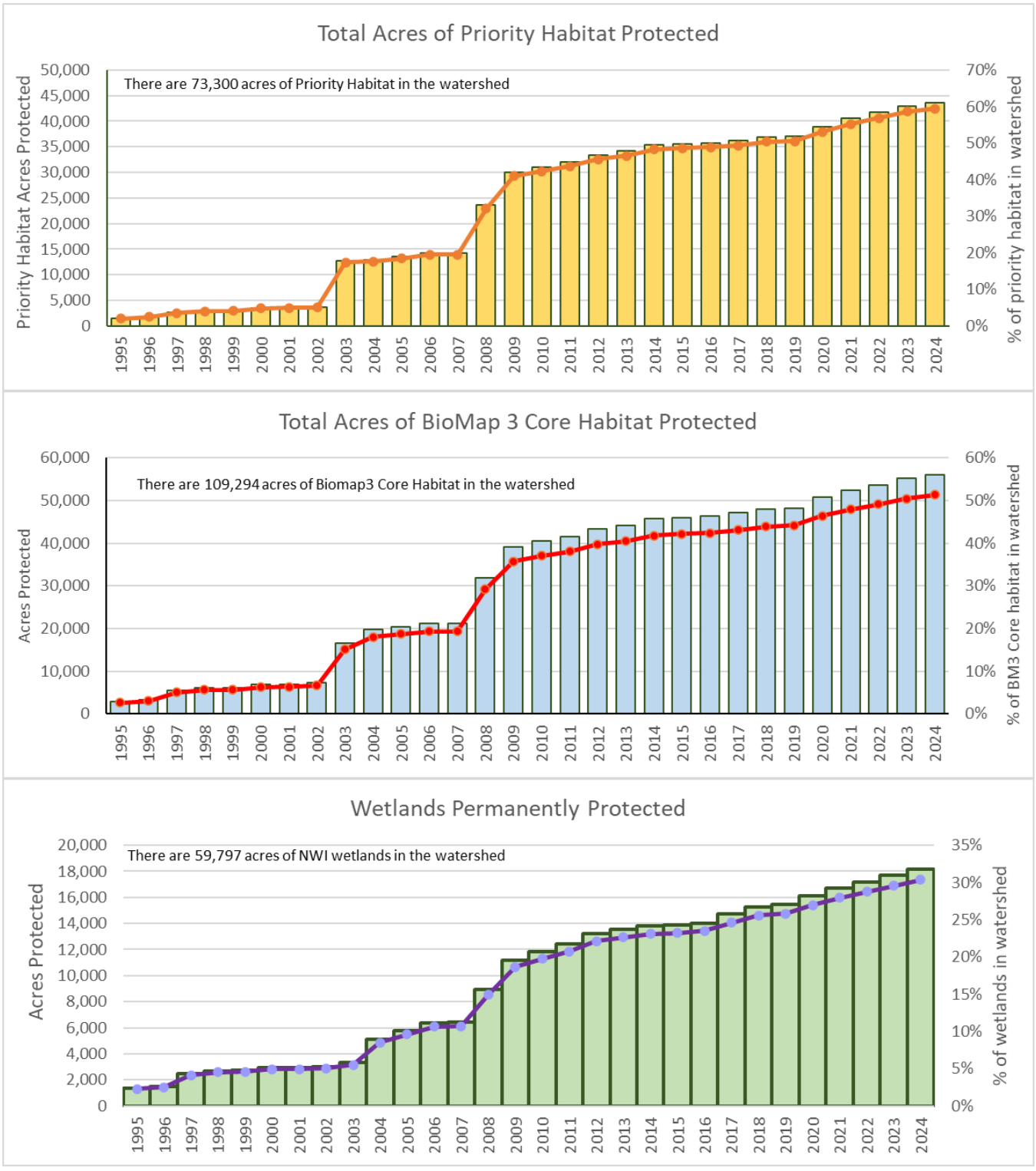


Figure 67. Amount and percent of total of endangered species priority habitat (top), Biomap 3 Core Habitat (middle), and wetlands protected in the Massachusetts portion of the Buzzards Bay watershed.

Table 18. Permanently protected lands in the watershed summarized by municipality (as 2024).

Town	protected acres in watershed[a]	total acres in watershed	percent protected[b]
Acushnet	1,514	12,082	12.5%
Bourne	10,162	21,892	46.4%
Carver	2,820	21,261	13.3%
Dartmouth	10,056	39,639	25.4%
Fairhaven	1,775	7,942	22.3%
Fall River	5,264	6,832	77.0%
Falmouth	2,939	11,883	24.7%
Freetown	553	3,131	17.7%
Gosnold	1,452	4,527	32.1%
Lakeville	56	145	38.6%
Little Compton	114	437	26.1%
Marion	3,180	9,036	35.2%
Mattapoisett	4,024	11,196	35.9%
Middleborough	4,253	11,075	38.4%
New Bedford	2,190	12,467	17.6%
Plymouth	11,003	21,651	50.8%
Rochester	4,981	21,113	23.6%
Sandwich	1,163	1,390	83.7%
Tiverton RI	665	3695	18.0%
Wareham	4,011	23,772	16.9%
Westport	6,232	28,441	21.9%
Totals	78,407	273,607	28.7%

a Acres of protected open space includes only protected land that falls within the Buzzards Bay watershed area and includes surface water in the parcel. The actual acreage within an entire town may be greater.
b Percentages of protected open space is defined here as the area of protected land that falls within the Buzzards Bay watershed area divided by the municipal area including freshwater ponds in the watershed.

Municipalities with the highest percentage of open space are those that hold a state forest, wildlife management area, or water supply reserve. The Commonwealth generally buys land that has extraordinary natural resource features and prefers to buy lands that augment its existing wildlife management areas and reserves. Some notable state properties include the southeastern Massachusetts Bioreserve, Rocky Gutter Wildlife Management Area, Myles Standish State Forest, Haskell Swamp Wildlife Management Area, Nasketucket Bay State Park, Demarest Lloyd State Park, Horseneck Beach State Park, and the Upper Cape Water Supply Reserve. The Commonwealth's large landholdings form an arc across the watershed and are critical to supporting the region's biodiversity.

The Commonwealth of Massachusetts owns more than 38,350 acres or about half of all the protected land in the Buzzards Bay watershed (Table 19). Municipalities are the second largest class of protected open space owners and account for nearly 14,226 acres or nearly 19% of all land protected, followed by other private entities (16%), and land trusts 15%. There are currently 10 local and 4 regional land trusts working to protect the southeastern Massachusetts landscape.

Because of the pace of development, loss of natural landscapes, and the benefits of protecting open space, in 2024 EEA adopted a "30 x 30" open space goal (30% of land permanently protected by 2030). Because the quality of open space protected is more important than the total acreage, and conditions in each town vary, municipalities should define their own targets in their open space plans. Municipalities in the Buzzards Bay watershed continue to make progress protecting open space, and based on current trends, 30% of the Buzzards Bay watershed will be protected open space by 2027 (Figure 65).

As described in more detail in Action Plan 4 Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience the passage of the MBTA Communities Law in 2021, and the passage of the Affordable Homes Act in 2024 should promote redevelopment of existing developed areas for the purposes of providing affordable housing, and theoretically should reduce development pressure on existing undeveloped lands. The outcomes of these laws will only be understood with time.

Preserving open space makes sense from both an ecological and cultural point of view. Naturally vegetated

Table 19. Permanently protected lands by owner type (as January 2025; MassGIS database).

Owner Type	protected acres in watershed [a]	total acres in watershed
State	38,841	49.6%
Municipal	14,465	18.5%
Private	12,274	15.7%
Land Trust	11,946	15.2%
Federal	576	0.7%
Private Nonprofit	106	0.1%
County	94	0.1%
Conservation organization	35	0.04%
Public Nonprofit	25	0.03%
Grand Total	78,363	

landscapes reduce erosion by slowing the rate of water runoff; control flooding by regulating water levels in rivers and streams; provide natural areas for infiltration of precipitation which recharges groundwater resources; provide habitat for diverse species; and protect our inland and coastal water resources by acting as filters for pollutants such as nitrogen and sediments. Additionally, protected lands provide areas for recreational activities, protect historically significant places, and preserve the charm and character of the region. Open space also makes sense for a town's tax base because undeveloped, protected land does not require costly community services, such as schools, police, and road maintenance. Many reports have documented the value of open space when compared to the high costs of community services.

Poorly planned and constructed development tends to pollute the environment through stormwater runoff from impervious surfaces and lawns; create contamination from onsite septic systems; impedes natural water flows; reduces groundwater recharge; fragments and degrades habitat; creates physical barriers to wildlife migration; and leads to the loss of our sense of place.

Goal

Goal 12.1. Preserve the ecological integrity of Buzzards Bay and its watershed by increasing the amount of permanently protected open space.

Objectives:

Objective 12.1. Protect coastal and inland surface water quality and drinking water supplies through land protection.

Objective 12.2. Permanently protect land that supports species biodiversity and priority habitats.

Objective 12.3. EEA, the Buzzards Bay NEP and the BBC should continue to support local land trusts and municipalities in their efforts to protect open space by assisting with grant applications and through direct grant funding for land protection projects.

Objective 12.4 Protect land that supports salt marsh migration with sea level rise and provides connectivity to other habitats.

Objective 12.5 Manage protected open space to meet objectives 12.1 to 12.4.

Management Approaches

Many entities have important roles in meeting the goals and objectives of this action plan, and they can use many strategies to increase open space. Municipal open space committees, conservation commission, and EEA have key responsibilities, but other agencies and organizations must help and participate. The Buzzards Bay NEP has been supporting local efforts to protect open space through technical assistance and grants (Figure 68). Land protection is generally achieved through acquisitions (ownership in fee) or conservation restrictions. Municipal conservation commissions are generally the local lead in land protection, but some permanently protected open space is owned by the board of Selectmen. The first step is for local government to define its vision and priorities. Municipal open space plans are the basis of that vision, and municipalities should develop these plans with broad public participation. All municipalities should adopt the Community Preservation Act to help finance their vision. Municipalities with approved open space plans must pursue and leverage state and federal grants using Community Preservation Act funds. As of 2025, municipalities must update these plans every ten years to ensure the plan has relevant objectives and to still be eligible for state open space grants. Table 20 shows the status of these plans among Buzzards Bay municipalities.

Conservation commissions should inventory their open space properties to determine whether their properties have been subject to any incursions from adjacent properties. Conservation commissions should also review all town owned conservation and open space lands to ensure the deed restrictions are recorded at the county deeds office that reflect municipal acquisition approvals.

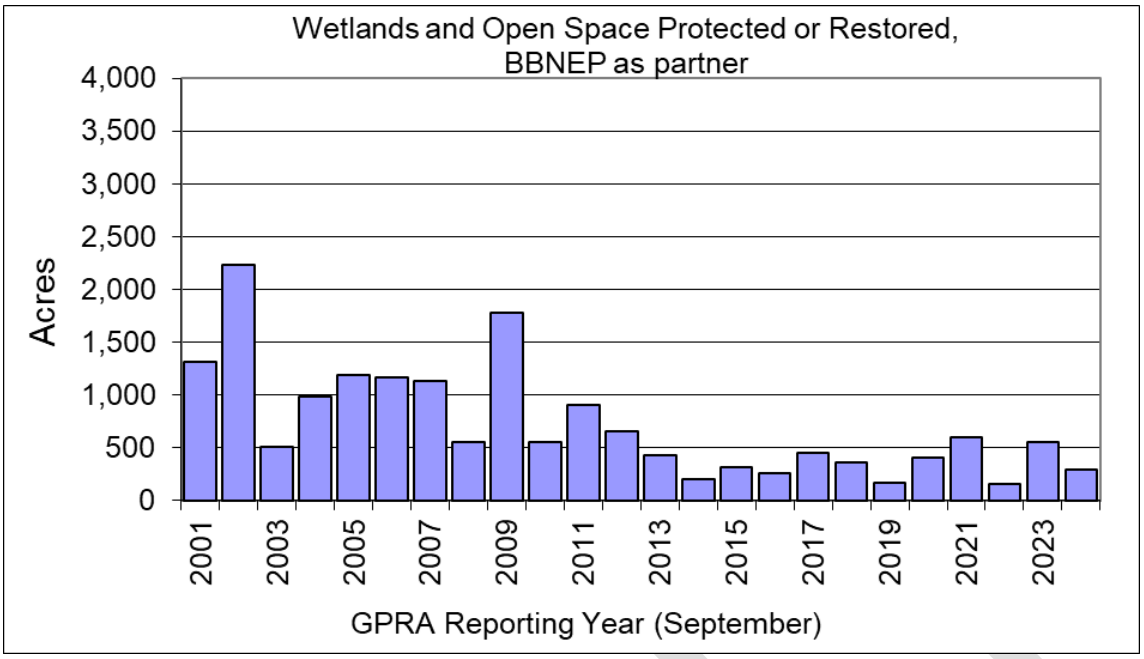


Figure 68. Open space protected annually with some level of assistance from the Buzzards Bay NEP or BBC as reported in Government Preformance Reporting Act reports to EPA.

Costs and Financing

Municipalities or their contractors must prepare and update open space plans. Sometimes state grants, land trusts or the Buzzards Bay NEP can help with this task. Local fund raising, municipal appropriations, or state and federal grants pay for land acquisitions. The Community Preservation Act is one of the best sources of local funds, and these monies often leverage state or federal grants or private donations. As of November 2023, the base state match to the program is 21.02%.

Adoption of laws and regulations that promote open space, like cluster development and transfer of development rights, generally have little direct costs. Moreover, from the municipal perspective, the loss of tax revenue from buying open space is often less than the cost of providing municipal services to new residential development. Strategies like permitting cluster development save money for both developers and the taxpayer by reducing infrastructure construction and maintenance costs.

Land trusts often encourage donations of land by educating property owners of tax benefits for land donations or for conservation restrictions. The placement of conservation restrictions can also reduce a property's assessed value, which in turn lowers annual property taxes. More widespread efforts to make property owners aware of these strategies could help meet local goals of open space protection.

Measuring Success

Ultimately, the number of acres of wetlands and habitat protected is the principal mechanism of tracking the success of this action plan. Programmatic tracking of municipal actions, like the approval of open space

Table 20. Open space plan status (1/1/25)

Community	eligible for state funding	Plan expiration
Acushnet	NO	Expired Plan
Bourne	NO	Expired Plan
Carver	NO	Expired Plan
Dartmouth	YES	Jul-30
Fairhaven	YES	Oct-25
Fall River	YES	Aug-25
Falmouth	YES	Feb-31
Freetown	YES	Jun-30
Gosnold	YES	Sep-25
Marion	YES	Nov-30
Mattapoisett	YES	Apr-29
Middleborough	YES	Jun-31
New Bedford	YES	Feb-28
Plymouth	YES	Dec-31
Rochester	YES	Oct-26
Wareham	NO	Expired Plan
Westport	NO	Expired Plan

plans, adopting the Community Preservation Act, and the Buzzards Bay NEP can track the number of towns without valid open space plans.

Roles, Programs, and Tools

Role of Municipalities

Municipalities adopt the Community Preservation Act through a ballot referendum. Each municipality appoints a committee, which decides how to use the funds, with expenditures approved by a town meeting vote. All Buzzards Bay watershed municipalities have adopted the Community Preservation Act except Rochester and Freetown.

Non-profit Land Conservation Organizations

While the land trust community has made great strides in open space protection, few area land trusts can afford to fund full-time staff members, and most function with only dedicated volunteers. The BBC, which has several staff members dedicated to land protection, has been instrumental in filling the gap. The BBC develops land protection strategies for the watershed, fundraises and writes grants, and maintains contact with large landowners. The Buzzards Bay NEP works cooperatively with the BBC by maintaining an open space database and providing high quality Geographic Information System (GIS) maps for use in grant applications and negotiations with landowners.

State Agricultural Preservation Restriction Program

The Commonwealth protects an added 5% of the watershed's open space through the Agricultural Preservation Restriction (APR) program. Administered by the MDAR, the APR program is a voluntary program aimed at protecting the state's most significant farmland soils. It offers a non-development alternative to owners of important agricultural lands by buying the development rights. The program pays farmers the difference between the fair market value and the agricultural value of their land. In exchange, the farmer

agrees to place a permanent deed restriction on the property that limits any future development. The APR program is highly competitive with preference given to working farms situated on highly productive agricultural soils.

In the Buzzards Bay watershed, most working farms (not including cranberry bog operations) exist in the towns of Westport and Dartmouth. Westport is one of the top-producing farm communities and was a leading dairy producing area until the early 2000s. The APR program has been actively working with these towns and local land conservation organizations to protect hundreds of acres of farmland. While there are scores of APR projects located in the Buzzards Bay Watershed, many of these farms were protected over twenty years ago. More recently, from 2018 through 2024, USDA funded only five APR projects in the Buzzards Bay Watershed, all within Westport.

Non-Regularity Methods of Conserving Open Space

Fee Ownership

Conveying open space in fee to a conservation organization is the most straightforward method of land protection. When land is acquired for conservation purposes, the conservation organization or land trust is required to ensure that the land has permanent protection and will keep the land in its natural state in perpetuity. The land may be acquired at fair market value, a bargain sale (less than market value), or donation. The donor of any land for conservation may be eligible to receive significant tax benefits, including an income tax deduction for the value of the property, estate tax reductions, and a Massachusetts state income tax credit.

Conservation Restriction

A Conservation Restriction (CR) is a legal agreement between a landowner and a conservation organization or municipality that permanently protects land for its conservation values. A CR extinguishes the development rights of the property but allows the landowner to continue to own and manage the land. The landowner's ability to sell the property or bequeath it to heirs remains. The CR may allow some activities such as planting a garden, building a small outbuilding, or replacing a driveway. A conservation restriction is permanent and stays with the property in perpetuity; future owners of the land will be bound by the terms of the CR. The CR holder monitors the land and ensures the terms of the CR are followed. A CR may apply to all or a portion of the property and public access to the property is not required. Like land donations, CR donations may be eligible for certain tax benefits.

Deed Restriction

A landowner may place a "term deed restriction" on their property to protect some of its features and control its future use. However, it is the least-preferred option in land protection because it does not remain with a property's title in perpetuity, and it can be rendered unenforceable under certain conditions. Under Massachusetts Law, the duration of a property deed may not exceed thirty years and then the holder of the restriction must re-record it prior to its expiration. No income or estate tax benefits are associated with a deed restriction because of its temporary nature.

Limited Development

Landowners may wish to protect property that has conservation value but are not able to sacrifice all the value of their asset. Limited development can serve as a workable alternative for landowners looking to preserve their land but also need some direct financial gain from their property. On appropriate parcels of land and with a cooperating developer, some development can occur while the remaining land is permanently protected through one or more of the methods described above. The new development should be strategically located to preserve the property's most critical scenic and natural resources, and the landowner will receive a cash return from the property.

Chapter Land Programs (Chapter 61, 61A and 61B)

Massachusetts has three different "Chapter Land" taxation programs, which allow private landowners to reduce the burdens of property taxes in exchange for agreeing to protect certain aspects of their land for a 10-year period. The Chapter Land statutes may be used to protect undeveloped forestland and keep it in wood production, it may be used to protect agricultural or horticultural lands, or to preserve open space and promote recreational uses for the specified period, but the protection is not permanent.

Chapter Lands are not permanently protected, but the program provides towns with some conservation advantages. For example, the statutes grant the town the right of first refusal on lands being sold for residential, commercial, or industrial purposes. The town must match a bona fide offer for conversion of the property from its forest, agricultural, or recreational use. In addition, towns may assign their right of first refusal option to nonprofit conservation organizations. Involvement of a land trust organization provides the town with greater flexibility to protect critical lands when town funds are not available, or action needs to be taken quickly. Such a transfer of rights requires a public meeting and the approval of the Board of Selectmen.

A significant amount of land in the watershed is enrolled the Chapter Land program. It is important for individual towns to identify parcels of particular importance due to size, habitat value, visual appeal, and proximity to waterbodies or recreational areas, and keep alert to preservation opportunities.

Basis of Protection Strategies

The following resources are the basis of land protection efforts used by municipalities, state and federal agencies, and land conservation organizations.

A. Protect Critical Natural Resources

Saltwater and Freshwater Wetlands

Wetlands serve many important purposes including flood control, prevention of pollution and storm damage, protection of public and private water supplies, and protection of fisheries, shellfisheries, and wildlife habitat. Wetlands are afforded substantial protection under state wetlands regulations. However, municipalities are encouraged to continue efforts to strengthen local wetlands bylaws to offer greater protection to these important resources. Land conservation organizations should work to establish connections between major wetland systems through protected land corridors.

Endangered Species Habitat/Core Habitat

It is essential to protect habitat for endangered and threatened species. As priority habitats are lost, species diversity decreases. Decreasing biodiversity diminishes ecosystem health and resilience to recover from human and natural disruptions. The U.S. Fish and Wildlife Service estimates that losing one plant species can trigger the loss of up to 30 other insect, plant, and animal species. Managers should give priority to conserving core habitats and critical natural landscapes and their surrounding watersheds as identified by the Natural Heritage and Endangered Species Program.

Groundwater Resources

Drinking water, our most precious natural resource, is often taken for granted. Protected lands in the form of woods and wetlands are vital to the region's water

supply because of their ability to recharge groundwater and act as filters for pollution. Municipalities can protect groundwater resources by using aquifer protection overlay districts and land acquisitions. Protection of land within the recharge areas to aquifers (Zone IIs and Interim Wellhead Protection Areas) is especially important.

Coastal Shorelines and Resources
Coastal shorelines support an abundance of life, are key to the region's economy, and important to our quality of life. However, shoreline habitat is rapidly diminishing due to irresponsible development, which compromises ecological functions by reducing habitat availability and negatively affecting water quality. Communities are strongly encouraged to protect natural shoreline conditions by minimizing the effects of shoreline use/development, restricting harmful activities, and reducing stormwater impacts. Degraded shoreline habitat should be restored where possible.

Surface Waters and Riparian Corridors
Surface waters provide wildlife habitat, drinking water, flood control, and areas for recreation. Riparian corridors, the vegetated lands that border surface waters, are particularly important to the health of freshwater ecosystems because they act as buffers to surrounding land uses. Protection of surface waters and adjacent riparian lands should be a land conservation priority as these areas build the foundation of open space corridors.

Forestlands
Contiguous, intact, forests provide habitat for many species, but they also protect our water supplies by acting as filters for nitrogen and sediment. Forests reduce erosion by slowing the rate of water runoff; regulate water levels in rivers and streams; bind atmospheric carbon; and provide areas for community recreation. Some of the most important forest areas to protect include large contiguous blocks, riparian areas, unique communities, and habitat for rare or endangered species.

Scenic & Historic Areas
Scenic open spaces maintain an area's rural character, contribute to quality of life and provide visual relief; historic places give each community unique character. Visual quality affects how people feel about a community and influences whether they would want to live in, visit, or set up a business in a particular area. Residents and visitors alike see most of a community while riding in their vehicles, making scenic vistas from roadways particularly important to protect. Views from sidewalks, hiking trails, bike paths, and recreational areas also contribute to a community's desirability.

Agricultural Lands
Active agricultural lands not only provide food and contribute to the local economy, but they hold aesthetic qualities and bring a sense of place to the region. Well-managed farmland can also benefit the environment by filtering wastewater and providing groundwater recharge. Development located too close to farming operations often results in conflicts when residents perceive normal farming practices in conflict with residential uses. Municipalities with prime or locally important farmland should review their regulations to ensure they support the continued operation of active farms.

B. Promote Interconnectedness of Protected Lands
Development in the watershed is fragmenting habitat and disrupting critical ecological processes. Fragmentation of the landscape reduces habitat biological capacity, destroys wildlife corridors, and genetically isolates members of a species. Connecting and preserving large tracts of a diverse assortment of high-quality interconnected habitat types, such as forests, fields, riparian corridors, and inland and coastal wetlands is crucial to protecting biodiversity in the watershed. From a regional perspective, it is important to examine the quality and location of existing protected lands to decide if it is possible to make connections when planning future conservation activities.

C. Protect Natural Resources through Construction of the Accessory Development Units
Almost all Buzzards Bay Municipalities have one or more existing village centers that support and encourage mixed-use development and higher density residential development. These villages usually have the necessary municipal infrastructure and amenities that allow this type of development including wastewater collection and treatment, public water supply, street lighting, and sidewalks. In August 2024, with the passage of the Affordable Homes Act, Massachusetts permitted Accessory Dwelling Units (ADUs), less than 900 SF, to be built by-right in single-family zoning districts in all communities. This provision will encourage greater density development in areas zoned for single-

family homes. Village centers may be particularly attractive areas for ADUs given the existence of municipal infrastructure.

More concentrated, walkable village centers will help reduce new construction in outlying areas and will help protect natural resources.

D. Promote Regional Cooperation in Land Protection

Critical resources, such as aquifers, river corridors, and coastlines all cross municipal boundaries. Granting agencies should strongly encourage regional efforts to protect these areas, because when towns and land trusts work together, they can better protect shared resources and reach common goals. When planning future conservation efforts, proponents should contact neighboring municipalities and their respective local conservation organizations.

E. Leverage Local Funding for Open Space Protection

While the Community Preservation Act is an excellent tool for protecting open space, towns should use preservation act funds to leverage private donations and state and federal grants. Municipalities and lands trusts should undertake public education before town meeting votes.

F. Increase Public Access to Protected Lands

Providing public access to protected land allows residents to see the benefits of preserving these properties. These attitudes can lead to greater public support for the protection of open space. Public access is an important aspect in open space planning; however, managers must consider the fragility and uniqueness of the natural resources contained on certain properties when deciding the type of access allowed.

G. Strategize for Large and Continuous Tracts of Land

Conserving large tracts of contiguous land not only protects the genetic viability and long-term survival rate of many diverse species, but it also protects fragile ecological processes. Regional planners should identify and protect the remaining areas of the watershed that hold sizable and undeveloped blocks of land to create or expand wildlife corridors.

Needed Actions

To supplement government-driven land acquisitions, all municipalities should adopt various smart growth planning techniques that best protect their critical resources and minimize growth impacts on water quality and habitat. These techniques could include mandatory cluster zoning; transfer of development rights; water resources protection overlay districts; and prohibitions on building in the velocity zone. Each municipality must decide what technique works best in their community. Municipalities can implement these approaches through municipal laws (bylaws or ordinances) and regulations.

Sufficient models exist for the development of laws and regulations to promote open space protection bylaws that meet local needs. The greatest challenge in adopting local strategies is building public support for passage at town meetings and in general municipal elections. Citizens groups and land trusts often help with needed public outreach efforts.

Municipalities could also protect the most valuable open space and wetlands by adopting local wetlands bylaws and regulations to address current weaknesses in state and federal wetlands laws and regulations. A fuller explanation of these approaches is described in Action Plan 7 Protecting and Restoring Wetlands.

The BBC has shown strong leadership in protecting open space, and coordinating with local, regional, and national land trusts to protect some of the most vital resources of Buzzards Bay. The BBC needs to continue this effort of supporting regional open space protection goals and providing help to communities, area land trusts, and landowners with land protection projects.

Each of the more than a dozen land trusts in the Buzzards Bay watershed must maintain or expand efforts to protect open space. Collectively land trusts have the greatest impact on protecting water quality and living resources in the Buzzards Bay watershed. Land trusts should continue to provide public access to protected lands, which allows the public to feel a sense of ownership, leading to increased support for land protection initiatives.

The USDA NRCS operates some valuable programs that support open space efforts, including the NRCS Wetland Reserve Easement, Agricultural Protection Restrictions, and Wildlife Habitat Improvement programs. The Department of Agricultural Resources should include proximity to NHESP priority habitats, and organic farming in its criteria for selecting properties to receive funding.

Action Plan 13. Protecting and Restoring Lakes, Ponds, and Streams

Problem

The 412 square mile Buzzards Bay watershed includes 7,594 acres of open freshwater and 1,684 acres of freshwater deep marsh [72] (Table 21). The open waters consist of freshwater ponds of various sizes with only 64 larger than 10 acres. These 64 ponds total 2,241 acres. [73] The numerous small and large perennial streams in the watershed total roughly 700 miles, with major streams and rivers totaling 100 miles [74]. The nine major rivers are the Westport River (East Branch), Paskamanset River, Acushnet River, Mattapoisett River, Sippican River, Weweantic River, Wankinco River, Agawam River, and Red Brook.

MassDEP classifies waterbodies in Massachusetts as having one or more of eight designated uses as defined in the Massachusetts Surface Water Quality Standards [75]. These designated uses are impaired in many Buzzards Bay watershed waterbodies. The causes of impairments are diverse and include impediments to fish passage, invasive weeds, bacteria or toxics contamination, and excess nutrient inputs. MassDEP classifies water quality conditions as "support," "impaired," or "not assessed" in relation to designated uses for specific waterbodies. MassDEP reports impairments to the U.S. EPA as required by the Clean Water Act, in its "Integrated List of Waters" reports. These integrated lists classify bodies of waters into different categories. Table 22 shows all categories and their definition on the state's Integrated List.

The state's Integrated List of Waters mostly characterizes major streams and larger ponds (Table 23. MassDEP has not assessed most small streams and ponds, and they have never reported the status of their designated use. MassDEP considers these unlisted surface waters as Category 3 waters (i.e., no uses assessed) by default. A summary how MassDEP classifies all Buzzards Bay waterbodies are shown in Table 23 and the map in Figure 69). Table 23 shows the causes of all impairments.

Table 21. Pond acres and stream miles in the Buzzards Bay watershed and included in the state integrated list.

Habitat Type	Within Watershed	Included on Integrated List	Not Listed
Pond/Deep Marsh Acres	9278	5037	4241
Stream Miles	700	92	608

Table 22. Massachusetts Integrated List categories and subcategories

- Category 1: Unimpaired and not threatened for all designated uses.
- Category 2: Unimpaired for some uses and not assessed for others.
- Category 3: Insufficient information to make assessments for any uses.
- Category 4: Impaired for one or more uses but not requiring the calculation of a Total Maximum Daily Load (TMDL).
- Category 4A: Impaired for one or more designated uses but does not require the development of a TMDL: TMDL has been completed.
- Category 4B: Impaired for one or more designated uses but does not require the development of a TMDL: Other pollution control requirements are reasonably expected to result in the attainment of designated uses.
- Category 4C: Impaired for one or more designated uses but does not require the development of a TMDL: Impairment is not caused by a pollutant.
- Category 5) Impaired for one or more uses and requiring a restorative "action" plan, such as a TMDL or Alternative Restoration Plan (impairment due to pollutant(s) such as nutrients, metals, pesticides, solids, and pathogens).

Table 23. Classification of Buzzards Bay waterbodies on the state Integrated List.

Category	Pond acres	# of Ponds	Stream miles	Stream units
2	186	6	5.9	5
3	1052	33	8.7	6
4A	743	2	66.6	3
4C	513	7	5.5	5
5	2543	20	6.1	17
Total	**5037**	**68**	**92.8**	**36**

[72] Based on the Mass GIS DEP 2007 wetlands coverage and modified by the Buzzards Bay NEP to exclude salt ponds and estuaries.

[73] Includes Herring Pond in Plymouth which is bisected by the watershed boundary as per 0.

[74] MassGIS “major stream” coverage; includes pond connections.

[75] Seven of eight designated occurring in the Buzzards Bay watershed include: "fish consumption", "habitat for fish, other aquatic life and wildlife", "primary contact recreation", "public water supply", "secondary contact recreation", and "shellfish harvesting."

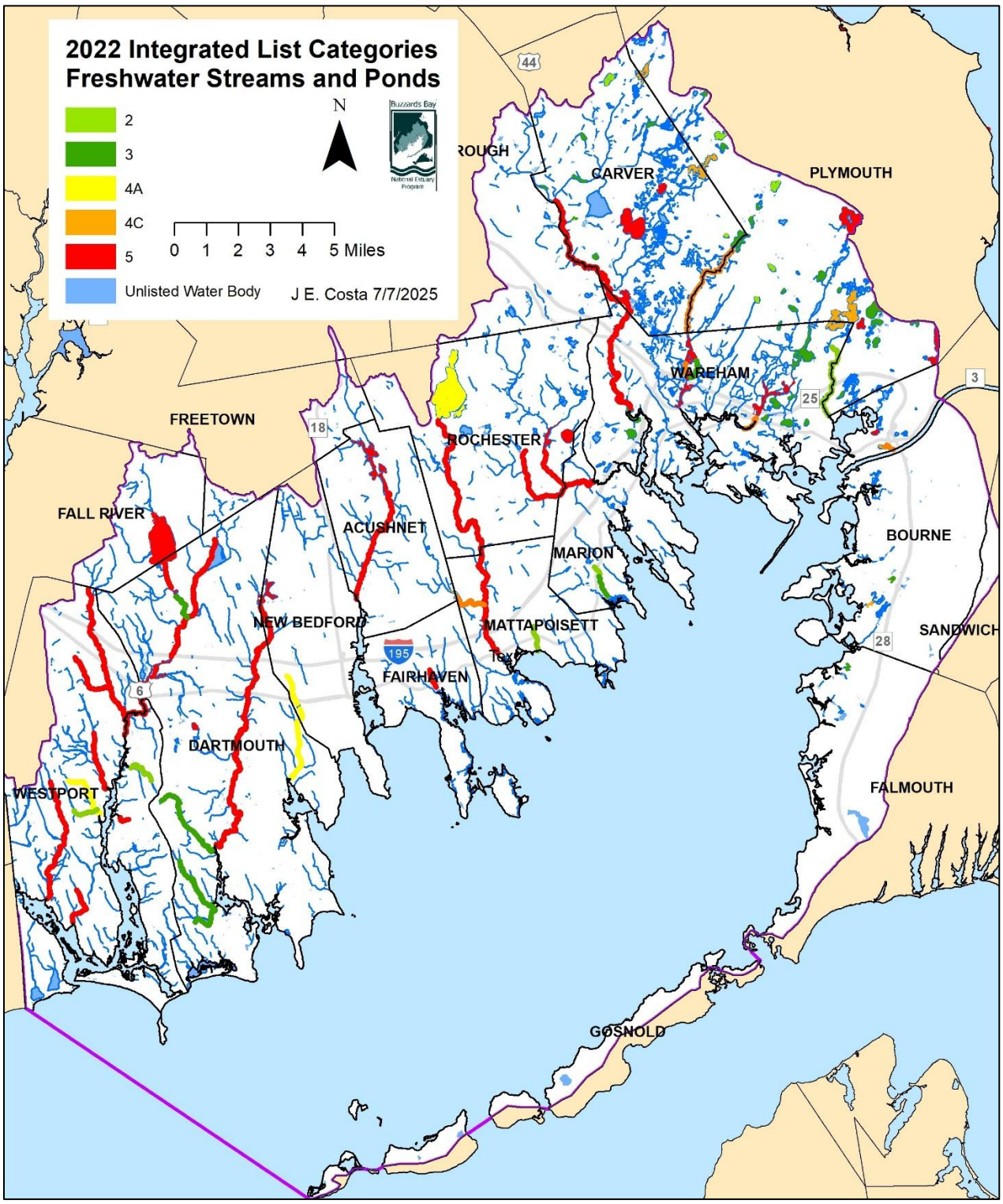


Figure 69. Water bodies included in the integrated list five categories, plus unlisted water bodies.

Abbreviated explanation of categories: Category 2 = Attaining some of the designated uses, unassessed for others, Category 3 - Unassessed, Category 4 - Impaired or threatened, but does not require the development of a TMDL, Category 5 = impaired or threatened and requires a TMDL. Waters (streams and ponds) colored blue (smaller units are omitted) are not included (unlisted) in the integrated list. From a MassGIS coverage based on DEP's *Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle May 2023.*

Table 24. Frequency of combined causes[1] of impairments in Buzzards Bay watershed freshwater ponds and stream segments (nutrient impairments highlighted).

Combined cause(s) of Impairment	# ponds	# stream segments	Total
categories 2 & 3	39	11	50
algae non-native aquatic plants **phosphorus, total**	**1**		**1**
aquatic plants (macrophytes) chlorophyll-a curly-leaf pondweed non-native aquatic plants transparency / clarity	1		1
aquatic plants (macrophytes) DDT in fish tissue dissolved oxygen mercury in fish tissue non-native aquatic plants **nutrient/eutrophication biological indicators phosphorus, total**	**1**		**1**
aquatic plants (macrophytes) Enterococcus fish passage barrier mercury in fish tissue non-native aquatic plants PCBs in fish tissue swollen bladderwort turbidity	1		1
aquatic plants (macrophytes) mercury in fish tissue non-native aquatic plants **nutrient/eutrophication** biological indicators PCBs in fish tissue turbidity	**2**		**2**
Asian clam DDT in fish tissue fanwort mercury in fish tissue non-native aquatic plants swollen bladderwort	1		1
benthic macroinvertebrates dissolved oxygen *Enterococcus Escherichia coli* (*E. coli*) fecal coliform		1	1
benthic macroinvertebrates dissolved oxygen lead		1	1
benthic macroinvertebrates *Enterococcus Escherichia coli* (*E. coli*)		1	1
brittle naiad, *Najas minor* curly-leaf pondweed fanwort	1		1
chlorophyll-a dissolved oxygen *Enterococcus*		1	1
chlorophyll-a transparency / clarity	1		1
combined biota/habitat bioassessments dissolved oxygen *Enterococcus Escherichia coli* (*E. coli*) fish passage barrier lead		1	1
curly-leaf pondweed eurasian water milfoil, Myriophyllum spicatum fanwort swollen bladderwort	1		1
dissolved oxygen *Enterococcus Escherichia coli* (*E. coli*) fecal coliform		1	1
dissolved oxygen *Enterococcus* fecal coliform fish passage barrier		1	1
dissolved oxygen fish passage barrier	1	1	2
dissolved oxygen mercury in fish tissue	1		1
dissolved oxygen non-native aquatic plants **phosphorus, total**	**1**		**1**
Enterococcus	1	3	4
Enterococcus Escherichia coli (E. coli) fecal coliform		3	3
Enterococcus fecal coliform temperature		1	1
Enterococcus fish passage barrier mercury in fish tissue swollen bladderwort	1		1
Enterococcus fish passage barrier non-native aquatic plants		1	1
Escherichia coli (E. coli)		2	2
Escherichia coli (E. coli) temperature		1	1
fanwort	1		1
fanwort mercury in fish tissue	1		1
fanwort non-native aquatic plants swollen bladderwort	1		1
fish passage barrier	3	5	8
fish passage barrier harmful algal blooms non-native aquatic plants	1		1
harmful algal blooms	1		1
harmful algal blooms mercury in fish tissue	1		1
mercury in fish tissue	4		4
mercury in fish tissue PCBs in fish tissue	1	1	2
Total	**68**	**36**	104

1 There are 25 unique causes of impairments in this table: algae non-native, aquatic plants (macrophytes), Asian clam, biological indicators, brittle naiad, chlorophyll-a transparency/clarity, curly-leaf pondweed, DDT in fish tissue, dissolved oxygen, *Enterococcus*, *Escherichia coli*, eurasian water milfoil, fanwort, fecal coliform, fish passage barrier, harmful algal blooms, mercury in fish tissue, *Myriophyllum spicatum*, *Najas minor*, non-native aquatic plants, PCBs in fish tissue, phosphorus, total, swollen bladderwort, total nutrient/eutrophication, and turbidity.

With respect to unlisted water bodies and documented impairments, it is important that MassDEP in its next update to the Integrated List reconcile any inconsistent designations by municipal, state, and federal agencies. For example, Massachusetts Department of Public Health (DPH) first issued fish consumption advisories related to PFAS in 2021 (see Action Plan 15 Reducing Toxic Pollution). In the Buzzards Bay watershed, DPH has a PFAS advisory for Fearing Pond, Plymouth (pregnant women and children should not eat any fish, and the general population should limit consumption of any fish to 2 meals per week). DEP's 2022 Integrated List classifies Fearing Pond as Category 2. Grews Pond in Falmouth has a similar DPH PFAS designation, but the pond is unlisted in DEP's 2022 Integrated list.

Buttonwood Pond, New Bedford is another waterbody needing reclassification. MassDEP currently lists the pond as Category 3, but DMF designates the pond as fully impaired to diadromous fish passage, and signage by the City of New Bedford notes the dangerously high bacteria levels in the pond. Currently the City of New Bedford and the BBC have received state and federal grants to begin addressing these problems.

The Integrated List must also be consistent with DPH data on fresh and saltwater public and semi-private beaches (see Action Plan 18 Protecting Public Health at Beaches). For example, Picture Lake (Flax Pond) in Bourne (Category 3) has had ten *E. Coli* violations between 2020 and 2022. Inconsistencies between DMF's shellfish bed closures and DEP's estuarine assessment units are discussed in the shellfish action plan.

While comprehensively identifying all impairments in the Buzzards Bay watershed is the first step toward achieving the goals of this action plan, the end point is to improve water quality and habitat so that all designated uses are attained Section 303(d) of the Clean Water Act [76] requires states to identify waterbodies not expected to meet surface water quality standards after the implementation of technology-based pollution controls[77] and to prioritize and schedule them for the development of a TMDL or Alternative Restoration Plan. There are five nutrient impaired fresh water bodies listed in the Buzzards Bay watershed. Among these nutrient-impaired water segments, White Island Pond already has a total phosphorus TMDL approved by MassDEP in 2010. Altogether there are 37 stream or pond Category 5 assessed water bodies that require some type of restoration planning.

To restore any impaired water body needs considerable effort by the state and local government. If MassDEP determines water quality standards cannot be met after implementing technology-based controls, MassDEP must prioritize water bodies and schedule them for the development of a TMDL. These TMDLs establish the total amount of pollutants added to a water body and still ensure attainment and maintenance of water quality standards. TMDLs or alternative restoration plans typically require assessments and development of local watershed plans. Completing assessments for many small freshwater bodies will be a challenge for MassDEP, and more challenging for property owners or municipalities to implement those plans.

Equally challenging is to prevent ponds and streams that now attain their designated uses from becoming impaired and losing an attained use. Strategies to minimize impacts from existing and new development and support this action plan are contained in Action Plan 1 Managing Nitrogen Pollution, Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure, Action Plan 8 Restoring Migratory Fish Passage and Populations, and Action Plan 18 Protecting Public Health at Beaches.

Goals

Goal 13.1. Protect beneficial water uses [78] ***and ecosystems in the Buzzards Bay watershed from pollution, Invasive species, climate change, and flow changes.***

Goal 13.2. Restore beneficial water uses and ecosystem functions in freshwater systems of the watershed

[76] The federal implementing regulation is 40 CFR 130.7.

[77] Technology-based pollution controls, also known as technology-based effluent limitations, establish minimum treatment standards for point source discharges based on available technologies. In practical terms, a TMDL is required if, for example, an estuary is not restored by limiting nitrogen concentration in a wastewater facility effluent.

[78] Beneficial uses are those listed in Massachusetts Surface Water Quality Standards.

affected by pollution discharges, invasive species, or changes in flow.

Objectives

Objective 13.1. Support MassDEP efforts to adopt total maximum daily loads for all freshwaters.

Objective 13.2. Help ensure that watershed plans are developed and implemented to meet recommended total maximum daily loads.

Objective 13.3. Help restore impaired wetlands habitat.

Objective 13.4. Protect open space that enhances and protects lakes, ponds, and streams.

Objective 13.5. Support studies that result in a better understanding of threats to ponds and streams.

Objective 13.6. Assess uses and impairments for all ponds and streams not yet assessed in the state integrated list of impaired waters

Objective 13.7 Encourage wastewater and stormwater management strategies that minimize direct and indirect phosphorus discharges to surface waters and groundwater.

Objective 13.8. Support studies to find new and innovative phosphorus removal methods from freshwater sediments.

Management Approaches

Achieving the goals of this Action Plan requires compliance with state and local laws and the Clean Water Act. MassDEP is the lead for many actions, but municipal participation and public input are needed to identify impairments of unassessed water bodies. As required by the Clean Water Act, MassDEP must develop TMDLs or alternative management plans for the 37 impaired water bodies named on the current Integrated Lists. Nutrient or bacteria contamination impairments might require a mass loading limit based on a watershed characterization and source allocation.

Although EPA requires this action, there is no timeline for its completion. Because the effort requires considerable staffing and would require millions of dollars to develop TMDLs or restoration plans for all Category 5 impaired freshwaters in the Buzzards Bay watershed will take many years. MassDEP must prioritize the unlisted stream segments and ponds in Figure 69. This work will be undertaken in the context of agency goals and priority to enact TMDLs (e.g., the 2024 report Massachusetts Vision 2.0: Clean Water Act Section 303(d) and Total Maximum Daily Load (TMDL) Development[79]).

Municipalities should not use the absence of TMDLs or alternative restoration plans to justify inaction. Early actions tend to be more cost effective. Municipalities can implement many commonsense actions to remove or treat pollution discharges to improve habitat and water quality. In the case of phosphorus discharges from agricultural lands, or fertilizers from residential lawns, municipalities could work proactively with growers and homeowners to increase awareness of the problem and potential solutions. When undertaking road work or improving drainage systems, municipalities should consider opportunities to eliminate or reduce and treat stormwater discharges to impaired water bodies. Such efforts would also meet goals contained in municipal stormwater plans to comply with MS4 permits. Other recommendations addressing elements of MS4 permit plans are discussed in Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

Most smaller ponds and streams are unlisted and considered category 3 waters (unassessed). Of the water bodies listed, nearly half of those are also unassessed. Many of these are small and include large areas of bordering vegetated wetlands or lack public access. Among these, MassDEP should prioritize assessment units where residents or municipalities have raised concerns about water quality or habitat impairments, or where water quality and habitat assessments exist. DEP's assessments will take years, but in the short-term, municipalities should consider resident concerns and local assessments, define local priorities, request a water body listing, and where practical, implement common sense measures to reduce existing impairments. Municipalities should set up water quality task forces identify impairments, priority freshwater systems, and identify potential management strategies, like treating or eliminating specific stormwater

[79] See also MassDEP's web page The Basics of TMDLs."

discharges. Interested residents should become involved in protecting and monitoring these freshwater systems. Municipalities may need to adopt new laws and regulations to reduce the impact of new development and to prevent new impairments.

Municipalities and dam property owners also need to recognize that ignoring impairments is not always a solution. In the case of dams, obstruction migratory fish passage (see also Action Plan 8 Restoring Migratory Fish Passage), and failing dams represent a financial liability, and the cost of dam removal may be less expensive than dam restoration.

Costs and Financing

Although stream and pond watersheds are often small, the development of watershed characterizations, local watershed plans, and TMDLs or other restoration plans for impaired waters, all have substantial costs (possibly millions over a decade). Implementation of these plans, whether they involve invasive plant management, stormwater management, or reducing fertilizer or wastewater discharges, will similarly cost millions. State, federal, and local government must all contribute. State bond funds and EPA 604(b) grants have funded watershed planning in previous years and bond funds should again be considered. Local government and property owners will bear most of the costs of remediation, and some efforts can be funded by the Community Preservation Act. State and federal funds can leverage local action.

Measuring Success

The percent of systems impaired, the total number of impaired systems, and the percent of unimpaired systems are all key measures for tracking progress towards the goals of this action plan. Development of local watershed plans and strategies; TMDLs, and number of systems removed from the impaired waters list are other metrics for tracking progress.

Action Plan 14. Reducing Trash in Wetlands and Waterways

Problem

Local economies that rely on a clean environment can suffer when trash clutters beaches, wetlands, and open space. Trash is not only an eyesore Figure 63) but also an inconvenience. Boaters and fishermen lose time and absorb the cost of mechanical repairs when floatable debris wraps around propellers and propeller shafts. Towns must pay personnel to keep beaches, parks, and public lands clean. Trash, including hazardous and non-hazardous waste, degrades habitat and ecosystems. Trash is aesthetically displeasing, decreases recreational and economic values of wetlands and waterways, can injure people and wildlife, contribute to garbage patches offshore, and results in cleanup costs borne by taxpayers. Plastics are often the largest contributor of trash and Figure 64 shows the top ten products found during beach cleanups.

The sources of marine and coastal debris vary from area to area and are sometimes difficult to pinpoint. Trash originates from illegal dumping on land and at sea, and is conveyed through indirect paths like stormwater systems, CSOs, and overland flow Figure 65 and Figure 73). Inland wetlands and open space are affected mostly by direct dumping, including improper disposal of pet waste bags. Trash can also wash ashore from distant sources. Plastics in trash, fine plastic particles, and plastic fibers in wastewater streams enter the environment and further break down into what are generally termed microplastics. These enter food webs including seafood. All levels of government must address these trash pathways.

Non-biodegradable litter threatens the health of many species of wildlife. Some plastic and rubber items such as balloons, six pack rings, fishing lines, fishing nets, plastic bags, and plastic utensils are commonly found in U.S. waters and cause death through entanglement, suffocation, or digestive tract blockage of marine birds, mammals, and turtles. This plastic and rubber debris often accounts for two-thirds of the volume collected on Massachusetts beaches.

Individuals often dump difficult to dispose of items, such as hazardous waste and certain home goods (televisions, couches, air conditioners, etc.) on undeveloped lands and wetlands because of the cost or inconvenience of disposal. While some financial barriers have been reduced for the disposal of electronics (see

Photo by Tony Williams.

Figure 70. Residents may find large accumulations of litter along rivers and at the headwaters of some bays.

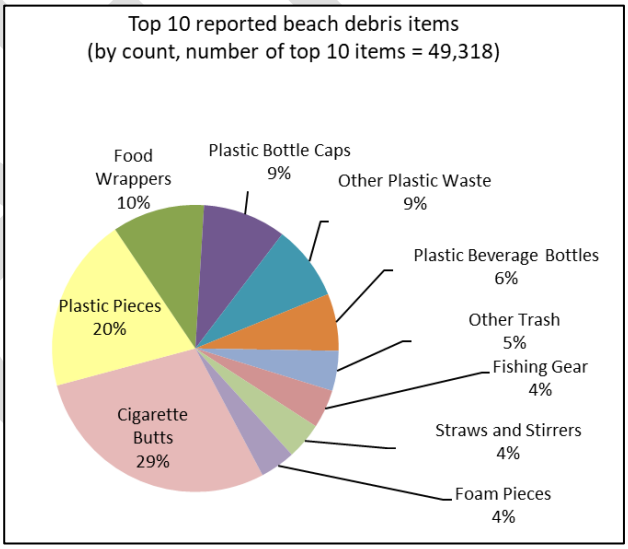


Photo by Joe Costa.

Figure 71. Top ten beach litter types collected in Massachusetts as part of Coastsweep 2024.

Action Plan 16 Reducing Toxic Pollution), the disposal costs of some home furnishing like mattresses results in illegal dumping. In the Buzzards Bay watershed, only the City of New Bedford has programs to pick up white goods, furniture, and mattresses for free or nominal cost.

In many urban and suburban areas, lottery tickets can be a locally important source of paper litter. In 2005, the Massachusetts lottery introduced an "instant replay" litter-recycling program where 20 used instant

lottery tickets could be redeemed for a new ticket. This program was considered successful, collecting 50 tons of tickets in the first year, but the state did not renew it.

Goal

Goal 14.1. Ensure that Buzzards Bay beaches, coastal waters, and inland wetlands habitat are clear of harmful, degrading, and nuisance levels of trash.

Objectives

Objective 14.1. Municipalities should ensure property owners provide and maintain waste disposal barrels at public beaches, marinas, parks, and boat haul-outs.

Objective 14.2. Manage stormwater and CSO networks to reduce or eliminate trash discharges.

Objective 14.3. Encourage fishermen and recreational boaters to not dispose of fishing lines, nets, cables, and trash at sea.

Objective 14.4. Educate the public and businesses on the importance of reducing trash inputs to the environment and involve them in the potential solutions.

Objective 14.5. Support state and local efforts to reduce plastic waste streams and trash on beaches and in wetlands.

Objective 14.6. Find and map important trash sites, natural collection points, encourage and support clean-up and remediation efforts and implement strategies that reduce future debris.

Management Approaches

Municipalities and the public are the lead for most actions. Other agencies and organizations must help and participate. EPA's Trash Free Waters program provides technical and financial support for projects designed to prevent trash from entering waterways. The program supports three principles: 1) source reduction through reuse, recycling, and package reduction, 2) collaborative partnerships to address specific trash pollution streams or undertake cleanups, and 3) supporting research to understand the impact of trash on the environment and human health. These approaches are adopted in this action plan.

Reducing trash in the environment requires education and awareness of the public, property owners, and businesses, as well as improved collaboration of local government with neighborhood associations and nonprofit organizations. One way to create collaborations between these groups and improve public awareness of the problem and reduce trash in wetlands is to undertake periodic cleanups. The CZM annual Coastsweep program is an excellent model. Coastsweep is a statewide beach cleanup organized each fall by CZM. Hundreds of volunteers collect marine trash and categorize and tally what they find. Over the last 37 years, over 100 thousand volunteers have

Figure 72. Litter accumulating on a storm drain grate.

Figure 73. Open curb drain without grates may allow plastic bottles and other litter to enter storm drain networks.

Photo by Kevin Bartsch.

removed more than 1 million pounds of marine debris from Massachusetts shores.

Municipalities and other property owners must provide outreach to address specific problems. For example, while dog owners are increasingly collecting pet waste in plastic bags, these waste bags are increasingly dumped in stormwater catch basins instead of disposing in trash receptacles. Pet owners need to be informed this practice is unacceptable.

Strategies to reduce plastic and other trash in the environment include screening or traps at stormwater inlets, ensuring the availability of waste receptacles in public parks and beaches, increasing awareness, encourage recycling, and increasing accountability of people who litter. Government can also set an example by implementing purchasing policies that focus on biodegradables and items less likely to enter litter waste streams. Some municipalities have banned the use of single use plastic film bags in supermarkets, allowing only paper bags or reusable plastic bags that stores encourage customers to reuse. Several towns in Massachusetts have also banned single-use plastic water bottles. Similarly, based on a student proposal, the New Bedford Sea Lab program, to reduce single-use plastic water bottle waste, installed bottle refill stations, and provided program participants with refillable containers. Government and plastic manufacturers are investigating plastic and plastic substitutes that are more biodegradable.

Removing large and floatable debris from the stormwater stream is an important need. Open curb drains that allow plastic bottles to flow into stormwater networks (see figure), should be discouraged in favor of stormwater grates. For areas where litter and debris are prevalent, municipalities should include debris and floatable reduction strategies such as litter traps and screens in their stormwater management plans. Regular catch basin cleaning and community education are the best tools for litter and debris control.

Implementing stormwater management plans and catch basin maintenance programs may cost municipalities hundreds of thousands of dollars, but the cost of debris removal and catch basin maintenance is typically a small fraction of the overall costs of stormwater management programs. Municipalities should particularly focus on remediating discharge pipes that in areas of high litter accumulation. Municipal MS4 stormwater management committees should help develop strategies to address this problem.

Requirements for businesses to provide and maintain waste receptacles, or to remove litter from parking lots before it blows on public ways is another important strategy. Many municipalities have special requirements to address this problem in businesses that serve fast food, or at convenience stores, for example. Failure to empty trash receptacles results in overflows that worsen trash problems.

School departments could institute programs to minimize litter disposal from students, including wise purchasing policies to reduce sources (e.g. buying biodegradable items like paper cups instead of plastic foam cups). Schools could also use announcements, signage, and trash barrels at key locations to help change student behavior. In 2022, with funding from the Buzzards Bay NEP, Sea Lab, a New Bedford School summer program, installed bottle filling stations to provide filtered water and reusable metal bottles to students. The project ended the need to provide thousands of plastic water bottles to the hundreds of students taking part in the 10-week summer program.

Since 1982, the Commonwealth of Massachusetts has had a five-cent deposit on carbonated beverage containers. Most agree that this law has become less effective because inflation has eroded the value of deposits, and the percentage of bottles returned has declined over time, from a high of 85% in 1995 to less than 38% in 2021 (Bottle Bill Resource Guide). Some of the non-returned bottles contribute to litter. Massachusetts legislators have repeatedly introduced legislation to either increase the deposit fee collected to ten cents or expand the law to include non-carbonated beverage containers. Small plastic alcohol bottles ("nips") are a common non-carbonated trash bottle. In 2024, the Massachusetts Senate passed a bottle bill amendment that proponents assert would lead to 3.1 billion additional containers being recycled each year in Massachusetts, slash bottle emissions by 182,000 metric tons per year, save cities and towns $36.5 million annually, and create hundreds of jobs. Again, this legislation failed to pass both houses.

Municipalities should provide waste collection barrels at public beaches, public marinas, and boat ramps, and support adequate pick-up, especially during heavy use periods. Municipalities sometimes debate providing barrels in public places because of costs to regularly empty barrels and dealing with inappropriate materials dumped in these containers. When private groups hold events on public properties, municipalities should require the group to provide adequate waste disposal containers. Municipalities generally have enforceable rules and regulations to reduce litter such as the Town of Falmouth regulations shown in Table 25. These initiatives are most effective when towns use signage and other notification to support public awareness.

In general, private property owners must manage trash on their own properties, but municipalities should act if trash consistently enters public ways.

Table 25. Litter and trash regulations in the Falmouth Town Code

§ 87-6 Littering. "Leaving litter, trash, rubbish or discarded lunch containers or similar articles upon the public beaches is strictly prohibited."

•Under non-criminal dispositions, littering has a $50 fine and can be enforced by the health agent.

§ 269-12 (7) waterfront marine businesses maintaining moorings are required to provide trash removal.

Wetland Stormwater Regulations FWR 2.00 (5): All basins/Ponds designed for stormwater runoff control shall "(d) have outflow pipes designed to minimize clogging (i.e. through the use of trash racks);"

Costs and Financing

The costs to implement this action plan are nominal; and the focus is to encourage individuals, businesses, and local government to take responsibility for the problem, reduce the waste stream, and encourage volunteerism to solve the problem. There are material and staff costs associated with stormwater pretreatment, street sweeping, cleanups, signage, and trash removal. Adopt-a-road or -wetland programs by businesses and non-profit organizations can meet some of these costs. Cleanups on public properties have nominal costs if volunteers provide organization and labor. The most expensive costs are related to removing debris in stormwater where the municipality uses slotted curb drains with no screening for coarse materials in the basin or downstream. The net cost to businesses and consumers would be determined by any changes to the bottle bill law.

Measuring Success

Measuring success in this action plan is difficult because the amount of litter collected is a function of collection effort. Assessments that are more complex could include evaluations of the extent of littering; however, programmatic achievements might be easier to track. These could include size of areas adopted for cleanup; length of beaches cleaned each year, and the number of cleanup events held. MS4 permits and local stormwater management plans should include measures to manage the entry of bottles and other trash into stormwater networks where municipalities use ungrated slotted road drains.

Action Plan 15. Reducing Toxic Pollution

Problem

Toxic contaminant pollution in Buzzards Bay is a complex issue. The largest single ongoing toxic pollution management problem in Buzzards Bay has been the decades-long cleanup of the U.S. EPA Superfund Polychlorinated Biphenyl (PCB) site in New Bedford Harbor. The EPA announced in 2022 that the work to remove PCB contaminated sediments from New Bedford Harbor is now on track to be completed by December 2025. New Bedford Harbor had been a primary focus of regulators because it is one of the few marine PCB Superfund sites in the country that was the basis of fisheries closures (Figure 67 and Figure 75), and a health concern for area residents. Chronic commercial and industrial discharges of metals and hydrocarbons also adversely affect the harbor. In addition, the DPH has issued freshwater fish advisories at many sites because of mercury, per- and polyfluoroalkyl substances (PFAS), PCB and DDT contamination (Figure 75). Mercury contamination is the result of atmospheric inputs and other pathways while PFAS, PCBs, and DDT contamination may relate to specific past discharges.

Smaller hazardous waste sites are still a problem throughout the watershed. In 2024, there remains five EPA Superfund sites [80] with ongoing remediation, 109 active hazardous waste sites on the state's Chapter 21E list, and 86 former oil or hazardous material release or disposal sites where an activity and use limitation has been filed on the property Figure 70). Most of these sites are in the greater New Bedford area and their cleanup is still challenging and complicated. Besides these known hazardous waste sites, MassDEP lists many water bodies as impaired by toxic pollutants (Figure 70) and some may require TMDLs.

Most other Buzzards Bay embayments are only affected by lower-level chronic discharges from recreational and commercial boating and urbanized landscape discharges, but contamination of seafood is still a concern. Similarly, contaminants of emerging concern like PFAS, are becoming ubiquitous in water and living organisms and need further study to understand health risks.

Figure 74. PCB pollution signage in Apponagnasett Bay, Dartmouth.

Photo by Bernadette Taber.

This action plan focuses on both remediating existing sites and reducing or eliminating point and non-point toxic inputs. Reduction in future inputs will be achieved primarily through toxic source reduction and management. Other action plans that address toxic pollution include Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure, Action Plan 6 Managing Impacts from Boating, Marinas, and Moorings, and Action Plan 17 Preventing Petroleum Products Pollution.

[80] Atlas Tack Corp., Fairhaven; New Bedford, New Bedford; Otis Air National Guard Base/Camp Edwards, Falmouth; Re-Solve, Inc., Dartmouth, Sullivan's Ledge; New Bedford

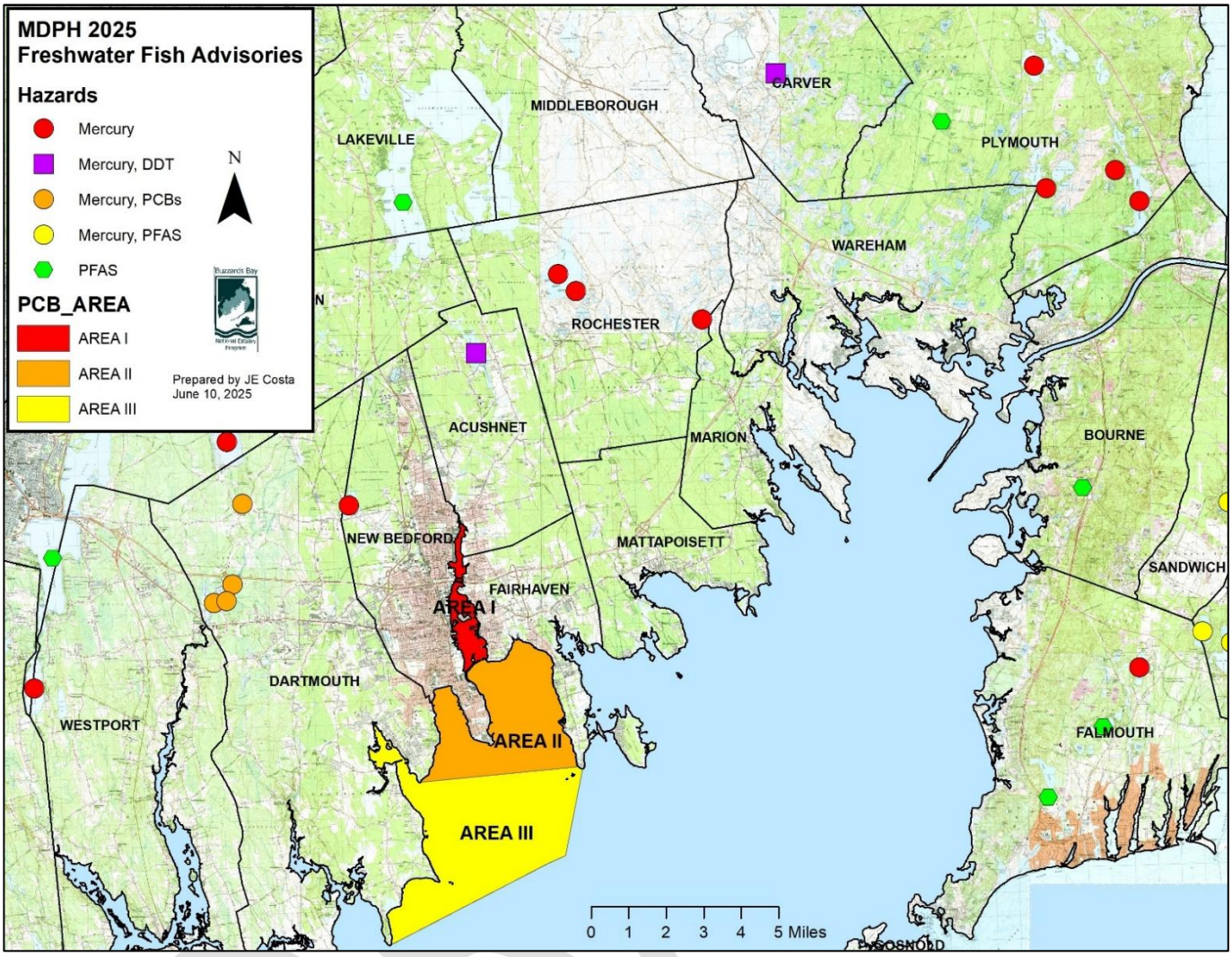


Figure 75. New Bedford area DPH PCB fish advisory areas (I, II, and II) and ponds with fish consumption advisories from mercury or DDT contamination (shaded red).

The New Bedford DPH fishing bans were enacted in 1979 pursuant to 105 CMR 260 and remain in effect today. MDPH advisory for everyone: do not eat fish, shellfish, or lobsters from Area I, lobsters or bottom feeding fish from Area II, or Lobsters from Area III. Data from the DPH Fish consumption Advisories website.

Additional Information

Scope of the problem

The wide-scale contamination of New Bedford Harbor with PCBs not only posed a persistent potential human health risk, but is the basis of an extensive fish, shellfish, and crustacean seafood closure around the harbor the remains in place (Figure 75). These closures were enacted in 1979 pursuant to 105 CMR 260. This is the only marine fishing area that Massachusetts has closed due to chemical contamination. This PCB contamination contributes to elevated, but generally less than action threshold of PCB concentration in seafood and birds in Buzzards Bay.

The Buzzards Bay watershed contains four other EPA Superfund sites. These are the Atlas Tack site in Fairhaven, the Sullivans Ledge site in the north end of New Bedford, the Re-Solve Inc. site in Dartmouth (various solvents, PCBs, and other contaminants), and the Otis Air National Guard site on Cape Cod (4 plumes, mostly various hydrocarbons from fuel dumping and a landfill, are traveling towards Buzzards Bay through groundwater in Bourne and Falmouth). Figure 75 shows past and present hazardous waste sites in the Buzzards Bay watershed.

While there is sediment and animal tissue testing associated with the New Bedford PCB superfund project, there is not similar testing for toxic metals and organic compounds for most other hazardous waste sites elsewhere in Buzzards Bay. The FDA has also issued guidance on "action limits" for contaminants in shellfish, fish, and other food animals, based on human health risks.

MassDEP's 2022 Integrated List of Waters contains 22 freshwater, estuarine and marine water bodies in the Buzzards Bay watershed that are impaired by some form of toxic pollution [81]. These impairments cover 22.1 square miles of water body and 14.7 miles of streams (Table 26). Most of these impairments require a TMDL (Category 5).

There are many potential sources of toxic compounds and chemicals within the Buzzards Bay watershed. These include both point and nonpoint sources and accidental spills (Figure 76). Point-source discharges include sewage treatment facilities, industrial discharges, combined sewer overflows, and storm sewers. Nonpoint sources include atmospheric fallout of contaminated dust particles and precipitation, contaminated groundwater, untreated stormwater runoff from developed areas of the watershed and other sources. Nonpoint sources are numerous, small, and generally unregulated inputs that discharge directly into receiving waters such as wetlands, streams and rivers, ponds and lakes, and the waters of Buzzards Bay. Toxic pollution sources and pathways include the following:

- Boats, ships, and other vessels that discharge or spill oil, fuel, wastes, cleaning fluids, and other toxic substances;
- Marinas, docks, and piers where boat washing, floor drains, refueling, and other activities could cause spills or runoff of toxic substances;
- Contaminated sediments and shellfish from areas contaminated through human activities. These areas are awaiting completion of cleanup;
- Stormwater runoff from developed areas of the watershed where toxic substances are used, stored, transported, or from atmospheric deposition;
- Agricultural use of pesticides, fungicides, insecticides, and herbicides;
- The use of fertilizers made from sewage sludge (these can contain high concentrations of heavy metals and organic pollutants);
- Landscaped areas, plant nurseries, and landscaping activities where pesticides, lawn care chemicals, and fertilizers are used or stored;
- Contaminated groundwater, surface water, or soils resulting from spills from underground storage tanks, industrial and commercial facilities and residences that use chemicals and fuel;
- Methyl tertbutyl ether contaminated groundwater from service stations and refueling facilities;
- Transportation facilities where spills from fuel storage, refueling, and service activities have occurred or through stormwater runoff;
- Wastewater treatment facilities that discharge secondary treated wastewater into wetlands or water bodies and septic systems that discharge wastes containing toxic substances into groundwater;
- Medical and research institutions that generate hazardous waste that is not properly disposed of;
- Household and institutional hazardous waste that is not properly disposed of;
- Leachate or spills of heavy metals and other contaminants from point sources such as waste management facilities and previously uncapped landfills;
- Residuals from fireworks (perchlorates in groundwater), explosives, and munitions disposal sites and testing ranges (e.g., Massachusetts Military Reservation, Nomans Island); and
- Illegal dumpsites, discharges.

Toxic contaminants of Concern

Scientists and regulators often divide contaminants into two major classes: 1) metals and other inorganic elements and compounds that lack carbon atoms, and 2) organic compounds characterized by having at least one carbon atom in their structure. Organic contaminants include hydrocarbons, petroleum products, organic solvents, pesticides, PCBs, dioxin, and many other substances that can harm living organisms, humans, and ecosystems through direct toxic effects on physiological functions. The EPA has designated certain contaminants as "Priority Pollutants" due to their toxicity to humans and ecosystems.

[81] Massachusetts updates these lists biannually and they are posted at DEP's integrated list website.

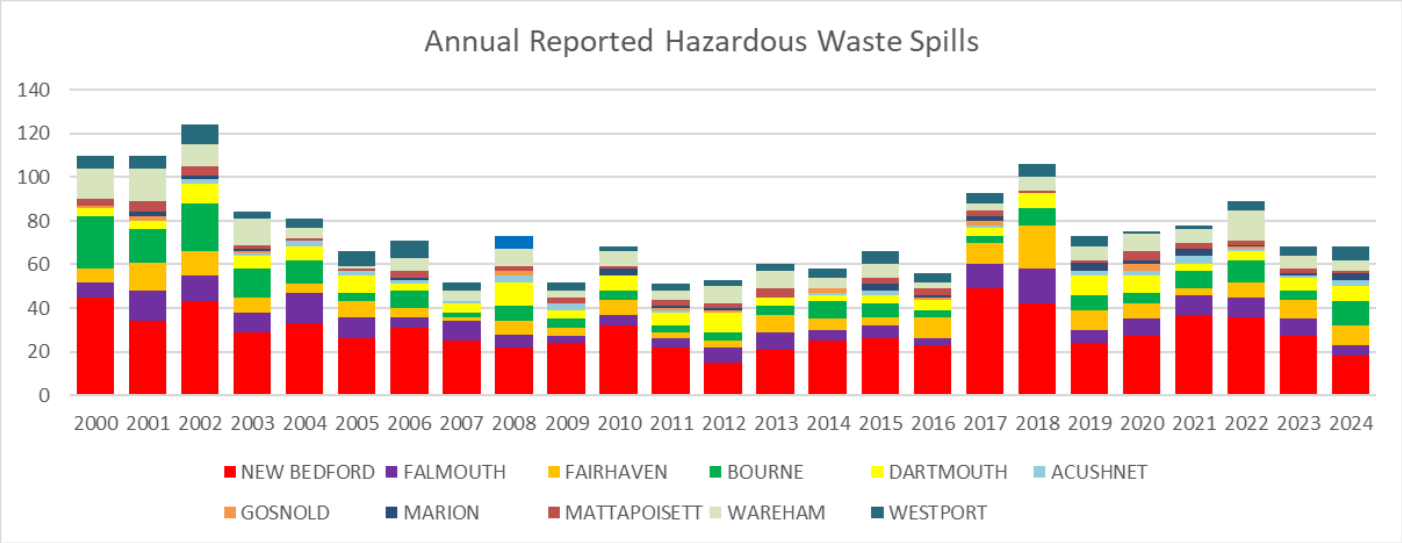


Figure 76. Annual reported hazardous material spills in Buzzards Bay coastal communities.

Totals include the towns of Bourne and Falmouth in their entirety. Data from the EEA Data Portal.

Other chemicals of concern are those not yet regulated, but where there is mounting evidence that they must be managed or controlled. These so-called "emerging pollutants" or "contaminants of emerging concern" are substances suspected of causing biological and/or ecological impacts but needing further research to confirm the extent of effects in nature. Examples include PFAS, certain endocrine disrupting compounds or estrogens found in many pharmaceuticals, personal care products, lithium containing batteries, and microplastics.

Hazardous waste site cleanup

Toxic contamination is regulated through several national and state programs. The cleanup of severe contamination with highly toxic materials at hazardous waste sites is regulated by the federal government through the U.S. EPA Superfund Program (under the Comprehensive Environmental Response and Liability System and Resources Conservation and Recovery Act). At Massachusetts designated hazardous waste sites, MassDEP oversees the Waste Site Cleanup program, largely guided by M.G.L. c. 21E. In 1993, Massachusetts adopted the Massachusetts Contingency Plan and supporting regulations (310 CMR 40) to create a regulatory framework for cleaning up existing and future hazardous waste sites in Massachusetts, including hydrocarbon spills. The purpose of the Massachusetts Contingency Plan is to "provide for the protection of health, safety, public welfare, and the environment by establishing requirements and procedures" for the cleanup and evaluation of hazardous waste sites.

Regulatory Programs

The release of toxic chemicals is regulated by a myriad of other programs. The U.S. EPA regulates both shallow and deep underground injection wells under the federal Safe Drinking Water Act amendments of 1996 (underground injection control). Although there are no deep injection wells in Massachusetts, shallow injection wells used for disposal of industrial and commercial wastewater exist. The Massachusetts Underground Injection Control regulations have been in place since 1982, and among the types of shallow injection wells of concern are floor drain discharges. Floor drain discharges are suspected of contaminating several water supplies in Massachusetts and illicit floor drain discharges are not uncommon. The MA Division of Water Supply regulates and oversees injection wells and provides guidance and assistance to owners of facilities with such discharges. The MassDEP Bureau of Waste Site Cleanup regulates underground storage tanks through its "Leaking UST Release Prevention Program" and requires operators of facilities that handle and store contaminants to prepare Spill Prevention Control Plans.

Point-source discharges above a certain discharge threshold require a permit from EPA's National Pollutant Discharge Elimination System (NPDES). Industrial outfalls require a NPDES permit, but most of these have been eliminated in the past 30 years, and most

industrial and manufacturing flows discharge to municipal sewers rather than individual outfalls. The NPDES Phase II program now regulates nonpoint sources including stormwater runoff and communities with urbanized areas must develop and implement stormwater pollution prevention plans and other control measures under the Phase II program (see Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure). The U.S. Coast Guard oversees the emergency response to spills occurring on the water and typically coordinates with local harbormasters, the MassDEP, and boards of health.

Section 305(b) of the federal Clean Water Act requires states to report to the EPA, Congress and the public on the water quality of freshwater and coastal water resources in terms of whether they support their designated uses such as aquatic life support, fish and shellfish consumption, drinking water supply, and recreation (swimming, boating). Section 303(d) of the Clean Water Act also requires states to list waters that do not meet water quality standards and schedule them for development of a TMDL. A TMDL defines the maximum amount of a pollutant discharged into a water body and still allow attainment of water quality standards. A TMDL also assigns acceptable pollutant loads among all potential sources. The sum of all pollutant load allocations, including point and nonpoint sources, natural background loads and a margin of safety, cannot exceed the total maximum allowable pollutant load calculated for the water body. States can submit an "integrated list of waters" under both Sections 305(b) and 303(d). The five categories of water quality classification are:

1. Unimpaired and not threatened for all designated uses;
2. Unimpaired for some uses and not assessed for others;
3. Insufficient information to make assessments for any uses;
4. Impaired or threatened for one or more uses but not needing a TMDL because either the TMDL is complete (4a), requires alternate controls (4b), or the impairment is not caused by a pollutant (4c); and
5. Impaired or threatened for one or more uses and requiring a TMDL.

In Buzzards Bay and its watershed there are 20 water bodies classified as Category 5 waters due to metal and/or organic pollutants (Table 26).

Pollution Prevention and Source Reduction

Reducing the sources and generation of toxic pollutants is one of the most cost-effective ways to control toxic pollution. Both the state and federal government have pollution prevention programs that work with business and educate consumers.

In 1989, the Massachusetts legislature enacted the Massachusetts Toxics Use Reduction Act to help industrial and commercial sectors reduce their use of toxic substances and to reduce toxic contamination. The Massachusetts Toxic Use Reduction Act required Massachusetts companies and industries that use large quantities of toxic chemicals to inventory their toxics and to develop a plan to reduce toxics use and storage.

Toxic compounds regulated under The Massachusetts Toxic Use Reduction Act regulations include those compounds listed in Section 313 of the Emergency Planning and Community Right to Know Act and the Comprehensive Environmental Response, Compensation, and Liability Act (aka the "Superfund" Act), excluding compounds that have been delisted by the Administrative Council on Toxics Use Reduction. As of 2024, there are 1,736 listed compounds in the Massachusetts Toxic Use Reduction Act Reportable Chemical List.

Recycling and hazardous waste pickups

Business and municipalities have varied programs for accepting household hazardous waste. Many national chains accept computers and other electronics. Several commercial auto service chains accept used motor oils and lead-acid batteries. Agencies discourage dumping of prescription medicines into toilets or the trash, and most pharmacies and some police stations now accept unused medications. Most communities in the Buzzards Bay watershed provide recycling services (both curbside and/or central drop-off facility), but the acceptance of household hazardous materials is variable. Some communities sponsor hazardous waste disposal events, but funding for these programs is intermittent and may not occur annually. Most communi-

ties do not provide central waste facilities where hazardous waste like fluorescent lights and used motor oil may be disposed. Many municipal recycling centers now accept mercury containing products like thermometers and old thermostats. Altogether, residents have options to dispose of household hazardous waste, but participation is impeded by a lack of public awareness and difficulty of disposal.

Needed actions

Implementing this action plan is complex because it involves industry, residential activity, the choice of products and compounds used, and regulated and non-regulated business activities. However, across all these activities and sectors of the economy, pollution prevention is one of the most important methods for achieving the goals of the action plan. Ensuring proper disposal and recycling of toxic materials is essential. The failure to have a speedy cleanup of hazardous waste sites, especially federal superfund sites, is still an important need.

Watershed and environmental organizations should help towns undertake outreach campaigns to homeowners to identify common household toxic and hazardous materials and provide guidance on proper disposal and safer alternatives. These efforts might include outreach materials, public service announcements, and website information.

There should be outreach targeting waterfront facilities that handle and/or store hazardous waste, especially those that have not obtained a multisector stormwater general permit for their stormwater discharges.

Existing sediment quality criteria are varied and not consistently applied. There are currently no sediment quality criteria at the state or national level, despite abundant data concerning existing sediment quality and potential impacts of contaminants in sediments. The lack of criteria makes it impossible to evaluate and improve contaminated sediments outside of Superfund areas. Adoption of final sediment quality criteria, reflecting decades of research by NOAA, EPA, USGS, and others, and incorporating toxicity values and biological impacts of contaminated sediments would be important steps to meet the goals of this action plan.

MassDEP should establish sediment quality criteria with respect to toxic materials for beach nourishment projects, dredging, and dam removal projects in Massachusetts. A draft policy was developed by CZM more than two decades ago but was not implemented. There is sufficient guidance and science now to identify suitable sediment quality criteria, based on NOAA, EPA, USGS and other states' and other nations' draft and interim sediment quality guidance. These efforts also relate to seafood quality criteria for toxics.

NRCS, EPA, MA DOA, and UMASS (Cooperative) Extension should expand education and outreach programs to minimize the use of pesticides and fertilizers to reduce offsite impacts. Numerous entities are or can be involved with these efforts including UMass Extension, NRCS, lawn care products vendors and manufacturers, golf course managers, qualified consultants in IPM, BBAC (for municipal users), gardening clubs and associations, etc. For resource management areas, an implementation strategy might involve forming a steering committee composed of representatives from these sectors. An outreach strategy could be used to target and educate all pesticide users.

All watershed municipalities should review recycling and hazardous waste cleanup programs to reduce disposal of these materials at landfills and incinerators.

A Buzzards Bay Toxics Use Reduction Action Committee could be reconvened to organize this effort and provide outreach to the public concerning the hazards of eating contaminated seafood, including the potential hazards related to lack of comprehensive seafood testing for all contaminants of concern.

Goal

Goal 15.1. Protect public health and the Buzzards Bay ecosystem from the effects of toxic contamination.

Objectives

Objective 15.1. Complete the clean-up of all designated federal superfund sites and state-designated hazardous waste sites according to approved clean-up schedules.

Objective 15.2 Reduce toxic contaminant discharges and loads to toxic impaired water bodies listed under section 303(d) of the Clean Water Act.

Objective 15.3. Support efforts to manage and reduce toxic chemicals to the environment through source reduction programs. These efforts include industrial pretreatment programs, hazardous waste pickup programs, reduction of pesticide releases through integrated pest management on agricultural lands, improved boating and marina practices, and proper recycling of hazardous waste by consumers.

Objective 15.4. Assess discharges and pathways of toxic contaminants of emerging concern like PFAS and microplastics and develop strategies to limit inputs based on new state and federal guidelines.

Objective 15.5. Meet all state, federal, and local action levels for toxic contamination in water and seafood.

Objective 15.6 Encourage the use of products that meet the EPA Safer Choice Standard.

Management Approaches

Implementing this action plan requires action by regulators, businesses and industry, and homeowners, with a focus on reducing toxic chemicals in waste streams. Property owners must manage or restore existing contaminated waste sites following state and federal hazardous waste clean-up laws and regulations. Users and manufacturers of toxic chemicals must prevent illicit discharges, monitor waste streams, and participate in industrial pretreatment programs. Government can incentivize the use of less toxic compounds and improved processes through tax policy. The proper disposal and recycling of toxic materials by businesses and consumers requires education, increased awareness, and the availability of disposal options. Better management and containment of contaminants from boats and marina operations, and expansion of hazardous waste collection days, and increased funding for recycling programs and facilities will reduce the discharge of toxic materials to Buzzards Bay and its surrounding watershed.

Costs and Financing

The costs to implement this action plan are varied and difficult to estimate. The cost of the New Bedford Superfund cleanup alone is close to $ I billion over forty years and is now nearly complete. Property owners or responsible parties largely fund other Superfund clean-ups and state hazardous waste sites. Hazardous material disposal collections are expensive, and often municipalities can only afford one collection event annually. Funding and staffing levels limit the ability of state industrial pretreatment programs to provide technical assistance and businesses to finance changes in industrial processes

Measuring Success

The NEP can evaluate the success of this action plan by the number of hazardous waste sites cleaned up, the volume or weight of hazardous materials collected, the concentration of toxic contaminants in wastewater facility discharges, the numbers and areas of water bodies that are impaired, and by various programmatic and management action measures.

Objective

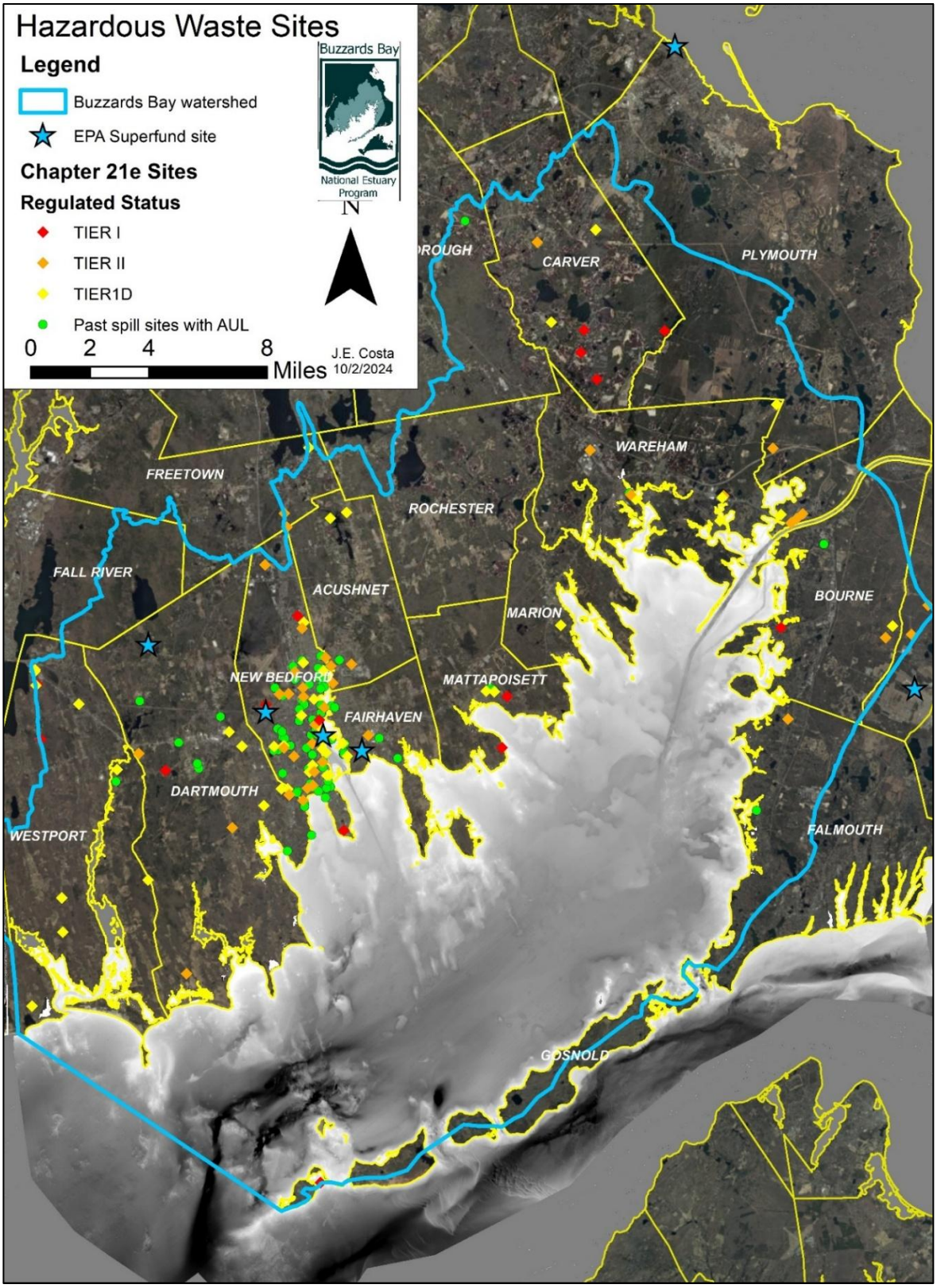


Figure 77. Past and present hazardous waste sites in Buzzards Bay. AUL are properties with activity and use limitation designations.

Table 26. Toxic contaminant related impairments in Category 4 or 5 Buzzards Bay water bodies or river segments.

Waterbody ID	Waterbody	Category	area/ length	unit	Cause
MA95031	Cornell Pond	5	12	acres	mercury in fish tissue
					PCBs in fish tissue
MA95051	Ezekiel Pond	5	36	acres	mercury in fish tissue
MA95097	Long Pond	4A	32	acres	mercury in fish tissue
MA95100	Marys Pond	5	81	acres	mercury in fish tissue
MA95-11	Paskamanset River	5	10.5	miles	lead
MA95110	New Bedford Reservoir	5	210	acres	mercury in fish tissue
MA95113	Noquochoke Lake	5	88	acres	mercury in fish tissue
					PCBs in fish tissue
MA95125	Sampson Pond	5	295	acres	mercury in fish tissue
MA95137	Snipatuit Pond	4A	711	acres	mercury in fish tissue
MA95151	Turner Pond	5	86	acres	mercury in fish tissue
MA95170	Noquochoke Lake	5	13	acres	mercury in fish tissue
					PCBs in fish tissue
MA95171	Noquochoke Lake	5	17	acres	mercury in fish tissue
					PCBs in fish tissue
MA95175	Copicut Reservoir	5	596	acres	mercury in fish tissue
MA95178	Halfway Pond	5	215	acres	mercury in fish tissue
MA95-33	Acushnet River	5	0.31	sq. miles	metals
					oil and grease
					PCBs in fish tissue
					polychlorinated biphenyls (PCBs)
MA95-38	Clarks Cove	5	1.9	sq. miles	PCBs in fish tissue
MA95-39	Apponagansett Bay	5	1.06	sq. miles	PCBs in fish tissue
MA95-42	New Bedford Inner Harbor	5	1.25	sq. miles	metals
					oil and grease
					PCBs in fish tissue
					polychlorinated biphenyls (PCBs)
MA95-43	Copicut River	5	1.3	miles	mercury in fish tissue
					PCBs in fish tissue
MA95-62	Buzzards Bay	5	8.07	sq. miles	PCBs in fish tissue
MA95-63	Outer New Bedford Harbor	5	5.78	sq. miles	PCBs in fish tissue
MA95-96	Doggett Brook	5	2.9	miles	lead

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Action Plan 16. Preventing Petroleum Products Pollution

Problem

This action plan addresses catastrophic and chronic discharges of petroleum-based and hydrocarbon products to Buzzards Bay and its surrounding watershed. These discharges of petroleum products have caused environmental degradation of water quality and habitat.

Oil spills impact mobile and stationary organisms, sensitive species, and vulnerable life stages, including eggs, larvae, and juveniles. If a spill occurs in a small, confined embayment, damage is heavier than with offshore spills. Other factors include winds and currents that can push oil into any harbor or embayment, worsening environmental impacts. Bathing beaches and nearshore shellfish areas are often among the most vulnerable areas.

Immediately after a spill, certain species may show high mortality. For organisms that survive, short-term stress and impaired metabolism may affect the ability of populations to reproduce. Scientists have observed long-term impacts on populations and ecosystems where toxic hydrocarbons persist. Thirty-eight years after the 1969 West Falmouth oil spill, oil residues and impacts were still evident in the marsh (Peacock et al., 2007).

The type of oil released greatly influences ecosystem response and human impacts. The *Bouchard 120* spill of No. 6 fuel oil killed hundreds of birds, and affected more than 93 miles of coastline, but had little impact on fish and invertebrates in the water or in subtidal areas. In contrast, the No. 2 oil spilled in Falmouth in 1969 released many highly toxic compounds in the water, and killed many fish and invertebrates, but this oil affected fewer birds (Figure 78).

Most large accidental discharges (Table 27) relate to Buzzards Bay having been a major transit route for tanker and barge traffic transporting heating and industrial oil and gasoline into Boston and northern New England markets. The largest of these spills was the 1969 *Florida* spill off West Falmouth, spilling 189,000 gallons [82] of No. 2 fuel oil. Most recently, in April 2003, the Bouchard No. 120 tank barge ran aground near the entrance of Buzzards Bay, spilling an estimated 98,000

Photo credits, left: Joe Costa; right: George Hampson

Figure 78. Impacts of heavy versus light fuel oil spills.

Left: Heavy viscous oils, like the No. 6 fuel oil that spilled from the Bouchard Tank Barge 120 into Buzzards Bay in 2003, primarily killed birds, plants, and animals by physical contact. Photo shows a dead cormorant. In contrast to the Bouchard spill, the No. 2 home heating oil that spilled in 1974 from the Bouchard Tank Barge 65 in Buzzards Bay was far more devastating to aquatic species (right photo fish and invertebrates like worms, crustaceans, and mollusks) because of toxic soluble compounds in the oil.

[82] The volume of the Florida No. 2 fuel oil spill was repeatedly misreported in several publications during the 1960s and 1970s because of conversion errors. The final volume reported to Congress in a 1975 report was 4,500 barrels. see the NEP website on past spills.

gallons of No. 6 fuel oil on its transit to the Mirant energy facility in the Cape Cod Canal. Estimated costs of the oil spill likely exceeded $80 million dollars and included $37.2 million dollars in state and federal cleanup activities, $9 million dollars in fines, $7.7 million dollars for the Natural Resource Damage Assessment, an estimated $12 million dollars in private settlements, more than $1 million in state cleanup fees, and $2.5 million in third party reimbursements.

In the aftermath of the aftermath of the Bouchard No. 120 oil spill, in 2004 the Commonwealth of Massachusetts passed the Massachusetts Oil Spill Prevention and Response Act (Chapter 251 of the Acts of 2004) that, among other things, imposed a delivery fee of 2 cents per barrel (later raised to 5 cents) on oil delivered to Massachusetts ports in order to establish a $10 million Massachusetts Oil Spill Prevention and Response Efforts fund. The law helped change federal navigation rules by requiring escort tugboats for oil tankers and prohibited the transport of oil through Buzzards Bay and the Cape Cod Canal unless a Buzzards Bay port was its destination. This more than halved the tonnage of hydrocarbons passing through the Cape Cod Canal.

Another outcome from the 2003 spill is that in 2007 the USCG implemented a Vessel Movement Reporting System (VMRS) requirement for Buzzards Bay. The VMRS provides for improved communication and positional awareness for all mariners. The system is helping commercial vessels (especially tug/barge combinations) use the Recommended Vessel Routes (so-called "green lanes. Captains not using the Recommended Vessel Route [83] must notify the VMRS control center ("Buzzards Bay Control").

MassDEP and municipalities have improved oil spill planning, and fees from oil transport in Buzzards Bay have funded other programs to reduce the risk of oil discharges. Collectively these actions appeared to minimize the threat of future catastrophic oil spills in Buzzards Bay and addressed many of the oil spill recommendations in the 1991 Buzzards Bay CCMP. Improved navigational aids may reduce the risk further and development of better water circulation models may improve the response to future spills.

Although not as conspicuous, the cumulative discharge of hydrocarbons from chronic spills and other discharges are important. Sources include discharges from smaller land spills, water-based spills, chronic discharges associated with stormwater, CSOs, industrial discharges, boat fueling facilities, waste oil disposal, and contamination of boat bilge compartments. While industrial pretreatment programs, together with more stringent limits in NPDES permits, have dramatically reduced contributions from permitted outfalls, spills discharges of petroleum products and from boating remain a concern.

To address small boat fueling spills, in 2001, CZM developed a Clean Marina Guide that includes suggested regulations, policies, and guidelines for all marina fueling facilities. Small chronic discharges of petroleum products from boat engines, stormwater, fishing fleets, road and parking area runoff, and other sources are more difficult to address. Elements of the Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure and Action Plan 15 Reducing Toxic Pollution compliment the goals and objectives of this action plan.

Additional Information

Regulatory Framework

The federal Oil Pollution Act of 1990 largely defines how the federal government responds to oil spills. This law levied a tax on oil to establish a trust fund to provide funds to enable emergency response teams to hire personnel needed to respond to these disasters, including when the responsible party is incapable or unwilling to do so. The law also required the use of double hull oil transport vessels beginning 2015 for transporting oil, and imposed requirements relating to vessel manning, training, alcohol and drug screening, standards for foreign tankers, vessel traffic and communications systems, and oil spill contingency plans for oil spill haulers and storage facilities. The Act addresses liability and requires that the US Coast Guard, which is the lead agency in responding to ocean spills,

[83] At the west entrance to Buzzards Bay, the VMRS zone is bounded by a line extending from Sakonnet Point, Rhode Island, to the Buzzards Bay Entrance Light, and then to the southwestern tip of Cuttyhunk Island. At the east entrance to Buzzards Bay, the VMRS boundary is the same as the boundary for the Cape Cod Canal, which is 1.6 statute miles seaward of the Canal Breakwater Light. Tugs/barges are escorted, with a federal pilot aboard the primary tug, before entering the VMRS zone.

to maintain a computer file of available spill containment and cleanup equipment and create Area Contingency Plans.

In related legislation, under the U.S. Comprehensive Environmental Response, Compensation and Liability Act of 1980, in effect since 1986, specifies who must pay spill cleanup costs of hazardous substances. This allows the federal government and the states, in their roles as trustees, to claim damages for injuries to natural resources.

Massachusetts' companion spill cleanup legislation is the 1983 Massachusetts Oil and Hazardous Material Release Prevention and Response Act (MGL 21E) and supporting regulations (310 CMR 40). This law essentially addresses cleanup issues where the federal laws and regulations jurisdiction ends. Whenever there is a spill of oil or hazardous material in Massachusetts, the "Massachusetts Contingency Plan" regulations define the cleanup process and establish cleanup endpoints. MassDEP enforces the cleanup process defined in the Massachusetts Contingency Plan. An important provision of the Massachusetts General Law Chapter 21E and regulations in the Massachusetts Contingency Plan is that they require the responsible party to hire an environmental specialist called a Licensed Site Professional to direct assessment and cleanup activities in response to a spill.

Once a spill occurs, the principal factor in minimizing environmental damage is the speed of response. Oil spreads rapidly, dispersing through the water column, making clean-up efforts more difficult, and eventually contaminating sediments. Cleanup effectiveness diminishes over time as weather disperses the oil. Most often, emergency responders only recover about 10-20% of the spilled oil.

Separate from the emergency response and cleanup actions of an oil spill, state and federal agencies conduct an after-the-fact evaluation of spill impacts on the environment referred to as the NRDA. The Oil Pollution Act of 1990 established the NRDA process. The objective of this process is to restore coastal and marine resources injured by releases of oil, and to obtain compensation for the lost use of these resources by the public. The law requires assessment of both environmental and indirect economic impacts.

After an oil spill, the state and federal government establish a board of trustees to oversee the NRDA process (state and federal agencies, any Indian tribes, etc.). These trustees guide scientists, economists, restoration experts, and attorneys on the collection of data during the emergency phase of the spill until the damage assessment is finalized. The trustees use this data for damage assessment and to help protect resources during the cleanup or remediation activities. Collectively the trustees utilize this data to determine the full extent and magnitude of environmental injuries and lost services and to define the type and scope of restoration best suited to address these injuries and lost services. These trustees also oversee and approve implementation of restoration activities. The responsible parties can undertake proposed restoration projects, or they can "cash out" and provide funds to the trustees to implement those agreed upon restoration efforts. The cash out negotiations are conducted by attorneys representing the state and federal government, and the responsible party(s).

Early successes after the 1991 Buzzards Bay CCMP

The grounding of two large vessels in Buzzards Bay in 1990 prompted the 1991 Buzzards Bay CCMP oil spill action plan and initiated actions to plan for and minimize future spills. These accidents, together with the 1993 grounding of the Queen Elizabeth II, led the BBC to advocate changes in federal and state navigation requirements and the BBAC to establish mutual aid agreements. The BBAC also began holding meetings and training sessions to improve the coordination of oil spill response among Buzzards Bay municipalities. At the same time, the Buzzards Bay NEP, through its municipal grant program, began to fund the purchase of oil spill containment equipment and training classes.

After the January 1996 grounding of the barge North Cape off Moonstone Beach and its disastrous effects on Rhode Island waters, concerns about oils spills and the need for local oil spill preparedness continued to prompt action by all three Buzzards Bay groups.

Collectively, these actions likely helped minimize the frequency of catastrophic accidents in Buzzards Bay, and helped ensure a high degree of success by local first responders to minimizing impacts to the 2003 *Bouchard 120* oil spill. But despite these successes, the 2003 *Bouchard* spill illustrated that such accidents can

and will continue to happen because of human error or negligence, and that many navigational and response issues still needed to be resolved.

Characterizing Spill Impacts

A common problem with catastrophic spills is the initial focus on containing the extent and impact of the spill during the emergency response phase. There is often less focus on systematically documenting the physical extent of oil landings or inventorying invertebrate and vertebrate species mortality. Key information, like hydrocarbon concentrations in the water column, is not collected because state managers, who might not have worked on a catastrophic spill, do not realize that this information is invaluable in the months or years of the NRDA process. In the absence of such data, scientists must instead use computer models to estimate mortality of aquatic species such as fish and crustaceans, including their planktonic juvenile forms.

The *Bouchard 120* spill had some similar problems. In the absence of actual measured hydrocarbon concentrations in the water column, the Aquatic Resources Technical Workgroup had to rely on computer models of toxicity. These models were inadequate to evaluate toxicity of oil in shallow nearshore areas. Similarly, the shoreline technical workgroup had to estimate the extent of the area of stranded oil (footprint) on beaches because the initial assessment teams focused on identifying oiled areas and did not calculate the area of stranded oil on sandy beaches.

Actions taken by town personnel in the initial hours and days of an oil spill can greatly minimize local impacts. One lesson learned from the response to the *Bouchard 120* oil spill was that cleanup was hampered by the inability to quickly integrate local first responders into cleanup activities, and the municipalities were in fact taking actions independently for several days. This problem occurred in part because local government did not have adequate access to the unified command structure. Decisions about the response and cleanup of oil spills are made through consensus of three parties: the USCG, MassDEP, and an agent for the National Incident Management System. Incident Command System guidelines allow for input to the unified command structure, through a liaison officer and better use of this mechanism could have minimized conflicts between the federal government and the municipalities.

After the 2003 oil spill, the USCG recognized the need to better integrate local needs and expertise into area contingency plans. In 2005, MassDEP created a Massachusetts Oil Spill Act Advisory Committee to help target uses of funds collected under the state Oil Spill Act. MassDEP also provided funding to the BBC to work with area oil spill coordinators to develop a geographic oil spill response plan for Buzzards Bay that includes specific boom deployment strategies and tie off locations in case of various oil spill scenarios. The BBC hired a contractor to complete a Buzzards Bay response plan in 2005. With funding from MassDEP, the BBC met with oil spill responders and local officials to update the response plan. Another contractor updated response plan in 2007.

Chronic oil spills in New Bedford Harbor

Less progress has been made on another problem identified in the 1991 and 2013 CCMPs. Commercial fishing vessels, which operate mostly out of New Bedford but also Westport, usually have their engine oil changed (10-120 gallons per boat) after practically every trip. It was believed that the inconvenience and the expense (at the time about 30 cents per gallon, today one dollar or more) of safely disposing of waste oil or contaminated bilge water, was believed to have resulted in a number of boat operators blatantly dumping oil into the bay or offshore waters. Although this is illegal, it is difficult to document violations and hence take enforcement actions. The USCG and MassDEP believe that contaminated bilge water is the principal cause of the frequent sheens that appear in New Bedford Harbor. Convenience and expense in disposing of waste oil may also be a problem for the general boating public but oil changes in small, launched boats is uncommon.

Table 27. Past large oil spills in Buzzards Bay.

Date	Vessel Name	Vessel Type	Location	Type	Volume Spilled (gallons)	Comments
14-Nov-63	Dynafuel	Tank Barge	A collision occurred between Mishaum Point Dartmouth and Cuttyhunk. The empty barge sank off New Bedford while under tow.	No. 2 Fuel Oil	unknown; probably residual oil from sunken tank barge	A 1970s scientific report notes oil came ashore near Nyes Neck, North Falmouth, during the winter of 1963. This may have been the result of collision of the Norwegian freighter *Fernview* with the with the empty tank barge *Dynafuel*. The vessels were locked together and caught fire. The empty barge sank in 40 feet of water.
16-Sep-69	Florida	Tank Barge	Fassets Point, West Falmouth	No. 2 Fuel Oil	189,000	The final estimate was 4,500 barrels spilled.
9-Oct-74	Bouchard 65	Tank Barge	Cleveland Ledge (near canal entrance)	No. 2 Fuel Oil	7,500-36,500	Hampson and Moul (1978) list the spill as indeterminate volume, but this may not reflect actual USCG reports. A 1975 article suggests 7,500 gallons, Town of Bourne Annual Reports imply 40,000 gallons or less. In 2001, Cape Cod Times suggested 25,000 gallons. In the NOAA report "Polluting Incident Compendium Part iii – Historic Spills: 1969 - 1993, it is noted that in 1974, Massachusetts had 110 spills recorded spill, the largest of which was 21,000 gallons. Another USCG document lists 36,500 barrels, but the units likely should have been reported as gallons.
28-Jan-77	Bouchard 65	Tank Barge	Cleveland Ledge	No. 2 Fuel Oil	81,144	Barge grounded, oil spilled on ice covered bay, some burned. The final estimate was 81,144 gallons (1,932 barrels) spilled, although initial press reports suggested 500,000 gallons spilled. The grounding ruptured four of the seven tanks.
2-Aug-77	unknown	unknown	Canal	No. 6 Fuel Oil	550	As reported in the 1977 Annual Report of the Town of Bourne (pg. 91) where they list 6 oil spills occurred during 1977 in the Town of Bourne waters. Four of those spills appear to be minor, with spill volumes listed as unknown.
1-Apr-78	Rhode Island	Tank Barge	Cape Cod Canal near Bourne Bridge	No. 2 Fuel Oil	6,000	A barge was carrying 77,300 gallons. Volume reported as 6,000 liters by Farrington et al. (1982).
24-Jan-85	Barge Corpus Christi	Tank Barge	South of Cleveland Ledge	No. 2 Fuel Oil	50-100	3x4 hole, anchored at Buoy 11.
30-Oct-85	M/V Sun Bird	Cargo Ship	Wilkes Ledge, off Mishaum, Dartmouth	No. 4 Fuel Oil	2,500	A 310-foot cargo ship out of Japan hit a shoal, causing a 2x20-foot long gash that ruptured a central fuel tank.
17-Sep-86	T/B ST-85	Tank Barge	Cleveland Ledge	Gasoline	119,740	Tank barge under tow by the tug *Seastar*, grounded. Two port tanks were damaged, including a gash 60 feet long. Initial reported gasoline losses were estimated at 23,000 gallons, later summaries list the spill as 119,740 gallons.
10-Jun-90	Bermuda Star	Cruise Ship	Cleveland Ledge	No. 6 Fuel Oil	7,500	The cruise ship went aground, impacts to Naushon. Incident news has an incorrect entry for a Burma Starr on June 11 with 110,000 gallons of number 6 (the vessel fuel oil capacity).
18-Jun-90	Bouchard 145	Tank Barge	Cleveland Ledge	Diesel oil or heating oil	100-200	Navigational error: vessel veered off course in fog. The 475-foot barge was loaded with 5 million gallons.

Table 27. Past large oil spills in Buzzards Bay.

Date	Vessel Name	Vessel Type	Location	Type	Volume Spilled (gallons)	Comments
7-Aug-92	Queen Elizabeth II	Cruise Ship	Sow and Pigs Reef, Cuttyhunk	No. 6? Fuel Oil	50	Empty fuel tank ruptured causing spill from residual oil.
27-Apr-03	Bouchard No. 120	Tank Barge	Entrance to Buzzards Bay	No. 6 Fuel Oil	98,000	Vessel travelling 6 knots 1/4 mile outside of lane marker.
9-Nov-08	Southern Cross	Tugboat	Dartmouth waters, south Buzzards Bay	Diesel	110	Tugboat grounding and partial sinking.
20-Mar-13	Justice	Tugboat	Stony Point, Wareham	Hydraulic Oil	330	The 93-foot tugboat lost its lower starboard drive unit, and the unit leaked 300 gallons of the 625 gallons of hydraulic oil contained within it.

This table does not include small less well-documented spills prior to 1990. Spills prior to 1982 are generally poorly documented, and it was not until after 1990 that natural resource damage assessment studies were undertaken. The summary also does not include land-based spills reaching the bay. For example, on February 7, 1975, five thousand gallons of home heating oil spilled into Sippican Harbor Marion (Boston Globe, Feb. 8, 1975, pg. 20). This entry may have been confused with the sinking of the coal barge Joseph J. Hock sinking off Penikese on Jan 22, 1947, after striking and breaking tow at Hen and Chicks. Additional information relating to this table is available at the Buzzards Bay NEP past spills web page.

In 2013, the BBC revisited the issue of chronic sheens in the harbor [84]. They concluded that a multi-pronged approach involving remote camera monitoring of harbor activities and oil sheens, better enforcement, and subsidized services to collect oily bilge water from commercial vessels in the harbor might be the most cost-effective approach in reducing chronic harbor hydrocarbon discharges. The New Bedford Harbor Development Commission, the USCG, and MassDEP should collaborate to reduce chronic discharges of hydrocarbons in New Bedford Harbor.

Goals

Goal 16.1. Reduce the amount, frequency, and impacts of petroleum product spills and discharges to Buzzards Bay.

Objectives

Objective 16.1. Support DEP's emergency preparedness and response efforts to prevent and respond to oil spills and hydrocarbon discharges.

Objective 16.2. Support and encourage adoption of source-reduction plans for chronic inputs of hydrocarbons into Buzzards Bay.

Objective 16.3. Regulators and municipalities should ensure there are adequate facilities for the collection of waste oil from cars and boats.

Objective 16.4. Regulators must investigate and take enforcement actions against the illegal discharge of oil.

Objective 16.5. Regulators and municipalities should ensure vessel and boat refueling operations employ systems to prevent petroleum spills and report spills when required.

Management Approaches

Reducing future hydrocarbon discharges and impacts to Buzzards Bay will require decreasing the likelihood of catastrophic spills, improving the cleanup effectiveness and response time when spills do occur, and better monitoring impacts after spills.

To reduce future impacts of oil spills, increased local availability of response equipment, installation of boom anchorages, improved training and coordination among municipalities, and periodic re-evaluation of spill response plans are continuing needs. Completion by NOAA of a water circulation oil spill trajectory model for Buzzards Bay will greatly improve predictions of the location of oil landings after a major spill. Installation of Physical Oceanographic Real-Time System (PORTS®), employed elsewhere around the country, will also aid with navigation, and spill model predictions. The state also needs to develop an oil spill damage assessment-monitoring plan in collaboration with local universities and research centers, to establish a protocol to collect essential data quickly for the environmental damage assessments after a spill.

With respect to chronic discharges of oil, better treatment of permitted discharges, including stormwater, can further reduce hydrocarbon release. (Stormwater related hydrocarbon discharges are addressed further in Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.) Strategies to reduce illicit discharges in New Bedford Harbor and Buzzards Bay may include remote camera monitoring of harbor activities and oil sheens, better enforcement, and services or a facility to collect oily bilge water from commercial vessels in the harbor. The increased use of 4-stroke engines will minimize hydrocarbon discharges from recreational boats. Municipalities can set an example by buying 4-stroke engines for harbormaster vessels. Local recycling programs and education remain important strategies.

Costs and Financing

Estimated costs for these approaches are Natural Resources Damage Assessment (NRDA) monitoring plan development, ~$80,000; NOAA circulation model, ~$100,000; Physical Oceanographic Real-Time System, $1 million installation, $200,000 annual operating costs; program to minimize illicit discharges to New Bedford Harbor, ~$200,000 in capital and $200,000 annual operating costs. Some costs might be eligible for Marine Oil Spill Prevention & Response Act funding, others through state and federal grants or appropriations.

Measuring Success

The effectiveness of measures to reduce large spills may take years to evaluate. Numbers of reported sheens and oil recovered from bilge water can be used

[84] Presentation at the Massachusetts Oil Spill Prevention and Response Act Advisory Committee meeting October 23, 2013.

to track measures to reduce small spills. Adoption of regulations with hydrocarbon BMP requirements can be tracked. Reductions of nonpoint sources of hydrocarbons can only be evaluated programmatically.

Action Plan 17. Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms

Problem

For millennia, the Buzzards Bay coastline has been subject to a rising sea level and storms that continue to erode and shift materials that change the shape, elevation, and position of the shoreline. Climate-related changes in the rate of sea level rise, coupled with storms, have accelerated these processes. Changes may occur gradually, or abruptly in response to extreme storm events. A 2022 NOAA sea level study estimates sea level along the East Coast will rise, on average, 10 - 14 inches in the next 30 years, which will be as much as the rise measured over the previous 100 years (Figure 79). In the study, if mean global temperatures increases 5° C by 2100, the model predicts a 10% chance that sea levels will increase 6.5 feet by 2100. This scenario has the most profound implications for coastal development.

The migration of barrier beaches and other sensitive shorelines as sea level rises alters wetland areas, causing migration or loss of habitat and dependent species. Structures and infrastructure built in hazard-prone areas can impede natural processes and increase habitat loss and degradation. When structures and infrastructure are damaged or destroyed by storms and flooding, they are not only a financial loss for the owner but can become a financial burden to government. Damaged structures and infrastructure can also become hazards to public health and the environment. Government regulations and policies that encourage development and redevelopment in these hazard prone areas, like Federal flood insurance programs and disaster relief efforts not requiring change, create moral hazards [85] that encourage property owners to build where the risks are too great without government support. These actions undermine government efforts to reduce risks and improve coastal resilience. Managing these risks requires cost-benefit analyses of managed retreat, relocation of infrastructure, armoring, and raising structure elevations. State and local government must identify and finance approaches to withstand, rapidly recover from, adapt to, and mitigate hazard events. The reader can find related goals can be found in Action Plan 17 Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms.

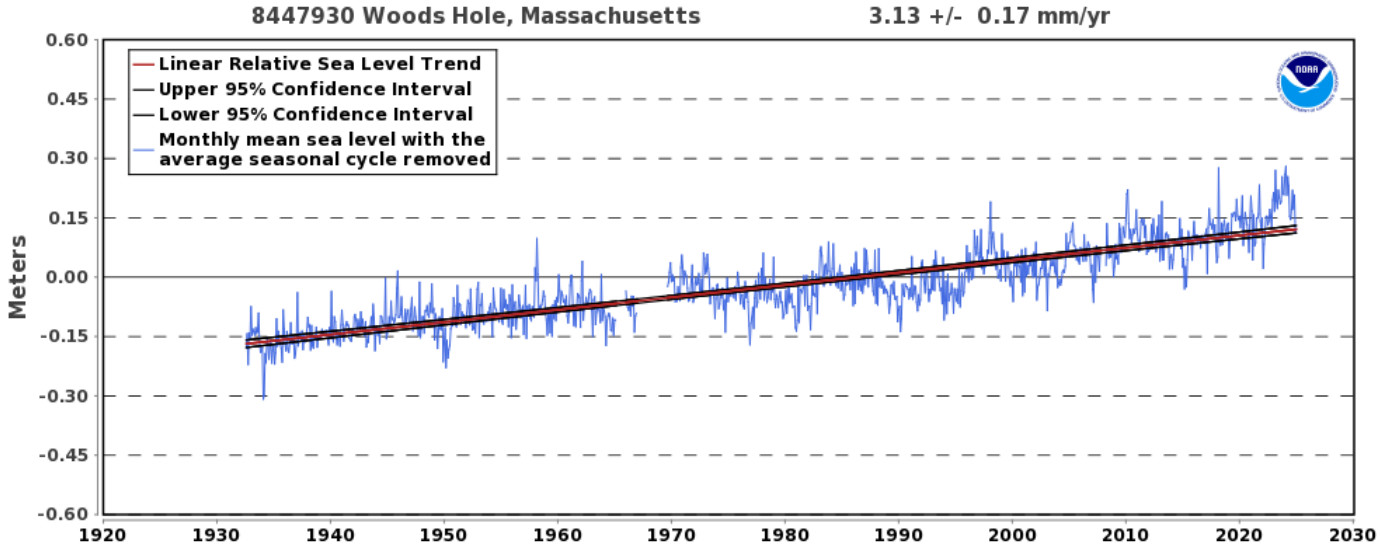


Figure 79. Mean sea level trend at NOAA tidal station 8447930 Woods Hole, Massachusetts.

The mean sea level trend for the entire record is currently 3.13 millimeters/year (1.22 feet/century), which is 20% greater than the 2.61 millimeters/year mean sea level rise from 1932 to 2012 reported in the 2013 CCMP.

[85] In economic theory, a moral hazard is a situation where a party may take risks because they may not feel the full costs that could incur by taking the risk. The insurance industry defined the term more than a century ago. The term is also used to characterize any behavior from an individual, who when insulated from a risk, behaves differently than if they were fully exposed to that risk.

Additional Information

Climate Change and Sea Level Rise

During the past 750,000 years, the earth has repeatedly cycled between ice ages lasting from 70,000 to 100,000 years, and brief warm periods lasting between 10,000 to 30,000 years. Since the peak of the last ice age 21,000 years ago, when glaciers covered Buzzards Bay with a mile thick sheet of ice, sea level has risen roughly 400 feet. During the last interglacial period (130,000 years ago), the earth's climate was warmer than today, nearly all of Greenland's ice sheet melted, and sea level was roughly 19 to 29 feet higher than today.

Sea level rose rapidly during the retreat of the ice sheet across North America beginning 19,000 years ago, averaging 4 feet per century. About 6,000 years ago, the rate of sea level rise slowed dramatically. During the past 4,000 years, sea level rise in southern New England likely was only 6 inches per century (Engelhart et al., 2011). During the past 3,300 years, the relative sea level rise near Boston was only 3 inches per century (Donelly, 2006). However, the rate of sea level rise is again increasing. The Woods Hole tidal records have documented a 1.2-foot rise during the past 90 years and the current rate is 1.7 feet per century (see Figure 19 in Chapter 2).

Since colonial times, the two principal ways of measuring coastal changes has been through shoreline mapping and more recently, through the collection of tidal elevation data. A casual examination of nautical charts from the 19th and early twentieth century shows that some tidal rocky areas, headlands, and tiny islands in Buzzards Bay have disappeared. A more thorough analysis of charts and aerial photographs by Massachusetts Coastal Zone Management in the early 2000s showed a horizontal migration of shorelines in a few parts of Buzzards Bay exceeding 10 feet a century. However, in most Buzzards Bay, shorelines have been relatively static during the past hundred years due to the protected nature of most of Buzzards Bay shores or because of the presence of bedrock. Historic coastlines and habitats are seen most easily near migrating barrier beaches. Figure 80 salt marsh peat offshore where the barrier beach and marsh existed hundreds of years earlier.

As noted by the Intergovernmental Panel on Climate Change and other sources, "anthropogenic warming and sea level rise will continue for centuries due to the timescales associated with climate processes and feedback, even if greenhouse gas concentrations were to be stabilized." Thus, for the indefinite future, coastal managers and planners need to focus on climate adaptation while promoting long-term policies to minimize the financial and ecological impacts of coastal development. Managers call this approach adaptation. While government needs to address greenhouse gas emissions that can worsen these background trends, only federal agencies can address national and international issues. The focus of this management plan is to implement strategies to reduce the severity of impacts of future storms and sea level rise on the coast and on existing and future development.

Figure 80. Aerial photograph of Sippewissett Marsh showing salt marsh peat offshore, remnants of a lower sea level centuries ago, and the inland migration of a barrier beach.

Development Pressures and Adaptation

With increased development on the coast including storm damage prone areas, efforts to protect these areas have included the filling of tidelands, and the "hardening" or armoring of shorelines through the construction of groins, revetments, bulkheads, and other structures. Through direct and indirect effects, there have been wetland losses and impairments, such as restrictions to tidal flow. Hardened shorelines also prevent natural shoreline processes, like coastal sand transport, which in turn may worsen coastal erosion rates. These structures also prevent the natural inland migration of salt marshes. Figure 81 shows how inland edges of salt marshes may not migrate because of roads, buildings, or walls. Preserving the ability of salt marshes to migrate, and the restoration of tidally

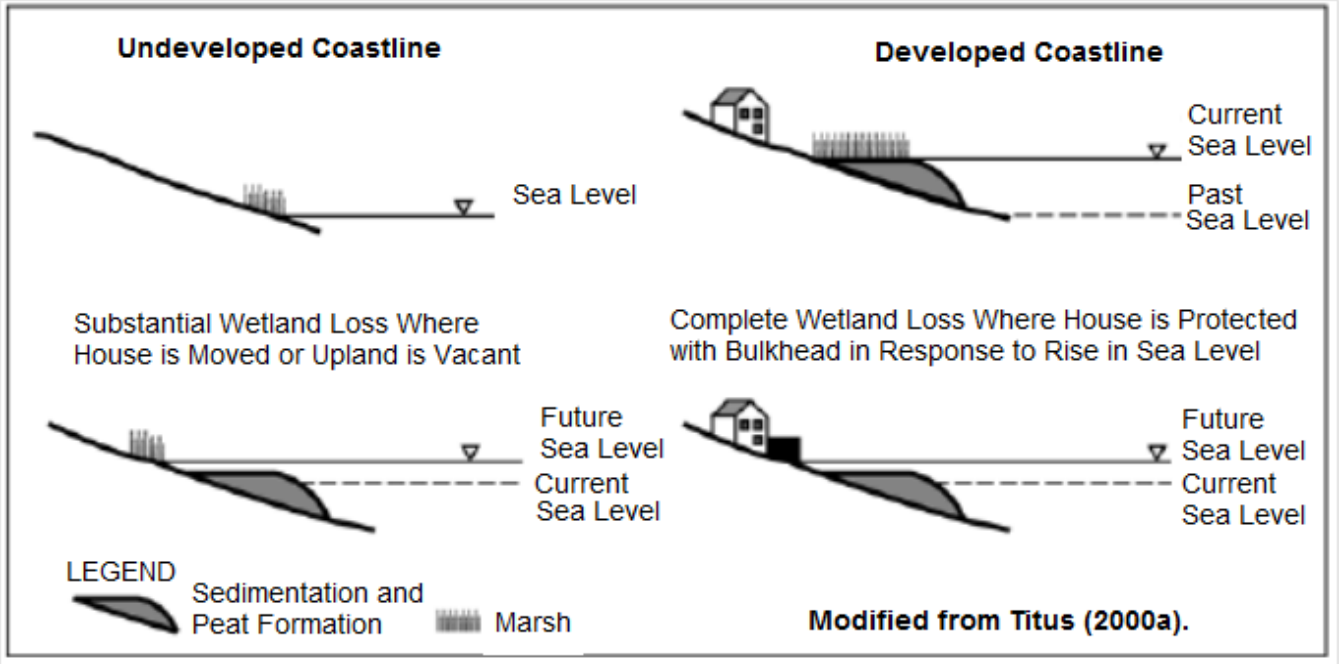


Figure 81. Salt marshes having been migrating inland for thousands of years as illustrated by the figure on the left. Construction of bulkheads and other structures prevent this inland migration, resulting in loss of salt marsh (right).

restricted salt marshes altered in the past, remain priority actions for the Buzzards Bay NEP.

Private residential and commercial construction in vulnerable coastal areas results in pressure on government to improve infrastructure (roads, utilities, and bridges) in those areas. After storms damage the new infrastructure, all taxpayers share the costs to restore damaged coastal areas. In older urbanized coastal areas, the economic value of public and private property and infrastructure was so great that municipalities often filled and armored large areas of tidelands [86]. In less densely developed coastal areas, there is a debate about whether the public (taxpayers) should bear the costs of protecting and rebuilding private property, and whether government should limit new development in these areas.

As sea level rises, managers must also address the inland migration of all wetlands and the increased elevation of groundwater near the coast. Groundwater levels near the coast may affect the performance of onsite wastewater systems and was the basis of a recommended 5-ft separation to groundwater (instead of standard four feet) of onsite wastewater systems called for the original 1991 CCMP. In their 1996 regulations, they required a five-foot separation in fast perking soils (like those found near coastal beaches). This strategy was more explicitly written into some municipal local regulations like the Town of Falmouth Septic System regulations where setbacks from surface waters and groundwater are based on "dynamic water table elevations that are responsive to seasonal and interannual variations in sea level and climate, and are projected to rise in proportion with rising sea level".

Since the creation of a federally subsidized National Flood Insurance Program, there has been an ongoing debate about moral hazards created by the program, and how the program may be encouraging development in high-risk areas. In fact, in the 1991 Buzzards Bay CCMP, a stated objective of this action plan was "to restructure the flood and hazard insurance programs in threatened areas so that the financial burden on the general public is decreased." The U.S. Congress finally addressed this issue in part with the passage of the Biggert-Waters Flood Insurance Reform Act of 2012. The legislation required the FEMA to make the necessary changes to the way it runs the National Flood Insurance Program . A key provision of the legislation required National Flood Insurance Program pol-

[86] Despite an estimated 2.5-foot rise in sea level, between 1700 and 1950, the cities of Boston and New York increased appreciably both in size and elevation as millions of cubic yards of fill were placed on uplands, tidelands, and wetlands.

icy rates to reflect true flood risks and costs. FEMA implemented these changes over several years resulting in higher insurance premium rates for existing and new construction in the flood plain. In 2019, five agencies adopted a new rule to implement provisions of the Act by requiring regulated institutions to accept certain private flood insurance policies in addition to National Flood Insurance Program policies.

Storm Damage and Storm Frequency

The frequency of hurricanes striking the US is somewhat unpredictable (Figure 82). Because most coastal development around Buzzards Bay occurred during the relatively quiescent period between 1970 and 2000 (see Figure 3 in Chapter 1), if a hurricane equivalent to the Hurricane of 1938 (estimated to be a Category 3 hurricane with a tidal surge of 14 feet in portions of Buzzards Bay) were to strike Buzzards Bay today, property damage would be far more extensive. This is because in the 1930s, most of the population lived in cities like New Bedford (which had a higher population than today), and a smaller fraction of the population in the 100-year flood zone. Surrounding communities were more rural, and the structures built closest to shore were often summer cottages, built to be expendable in the face of coastal storms. With improved roads and infrastructure and with government subsidized flood insurance programs that de facto promoted residential growth near shore, development within the flood zone of Buzzards Bay increased dramatically. Even in the face of relatively minor storms, Buzzards Bay communities have seen tens of millions of dollars in claims under the National Flood Insurance program since 1978 (Table 28).

While the size and timing of future storms and shoreline changes are not known, shorelines will continue to erode and migrate. Irrespective of changes in future storm intensity, the effects of another direct hit of a category 3 hurricane in Buzzards Bay like the hurricane of 1938 will be immediate and profound given all the new development along the coast and given that sea level is now 1 foot higher than then.

Goals

Goal 17.1. Protect public health and safety and strengthen resilience to coastal hazards including rising sea level, shifting shorelines, and damage from storms and storm surge.

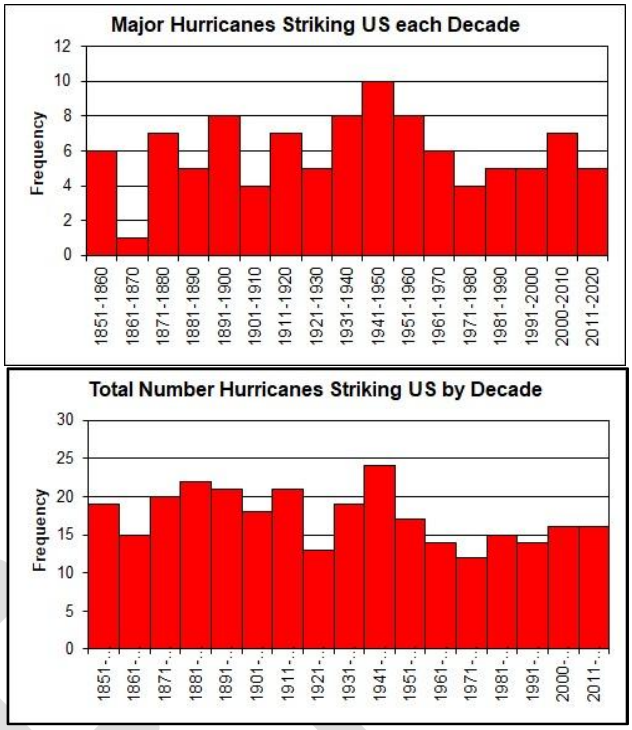


Figure 82. Frequency of major hurricanes (greater or equal to category 3) striking U.S. during the past 150 years.

The frequency of severe hurricanes striking seems to be cyclic, but future trends are less certain. Data from Blake et at. 2005, modified to include 2005 (severe year) and 2006 (hurricane free year) and 2007 and 2008 data. See also: National Hurricane Center strikes page.

Goal 17.2. Plan for sea level rise, shifting shorelines and sand formations, and the inland migration of coastal wetlands and the species that use these habitats.

Objectives

Objective 17.1. Incorporate sea level rise, increased frequency and intensity of coastal flooding and storms, and expected shoreline change into all relevant planning and management programs.

Objective 17.2. Encourage coastal municipalities to evaluate existing and future vulnerabilities and develop hazard mitigation and climate adaptation plans and adopt near- and long-term coastal resilience strategies.

Objective 17.3. Adopt regulatory and non-regulatory strategies to require resilient development and guide growth away from high hazardous areas.

Objective 17.4. Adopt state and local emergency response plans to address emergency conditions caused by reduced access and flooding of coastlines.

Objective 17.5. Support research and monitoring into the efficacy of management practices to prevent salt marsh loss.

Objective 17.6. Encourage coastline climate resilience strategies that are compatible with the migration of wetlands and barrier beaches.

Objective 17.7. Promote land management, land protection, and restoration that support potential marsh migration or creation.

Objective 17.8. Help municipalities identify and map marsh migration areas, and barriers to marsh migration.

Objective 17.9. Assist municipalities to identify municipal infrastructure most threatened by sea level rise and coastal storms and support efforts to improve resilience or move assets to less vulnerable locations.

Objective 17.10 Support beneficial reuse of dredge sediments for beach nourishment projects.

Management Approaches

While municipalities are the lead for many actions, various state and federal agencies must provide funding, technical support and guidance to achieve the goals of this Action Plan. This action plan requires changes in regulations, policies, and actions by all levels of government to make coastlines and shoreline development more resilient to increasing rates of sea level rise and more frequent or more intense storms. A good starting point for municipalities is to develop geographic databases to inventory infrastructure, nearshore habitat, aquaculture enterprises, structures, natural resources, and tideland characteristics to enable municipalities to inventory property, resources, and enterprises most vulnerable to sea level rise and catastrophic storms, this information can help guide planning efforts and prioritize management action.

Once municipalities understand and inventory the threats they face, they can mitigate some risks through participation in various state and federal programs. Below are state and federal programs that provide financial and technical aid to municipalities to address these issues.

Federal

FEMA has several programs to reduce risks and costs associated with their flood insurance program. Massachusetts joined the National Flood Insurance Program in 1978 and was one of the first states to develop a State Hazard Mitigation Plan in 1986. In 2018, Massachusetts adopted the State Hazard Mitigation and Climate Adaptation Plan, the first plan of its kind to successfully integrate climate change impacts and adaptation strategies with hazard mitigation planning. This FEMA-approved plan remained effective for 5 years until its most recent update in 2023 as the Resilient-Mass Plan. Municipalities similarly adopt their own hazard mitigation plan. The purpose of these plans is for municipalities to define potential natural disaster risks, develop strategies to reduce the impact catastrophic events, and minimize loss of life and property damage by acting before a disaster strikes. With an up-to-date FEMA-approved hazard mitigation plan, states and municipalities could be eligible for federal assistance, depending on the availability of funding. As of January 2025, only three municipalities on the coast on Buzzards Bay had current plans and six had expired plans (Table 29).

Similarly, municipalities taking part in the Community Rating Systems program not only lessen potential future flood damage and improve public safety, but the flood insurance premium charged to homeowners is reduced. By adopting specific practices specified in the Community Rating System program, municipalities can reduce insurance premiums paid by residents. From an environmental policy perspective, many activities that achieve high Community Rating System scores also reduce environmental impacts from new development or reduce environmental impacts resulting from natural disasters (Table 28). Currently no Buzzards Bay coastal communities take part in the Community Rating System (Table 29).

An underlying principle of these programs is that government must not create incentives for private construction in high-risk zones. Similarly, municipalities should avoid public spending on infrastructure in high-risk areas. However, if municipalities cannot move infrastructure, they must make it more resilient. Municipalities must conduct inventories and evaluations of their risks when they prepare hazard mitigation plans or take part in the FEMA community rating systems to make their community more resilient and to reduce insurance costs for property owners. Regional planning agencies and CZM should aid in these efforts. The state and municipalities should lead by example by not building new public structures in high-risk areas.

In 2008, FEMA, Army Corps of Engineers, and the National Weather Service developed the SLOSH model. These agencies used the model to evaluate the threat from hurricane storm surge and emergency managers used it to find areas to evacuate including the development of local hurricane evacuation routes (Figure 76). SLOSH maps are a useful resource for local managers in Buzzards Bay communities with southern-facing shorelines which receive more direct impact from hurricanes (tropical storms) than from extratropical storms which more directly impact the northeastern facing shorelines.

State

EEA and CZM have grants can support and help implement FEMA programs or support municipal planning and resilience projects.

In 2017, EEA created the municipal vulnerability preparedness (MVP) grant program. The state-funded program helps municipalities to assess their vulnerability to climate change impacts, develop plans to increase resilience, and implement priority projects. Categories of preparedness include hazards like flooding, extreme heat, and sea level rise. The program's planning grants encourage community engagement to develop a local resiliency plan and become a certified MVP community. Municipalities can receive MVP level 1 or MVP level 2 certification. The certification makes the community eligible for the program's action grants that address identified vulnerabilities. All Buzzards Bay watershed communities have received Level 1 certification. As of 2024, the towns of Westport are undergoing level 2 certification. All Buzzards Bay coastal municipalities have received at least one action grant except Bourne and Marion.

Table 28. Selected Community Rating System activities that may benefit the environment.

Listed by CRS program category number; from FEMA, 2025.

420 a: Is a portion of your Special Flood Hazard Area (SFHA) kept as park or other publicly preserved open space
420 c: parks or other publicly preserved open spaces preserved in or restored to their original natural state
420 e: have density transfers or other regulations to encourage developers to keep the SFHA as open space
420 f: Is a portion of your SFHA zoned for minimum lot sizes of 5 acres or larger
430 a (1): prohibit filling or require compensatory storage in all or parts of the SFHA
430 a (2): prohibit certain types of buildings from all or parts of the SFHA
430 a (3): prohibit or limit the storage of hazardous materials from all or parts of the SFHA
430 b: have a freeboard requirement
430 c: compaction and erosion protection requirements for fill that is used to support buildings
430 f: require critical facilities to be protected to the 500-year flood level
430 g: require a non-conversion agreement signed by the permit applicant for an elevated building
430 i: regulations that ensure that every new building will be built to be protected from local drainage flooding
450 a: require new developments to build storm-water retention or detention basins
510 c: adopted a plan to protect aquatic or riparian species or other natural floodplain function
520: Have buildings in the floodplain been acquired and the properties are now open space
540 a: a program to regularly inspect streams, ditches, and other channels and to remove debris when found
540 c: a capital improvements program for drainage improvements
540 d: an ordinance that prohibits dumping debris, junk, grass, and other landscape waste in drainageways
610 e,f: Are you a StormReady or TsunamiReady community

Table 29. National Flood Insurance losses in Buzzards Bay coastal communities*.

Community Name	Repetitive Total Losses**	Paid Losses	Unpaid Losses	Total Payments	Dollars per Paid Claim	Policies In-force	Total Insurance Coverage	Hazard Mitigation Plan (2025)	CRS participant (2021)
Acushnet	0	1	0	$14,622	$14,622	9	$2,679,000	no	no
Bourne	33	377	82	$5,435,069	$14,417	711	$193,733,000	expired	no
Dartmouth	18	76	46	$778,988	$10,250	374	$109,612,000	expired	no
Fairhaven	58	314	81	$3,273,025	$10,424	528	$129,618,000	expired	no
Falmouth	85	472	147	$9,091,549	$19,262	1774	$490,529,000	yes	no
Marion	11	131	43	$2,877,321	$21,964	396	$118,273,000	yes	no
Mattapoisett	49	380	88	$6,754,052	$17,774	563	$158,335,000	expired	no
New Bedford	0	27	24	$635,184	$23,525	252	$82,163,000	expired	no
Wareham	60	721	114	$11,500,072	$15,950	1295	$328,825,000	yes	no
Westport	22	78	29	$1,112,631	$14,265	227	$67,716,000	expired	no

* Data from FEMA as of January 2025.
**1985-2023

CZM has long been a leader in providing technical and financial assistance to Massachusetts coastal communities to help manage coastal storm impacts to development, infrastructure, and natural resources. Key milestones over the last two decades include:

In 2006, at the request of the Governor and State Legislature, CZM launched the Coastal Hazards Commission that reviewed existing coastal hazards practices and policies, described data and information gaps, and

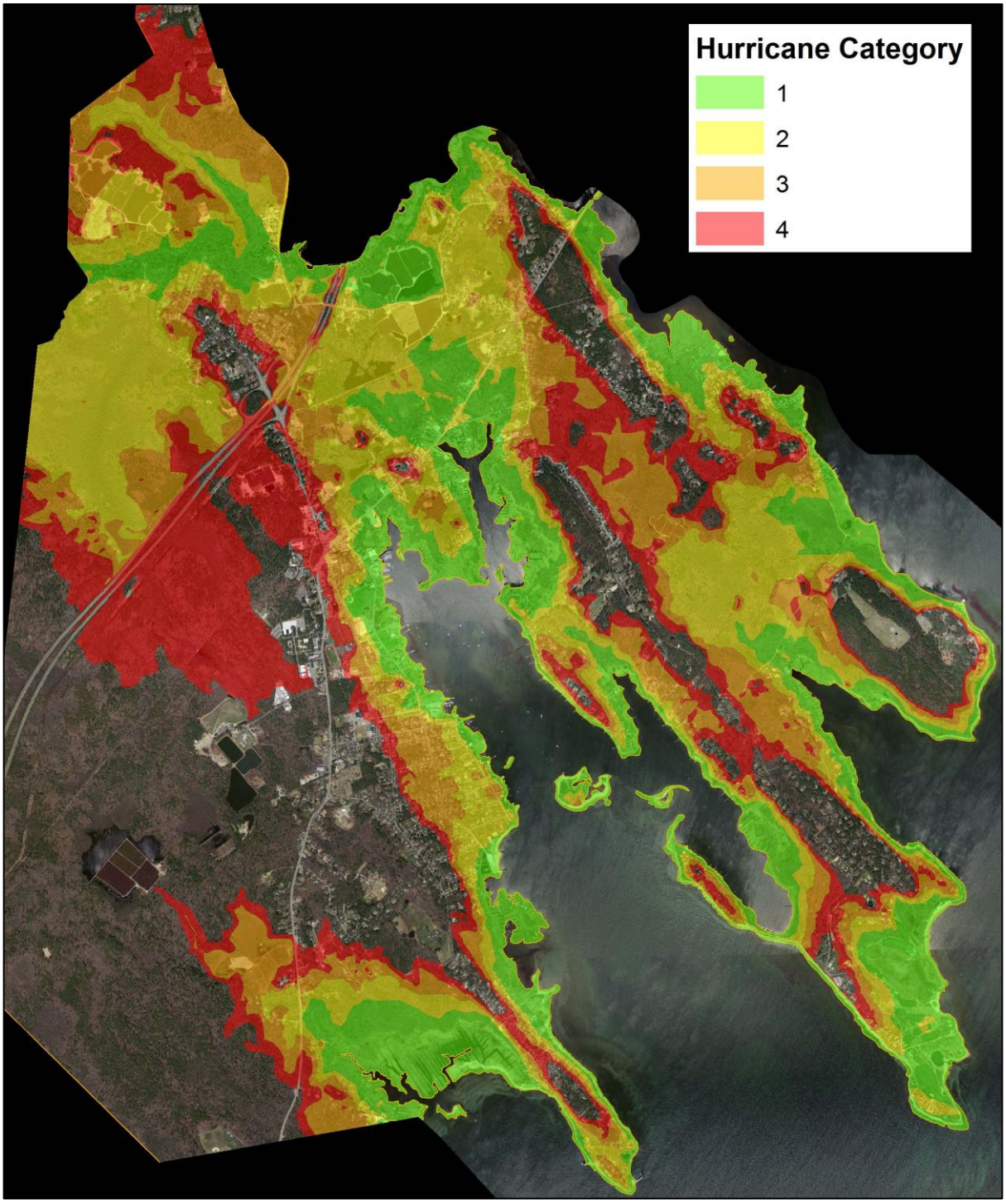


Figure 83. 2013 SLOSH flooding model map of Marion, MA produced by the U.S. Army Corps of Engineers.

The model shows the worst-case flooding scenario for Category 1-4 hurricanes striking Buzzards Bay. Marion is one of several Buzzards Bay communities with extensive areas within the flood zone. In 2013, the Buzzards Bay NEP estimated the assessed value of structures within the FEMA floodplain (nearly the Category 2 storm boundary here) to be 93.5 million dollars.

drafted recommendations for administrative, regulatory, and statutory changes. The Commission's 2007 report had 29 recommendations to improve the management of risk from coastal hazards in Massachusetts. The state and coastal communities have achieved nearly all these recommendations.

Between 2009 and 2011, CZM's StormSmart Coasts Program provided "direct in-community" technical assistance to seven communities on five pilot projects to demonstrate the application of coastal resilience strategies in local projects. To support these pilot projects, CZM provided guidance on incorporating projected sea level rise scenarios in community vulnerability assessments, public outreach, and local floodplain management regulations. In 2013, CZM published *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning* to assist coastal communities in Massachusetts in considering and applying future conditions in current, local planning processes.In 2011, Massachusetts released its Climate Change Adaptation Report which was the first broad overview of climate change and its effect on multiple sectors, ranging from natural resources, public health, infrastructure and the economy. This report specifically calls out the critical need to provide financial assistance, in addition to technical assistance, to communities grappling with implementing climate change adaptation strategies.

CZM also updated its program plan in 2011 with these goals : "(1) prevent, eliminate, or significantly reduce threats to public safety, property, and environmental resources resulting from hazards such as erosion, flooding, and storm damage; (2) allow natural physical coastal processes to continue while allowing appropriately sited coastal development and economic growth and promote the use of non-structural alternatives for shore protection where appropriate and to the extent feasible; (3) limit, prohibit, or condition public expenditures in coastal high hazard areas to ensure that increased exposure to coastal hazards is not encouraged; and (4) prioritize public expenditures for acquisition and relocation of structures out of hazardous coastal areas." Collectively, state, federal, and local policies, laws, and regulations, as currently implemented, are not yet adequate to meet these goals.

n 2023, Massachusetts launched the ResilientCoasts Initiative, a holistic strategy to address climate impacts along the Massachusetts coastline of Massachusetts. The CZM-led initiative aims to develop a comprehensive statewide approach to coastal resilience including identifying regulatory, policy, and investment strategies the state can lead to accelerate the pace of resilience. The ResilientCoasts Plan establishes 15 Coastal Resilience Districts based on shared risks and characteristics, to inform the scale of regional collaboration on coastal resilience. The ResilientCoasts Initiative is embedded within ResilientMass, which is the umbrella initiative for the state's climate adaptation and resilience programs, policies, and plans. The ResilientMass Plan, which serves as the State Hazard Mitigation Climate Adaptation Plan, defines how the state will withstand, rapidly recover from, adapt to, and mitigate after natural hazard events. The plan, which is updated on a five-year cycle, reviews resilience options to proactively identify approaches that work statewide and within regions, explore financing mechanisms to find creative and sustainable ways to pay for projects, and review regulations to ensure effective long-term implementation." After catastrophic storms, state and local agencies should review opportunities to buy storm damaged and storm prone properties from willing sellers. FEMA's Hazard Mitigation Grant Program provides such funding, but state agencies and municipalities must apply. Municipalities can fund such acquisitions through Community Preservation Act funds. The estimated costs of these acquisitions will total many tens of millions after a major catastrophic storm.

Other Management Opportunities

From a planning point of view, shoreline dynamics occur broadly within three hydrologic regions: flood-prone areas, surface-water areas, and groundwater areas. Managers must consider many issues including loss of uplands, increased flooding impacts, loss of wetlands, accelerated shoreline changes, saltwater intrusion, and elevated groundwater levels. For currently developed areas, two basic management strategies are available: retreat from the rising water or attempt to protect threatened areas, with varying combinations of both. For undeveloped areas, avoidance is another possibility. However, political, legal, and economic considerations will probably override long term planning. Although we know that changes are occurring now and cannot be reversed, the issues of property rights and equity will probably dominate how the problem is managed. The challenge is to incorporate existing scientific information, even with its uncertainties, into a rational and fair management scheme.

Municipal planning boards can 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. For example, the Marion subdivision regulations prevent new subdivisions in the flood zone. Broader zoning measures will require town meeting approval. Possible supporting state legislation may be needed for town meeting decisions.

Through municipal zoning and local wetland bylaws, Buzzards Bay municipalities can create coastal construction setbacks and regulate construction activities more stringently for areas predicted to be subject to sea level rise, erosion, or flooding. Such regulations should prohibit the construction of seawalls, revetments, and groins to allow wetland and natural sediment migration processes. Priorities should be set focusing first on the velocity zone and faster eroding coasts.

The state building code offers opportunities to help structures become more resilient to storms. In the 2013 CCMP, state required freeboard requirements in building construction was identified as a management solution for coping with rising sea level. Freeboard refers to an additional height a structure's lowest floor must be elevated above the FEMA flood elevation. The 10th Edition of the Massachusetts State Building Code, issued October 2024, requires 2 feet of freeboard in Zone A/AE and 3 feet in Zone V and Coastal A Zone. State law does not allow municipalities to create local building codes, however, beginning in 2009, Massachusetts enabled municipalities to adopt different versions of the standard state code called stretch codes (Stretch Code, the Specialized Code, and the Massachusetts Energy-Zero Code). These codes primarily focus on energy efficiency requirement, but some elements address improved building resilience in flood prone areas.

Municipalities should prepare and distribute outreach materials encouraging the voluntary adoption of freeboard for new and major reconstruction. Property owners may incorporate freeboard if they recognize the savings in insurance costs. All municipalities should adopt and keep up to date their hazard mitigation plan and take part in the Community Rating System. The CRS not only benefits communities by focusing their planning efforts, and minimizing public storm-related expenses, but also can result in low insurance premiums for residents. CZM, in cooperation with U.S. Army Corps of Engineers, should help implement a program of regional sand management through adoption of state policies, regulations, and activities that promote beach nourishment as the preferred alternative for coastal hazard protection and require beneficial uses of dredged materials, with limited waiver ability from the requirement. Municipalities should consider beneficial uses of dredge materials, even beyond their political boundaries.

CZM and MassDEP should develop a guidance document or revise the Wetland Protection Act regulations to incorporate best management practices or performance standards for "land subject to coastal storm flowage." The state's Wetlands Protection Act regulations have long lacked clear performance standards for land subject to coastal storm flowage.

CZM should conduct a regional sand management study to identify (1) critically eroding public beaches where access is open to the public, (2) areas most vulnerable to coastal hazards, and (3) potential regional beach nourishment methodology and costs. CZM will need to update and complete the 2000 draft document entitled Assessing Potential Environmental Impacts of Offshore Sand and Gravel Mining for the Purposes of Beach Nourishment to include contemporary state of knowledge about the potential short- and long-term physical and biological impacts associated with offshore sediment removal.

There are both confusion and confounding technical issues surrounding the real-world elevations of the mean high-water mark and the high tide line (the latter defined by the annual high tide or "king tide") [87]. Often engineers do not correctly record these elevations on plans submitted to state and local permitting agencies. These issues can minimized through the presentation of data, maps, and information like the tidal datum viewer on the Buzzards Bay NEP website.

[87] Under Massachusetts Wetland Protection Act regulations, the elevation of the mean high water (MHW) mark is based on the average predicted MHW during the currently adopted National Tidal Datum Epoch (1983-2001). Under federal law, the high tide line (HTL, or highest tide of the year), does not have a specific reference time period defined. This ambiguity has prompted some (like the state of Connecticut Department of Transportation, see Doody 2009) to call for a definition based on predicted highest annual tides during a tidal epoch.

Costs and Financing

Some of the expenses associated with this action plan relate to conducting risk assessments, planning, and adopting or amending laws and regulations. The cost of mapping and identifying vulnerable infrastructure or assessing natural resources might cost many tens of thousands of dollars. The cost of making infrastructure and buildings more resilient is far greater and depends upon what strategies are adopted, and how much infrastructure is at risk. Moving or protecting roads, sewer lines, water lines, and buildings have appreciably higher costs. Implementing regulatory and policy changes that reduce future development in high-risk areas have nominal costs.

Local needs of Buzzards Bay municipalities exceed millions or tens of millions of dollars annually. State and federal agencies are Important funding sources for planning and assessment tasks include FEMA, EEA, CZM, and NOAA. Local funding sources include town meeting appropriations for capital costs, and the Community Preservation Act.

In an effort to maintain the health and longevity of salt marshes, we support further monitoring and studies about shifting coastlines, thin sediment layer deposition, runnelling, and removal of impediments to marsh migration

Measuring Success

Because of the rarity of catastrophic storms and slowness of sea level rise, the NEP should track this action through programmatic actions. Completion by municipalities of hazard mitigation plans, adoption of changes in the state building code, adoption of local bylaws, ordinances, and regulations that support climate adaptation will be the primary measures for tracking success. Tracking changes in coastlines, coastal development, and coastal habitat like salt marshes, will help document changes in the rate of ecosystem change.

Action Plan 18. Protecting Public Health at Beaches

Problem

The shoreline of Buzzards Bay has about 70 public bathing beaches (municipal and state-owned) stretching 13.4 miles, and 70 "semi-public" beaches (beaches associated with hotels, motels, summer camps, condos, and neighborhood associations) stretching 18.6 [88] miles (Figure 84). Beaches are an important recreational, aesthetic, and economic resource to residents and visitors. Bathing beaches are popular with residents and tourists and are an important to local economies and a source of revenue for municipalities (Table 30) to meet the operating costs of lifeguards, water quality testing, and other beach services. For many people, bathing beaches are the only direct exposure or use of Buzzards Bay, and as such, the quality and condition of bathing beaches plays an important role in how the public perceives the health and condition of Buzzards Bay. An important potential risk to human health at bathing beaches is exposure to bacterial and viral pathogens through contact or ingestion of contaminated waters. Other threats include harmful algal blooms, and exposure to toxic materials, spills, and harmful debris.

State and local government minimize risk to human health by testing bathing beaches for bacterial indicators of pathogens and notifying the public through beach closures or advisories when concentrations exceed thresholds. Testing is typically weekly during the swimming season. In marine waters, *Enterococcus* is the indicator bacteria used to identify the presence of fecal contamination. Freshwater beaches are for either *Enterococcus* or *E. coli.* The presence of these indicator bacteria may indicate the risk of exposure to other pathogenic bacteria or viruses.

This action plan describes ways in which government can minimize human health threats by reducing pollution discharges and improving testing. Treating stormwater discharges, encouraging pet waste management, improved testing and reporting, and identifying the most serious pollution discharges will achieve the goals of this action plan.

Loss of beaches due to erosion is addressed in Action Plan 18 Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms. Aesthetic and health risks associated from debris on beaches are addressed in Action Plan 14 Reducing Trash in Wetlands. Contamination of shellfish with pathogens is addressed in Action Plan 2 Protecting and Enhancing Shellfish Resources.

Table 30. Municipal 2024 beach parking sticker costs.

Town	Resident/ Taxpayer	Non-Resident	Senior	Daily Fee parking
Falmouth	$40	$375 (seasonal)	not offered	4 beaches, $10-$30
Bourne	$25	$50	$15	none
Wareham	$15	$50	$5 at 65	$5
Mattapoisett	$10	$35	free at 65	$10
Marion	$10	not offered	free at 70	none
Rochester[a]	$20	not offered	free at 70	none
Fairhaven[b]	$40	$150 (season)	$20 at 62	$5
New Bedford[c]	$15	$30	$5 at 65	$3
Dartmouth	$40	$40	$30 at 65	$10[d]
Westport	$50	not offered	$25 at 65	none[e]

(a) Rochester residents can use beaches in Marion.
(b) Fairhaven is the only town that requires a seasonal pass for bicyclists and pedestrians.
(c) Seasonal rate at Fort Taber, East Beach, and West Beach is $60.
(d)There is $12 resident and $40 non-resident parking fee at the state operated Demarest Lloyd State Park.
(e)There is $14 resident and $40 non-resident parking fee at the state operated Horseneck Beach State Reservation.

Additional Information

Anyone can walk onto a public beach in Buzzards Bay, but parking at some beaches may be limited to residents with beach stickers or upon payment of a daily fee. Some large tracts of state, municipal, and non-profit owned conservation lands may allow public access to the water, but the property owner does not test the water or provide lifeguards. Some semi-public beaches, including beach association and neighborhood/community beaches, private pay-to-use beaches, club and resort beaches may have intense use and often provide lifeguards and beach testing. The rest of Buzzards Bay's coastline is largely privately owned parcels.

[88] This is the breakdown in the MassGIS Marine Beaches dataset. The Massachusetts Department of Public Health database has a somewhat different breakdown with 118 named beaches or beach segments. Semi-public beaches may have a common access point but generally lack public parking and may not be guarded.

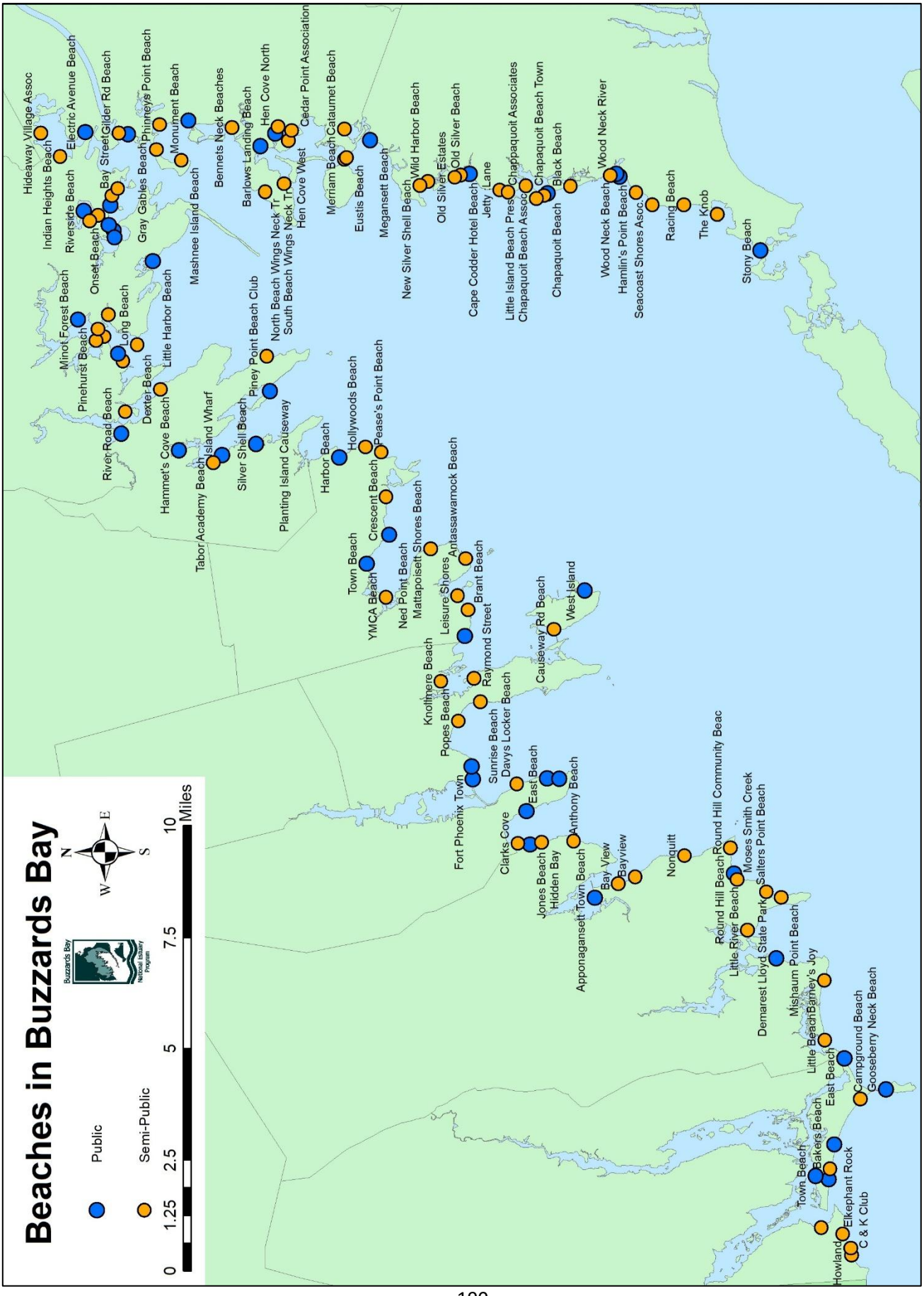


Figure 84. Selected public (municipal and state) and semi-public beaches along Buzzards Bay.

Data from MassGIS.

In Massachusetts, private property rights generally extend to the low tide mark, and the owners of these beaches and their guests have exclusive use of these areas except for public rights for fishing, fowling, and navigation. State regulations do not require owners of these private beaches to test water quality.

Swimming at beaches may pose a health risk if pollution discharges at or near the beaches. The most frequent illness documented from contaminated beaches are various forms of gastroenteritis (e.g. *Campylobacteriosis*), but potentially more serious diseases may result including salmonellosis, giardiasis, and hepatitis A. In freshwater ponds and brackish waters, skin lesion diseases such as impetigo can also occur. Historically in Massachusetts, local Boards of Health are responsible for implementing state laws relating to beach safety under MGL Chapter 111.

In 2000, the U.S. Congress enacted the Beaches Environmental Assessment and Coastal Health Act to improve the quality of coastal recreational waters by awarding grants to states and tribes to monitor water quality at marine beaches and notify the public when there is a public health risk. Also in 2000, the Massachusetts Beaches Act (Chapter 248 of the Acts of 2000) was passed, with supporting regulations issued in 2001 (105 CMR Section 445). The act mandated that the state Department of Public Health (DPH) create a program for required monitoring, testing, and posting of public and semi-public beaches. The regulations require at least weekly testing.

By 2004, all Massachusetts coastal municipalities implemented these new water quality standards and monitoring procedures. This increased compliance also resulted in increases in the number of beach closures and advisories statewide due to more frequent testing. [89] In 2014, the DPH Public Health amended the bathing beaches regulations defining water quality as unacceptable when two samples collected on consecutive days exceed the established water quality standard. While the original 2001 regulations allowed for a tiered system of testing beaches, the 2014 regulations dropped the tiered system and required at least weekly during the bathing season "at a time and day approved by the Board of Health or the Department." However, boards of health can issue variances to allow for less frequent testing (as little as every 30 days) if two years of weekly testing and a sanitary survey have been completed along with other conditions.

Table 31. Number of bacteria test exceedances at marine beaches in Buzzards Bay in 2023.

Data from DPH. Both public and semi-public beaches included.

Town	# of Violations	%violations
Bourne	5 of 180 tests	2.78%
Dartmouth	15 of 205 tests	7.32%
Fairhaven	4 of 98 tests	4.08%
Falmouth	18 of 348 tests	5.17%
Marion	1 of 126 tests	0.79%
Mattapoisett	15 of 182 tests	8.24%
New Bedford	2 of 151 tests	1.32%
Wareham	20 of 203 tests	9.85%
Westport	0 of 48 tests	0.00%
Average	80 of 1541 tests	5.19%

There is now 100% reporting compliance for Massachusetts public beaches, and DPH publishes an online beach water quality dashboard during the beach season providing near real-time information on bacteria levels at public beaches and current beach postings.

Towns must post beaches that do not meet these requirements with a sign that states "WARNING! NO SWIMMING. SWIMMING MAY CAUSE ILLNESS." Local boards of health could also issue such a notice after any significant rainstorm at a bathing beach where there has been a history of rainstorm-related violations. However, no municipality in Buzzards Bay has adopted such a pre-emptive closure policy even though ample data justifies such actions. Municipalities may hesitate to preemptively enact rainfall beach closures because of concerns about potential impacts to local tourism and the economy, and the difficulty of managing such closures. Boards of Health may close beaches for other public safety reasons, like stinging jellyfish or harmful algae.

Figure 85 shows four Buzzards Bay beaches that have periodically exceeded the safety standard for marine swimming beaches at least once between 2020 and 2023. [90] Table 31 shows the percentage of all samples tested that violated saltwater beach standards in

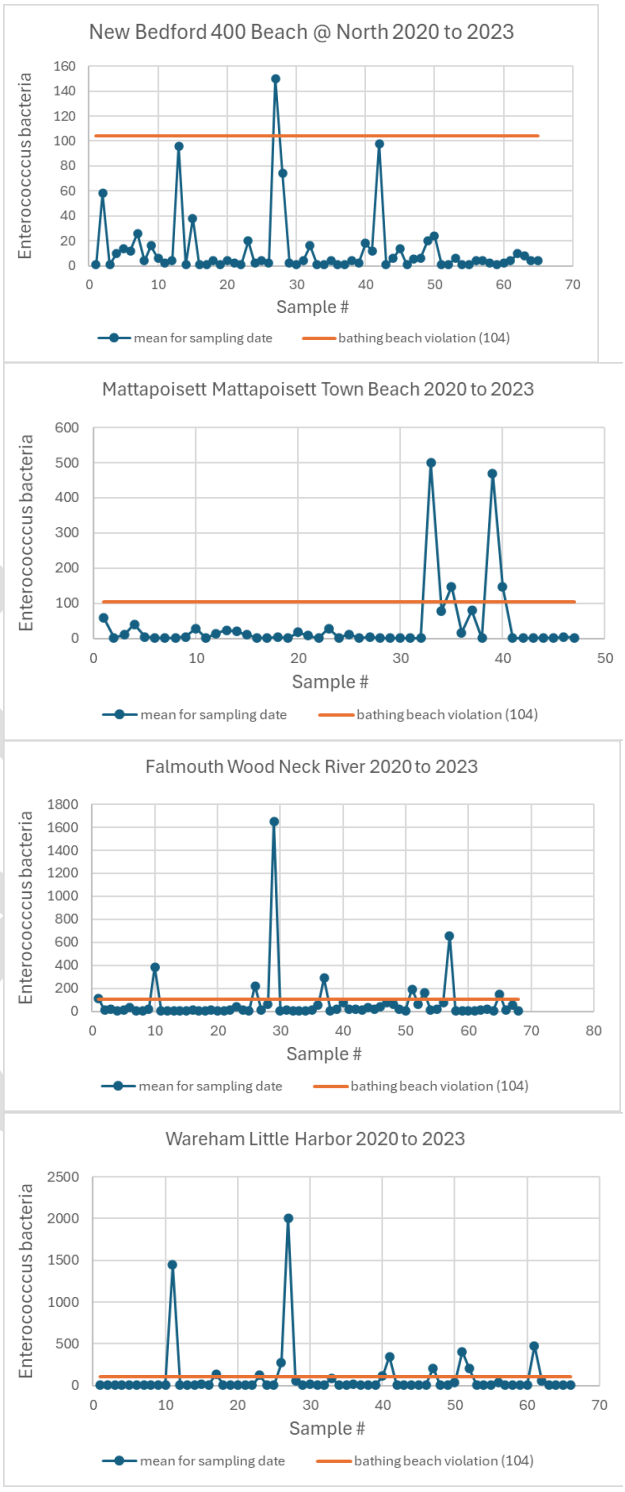
[89] "Cape beaches rank among best in state." Hilary Russ. Cape Cod Times August 09, 2007.

[90] 2023 Massachusetts Beach Testing Results Annual Report.

each Buzzards Bay coastal municipality (average 5.2%) and Figure 86 shows data over time since 2003. DPH reports that closures strongly correlate with summer rainfall totals, and most Buzzards Bay closures are linked to heavy rains. Municipal boards of health also close freshwater beaches for bacteria pollution, but statewide in 2023, 29% of all freshwater beach closures were due to harmful algae.

The biggest challenge for state and local health officials to reduce and minimize the frequency of beach closures is to minimize the impacts caused by stormwater discharges, particularly during heavier rains. Most of the high concentrations of *Enterococci* at the beaches in Figure 85 occurred after rainstorms, with the volume of rain being important. After heavy rains, water bacteria concentrations at beaches are elevated. Typically, after a 1- to 2-inch rain, Boards of Health close six to twelve beaches around Buzzards Bay after testing. In contrast. In contrast, a 0.1-inch rain may have no impact on water quality. Similarly, strong winds and heavy surf can resuspend sediments contaminated with bacteria in the water column, elevating bacteria counts. Because cities and towns tend to sample on prescribed days of the week rather than intentionally sampling after heavy rain, they are not fully characterizing rainfall related water quality health risks in their monitoring programs.

In the Buzzards Bay watershed, combined sewer overflows are problematic for bathing beaches only in the City of New Bedford. Stormwater often has elevated bacteria levels, stormwater runoff discharged from pipes, overland, or conveyed to streams that discharge near beaches, contribute to beach closures around Buzzards Bay. Bacteria concentrations near these sites are generally higher during ebbing tides. For example, at Mattapoisett Town Beach (Figure 85) a culvert near the town beach discharges water from a stream that passes through the town village collecting groundwater and stormwater discharges. Concentrations of bacteria in stream are high, especially after rain. In general, beaches near salt marshes or streams tend to have worse water quality because of wildlife and other land sources. Bacteria concentrations at Wood Neck River Beach in Falmouth illustrate this pattern. Bacteria concentrations at this beach are typically higher than bacteria concentrations than Wood Neck beach, which is on the opposite side of a barrier beach (Figure 87). Extreme rainfalls elevate bacteria concentrations everywhere in Buzzards Bay.



Data from DPH, figure prepared by Joe Costa.

Figure 85. Selected Buzzards Bay beach monitoring results between 2020 and 2023 compared to the safe swimming standards (104 Enteroccus bacteria).

At some beaches, health managers have tied high bacteria concentrations to the presence of waterfowl.

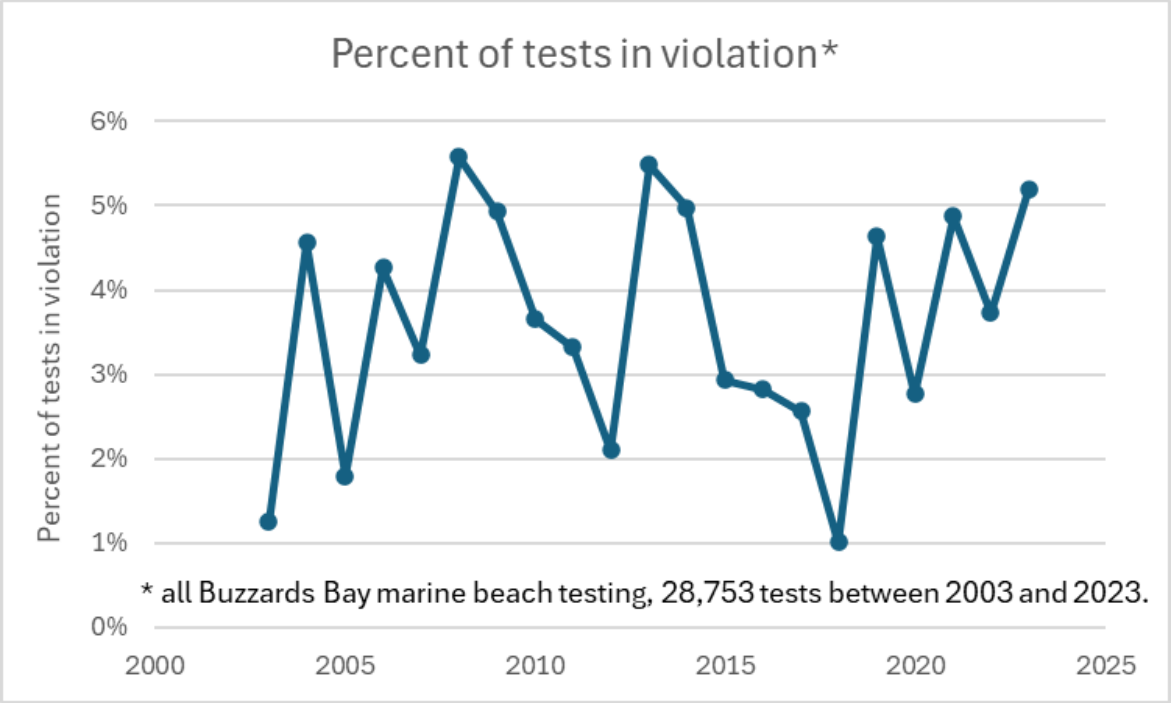


Figure 86. Long-term trends in beach testing violations among Buzzards Bay Towns (long-term average is 3.6%; 2019-2023 average is 4.2% .

Data from DPH beach dashboard; figure prepared by Joe Costa.

Canada geese may congregate in such numbers that the beach wrack line consists mostly of goose feces. In freshwater ponds, simple methods to discourage the congregation of geese, such as low fencing and shrubbery plantings, have proved cost effective. These techniques work because plantings and low fences obscure line of sight and play on the animal's fear of hidden predators [91]. Municipalities often erect signage at geese congregation areas to discourage feeding.

Another problem often documented is the role of dog waste on beaches and in neighborhoods of stormwater networks contributing to beach stormwater discharges. Because of increased government and public awareness of the problem, the state and most municipalities have banned pets from bathing beaches, principally during the summer, provided collection bags and disposal containers in parks and other public lands, and have undertaken public education using signage in public locations (e.g., Figure 88 and Figure 89).

For public health officials, the biggest obstacle in using water quality testing data is that it takes 24 hours to receive the results because of incubation times needed for bacterial growth in media. This delay increases exposure of bathers to unsafe bacterial levels and contributes to unnecessarily long closures if an ephemeral event caused the closure. The testing results delay also makes it very difficult for investigators to track the origins of contamination because sources may dissipate before a field investigation begins. For these reasons, state and federal agencies have been continuing to develop and evaluate more rapid assays. Conversely, failure to close a beach after one high observation resulted in the 2014 regulation change to require mandatory beach closures after two consecutive violations of the water quality standard.

For all these reasons it is important for water testers to record, on their field sampling data sheets, the volumes and dates of recent rainfalls, tidal level and current direction, wind speed and direction, surf conditions, water transparency, and temperature to aid in the evaluation of datasets later by analysts. DPH does not collect all this information in field data sheets, but water samplers should record the information to understand site-specific causes of closures and help with later source tracking studies.

[91] Department of Conservation and Recreation. 2004. "Goose Fencing a Success!" 2-page fact sheet, Lakes and Ponds Program.

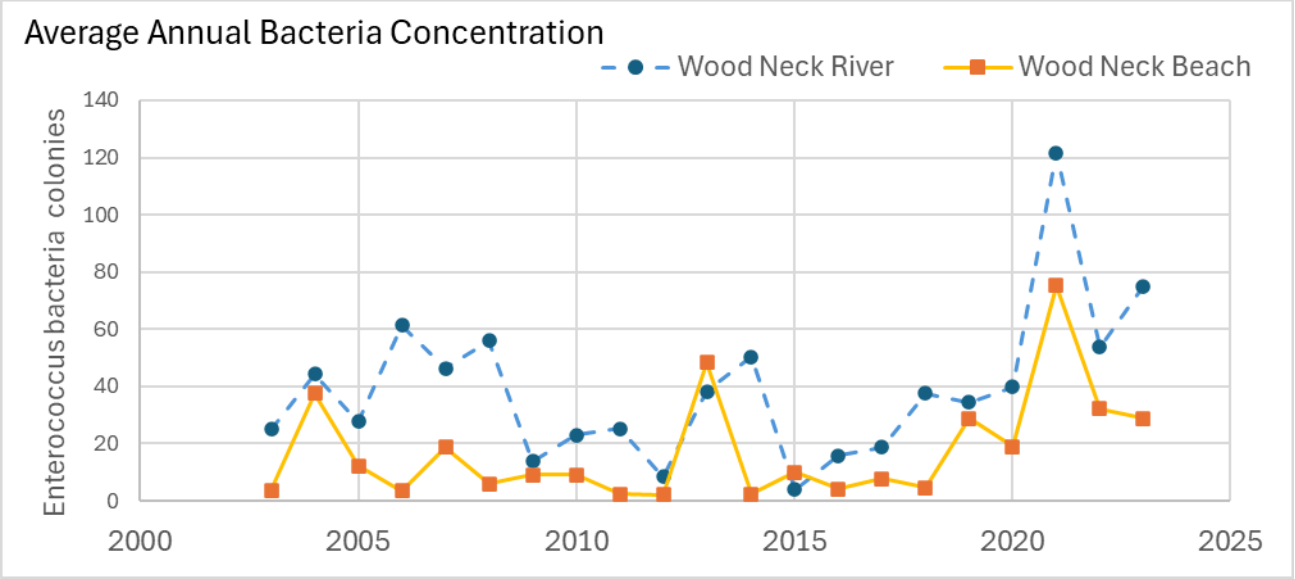


Figure 87. Comparison of water quality at a beach along a large marsh creek (Wood Neck River) compared to an adjacent beach on the outer coast (Wood Neck Beach).

Data from Massachusetts Department of Public Health; figure prepared by Joe Costa.

Goals

Goal 18.1. Reduce or eliminate pollution sources that cause elevated bacteria levels in beach waters.

Goal 18.2. Manage beaches to reduce human exposure and health risks based on site-specific conditions.

Goal 18.3. Prohibit pet recreation on beaches and encourage pet waste collection in stormwater drainage areas.

Objectives

Objective 18.1. Reduce contaminated stormwater discharges to beach areas.

Objective 18.2. Increase public awareness about areas prone to contamination or conditions that may lead to elevated contaminant levels at beaches.

Objective 18.3. Municipalities should adopt and enforces pet recreation prohibitions on beaches during the summer beach season.

Objective 18.4. Encourage pet waste collection and proper disposal in stormwater drainage areas around beach areas.

Objective 18.5. For high use beaches, municipalities should adjust testing frequency and timing to better document rainfall effects on beach water quality, and if necessary, implement preemptive rainfall closures.

Objective 18.6. Support development and implementation of more rapid assays to document existing conditions and, where necessary, implement preemptive rainfall closures and advisories.

Vulnerabilities and Progress Made

Increased development near the shore, warmer waters, and more frequent intense storms will worsen the frequency of beach closures and advisories around Buzzards Bay. Bacterial exceedances are strongly correlated with rainfall, underscoring the need for municipalities to treat stormwater discharges near bathing beaches. Since the 2013 CCMP, the percentage of testing violations has been relatively static to a slight increase during the past five years. No municipalities have set up rainfall conditional closures.

Management Approaches

To meet the goals of this Action Plan requires two types of action. First, municipalities must find and eliminate pollution sources causing bacterial exceedances at the beaches. Second, owners of beaches should test more often during adverse conditions to assess water quality conditions after moderate to heavy rains and storms.

Current beach testing practices only catch storm-related impacts by chance. Evaluating beaches during adverse conditions will better protect the public from waterborne diseases and minimize health risk. Municipalities with 15% exceedances each summer at their

beaches should test their beaches at least twice per week and conduct sampling to identify sources.

Collecting samples for an evaluation of adverse conditions at a beach requires work during off-hours and may require contractors. Such data could justify rainfall conditional beach closures. MA Department of Public Health and other agencies should continue to evaluate and promote rapid assays. Municipalities should exclude pets from bathing beaches and encourage pet owners to clean up pet waste.

Costs and Financing

Remediating pollution sources can be costly, especially for those beaches near a brook or drainage system where many sources may be contributing to elevated pollution loads. Most of these pollution sources will be associated with stormwater discharges, and these costs are addressed more comprehensively in Action Plan 3 Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure.

The cost of increased monitoring is relatively modest, but because laboratories charge extra fees for samples taken at times that require processing during non-working hours, municipalities must budget for these added sampling costs. If a municipality chooses to use contractors to collect beach samples, this will require significant extra costs. Dog waste receptacles have minimal costs and are good education tools.

The cost of signage is minimal to raise beachgoers awareness of not swimming during or after heavy rains in tidal creeks or near discharge pipes or culverts, especially during outgoing tides.

Measuring Success

The final measure of success of this action plan will be the documentation in the frequency of beach closures and advisories as reported to the DPH Beach Dashboard. The Buzzards Bay NEP can track programmatic actions, like litter and pet waste signage, implementation of rainfall conditional closures, and remediation of storm drain discharges.

Figure 88. A bag dispenser for pet waste.

Figure 89. Sign posted by Massachusetts DCR at state parks and beaches.

Action Plan 19. Monitoring Management Action, Status, and Trends

Problem

NEPs and state and federal regulatory and granting agencies often track water quality data and programmatic actions to evaluate the effectiveness of management action or inaction. The Clean Water Act section 320(b)(6) explicitly requires each NEP Management Conference to "monitor the effectiveness of actions taken pursuant to the plan," to meet these two goals: "measure the effectiveness of the management actions and programs implemented under the [CCMP]; and provide essential information that can be used to redirect and refocus the CCMP during implementation." For Clean Water Act initiatives, a key question has always been, "Are we making waters more fishable and swimmable?" More precisely, is the government preserving and protecting ecosystem health and the integrity of the natural environment, and do those waters provide their "designated uses." Funding agencies want to know whether grantees succeeded in protecting or restoring the environment. Communication of outcomes can be difficult because static environmental conditions in the face of new development or added pollution inputs is a measurable success.

To meet the Clean Water Act requirements, NEPs must track water quality and living resources data, actions by government, and support some level of research and monitoring to ensure collected data adequately characterizes environmental conditions and risks.

Each action plan in the CCMP includes monitoring strategies and information that the NEP and agencies should track. This action plan reiterates some of the most important elements of the action plans but also addresses some broader watershed monitoring and assessment issues. The Buzzards Bay NEP and government agencies must track actions and outcomes of action toward CCMP goals. This monitoring helps meet the broader goals of the CCMP including such as showing the benefits of funding, communicating results, and build support for needed funding.

Goals

Goal 19.1. Document environmental trends of water quality, living resources, and habitat to assess the effectiveness of management actions taken or identify the need for new actions.

Goal 19.2. Identify research and monitoring needs to understand more clearly the causes of impairments, reduce uncertainties about health risks, and better define conditions in Buzzards Bay.

Objectives

Objective 19.1. The Buzzards Bay NEP should monitor programmatic actions and support partners that monitor water quality and living resources to document the implementation of the Buzzards Bay Comprehensive Conservation and Management Plan and the success of management action taken.

Objective 19.2. Regulatory and granting agencies should define essential monitoring requirements that grant recipients must collect to evaluate restoration project success or new methods.

Objective 19.3. All levels of government must ensure that funding is available to implement essential monitoring programs.

Objective 19.4. Organizations that monitor water quality and living resources must revise and adapt monitoring programs to meet changing needs and information gaps.

Objective 19.5. Disseminate data and syntheses of information to scientists, managers, and the public.

Objective 19.6. Encourage scientists and agencies to evaluate emerging contaminants and other stressors to the environment.

Objective 19.7. The Buzzards Bay NEP should track funding in meeting Massachusetts environmental justice goals.

Management Approaches and Issues

Once an NEP finishes its CCMP, the primary functions of the Buzzards Bay NEP are to "monitor the effectiveness of actions taken pursuant to the plan" and "develop plans for the coordinated implementation of the plan by the states as well as federal and local agencies participating in the conference" (Clean Water Act Section 320 (b). In this updated CCMP, each action plan "Measuring Success" section defines what the Buzzards Bay NEP should track to evaluate progress in that action plan. Table 32 below summarizes these metrics.

Some of the tracking metrics in Table 32 relate to monitoring water quality or specific living resources.

Beach and shellfish bed testing for bacteria, water quality data to assess eutrophication, and eelgrass bed cover are some of the key water quality metrics found in the action plans. However, many of the metrics the Buzzards Bay NEP can track are programmatic metrics required by various state and federal regulations. Examples include tracking bathing beach and shellfish bed closures, number of acres of habitat and wetlands protected, numbers of hazardous waste spills, and similar metrics reported by agencies. These data are useful, but managers must evaluate and synthesize data, if only to define action or conditions within the Buzzards Bay watershed. The Buzzards Bay NEP can fulfill its Clean Water Act mandate largely by mining and compiling data from various sources, and communication progress toward CCMP implementation.

One of the most important programmatic metrics for the Buzzards Bay NEP to track is the number and area of water bodies on the state's Integrated List of impaired waters (as river miles and water acres). The impaired waters list is the ultimate measure of success of actions taken to meet the Clean Water Act goals, but using it has pitfalls. First, MassDEP has not assessed all fresh and marine water bodies for impairments. This means as agencies and scientists complete new monitoring programs or watershed assessments, the new information will increase the number or area of water bodies and wetlands that MassDEP defines as impaired. This happened when the Massachusetts Estuaries Project studied estuaries to decide if they needed a watershed nitrogen loading TMDL. Waters became listed because of new information. Given the cost of such watershed pollution assessments, assessing state waters will continue to require appreciable state and federal staff resources and funding. For these reasons, while the state's Integrated List of impaired waters is important, data on water quality and living resources are equally important.

While agencies often track local programmatic action or data related to water quality or living resources, there is an unmet need to assemble this information to communicate information to the public and local government. The BBC's State of Buzzards Bay reports, DEP's Integrated List of Waters interactive maps, and SNEP's planned state of the region reports are excellent examples of showing how water quality and living resource impairments can be summarized in the context of regional conditions. What is lacking are more systematic summaries of municipal and state programmatic actions shown in Table 32. The Buzzards Bay NEP can meet that need and assemble a summary of these metrics on its website.

An example of the programmatic tracking of municipalities was the Commonwealth Capital Program in place between 2003 and 2007. The Commonwealth Capital program incentivized municipalities to adopt smart growth approaches. To achieve this, the state gave a competitive advantage to municipalities that had adopted or committed to adopting certain land use practices. EEA awarded points for more than two dozen smart growth municipal actions like adopting the Community Preservation Act, passing a Right-to-Farm bylaw, having a current municipal Master Plan, and having a Water Conservation Plan. The municipality's "Commonwealth Capital Score" represented up to 30% of the evaluation score in proposal review. While the initiative was short-lived, the Buzzards Bay NEP used the environment-related actions tracked by Commonwealth Capital--self-reported by municipalities in their grant applications-- to track actions already identified in the CCMP. The Commonwealth Capital program tracking was a useful model by providing an objective standard for quantifying municipal accomplishments and less subjective than municipal "report cards".

The Buzzards Bay NEP should track the old Commonwealth Capital Smart Growth metrics and other municipal actions specified in each action plan and make this information available online to enable comparisons among towns and to document trends. Besides the smart growth actions reported in the Commonwealth Capital Program, other municipal programmatic benchmarks include compliance with watershed permits, adopting TMDLs, adopting wetland bylaws, and adopting bylaws relating to transfer of development rights and cluster development.

Agencies needing to monitor permit compliance, should ensure that permit information is readily available online. For example, until 2021, the EPA had posted municipal MS4 permits and annual reports on their MS4 permit website. Since that time, EPA has not posted municipal annual reports but could resume this practice in the future.

Recently, Massachusetts created the EEA Data portal. This is a powerful resource that summarizes state databases relating to permitting and pollution that was used to generate information for the CCMP. The data portal allows environmental data searches on wetlands and other permits, regulated facilities, hazardous waste spills, inspections, enforcements, lead & copper in schools, and other datasets. This portal fulfils the need to provide public access to pollution data identified in this action plan. A similar function is provided by EPA's website, How's my waterway? which provides an interactive map to see all permitted discharges in communities.

The Massachusetts Division of Marine Fisheries has long undertaken shellfish sanitary survey requirements as required by 322 CMR 16.00, Shellfish sanitation, harvest, handling and management. These reports are an assessment of local environmental conditions and pollution sources, including impacts to water quality in the area, and are a valuable resource for identifying problem discharges. While DMF traditionally provide these reports to municipal shellfish officers and Select Boards, neither Buzzards Bay municipalities nor DMF have ever posted the reports online, undermining their value to educate the public and assist resource managers in tackling difficult pollution problems. DMF does post shellfish bed closure maps online.

It is difficult for non-profits and researchers to receive sustained funding for routine monitoring. This is true even for the BBC's BayWatchers which MassDEP uses to designate or assess water quality impairments, and is a powerful outreach tool prompting many local initiatives. Recognizing the value of long-term monitoring efforts the Buzzards Bay NEP helped establish and supports the BayWatchers program. In the last decade, the Buzzards Bay NEP established the Buzzards Bay Stormwater Collaborative to monitor stormwater discharges and find illicit discharges, a program to monitor salt marsh loss at sentinel sites, and a program to monitor nitrogen discharges from Buzzards Bay rivers. The Buzzards Bay NEP should work with its partners to ensure these, and similar programs stay funded.

Costs and Financing

The costs of tracking programmatic actions and posting permits or reports are modest. The cost of field monitoring described in the various action plans in the CCMP may total hundreds of thousands of dollars annually. Some restoration projects require monitoring, but not always. Often monitoring needs are met by research grants, or federal watershed assessment grants (604b), but most monitoring costs must be borne by agencies managing the environment.

Information is often lacking about the relationship between environmental risks to human health risks, and the relationship between the two if often underestimated and misunderstood. A fruitful line of research could assess data from public health agencies, hospitals and physicians who test and treat patients. Such a study could better define the relationship with beach and shellfish bed closures and illness, which can inform coastal resource managers.

Measuring Success

This action plan summarizes monitoring recommended in each Action Plan's measuring success sections. The measure of success for this action plan with an online tracking the status and findings of the monitor tasks defined in Table 32.

Table 32. Summary of monitoring actions to measure success of each action plan.

Monitoring type: (LR-living resource, WQ= water quality, P=programmatic. Funded costs are activities funded or required under some existing regulatory program. Each Action Plan contains an explanation of costs shown in this table.

Action Plan / Monitoring Action	Type	Data source	Reporting frequency	Status availability	Cost
1. Managing Nitrogen Pollution					
Eelgrass mapping	LR	DEP	5 yrs	ongoing	$250k
Baywatchers	WQ	BBC	summers	ongoing	$250k
River monitoring for nitrogen loads	WQ	BBC	annually	ongoing	$80,000
Integrated List designation impaired by nutrient pollution (number of water bodies and area)	P	DEP	2 years	ongoing	funded
TMDL and watershed plan status	P	NEP	annually	ongoing	nil
2. Protecting and Enhancing Shellfish Resources					
DMF shellfish area bacteria monitoring	WQ	DMF	weekly	ongoing	funded
Shellfish growing area status, acres closed	P	DMF	as needed	ongoing	funded
commercial catch	LR	DMF	annually	ongoing	funded
recreational permits	P	towns	annually	ongoing	reported
3. Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure					
Compliance with MS4 permits	P	EPA	annually	ongoing	not funded?
Monitor adoption of bylaws, regulations, and policies required for MS4 compliance	P	towns	annually	ongoing	modest
IDDE investigation status	P	Stormwater Collaborat.	annually	ongoing	nil
Swimming beach status from Action Plan 19	P	MDPH	weekly	ongoing	reported
Shellfish closure status from Action Plan 2	P	DMF	weekly	ongoing	reported
4. Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience					
Adoption of laws and regulations, scoring like the former Commonwealth Capital program	P	NEP	annually	NEP quanti-fies	nil
5. Managing Onsite Wastewater Disposal Systems					
enumerating septic system numbers, failures, removals, status	P	towns	annually	NEP quanti-fies	modest
bylaws and regulations (e.g., n-reducing for new development)	P	towns	annually	NEP quanti-fies	modest
6. Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging					
Boat pump-out volumes	P	towns	annually	not tracked	modest
Percent of marinas with multi-sector permits	P	EPA	annually	NEP quanti-fies	modest
Use of eco -moorings (number/fraction of town moorings)	P	NEP	annually	NEP quanti-fies	modest
7. Protecting and Restoring Wetlands					
Municipalities have con com staff, local bylaw/regulations	P	Towns	annually	NEP quanti-fies	modest
Monitor wetland area, interpretation of aerial photographs from 1992 study and earlier imagery	LR	DEP?	10 years	discontinued	$400k?

Action Plan / Monitoring Action	Type	Data source	Reporting frequency	Status availability	Cost
Acres altered or restored, mine statistics from MassDEP permits	P	DEP/towns	annually?	develop	unknown
8. Restoring Migratory Fish Passage and Populations					
Fish counts, costs associated with maintenance of equipment costs, inspections	LR	DMF/BBC	annually	ongoing	$100k
Number of restorations undertaken (pond acres river miles restored)	P	NEP	annually	NEP devel-ops	nil
Number of fish runs classified as impaired	P	DMF/DEP	annually	as reported	nil
9. Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species					
Wetlands and priority habitat permanently protected as open space	P	NEP	annually	NEP devel-ops	nil
Number of new or total vernal pools certified	P	DEP	annually	data mining	nil
Osprey nesting pairs, roseate tern counts	LR	FWS	annually	data mining	nil
10. Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies					
Track municipal per capita water use and unaccounted water losses from public water supplies	P	DEP	annually	data mining	nil
Track well withdrawals, river flow, and representative pond levels (may require added gauges)	P	DEP	annually	data mining	nil to $100k
Review of municipal drought response rules and regulations	P	NEP	biannually	NEP devel-ops	nil
11. Managing Invasive Species					
NEP supports the CZM Marine Invader Monitoring and Information Collaborative	LR	CZM	every four years	NEP devel-ops	$100k
Encourage public use of phones apps to map and report invasives	LR	the public	annually	ongoing	nil
12. Protecting Open Space					
Monitor acres of open space protected including acres of wetlands and NHESP habitat	P	MassGIS/NE P	annually	ongoing	funded
Track municipal open space plan status	P	EEA	annually	ongoing	nil
Track Community Preservation Act adoption (only Rochester has not adopted)	P	NEP	annually	NEP devel-ops	nil
13. Protecting and Restoring Lakes, Ponds, and Streams					
Number and percentage areas unassessed or impaired on state integrated list	P	DEP	annually	ongoing	nil
Number of waterbodies with or needing TMDLs or watershed plans	P	DEP	annually	datamining	nil
14. Reducing Trash in Wetlands and Waterways					
CZM beach cleanup collection data and number of Buzzards Bay sites	P	DEP	annually	ongoing	nil
MS4 permits and local stormwater management plans have a program to manage litter in network	P	towns	review bian-nually	ongoing	nil
15. Reducing Toxic Pollution					
Integrated List designation impaired by toxic pollution (number of water bodies and area)	P	DEP	2 years	ongoing	funded
Status of Hazardous Waste Sites (number needing cleanup, cleanup completed, spill events)	P	DEP/EEA	annually	ongoing	funded
Status of Superfund sites	P	EPA	annually	ongoing	funded
Availability and number of watershed hazardous waste events	P	Towns	annually	NEP devel-ops	funded

Action Plan / Monitoring Action	Type	Data source	Reporting frequency	Status availability	Cost
PFAS and toxics in drinking water and wastewater, number of violations	P	DEP	annually	ongoing	unknown
16. Preventing Petroleum Products Pollution					
Reported spills in Buzzards Bay (events and gallons)	P	DEP/EEA	annually	ongoing	funded
Number of sheen events in New Bedford Harbor, spills in watershed	P	DEP/EEA	annually	reported?	funded
Municipal stormwater plans that address hydrocarbons in runoff?	P	?	?	?	?
17. Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms					
Monitor salt marsh loss through aerial and drone surveys, sentinel sites	LR	NEP	annually	ongoing	$120k
Monitor resilient actions taken in EEA resilient tracker portal	P	EEA	annually		
Track municipalities that have completed MVP and Hazardous Mitigation Planning	P	EEA	annually	data mining	
18. Protecting Public Health at Beaches					
track beach closings in Buzzards Bay towns	WQ	DPH	annually	ongoing	funded
19. Monitoring Management Action, Status, and Trends					
NEP creates a website summarizing this table with stats and links	P	NEP	annually	NEP devel-ops	nil
20. Enhancing Public Education and Participation					
Not easily measurable					

Action Plan 20. Enhancing Public Education and Participation

Problem

Government can be slow to address environmental problems because of lack of resources, financial constraints, political pressures, concerns of potential economic impacts, or failure of legislative and executive bodies to revise or adopt new laws and regulations. In a democracy, the public's concerns and understanding of the issues strongly drive government's response to any problem. While it is true that given the same set of facts, people can disagree about the proper course of action depending on individual priorities and values, having a common vocabulary in defining problems can facilitate the development of consensus among disparate parties. If the public is ill informed about a particular environmental problem, or if it does not have a clear understanding of important technical and regulatory issues, they may not appreciate the costs and benefits of management actions. Contributing to the problem, if resource managers have not educated many people about concepts like the connection between ground and surface waters, pollution pathways in local watersheds, how towns treat or dispose of solid waste, they may have less of an appreciation or understanding of the health or economic risks they face.

Because the CCMP has many recommendations directed at local government, and enacting these recommendations may require approval by voters or town meeting or local boards, it is particularly important to have an informed citizenry to help make these decisions. Citizen groups and environmental non-governmental organizations can provide a crucial role in educating adults and children that will ultimately lead to the necessary social, political, regulatory, legislative, and legal actions to support efforts to protect and restore Buzzards Bay and surrounding watershed. The contribution of these non-governmental partners will be most important when legislative bodies and governmental boards must make specific planning, regulatory, and budgetary decisions.

Many action plans in this document include elements of outreach and education. This action plan addresses some statewide, regional, and local issues that should be addressed to meet the broader goals of the CCMP. As described in Chapter 1, the BBC, BBAC, and Buzzards Bay NEP have partitioned outreach responsibilities. The Buzzards Bay NEP and BBAC focus outreach on municipal government through meetings, training workshops, websites, and the municipal grant program. In contrast, the BBC is the lead entity for communicating environmental issues to the public. The BBC undertakes a diverse range of public events, school programs, and outdoor activities supported by social media, newsletters, and websites. All three organizations tend to focus outreach on advancing specific projects, while the BBC captures broad awareness of Buzzards Bay issues through large public events like the Buzzards Bay Swim and Watershed Ride. A large fraction of the BBC's $10 million operating budget relates to public communication.

Goals

Goal 20.1. Expand the public's knowledge of the natural resources and water quality of Buzzards Bay and surrounding watershed and the threats they face.

Goal 20.2. Increase public participation in actions that support the goals, objectives, and recommendations in the Buzzards Bay Comprehensive Conservation and Management Plan.

Objectives

Objective 20.1. Improve the public understanding of watersheds and the flow of water from precipitation along the land surface and in the ground.

Objective 20.2. Improve the public understanding of pollution sources and pathways in the environment.

Objective 20.3. Improve the public understanding of human and natural effects on plant and animal populations and ecosystems.

Objective 20.4. Improve the public understanding of the adverse impacts of accelerated sea level rise and other climate impacts.

Objective 20.5. Promote community involvement in planning and environmental decision-making to support and enhance the environmental quality of their neighborhoods.

Management Approaches

Meeting the goals and objectives of this action plan requires improved education of both children and adults on how human activities affect water quality, living resources, human health, and ecosystems within Buzzards Bay and its surrounding watershed. Voters need sound information when voting at town meeting, or electing their representatives, Municipal representatives and staff need information and training to effectively implement local laws and regulations. Local school departments have a primary responsibility for educating young people in science and technology. Environmental nonprofit organizations have a fundamental role in promoting public awareness and advocating for environmental causes. Nonprofits and agencies should review public and private education curricula and help develop and improve environmental literacy.

In 2016, the Massachusetts Department of Education updated the Massachusetts Science and Technology/Engineering Standard. The goal of the standard is to create an "engaging, relevant, rigorous, and coherent" student curriculum that emphasizes core concepts and the application of science and engineering skills "to support student readiness for citizenship, college, and careers." The state required each district to develop its own plan that accounts "for local conditions, initiatives, and resources," and that instruction emphasizes relevance, rigor, coherence, and engagement of students. In 2025, the Massachusetts Department of Elementary and Secondary education released a guide explaining how they include climate education in the state's science standards.

While the state standard provides a framework for improved education of Massachusetts children in science, technology, and engineering, it does not explicitly address environmental education needs. In 2016, the Massachusetts Environmental Education Society developed a The Massachusetts Environmental Literacy Plan. The plan provides "a unified and collaborative framework for organizations, agencies, schools, businesses and individuals to help Massachusetts sustain the natural environment" with the goal to "enable our citizens to have the knowledge, skills, and resources to shape a more sustainable and prosperous future". The Massachusetts Environmental Literacy Plan describes opportunities within the state standard to build environmental literacy. Among the state's 264 science and technology education standards, 46% meet at least one environmental literacy goal. Among these, 71% support "ecological systems knowledge", 22% support "critical thinking", 5% support "appreciation of natural systems through direct observation and experience" and 11% of the standards support developing local action planning. Advocates for the Environmental Literacy Plan argue that students graduating from high school have few opportunities "to exercise ecological knowledge through critically grappling with humans' role in creating, exacerbating, or solving environmental issues, or developing new or better solutions for themselves or their communities". The authors of the study found that increasing student participation in field observation was a particularly important need.

Neither the Commonwealth of Massachusetts nor Buzzards Bay watershed municipalities have adopted environmental literacy plans, and implementation is ad hoc and subject to local funding. In 2023, a Massachusetts legislator filed a bill that would set up a Climate Science Education Trust Fund. The legislation did not pass but illustrated that there was legislative support for funding local environmental literacy.

Despite the absence of specific local environmental literacy plans, there has been state and federal support for specific local initiatives, especially programs that support children to observe the environment. For example, in 2019 NOAA provided a B-WET (Bay Watershed Education and Training grant) to the BBC to provide meaningful watershed environmental educational experiences for New Bedford youth. The grant complimented other BBC youth and adult education programs and nature hikes. The Massachusetts Institute of Technology Sea Grant Program offers a similar "Solutions Through Research, Education, and Art in Massachusetts" grant program that funds local environmental literacy programs.

The New Bedford public schools' Sea Lab summer enrichment program is an example of how municipal government can use a summer school program to both teach science and technology to grade school and junior high school students to better their lifelong opportunities, and to also communicate concepts about how pollution affects water quality and the environment. The Buzzards Bay NEP has supported the program since 2021, by providing funds for field trips,

instructional supplies, and scholarships for students with financial needs.

Advocacy and education by leaders and citizen groups will remain a core strategy to promote the adoption of regulatory and non-regulatory actions by local, state, and federal government. Both private groups and public agencies should use alternate strategies for communicating information including videos on social media.

Costs and Financing

Annual public education costs can be appreciable or negligible depending on the approach and type of campaign. Schools, government agencies, and non-governmental agencies must prioritize outreach programs based on their resources. Potential funding includes various state, federal, and private sources depending upon initiative.

Measuring Success

The easiest metric for the NEP to track is the adoption of Environmental Literacy Plans, however, Massachusetts municipalities haven't widely adopted environmental literacy plans because of a lack of state and federal funding, and competition with other demands,: while a Massachusetts Environmental Education Plan was passed in 1999, it never gained traction due to cuts in federal funding and changes in leadership, and has become a low priority.

There is no simple way to decide if the environmental education efforts are successful. One potential method of quantifying the success is to periodically conduct baseline public opinion surveys of attitudes and knowledge. Overall, public education is a long-term, generational, and unending task. The best short-term measure of outreach efforts is support for local environmental projects and initiatives.

Chapter 4. Implementing the Buzzards Bay CCMP

The CCMP in Perspective

Buzzards Bay is an estuary in continuing transition, subject to continuing stresses from new development, cumulative discharges of pollution, and influenced by climate stressors. Threats to Buzzards Bay from increased development along its shores and decades of dumping industrial and municipal waste into its waters led to the first calls in the 1980s to restore and protect the bay. Congress created the Buzzards Bay Project (later the Buzzards Bay National Estuary Program) to assess these threats and formulated a plan to address them with its many partners. This became the 1991 Buzzards Bay Comprehensive Conservation and Management Plan (CCMP) [92].

Even with the creation of the first Buzzards Bay CCMP, the Buzzards Bay NEP recognized that no single planning document could hope to address all watershed environmental issues in a comprehensive way. Like many of the first National Estuary Program CCMPs, there were many challenges in creating, implementing, and monitoring outcomes (Colt, 1994; Imperial and Hennessey, 1996). Nonetheless, despite their limitations, these ecosystem-based management plans, and the programs that implemented them, would become models for other watershed initiatives around the country. As noted by Schneider et al. (2003), NEPs helped create less coercive community-based solutions that have fostered regional networks. These networks "span more levels of government, integrate more experts into policy discussions, nurture stronger interpersonal ties between stakeholders, and create greater faith in the procedural fairness of local policy, thus laying the foundation for a new form of cooperative governance." [93]

In this *Buzzards Bay Comprehensive Conservation and Management Plan 2025 Update,* we recognize there are inherently many tools and solutions that can be employed to address complex watershed problems and the cumulative impacts of pollution and development. At its core, the document still recognizes the importance of community-based solutions and the continued collaboration of a network of stakeholders as a recipe for success.

The Players and Their Roles

This chapter provides a broader overview of the key organizations and agencies who will be most involved in implementing actions needed to achieve the stated goals presented in the action plans of Chapter 3. We also call out some of the most important challenges all will face in meeting the goals and objectives laid out in this document.

Each action plan in the CCMP names agencies and organizations that are either responsible for taking those steps or could be partners in achieving the specified goals. These entities include regulatory and planning agencies at the federal, state, regional, and local level, legislative bodies, research and academic institutions, citizens groups, land trusts, and other non-governmental organizations. Table 33shows the likely lead entities that can best achieve the goals and objectives in the action plans.

For some of the specific action plan objectives, a single entity or agency can achieve the desired result. For still other actions, the implementation may rest with one entity, but another may be able to provide technical or financial assistance. Because many of the entities and organizations identified in this document have authorities, responsibilities, or interests that overlap, communication and coordination among partners can help ensure success.

Federal and state regulatory agencies, such as the EPA and Massachusetts MassDEP, have regulatory powers to require specific actions. However, most strategies described in the CCMP will require local government action because municipalities have the greatest capacity and authority to address the cumulative impacts of growth and nonpoint source pollution. The responsibility and burdens to local government have only been growing as state and federal agencies have been aggregating nonpoint source pollution to require comprehensive solutions. This is particularly evident in the issuance of Phase II MS4 stormwater permits that require comprehensive management of municipal stormwater infrastructure, and the adoption of TMDLs for nitrogen by MassDEP and EPA. Because the Massachusetts constitution

[92] The program followed draft guidance later formalized in EPA 1992.

[93] Although collaborative solutions are not necessarily a panacea to complex environmental problems (Lubell, 2004).

provides considerable home rule authority, this also means that the specific management strategy to address these cumulative impacts will vary among municipalities.

While it is true that the burden to address many pollution sources has increasingly shifted to municipalities, this document recognizes that only an integrated intergovernmental approach can achieve the many goals. This is essential because the cost and scale of some of the problems are so great, it is impossible for local government to carry the load. This is particularly clear in meeting bacteria and nitrogen TMDLs, where the cost of sewering and stormwater treatment to meet these TMDLs will likely cost several billion dollars. It is therefore essential that federal and state agencies, and regional planning agencies, provide scientific and technical information, technical assistance staff, and funding to guide municipal actions, laws, and regulations. It is also important for the state and federal government to provide financing to help leverage or fund local implementation. State and federal agencies can further support and complement local decisions with other regulatory actions and policies.

While the preceding discussion acknowledges the leading role of local government to address many land-based problems, the Commonwealth of Massachusetts has specific responsibilities that relate to tidelands and land under the ocean. First, the Commonwealth is responsible for ensuring public access to the intertidal zone for fishing, fowling, and navigation as defined in Chapter 91 of the Massachusetts General Laws. Second, the Commonwealth owns, on behalf of the public, all rights in tidal waterways beyond the low water mark (land under the ocean). The responsibility of the Commonwealth in managing activities offshore was further expanded by the Massachusetts Ocean Act and defined by the 2009 Massachusetts Ocean Plan and other documents. The state holds these rights "in trust" for the benefit of the public. This responsibility of stewardship of these public trust lands [94] and most action plans focus on protecting the integrity of the Buzzards Bay ecosystem.

Table 33. Primary lead entities that must implement the CCMP action plans.

	Action Plan	Primary Leads
1	Managing Nitrogen	Municipalities, EPA, DEP
2	Protecting and Enhancing Shellfish Resources	Municipalities, DMF
3	Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure	Municipalities, EPA, DEP
4	Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience	Municipalities
5	Managing Onsite Wastewater Disposal Systems	Municipalities, DEP
6	Managing Impacts from Boating, Marinas, and Moorings	Municipalities, MassDEP, CZM
7	Protecting and Restoring Wetlands	Municipalities, DEP
8	Restoring Migratory Fish Passage	Municipalities, DFW
9	Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species	Municipalities, MEPA, DEP
10	Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies	Municipalities, DEP
11	Managing Invasive Species	EPA, DEP
12	Protecting Open Space	Municipalities, EEA
13	Protecting and Restoring Lakes, Ponds, and Streams	DEP, DFW
14	Reducing Trash in Wetlands	Municipalities, Citizen Groups
15	Reducing Toxic Pollution	DEP, EPA, Municipalities
16	Preventing Petroleum Products Pollution	DEP, USCG, EPA
17	Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms	Municipalities, CZM, DEP
18	Protecting Public Health at Swimming Beaches	Municipalities, DPH
19	Monitoring Management Action, Status, and Trends	Buzzards Bay NEP, BBC, DMF, DEP
20	Enhancing Public Education and Participation	BBC, Buzzards Bay NEP, DEP

With respect to implementing actions, it is important to recognize that the public will not automatically embrace the management recommendations presented in the CCMP, or any other planning document for that

[94] A full discussion of the Public Trust Doctrine is contained in Slade, 1997.

matter, merely because they have good ideas. Political concerns may be driven by costs, individual or collective hardships, property rights, or other issues. Some municipal actions will require the support of a majority of voters. Some local initiatives just need vocal leaders demanding action. Underlying all these actions is the need for public involvement. The need for increased public awareness and understanding of environmental issues emphasizes the importance of Action Plan 20 Enhancing Public Education and Participation.

At all levels of government, better planning is one of the most important strategies to prevent worsening water quality and habitat degradation. Good planning defines a course for restoration and pollution reduction strategies. During the 1980s and 1990s, efforts to manage growth in Massachusetts municipalities often failed and instead promoted sprawl because local managers did not carefully consider the effects of changes in policies and regulations. The resulting patterns of development sprawl also increased financial burdens to local government. A good example of these impacts is large lot size zoning without allowing clustering. This approach caused the cost of new homes and infrastructure and services (repaving and plowing of roads, water and sewer service, school bus costs, etc.) to skyrocket. Buzzards Bay communities should learn from these past mistakes and engage in better land use planning and adopt smart growth and low impact development techniques to manage the impacts of future growth.

To achieve all the goals of the 2025 Buzzards Bay CCMP will likely take decades. This is because some particularly intractable problems, like stormwater management and nitrogen reductions, will cost billions of dollars and immense levels of effort among local, regional, state, and federal entities. Continued cooperation among the different levels is essential to protect and enhance the viability of the bay and its watershed resources because no one level of government can solve all the problems. Implementation will require improved regulatory programs, planning, establishing a regional perspective, taking legislative action, and institutionalizing the recommendations contained Table 33 shows the primary leads for actions identified in the CCMP. Throughout this document more specific actions and strategies are defined involving many more agencies and organizations than shown in this table. However, not all agencies or entities face equal levels of effort. In the sections below, we describe the greatest challenges that face the three levels of government.

Federal Challenges

In Massachusetts, EPA has primary responsibility for issuing wastewater discharge permits (both wastewater and stormwater) under the National Pollutant Discharge Elimination System (NPDES), although most permits are issued after consultation with DEP. EPA also has principal authority in enforcing the Clean Water Act and ensuring compliance of TMDLs and water quality standards. Given the scale and scope of addressing stormwater and nutrient pollution problems, and local government costs to comply with pathogen and nutrient TMDLs, EPA with MassDEP must proactively help local government to act. EPA must also promote state action needed to implement these programs and achieve the goals of the Clean Water Act.

In 2000, EPA developed an improved (but still imperfect) set of indicators for evaluating and classifying swimming beaches. At about the same time, the FDA made some minor changes in how they classified shellfish beds and assessed risks associated with pathogens in the water. Both agencies must continue their efforts studying and evaluating new approaches and developing water indicators to assess public health risk associated with pathogen contamination of coastal waters.

During the past 35 years, the U. S. Department of Agriculture (USDA) Natural Resource Conservation Service has expanded its efforts considerably to protect and restore wetland habitats and water quality. While these efforts have been admirable, more effort is required to encourage farmers to implement best management practices to minimize pollutant runoff from farmlands. USDA should also ensure that farm plan agreements are adhered to and enforced through the various USDA farm loan programs. The USDA should continue to work with farmers to minimize the offsite transport of agrichemicals and better manage water use.

Federal agencies are undertaking a variety of planning activities to help meet the goals and objectives relating to shifting shorelines and sea level rise. A decade ago, FEMA updated floodplain boundaries in Buzzards

Bay municipalities. The agency should continue to work with the municipalities and state to help develop hazard mitigation plans and encourage municipalities with large numbers of structures at risk to participate in the Community Rating System. Other agencies should support other climate adaptation measures.

State Challenges

MassDEP is the major regulatory authority for environmental protection in Massachusetts, and as such, has the responsibility for most state recommendations contained in this management plan. EPA issues NPDES permits after consultation with DEP. In this regard, this agency is on the frontline in ensuring the goals and requirements of those programs are met.

Perhaps DEP's greatest responsibility in the next decade will be to encourage towns to adopt management strategies to meet nutrient and bacteria TMDLs. Their responsibility is more crucial given recent legal decisions affirming limits to EPA's abilities to manage certain nonpoint sources of pollution. The agency can achieve this goal through its grant programs, permit programs, and through enforcement action.

DMF similarly faces difficult challenges in implementing new interstate shellfish sanitary guidelines which are expanding shellfish bed closures around wastewater facility outfalls.

Local Challenges

Most streams and ponds in the Buzzards Bay watershed and near coastal waters of Buzzards Bay are affected by small yet cumulatively significant and numerous nonpoint sources of pollution. Increasingly, through permit programs like the MS4 NPDES stormwater program and through implementation of TMDLs, state, and federal government has directly shifted responsibility for action to local government. In Massachusetts, because a considerable amount of authority has been delegated to municipalities, these discharges can and should be managed by local boards and municipal departments. This will not happen automatically, or quickly, because local government has neither the financial capacity for massive infrastructure changes, nor personnel to implement many of the needed programs.

Many Buzzards Bay communities are handicapped in their efforts to implement local regulatory programs because they lack personnel with either the requisite technical expertise, or they lack enough staff to handle all the new responsibilities thrust upon them by the state and federal government. Some smaller Buzzards Bay communities lack professional staff like planners and conservation agents or full-time health agents. Many municipalities do not have staff and software to undertake the simplest of GIS analyses. Due to the wide range of disciplines required of any one local employee, even the communities that retain staff are hard-pressed to deal expertly with the many complex environmental issues that they must confront. It is for these reasons that the Buzzards Bay NEP directs so much of its operation toward providing technical and financial assistance to Buzzards Bay municipalities.

To focus local efforts, each municipality should establish a water quality committee, and staff to support the committee. This committee can meet MS4 permit requirements and other goals within the municipality. The responsibilities of the committee, and a water quality coordinator to staff it, would be to:

- Establish water quality goals and objectives for the town so that municipal departments and boards clearly understand the critical water quality and living resource issues that need to be addressed.
- Review the community's present management and regulatory policies and recommend necessary modifications.
- Advise select boards and other policy makers as to appropriate actions necessary to meet these goals and objectives.
- Review relevant environmental data collected by state and federal agencies and local departments and integrate this information into the local management program.

This recommendation was in the 1991 CCMP but was rarely implemented [95]. Efforts to develop comprehensive water management plans, Phase II MS4 permits, and state and federally imposed TMDLs make such a committee even more important.

As noted above, Buzzards Bay communities need to better plan for growth and development in a way that protects environmental quality. Adopting "smart growth" and "low impact development" techniques and regulations are essential to meet this goal.

Establishing a Regional Perspective

While pollution in Buzzards Bay is often localized, it is also important to view Buzzards Bay and the living resources in its watershed as a regional resource shared by municipalities. This is particularly true in the case of nitrogen loading and stormwater discharges influencing water quality and habitat in the estuaries around the bay because these problems typically cross municipal bounds. Because restoration efforts will often require coordination among two or more communities, and because addressing nitrogen and stormwater impacts will cumulatively cost billions, regional or intermunicipal collaborations might be one mechanism to reduce costs.

The appreciation of Buzzards Bay as a regional resource became clear for the wrong kind of reason after the *Bouchard 120* oil spill in 2003. The spill bound together municipal first responders and other local officials, state, and federal legislators, and the public in a way that sped up the cleanup of Buzzards Bay and fostered improvements to navigation and oil transport in Buzzards Bay.

Bay-wide organizations, like the Buzzards Bay Coalition, the Buzzards Bay Action Committee, and the Buzzards Bay NEP have all been instrumental during the past 35 years encouraging regional and intermunicipal collaborations and raising the awareness of residents and local officials as to their common interests in protecting Buzzards Bay, but more effort is needed. The protection of a resource the size and complexity of Buzzards Bay requires cooperation and consistency of approach among the communities sharing these resources. It is for this reason that these three Buzzards Bay regional organizations, together with regional planning agencies like the Southeast Regional Planning and Economic Development District and the Cape Cod Commission, continue to implement initiatives that cross municipal boundaries and enhance watershed awareness.

Institutionalizing the Buzzards Bay CCMP

It is unimportant whether the average Buzzards Bay resident knows or understands that a Comprehensive Conservation and Management Plan exists for Buzzards Bay and its watershed. What *is* important is that both young people and adults understand the sources of pollution and environmental degradation, and what actions, both individually and collectively, need to be taken to protect the environment. They must also understand the costs of action and inaction. Without an informed citizenry, inaction will be the norm.

However, even with the noblest intentions, failure to act may occur because of high costs. Therefore, it is vital that regulations and the burden of restoring degradation be placed on those causing the degradation. More importantly, public policies and regulations must be structured so that new development and redevelopment not only prevents new impacts but also helps mitigate existing impacts. In this way, the cost of restoring the environment becomes incorporated into the cost of development.

The CCMP is not a regulatory document, so successful implementation will require continued commitment and collaboration of all the partners. The Buzzards Bay NEP staff has successfully forged strong institutional arrangements with local, state, and federal stakeholders during the past twenty years. The emphasis has been on fostering partnerships with town regulatory boards because most CCMP actions are directed at local government, which has the greatest burden to implement the CCMP, and because they most need NEP technical and financial assistance. The staff's focus has been on providing technical assistance to planning boards, boards of health, and conservation commissions. This help takes the form of

[95] After the first CCMP was approved, the Town of Bourne established what is now called the Selectmen's Task Force on Local Pollution, which remains in existence to this day. The task force over the years has developed programs and plans to reduce pathogen and nutrient pollution in the Town's coastal waters.

bylaw development, workshops, open space planning, septic system tracking, stormwater treatment designs, GIS capability, and other useful implementation tools. Since the CCMP's approval by the EPA in 1992, Buzzards Bay NEP staff has had the opportunity to work in all major Buzzards Bay watershed towns to varying degrees. The staff's ability has strengthened local ability and accelerated CCMP implementation.

Besides technical assistance, the Buzzards Bay NEP has helped local grant writers with proposals and secured highly competitive state and federal funds that were probably otherwise out of reach.

The Buzzards Bay NEP's ability to strengthen local capacity and facilitate CCMP implementation can be seen in numerous examples over its history. In the 1990s, the Buzzards Bay NEP could be seen in the deployment of SepTrack (onsite septic system software) and grants to provide GIS capability to the communities, and to enhance the towns' abilities to work with GIS data, prepare for oil spills, and provide funding for professional staff to boards of health and conservation commissions. In the 2000s, efforts continued through expansion of stormwater GIS databases, assistance on the update of open space plans, and an expanded municipal grant program, supplemented with state funds, to help leverage many new actions.

Beyond establishing strong local relations, the Buzzards Bay NEP has also developed a solid working arrangement within state government. This starts with the program being housed within the CZM, which provides a special institutional advantage. The program has used the prestige of CZM and the expertise of key staff to further the accomplishment of many program priorities within the Buzzards Bay watershed. CZM also provides valuable administrative support and framework to the program.

The Buzzards Bay Action Committee has been an essential partner guiding the Buzzards Bay NEP's grant and technical assistance program. The monthly meetings of the BBAC have also been effective in furthering local partnerships. These sessions have allowed discussions that both promote the Buzzards Bay NEP's activities and provide an opportunity to hear from town representatives about community needs. The BBAC has used these forums to help the Buzzards Bay NEP establish funding priorities, and to ensure that the municipal needs are incorporated into the program's annual work plan.

The Buzzards Bay Coalition has become a leader of environmental action, advocacy, and education in the Buzzards Bay watershed. It is a membership-supported nonprofit organization, which, because of strong leadership and public support, has grown into a nationally recognized organization with an annual budget of over a million dollars, and more than 20 regular staff. As noted on their website, the Coalition is dedicated to the restoration, protection and sustainable use and enjoyment of Buzzards Bay and its watershed. The Bay Coalition works to improve the health of the bay ecosystem for all through education, conservation, research, and advocacy. The vision of the Coalition is:

- A Bay shoreline defined by safe swimming beaches, open shellfish beds, and stretches of scenic open spaces for all to enjoy.
- Healthy waters that support abundant fish, shellfish, and wildlife populations.
- A Bay safe from the threats of oil spills, industrial and sewer discharges, and ocean dumping.

The Coalition has also collaborated with the Buzzards Bay NEP on the program's EPA grant and other initiatives for many years. The organization has been instrumental in assisting Buzzards Bay municipalities to seek and receive grants from the Buzzards Bay NEP and other state and federal agencies in their efforts to meet the goals of the organization and the CCMP.

Massachusetts Coastal Zone Management (CZM) has supported the Buzzards Bay NEP and included elements and recommendations in the CCMP in its program plan and other documents. Other elements of the CCMP will be considered in future CZM program updates submitted to NOAA. CZM has a well-established and effective review process for evaluating projects, especially federal actions that may affect the

state's coastal zone. This process can address priorities in the CCMP and Buzzards Bay watershed that are not currently addressed in the state program plan [96].

At the state and federal level, the Buzzards Bay CCMP can continue to be institutionalized into other programs as has been done during the past decade. This includes providing priority funding to projects that implement CCMP recommendations and refocusing state and federal programs to achieve CCMP goals. EPA has already implemented such a policy in its 319 NPS pollution program and in its 604(b) watershed programs.

Because nitrogen management is a key focus of the original CCMP, the Buzzards Bay NEP focused much of its early efforts in promoting state and local action on nitrogen related issues. The Buzzards Bay NEP was instrumental in helping the Massachusetts MassDEP to incorporate nitrogen management issues into its rewrite of the state onsite septic system code in 1994 and in 1996, and in the adoption of new policies and regulations for the adoption and use of innovative wastewater systems. This work also set some of the groundwork for nutrient and pathogen TMDLs that were adopted by MassDEP and the Massachusetts Estuaries Project in the 2000s. It is important the Buzzards Bay NEP continue to support DEP's efforts to develop and adopt TMDLs, and in assisting municipalities to implement actions to meet those TMDLs once approved. It is also essential that the Buzzards Bay NEP work on stormwater management issues and assist towns in their efforts to treat stormwater and implement programs to improve water quality and meet bacteria TMDLs.

A key responsibility of the Buzzards Bay NEP is to monitor the implementation of actions by municipal, state, and federal government, and the private sector, that support the goals of the CCMP. Another responsibility is to facilitate those actions whenever possible through financial or technical assistance. The Buzzards Bay NEP, a unit of the Massachusetts Office of Coastal Zone Management, works under the guidance of its Steering Committee [97]. It is essential that the members of the Steering Committee meet periodically to assess progress and action, improve coordination and collaboration of the partners, ensure participation of other entities and organizations, and promote actions within their programs that further CCMP goals. These activities are essential in the broader effort to protect and restore water quality and living resources in Buzzards Bay and its surrounding watershed.

As described in Section 320 (b)(7), the Buzzards Bay NEP and the state can assess whether other federal grants and initiatives are consistent with the Buzzards Bay CCMP. While CZM routinely conducts federal consistency review on MEPA projects, the NEP does not systematically review MEPA filings. However, in letters of support or review of projects, does name those Action Plans the proposed work supports. This federal consistency toll should be considered whenever the Buzzards Bay NEP reviews projects.

[96] This has already occurred in several instances where CZM submitted comments to MEPA on large groundwater wastewater discharges outside of the Massachusetts coastal zone, but within the Buzzards Bay watershed, that would cause environmental degradation due to nitrogen loading. Reauthorization of the Coastal Zone Management Act in the 1990s expanded state authority to go beyond the designated coastal zone.

[97] The Steering Committee currently consists of the Massachusetts Office of Coastal Zone Management, U.S. Environmental Protection Agency New England, Massachusetts Department of Environmental Protection, Southeastern Regional Planning & Economic Development District, Buzzards Bay Action Committee, and the Buzzards Bay Coalition.

Chapter 5. Finance Strategy

Overview

The original 1991 CCMP and later updates are the consensus approach of the Buzzards Bay NEP's Management Conference and all the participants involved. The CCMP recommends priority actions to address point and nonpoint sources of pollution to restore and support the chemical, physical, and biological integrity of the bay and its surrounding watershed. CCMP goals include protecting and restoring key habitats and plant and animal species as well as protecting commercial and recreational uses of natural resources. This plan is a long-term framework for action by local, state, and federal government, and the public.

As articulated in Costs and Financing sections of each Action Plan, it will cost billions of dollars and take decades to achieve the long-term goals and objectives of the CCMP. It is not the responsibility of the Buzzards Bay NEP to fund these actions, rather, the Buzzards Bay NEP's role is to monitor actions taken, develop strategies and plans to help CCMP implementation, and to strategically leverage other resources and actions to continue progress.

The goal of the Finance Strategy of the CCMP 2025 Update is to articulate the financing options needed to fulfill CCMP goals to protect and restore water quality and living resources of Buzzards Bay and its surrounding watershed. Different levels of government and other entities must undertake specific actions and bear the associated costs. Implementing these Action Plans will require diverse or dedicated funding sources. Ultimately, funding depends on residents, government agencies, and legislators believing investments in the environment are needed and a priority over other needs. Because the Buzzards Bay NEP has a role in facilitating CCMP implementation, the Finance Strategy also addresses how the Buzzards Bay NEP will continue to be funded.

Financing the Action Plans

Financing the Buzzards Bay NEP

The Buzzards Bay NEP receives $850,000 of base program funding from the EPA under Section 320 of the Clean Water Act, $250,000 annually from the SNEP, and for the past four years, received $900k through the Infrastructure Investment and Jobs Act (IIJA). Of the base funding, about $700,000 funds staff, technical support, monitoring, program operations, fringe and indirect. The balance of the base funding ($150k) plus the SNEP and IIJA funds are directed toward municipal grants and subawards to support local actions. EPA combines base and SNEP funds in a single Cooperative Agreement with EPA, requiring a 1:1 match. The IIJA funds, scheduled to end in 2026, require no match. The NEP meets required match for its Base and SNEP funding primarily state grant program match, NEP partners, and through match to the Buzzards Bay NEP's grant program. EPA base funding is essential to sustain the NEP's core mission--to monitor implementation of the CCMP and help leverage new actions. After termination of the IIJA funding, the NEP must seek grants and other state and federal funding to leverage continued action and new initiatives.

Financing the CCMP Action Plans

In each action plan, there are estimates on the costs to achieve various goals or to implement certain programs. To better organize and clarify the responsibilities and costs associated with various programs, we used our best professional judgment to identify specific costs and financing options. Certain efforts, such as managing and treating stormwater and nitrogen discharges to meet water quality goals and TMDLs, will likely total billions of dollars and take decades to achieve. Achieving other goals and objectives will be far less costly.

In this chapter, we summarize the costs estimated in the Action Plans, and likely potential funding sources and mechanisms. We also name those state and federal programs that need more funding. We present only brief descriptions of options and refer the reader to more comprehensive assessments and evaluations including various wastewater financing options summarized in the Cape Cod 208 plan.

Financing the implementation of a CCMP is different from financing a NEP, but they are related. To achieve the goals of a non-regulatory document like the CCMP, not only must progress be tracked, but approaches and actions must be continually refined and improved upon. State and local government must often initiate new adaptive approaches to overcome

government and public inertia. The NEPs and its partners can undertake or facilitate these actions. For this reason, this chapter primarily identifies funding sources that support local action. We also describe past funding of the Buzzards Bay NEP's partners on its federal Cooperative Agreements with EPA, the citizen-group non-profit the BBC, and the municipal non-profit the BBAC. [98]

As described in the Action Plans, local government will bear most of the costs and burdens of implementing the CCMP as they have the authority to adopt and implement the kinds of policies, regulations, and programs needed to achieve water quality and habitat restoration goals. Some recommendations in the CCMP have such high costs that they may require years of sustained funding. The municipalities will succeed only if regional, state, and federal government also share in the regulatory and financial burdens of these municipal efforts.

Past Funding

To understand opportunities to fund the recommendations in the CCMP 2025 Update, it is important to appreciate past funding sources of the Buzzards Bay NEP, its non-governmental partners, and the municipalities. Understanding how municipalities have funded and implemented past recommendations is particularly important because municipal government bears the greatest responsibility and cost in implementing the recommendations in the management plan.

Buzzards Bay NEP

The forty-year history of funding of the Buzzards Bay NEP can be broken into three broad periods. Between 1985 and 1992, large amounts of federal dollars were received to characterize environmental problems, develop the first CCMP, and undertake environmental demonstration projects. Funding during this period averaged close to $1 million per year. Between 1993 and 2001, the Buzzards Bay NEP continued to receive federal base funding, but at dramatically reduced levels. To offset these losses, the Buzzards Bay NEP brought in added grant dollars through various grant programs for special initiatives like the Massachusetts Septic System Test Center and Toxics Use Reduction Program. During this period, the Buzzards Bay NEP also received two congressional earmarks totaling $1 million dollars, and state earmarks totaling $400,000. These earmarks were directed into the municipal grant program.

After 2001, the Buzzards Bay NEP changed its financing strategy and used its federal funding primarily to fund core staff to provide technical assistance and fund a municipal grant program. Rather than the NEP securing funds to expand its program, the NEP helped watershed municipalities and partners in securing state and federal funds, with the NEP providing free assistance in helping our partners implement grant work plan tasks. This strategy proved effective because state and federal programs subsequently funded municipal projects where the NEP funded planning or design phases. Thus, Section 320 federal funds to the NEP were able to leverage many more state, federal, and private dollars toward CCMP implementation.

This new approach had several advantages. The Buzzards Bay NEP did not have to act as an administrative agent to other state or federal grant programs nor was it reliant on increasing state and federal dollars. This approach allowed the Buzzards Bay NEP to refocus efforts on providing technical assistance and grants to municipalities and our partners to implement specific initiatives. Any additional state or federal funds received by the program above federal base levels (initially around $500,000 per year, later up to $1 million per year) were principally directed to the Buzzards Bay NEP's grant program.

Buzzards Bay Coalition

The Buzzards Bay NEP Citizens Advisory Committee (CAC) split in 1987 to form a citizens non-profit called the Coalition for Buzzards Bay (renamed in 2011 as the Buzzards Bay Coalition),. After its formation in 1987, the Buzzards Bay Coalition received considerable funding from the Buzzards Bay NEP to implement education, outreach, and water quality monitoring programs. This funding together with private donations, helped firmly establish the Coalition during its

[98] Both the Buzzards Bay Coalition and the Buzzards Bay Action Committee were created as offshoots from the Buzzards Bay NEP's Citizen Advisory Committee.

formative years, providing assistance in creating a strong membership base. The Coalition cut back on some efforts during the mid-1990s when their funding from the Buzzards Bay NEP was reduced. However, by the late 1990s, with new strong leadership, new initiatives focusing on land and habitat protection, and successful and creative financial development programs, the Coalition grew to an annual budget of $1.5 million and 15 staff members by the mid-2000s. Today the Coalition is funded by a roughly equal mix of membership dues, donations, special endowments, and grants. The organization today is not only a key partner to the Buzzards Bay NEP, but it also provides much-needed non-federal match to the Buzzards Bay NEP's federal grants. More importantly, the Coalition's diverse programs now implement so many CCMP recommendations, making it a keystone organization to the future protection of water quality and living resources of Buzzards Bay and its watershed.

Buzzards Bay Action Committee

In 1989 the Buzzards Bay Advisory Committee, an advisory committee of the Buzzards Bay NEP since 1987, re-formed as a non-profit municipal organization called the Buzzards Bay Action Committee (henceforth, the BBAC). Initially the Buzzards Bay NEP funded the BBAC to hire the group's first executive director. When funding from the Buzzards Bay NEP diminished in the mid-1990s, the BBAC reorganized with a part time director funded solely by dues from the member municipalities. This funding proved adequate for the organization with some funds available for special projects. The BBAC also occasionally received small grants from state and federal sources like an EPA Healthy Communities grant to establish the Buzzards Bay Stormwater Collaborative. Today, BBAC meetings are an important forum for municipalities to learn about new issues facing Buzzards Bay, share knowledge about addressing environmental problems, and provide feedback and guidance to the Buzzards Bay NEP on the direction of its technical assistance and grant programs.

Buzzards Bay Municipalities

The Buzzards Bay NEP has had a highly effective municipal grant program in place since 1990 assisting Buzzards Bay municipalities. This program, funded through EPA Section 320, EPA demonstration project funds, Congressional add-ons, SNEP, IIJA, and state match programs, has been highly effective in leveraging CCMP actions and remains a core function of the Buzzards Bay NEP, and an important financial resource to local government.

State Grant Programs

Several state programs have been invaluable to Buzzards Bay municipalities. These include the various past and present CZM grant programs, and the MassDEP 319 NPS, 604(b), and MS4 grant programs. Equally important in the last decade were EPA SNEP grants, administered by the Buzzards Bay and Rhode Island NEPs in the SNEP's first two years (2015 and 2016).

Besides these grant programs, the state's Clean Water State Revolving Fund (SRF) is the source to fund several key environmental restoration efforts, particularly municipal sewage treatment plant upgrades and sewer expansion. The SRF can also fund stormwater system upgrades, although towns do not often apply for loans to manage stormwater.

The financing of implementation activities and leveraging of CCMP actions is part of an ongoing aggressive strategy by the Buzzards Bay NEP to tap into various state and federal financial and technical assistance programs. Other Buzzards Bay NEP partners have similarly had success in attracting state and federal dollars. For example, for its water quality monitoring program the Coalition received $100,000 in 2022; and $150,000 per year between 2023 and 2024.

The Buzzards Bay NEP's success in acquiring funding for partners is illustrated by the leveraged funds reports prepared by the Buzzards Bay NEP for the EPA. These reports show that modest federal funding to the Buzzards Bay NEP has leveraged two to four times the EPA funding from nonfederal sources.

Costs of Implementing the CCMP

The cost of achieving the goals of the CCMP (and to achieve full compliance with the federal Clean Water Act), will likely exceed $9 billion and take decades to implement. This cost is largely driven by expenses needed to comply with two federally mandated Clean Water Act elements: compliance with pollutant TMDLs and compliance with the NPDES program, particularly Phase II municipal stormwater (MS4) system permit compliance.

The TMDL requirements under the Clean Water Act will eventually result in most of the urbanized portions of Buzzards Bay being sewered or connected to advanced wastewater treatment systems to remove nitrogen. The Buzzards Bay NEP estimates the sewer expansion, together with the construction of advanced wastewater facilities of various scales, will likely cost $3 to $4 billion. Similarly, compliance with municipal MS4 stormwater permits may cost municipalities up to $1 billion to treat all stormwater discharges in impairment areas to meet water quality standards.

Most other CCMP recommendations will cost far less to implement, and some have virtually no cost. Table 34 shows a summary of costs by action plan.

The Future

The Buzzards Bay NEP, together with our partners, expect continued success in securing state and federal competitive grants and local funds to fund specific implementation projects. Some state and federal agencies, in their review of grants, consider whether applications support or implement the recommendations contained in the CCMP.

An important challenge faced by Commonwealth environmental agencies (including the Buzzards Bay NEP) has been obtaining federal funding passed through non-governmental agencies. Increasingly the federal government has privatized federal grant funding through non-governmental organization like the National Fish and Wildlife Federation (NOAA) and Restore America's Estuaries (EPA). While the system works well for many organizations and municipal government, Massachusetts state agencies are subject to laws and regulations that have excluded their ability to secure these funds. Specifically, any agency receiving gifts, donations, or grants from any entity other than the federal government must establish an expendable trust account (required by CMR 801.5000). The state comptroller requires the grants to be deposited into an expendable trust account in advance of their expenditure, whereas the granting agencies require the grant recipients to expend the funds before they are reimbursed. The agency must also establish a board of trustees for every grant. Currently EEA and CZM are working the Comptroller to change the rules for this class of funds. These changes are essential for the future financial security of the Buzzards Bay NEP.

Table 34. Summary of possible costs over a 20-year period (approximate mid-range estimates) by action plan.

Values should be considered approximate and based on best professional judgment.

Action Plan	approximate mid range costs
1: Managing Nitrogen	$2 billion
2: Protecting and Enhancing Shellfish Resources (costs other than stormwater)	$10,000,000
3: Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure	$1 billion
4: Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience	>$10, 000,000
5: Managing Onsite Wastewater Disposal Systems	$1,000,000
6: Managing Impacts from Boating, Marinas, and Moorings	$17,000,000
7: Protecting and Restoring Wetlands	$20,000,000
8: Restoring Migratory Fish Passage	$25,000,000
9: Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species	$50,000,000
10: Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies	$100,000,000
11: Managing Invasive Species	$10,000,000
12: Protecting Open Space	$100,000,000
13: Protecting and Restoring Lakes, Ponds, and Streams	$6,000,000
14: Reducing Trash in Wetlands	$1,000,000
15: Reducing Toxic Pollution (excludes $1 billion+ Superfund cleanup costs)	$10,000,000
16:Preventing Petroleum Products Pollution	$5,000,000
17: Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms	$2,000,000
18: Protecting Public Health at Swimming Beaches	$1,000,000
19: Monitoring Management Action, Status, and Trends	$40,000,000
20: Enhancing Public Education and Participation	$20,000,000
Approximate Total	$3,500,000,000

Key State and Federal Grant Programs to fund CCMP recommendations

5 Star Restoration Program

Agency: EPA

The Five Star Restoration Program brings together students, conservation corps, other youth groups, citizen groups, corporations, landowners and government agencies to provide environmental education and training through projects that restore wetlands and streams. The program provides challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects.

Eligibility: non-profit community-based organizations, conservation organizations, local governments, and school districts.

604(B) Water Quality Management Planning Grants

Agency: MassDEP

604(b) grants fund municipalities and other eligible recipients to conduct water quality assessments and watershed pollution reduction planning.

Eligibility: Municipalities, other state agencies, regional planning agencies, and non-profits.

Agricultural Environmental Enhancement Program

Agency: Department of Agricultural Resources (DAR)

For the purchase of materials to implement agricultural conservation practices that improve water quality, conserve water, reduce greenhouse gas emissions, or conserve energy.

Eligibility: Farmers/growers/shellfish growers as identified by Massachusetts General Laws (MGL) engaged in commercial agriculture production.

Buzzards Bay Watershed Municipal Grant Program

Agency: Buzzards Bay NEP

The Buzzards Bay National Estuary Program offers grants to Buzzards Bay watershed municipalities with feasibility, assessment, design, and construction of stormwater facilities, permanent land preservation through direct acquisition or easement, installation of conservation moorings, projects that support restoration of wetlands, habitat, migratory fish passage, and culvert replacements, construction of boat pump-out facilities, creation of online reporting systems for tracking alternative septic systems, projects that mitigate or restore coastal waters, or freshwaters, adversely affected by nutrient loading or bacteria pollution, and other activities in support of the CCMP.

These funds are available through U.S. EPA National Estuary Program Cooperative Agreement.

Eligibility: Eligible towns include Fall River, Westport, Dartmouth, New Bedford, Acushnet, Fairhaven, Rochester, Mattapoisett, Marion, Wareham, Middleborough, Carver, Plymouth, Bourne, Falmouth, and Gosnold. Projects must lie within the Buzzards Bay watershed.

Clean Vessel Act Grant Program

Agency: Division of Marine Fisheries Gloucester Office

The Massachusetts Clean Vessel Act (MA-CVA) Program provides free pumpout service to recreational boaters along the coast. The program is funded by the U.S. Fish and Wildlife Service's Sportfish Restoration Program. Every year, the State applies for federal funds to buy or replace CVA equipment for use by towns, cities, and private marinas to offer free pumpouts.

Eligibility: Municipalities, private boating facilities, and non-profits.

Clean Water State Revolving Loan Fund Program

Agency: MassDEP

Provides low-cost financing to aid communities to meet the water-quality standards of the Clean Water Act. The program supports watershed management priorities, stormwater management, green infrastructure, and treatment works and infrastructure. New projects receive a state-subsidized 2% interest loan.

Eligibility: Cities, towns, and wastewater districts

Conservation Partnership Grant Program

Agency: Division of Conservation Services (DCS)

This program can help not-for-profit groups acquire interests in land for conservation or recreation purposes. Potential projects fall into one of two categories: acquisition of the fee interest in land or a conservation restriction, or due diligence costs for donations of land or CRs.

Eligibility: This grant program is open to qualified IRS 501(c)(3) organizations that support Section 4 of Chapter 180 of the General Laws. Municipalities are not eligible for funding.

Cranberry Bogs & Coastal Wetlands Restoration Grants

Agency: Division of Ecological Restoration

Funds the early phase of feasibility, project planning, preliminary design, and construction of retired cranberry bog and coastal wetland restoration projects. The purpose of this funding is to support public and private entities engaged in restoration efforts to remove stressors that impair the function and resiliency of wetland and stream habitats.

Eligibility: State, regional, or municipal organization, non-governmental agency, and public or private entity that either owns or has the authority to represent the owner of the proposed restoration project site.

Culvert Replacement Municipal Assistance Grant Program

Agency: Division of Ecological Restoration

Funds replacing or removing an undersized, perched, and/or degraded culvert found in an area of high ecological value. This funding is to encourage applicants to replace aging culverts with better designed crossings that meet improved structural and environmental design standards and flood resiliency criteria.

Eligibility: local and regional government units, municipalities, and tribal governments

Drinking Water Supply Protection Grant Program

Agency: MassDEP

To protect key parcels of land that protect current and future water supplies.

Eligibility: Municipalities and public drinking water suppliers established by the Legislature.

Drinking Water State Revolving Loan Fund Program

Agency: MassDEP

Provides low-cost financing to help community public water suppliers meet federal and state drinking water requirements. The program's goals are to protect public health and strengthen compliance with drinking water requirements while addressing the Commonwealth's drinking water needs. The program incorporates affordability and watershed management priorities.

Eligibility: Public water suppliers

Federal Land and Water Conservation Fund

Agency: Division of Conservation Services (DCS)

The Federal Land & Water Conservation Fund (P.L. 88-578) provides up to 50% of the total project cost for acquisition of parkland or conservation land, creation of new parks, renovations to existing parks, and development of trails.

Eligibility: Municipalities that have an up-to-date Open Space and Recreation Plan, Department of Conservation and Recreation, Department of Fish and Game, Massachusetts federally recognized tribes (Mashpee Wampanoag Tribe and Wampanoag Tribe of Gay Head - Aquinnah), and the land must be open to the public.

Building Resilient Infrastructure and Communities Program

Agency: Massachusetts Emergency Management Agency (MEMA)

An annual FEMA Hazard Mitigation Grant program is funded by FEMA and administered through a partnership with MEMA. BRIC aims to support proactive investment in community resilience and risk reduction from natural hazards.

Eligibility: States, tribal governments, territories and local communities.

Flood Mitigation Assistance Program

Agency: MEMA

Flood Mitigation Assistance employs cost-effective measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.

Eligibility: States, tribal governments, territories and local communities.

Hazard Mitigation Grant Program

Agency: MEMA

Cost-shared grants for natural hazard mitigation planning and projects for communities (post-disaster). Dependent on future Presidential disaster declarations.

Eligibility: Municipalities, state agencies, certain non-profits.

Seaport Economic Council Grants

Agency: Executive Office of Economic Development

This program funds projects that stimulate the maritime economy and grow jobs. Successful grant applications should seek funds for capital expenses rather than operating expenses and fall in the following categories: Innovation grants that promote job creation and economic growth in the maritime sector, local maritime economic development planning grants, grants to public education institutions, supportive

coastal infrastructure project grants, and dredging design and permitting grants.

Eligibility: All 78 coastal communities of the Commonwealth and other qualified public entities.

Lakes And Ponds Program

Agency: DCR Division of Water Supply Protection

To protect, manage, and restore valuable aquatic resources, this program provides technical assistance, helps to monitor water quality at various public beaches to ensure public safety, and provides educational materials to the public about various lake issues.

Eligibility: Municipalities, citizens group, and other local nonprofit groups.

Mass Wildlife Habitat Management Grant Program

Agency: Division of Fisheries and Wildlife

Provides assistance to private and municipal owners of protected lands to enhance wildlife habitat, while promoting public access for outdoor recreation.

Eligibility: Owners of private or municipal conserved lands in the Commonwealth of Massachusetts.

Land And Water Conservation Fund Grant Program

Agency: Division of Conservation Services

The Federal Land & Water Conservation Fund provides up to 50% of the total project cost for the acquisition, development, and renovation of: parks, trails, and conservation areas.

Eligibility: Municipalities that have an up-to-date Open Space and Recreation Plan; Department of Conservation and Recreation; Department of Fish and Game; Massachusetts federally recognized tribes (Mashpee Wampanoag Tribe and Wampanoag Tribe of Gay Head - Aquinnah)

Local Acquisitions for Natural Diversity Grant

Agency: Division of Conservation Services

This program helps cities and towns acquire land for conservation and passive recreation purposes. The grants reimburse cities and towns for the acquisition of land in fee or for a conservation restriction.

Eligibility: Municipal conservation and agricultural commissions from communities with an up-to-date Open Space and Recreation Plan

Coastal Habitat and Water Quality Grants

Agency: CZM

Formerly called the Coastal Pollutant Remediation Grant Program, the Coastal Habitat and Water Quality Grants provides funding for projects that assess and treat stormwater pollution and support comprehensive habitat restoration planning. Eligible project activities include, but are not limited to: 1) Efforts to assess, identify, and characterize nonpoint source (NPS) pollution impacts from stormwater runoff to coastal waterbodies; 2) design and construction of stormwater structural Best Management Practices (BMPs) (priority is given to practices that address contaminants of concern in coastal waterbodies); 3) capacity-building activities—including trainings for municipal staff, bylaw development, and case studies—that support future implementation of green stormwater infrastructure (methods that replicate natural processes to trap and filter stormwater prior to reaching local waterbodies); 4) development of habitat restoration plans, including data collection and synthesis, natural resource assessments, and restoration prioritization work; 5) advancement of priority land acquisition planning activities for the purposes of restoration, buffer protection, and/or future marsh migration.Eligibility: Municipalities within the Massachusetts coastal watershed, along with federally recognized Tribes, certified 501(c)(3) nonprofit organizations, regional planning agencies, and stormwater collaboratives in partnership with eligible municipalities.

Massachusetts Environmental Trust Grants

Agency: Massachusetts Environmental Trust (MET)

MET funds projects that encompass environmental advocacy and educational activities related to aquatic habitat improvements and threatened and endangered marine life protection and conservation. Proposals should incorporate objectives that include enhancing biodiversity, promoting smart growth, understanding the impacts of climate change and fostering

climate resilience strategies, promoting environmental awareness, and addressing EJ concerns and communities.

Eligibility: Non-profit organizations, educational institutions, municipalities, and state agencies

Sustainable Materials Recovery Program

Agency: MassDEP

These grants support local recycling, composting/organics, reuse, source reduction, program development, and enforcement activities that increase diversion and reduce disposal.

Eligibility: Massachusetts municipalities and regional governments

Parkland Acquisitions and Renovations for Communities Grant Program

Agency: Division of Conservation Services

This program to aid cities and towns to acquire land for park and outdoor recreation purposes. These grants are used by municipalities to buy parkland, build a new park, or to renovate an existing park.

Eligibility: Any town with a population of 35,000 or more year-round residents, or any city regardless of size, that has an authorized park /recreation commission

Recreational Trails Grants Program

Agency: DCR

The Recreational Trails Program is a federal assistance program of the U.S. Department of Transportation's Federal Highway Administration, administered at the State level by MassTrails. The grant program provides funding for the development and maintenance of recreational trail projects. Both motorized and non-motorized trail projects qualify for assistance.

Eligibility: Municipalities, Native nations, non-profits, and other public entities

Massachusetts Dredging Program Grant

Agency: Executive Office of Economic Development

The Massachusetts Dredging Program is a capital grant program that provides funding to coastal municipalities for saltwater dredging. Construction grants are competitively awarded with a focus on shovel-ready projects that support the economic vitality, vibrant waterfronts, maritime safety, or ecosystem health of Massachusetts's harbors.

Eligibility: The Commonwealth's 78 coastal municipalities

Priority Projects Program Advancement Grant

Agency: Division of Ecological Restoration

This supports wetland and river restoration projects that bring significant ecological and community benefits to the Commonwealth. DER is interested in funding active, existing Priority Projects and Provisional Projects which are at any stage of development, including dam removal, river restoration and stream crossing upgrades, urban river revitalization, cranberry bog restoration, and coastal and freshwater wetland restoration, or combinations thereof.

Eligibility: Any Priority Project Lead Project Sponsor (LPS), State, Regional, or Municipal agency, Non-Governmental Organization, or public or private entity that either owns or has the permission by the landowner of the existing Priority Project to advance restoration work.

Section 319 Nonpoint Source Competitive Grant Program

Agency: MassDEP

With EPA funding through Section 319 of the Clean Water Act, MassDEP provides grants for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. Eligible projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of NPS pollution within a watershed/subwatershed; contain an appropriate method for evaluating the project results; and address activities that are identified in the most current Massachusetts NPS Management Program Plan.

Eligibility: Massachusetts public or private entity

Chapter 6. Habitat Protection and Restoration Strategy

Beginning in 2025, EPA requires a Habitat Protection and Restoration Strategy for updated CCMPs. In EPA's 2025 guidance they write,

"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 a chapter in the CCMP and should discuss:

- *relevant habitat types and key species in the study area; goals and measurable objectives to address them;*
- *recurring extreme weather events and other stressors and impacts on the study area;*
- *identify key activities to implement the action, including affected habitat types, or resources;*
- *identify lead implementors and partners;*
- *include the proposed action plan timeframe, and where appropriate, key milestones for completion;*
- *estimate the range of potential costs of the overall action and identify the possible sources of funding;*
- *include protection and restoration targets and performance measures (quantitative measures and intended environmental results wherever possible). The strategy can make it easier for NEPs to plan and report on their habitat protection results; and*
- *any considerations for how changes in federal, state or local regulatory authorities may affect protection and restoration priorities."*

The protection and restoration of habitat is a core element of most of the CCMP's Action Plans. Instead of reorganizing Action Plans to meet this requirement or creating a stand-alone but redundant document, this chapter identifies those Action Plans in the updated CCMP that constitute the Buzzards Bay NEP's Habitat Protection and Restoration Strategy.

Many CCMP Action Plans are particularly focused on habitat or ecosystem impairments, including those habitats and species prioritized for protection and restoration efforts. However, the three most salient Action Plans are Action Plan 7 Protecting and Restoring Wetlands, Action Plan 9 Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species, and Action Plan 12 Protecting Open Space. Action Plan 12 is especially noteworthy because it documents how wetlands and rare and endangered species habitat are protected as open space is protected. In each Action Plan we identify authorities with regulatory oversight of habitat and species.

Table 35 summarizes all relevant Action Plans that meet the NEP's Habitat Protection and Restoration goals and explicitly include habitat restoration in the goals and objectives. Chapter 2 identifies climate stressors that threaten habitat protection and restoration. Individual action plans identify key activities to implement the action plan and lead implementors and partners. Wherever practical, action plans specify a timeframe to complete tasks and estimated costs.

The ability to meet the NEP goals depends on many factors including federal, state, and local agencies enforcing laws and regulations that protect wetlands, isolated wetlands, waters of the US, and rare and endangered species and their supporting habitat. Implementing these laws and regulations requires adequate funding from the respective regulatory agencies. Any weakening of related environmental laws and regulations and the cooperation or interest of private property holders are other factors that will limit the effectiveness of agencies, municipalities, and non-profits from achieving the various habitat protection and restoration goals contained in the Action Plans.

Table 35. Action plans with explicit goals or objectives that address habitat protection or restoration goals

Action Plan	Habitat Type
Action Plan 1. Managing Nitrogen Pollution	water, marine benthic
Action Plan 2. Protecting and Enhancing Shellfish Resources	shellfish habitat
Action Plan 3. Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure	shellfish, wetlands, water
Action Plan 4. Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience	various habitats
Action Plan 6. Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging	water, marine benthic
Action Plan 7. Protecting and Restoring Wetlands	all wetland types
Action Plan 8. Restoring Migratory Fish Passage and Populations	diadromous fish
Action Plan 9. Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species	listed rare and threatened species habitat
Action Plan 10. Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies	freshwater habitat
Action Plan 11. Managing Invasive Species	various native species
Action Plan 12. Protecting Open Space	wetlands and listed rare and threatened species habitat
Action Plan 13. Protecting and Restoring Lakes, Ponds, and Streams	freshwater habitat
Action Plan 14. Reducing Trash in Wetlands and Waterways	all wetland types
Action Plan 17. Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms	various habitats

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Appendix B. Updates to the 2013 CCMP goals and objectives

This appendix summarizes revisions to the "goals" and "objectives" shown in the 20 Action Plans in the Buzzards Bay Comprehensive Conservation and Management Plan 2013 update. The stated goals are still aspirational and without a deadline. Objectives are key intermediate steps needed to achieve the overarching goals. The objectives are not meant to be an exhaustive list of all actions in support of the goals but are meant to describe important action items that should be implemented or supported by funding and technical assistance by all levels of government. New research-related objectives added to some Action Plans and are meant to describe essential information needed to achieve the goals and objectives of that Action Plan. Because Action Plan 15 Managing Coastal Watersheets, Tidelands, and the Waterfront in the 2013 Update was deleted in the 2025 update, Action Plans 16 to 21 were renumbered 15 to 20. The order of some objectives were rearranged in some action plans to group related objectives, and this resulted in changes in objective numbering.

While some objectives have increased specificity ("Regulators should..."), others do not specify a responsible entity because many levels of government and organizations may be involved.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Action Plan 1 Managing Nitrogen Sensitive Embayments		
Goal 1.1. Ensure that no designated uses will be lost, nor ecosystems adversely affected by excessive contributions of nitrogen to any area of Buzzards Bay.	Goal 1.1. Prevent degradation of water quality and loss of habitat and living resources caused by excessive nitrogen inputs.	Reworded
Goal 1.2. Restore lost designated uses and adversely affected ecosystems impaired by the excessive contribution of nitrogen to any area within Buzzards Bay.	Goal 1.2. Restore water quality and losses of habitat and living resources caused by excessive nitrogen inputs.	Simplified for clarity
	~~Goal 1.3: Ensure that the watershed nitrogen total maximum daily load margin of safety calculation consider climate stressors that may exacerbate coastal eutrophication like temperature, precipitation, and acidification.~~	Idea moved into Objective 1.3.
Objective 1.1. To develop and adopt scientifically based nitrogen total maximum daily loads (TMDLs) for nitrogen impaired areas of Buzzards Bay.	Objective 1.3 By 2035, MassDEP completes science-based watershed nitrogen loading studies for all impaired Buzzards Bay embayments. Ensure that resulting EPA-approved Total Maximum Daily Loads include required margin of safety calculations that account for climate stressors like temperature, precipitation, and acidification that may worsen effects of coastal eutrophication.	Changed order, added climate element; clarified wording, set target date.
Objective 1.2. To reduce the amount of nitrogen currently entering nitrogen-impacted embayments, including all areas identified on 303(d) and Integrated Lists, according to limits specified in approved TMDLs.	Objective 1.4. Reduce nitrogen loads to nitrogen-impaired embayments to meet EPA-approved watershed nitrogen Total Maximum Daily Load limits and waste load allocations.	changed order of objectives, re-written for clarity, new number because objectives reordered
Objective 1.3. To ensure new additions of nitrogen to coastal waters do not cause, or contribute to, a violation of state surface water quality standards, or exceed federally approved TMDLs.	Objective 1.5. Regulators should ensure new additions of nitrogen to coastal waters do not cause, or contribute to, a violation of state surface water quality standards, or exceed EPA-approved watershed nitrogen Total Maximum Daily Load limits.	Eliminated acronym and dropped the word "To", new number because objectives reordered
Objective 1.4. To ensure that state and federal discharge permits meet nitrogen loading limits and waste load allocations specified in approved TMDLs.	Objective 1.6. Regulators should ensure that federal surface water and state groundwater discharge permits set limits that meet nitrogen loading limits and waste load allocations specified in approved Total Maximum Daily Load limits.	Eliminated acronym and dropped the word "To.", new number because objectives reordered
Objective 1.5. To promote the development and implementation of local plans to manage nitrogen sources to meet TMDLs and waste load allocations.	Objective 1.1. Promote the development and execution of local nitrogen management plans to manage nitrogen sources to meet Total Maximum Daily Load limits and waste load allocations.	Clarified wording, new number because objectives reordered, also partly covered in Objective 1.1
Objective 1.6. To promote the development and support the use of alternative and advanced nitrogen reducing wastewater treatment technologies at all scales of flow.	Objective 1.7. Promote the continued development and use of new or improved nitrogen-reducing wastewater treatment technologies at all scales of flow (from onsite systems to municipal scale).	Dropped the word "To", new number because objectives reordered

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 1.7. Monitor water quality and natural resources like eelgrass beds at a sufficient frequency to document management needs, assess the effectiveness of actions taken, and to document ongoing changes and variability in water quality and ecosystems health.	Objective 1.8. Monitor water quality and natural resources (e.g. eelgrass beds, algae, dissolved oxygen), at a sufficient frequency to document management needs, assess the effectiveness of actions taken, and to document ongoing changes and variability in water quality and ecosystems health.	Clarified wording and called out DO and algae monitoring, new number because objectives reordered
	Objective 1.9 Support studies of how changing water temperature and clarity relate to eelgrass loss and incorporate this information along with macroalgal and periphyton cover into an eelgrass health index.	New objective
	Objective 1.10. Support studies that advance the understanding of the relationship between changing water temperature, influence of increased stormwater volumes, changing precipitation patterns, and acidification, on amounts and chemical forms of nitrogen conveyed to coastal waters and how the changes may affect achieving Total Maximum Daily Load limits.	New research objective.
	Objective 1.11. Continue to collect and analyze water temperature and nutrient levels in	New research objective.
	Objective 1.12. Collect and analyze stream temperature, flow, and nutrient loads to better	New research objective; moved management element to Action Plan 3.
	Objective 1.13. Collect and analyze treated and untreated stormwater samples for nutrient loads.	New research objective.
	Objective 1.14. Support development of improved groundwater flow and nutrient loading models, including those that account for climate change impacts.	New objective consistent with MassDEP Title 5 regulation changes and acknowledge the several paths for a municipality to achieve TMDL compliance
	Objective 1.15. Support studies that advance the understanding of nitrogen cycling in sediments of state-designated Nitrogen Sensitive Areas.	New objective consistent with MassDEP Title 5 regulation changes
	Objective 1.16. Encourage adaptive management and performance checkpoints in watershed management planning to address new sources of nitrogen in waterseds to ensure continue progress toward meeting state-designated Total Maximum Daily Loads.	New research objective.
Action Plan 2 Protecting and Enhancing Shellfish Resources		
Goal 2.1. Increase availability of shellfish resources for recreational and commercial use.	Goal 2.1. Increase availability of shellfish resources for recreational and commercial use.	no change

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Goal 2.2. Restore habitat to increase the abundance and distribution of shellfish resources.	Goal 2.2. Restore habitat to increase the abundance and distribution of shellfish resources.	No change
Objective 2.1. To keep open all shellfish resource areas now open, and to open priority resource areas that are now closed.	Objective 2.1. Support efforts to prevent new shellfish resource area closures and open priority resource areas.	Reworded for clarity
Objective 2.2. To increase the ability of DMF to carry out the sanitary survey program and provide technical assistance to municipalities to better manage shellfish resources.	Objective 2.2. The state should increase the Massachusetts Division of Marine Fisheries ability to carry out the sanitary survey program, comply with the National Shellfish Sanitation Program, and DMF should also continue to provide technical assistance to municipalities improve local management of shellfish resources.	Eliminated acronym and added reference to NSSP.
Objective 2.3. To increase the capacity and commitment of municipalities to remediate pollution sources that are contributing to shellfish bed closures.	Objective 2.3. The state and federal agencies should increase grant opportunities to help municipalities remediate pollution sources contributing to shellfish bed closures, and to meet watershed bacterial TMDL limits.2.3. The state and federal agencies should increase grant opportunities to help municipalities remediate pollution sources contributing to shellfish bed closures, and to meet watershed bacterial TMDL limits.	Rewrote and added bacteria limits
Objective 2.4. To expand the use of the conditionally approved classification for shellfish areas.	Objective 2.4. Where justified and supported locally, Division of Marine Fisheries and municipalities should expand the use of the rainfall conditionally approved classification to reduce seasonally closed or prohibited shellfish areas.	Clarified the intent
Objective 2.5. To eliminate pollution sources and disturbances contributing to the permanent loss of shellfish habitat and enhance and restore shellfish habitat.	Objective 2.5. Municipalities, working with the Division of Marine Fisheries should eliminate pollution sources and disturbances contributing to the permanent loss of shellfish habitat.	Split into two objectives and reworded
	Objective 2.6 Grant awarding entities, in concert with the Division of Marine Fisheries and municipalities, should support pollution studies using sound hydrodynamic models to evaluate the adequacy and minimum size necessary for effective buffer zones around wastewater treatment plant outfalls.	Split from 2.5 above and expanded idea, reordered objectives
Objective 2.6. Expand programs to propagate, seed, and relay shellfish.	Objective 2.7. The Division of Marine Fisheries and municipalities should expand programs to propagate, seed, and relay shellfish.	Renumbered 2.7, text unchanged
	~~Objective~~ 2.8. Investigate and develop strategies to help make shellfish resources more resilient to changes in habitat caused by coastal eutrophication and climate stressors.	New objective
	Objective 2.9. The BBNEP should assist and support municipal efforts to track recreational shellfish catch and resource abundance.	New research objective.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	Objective 2.10. Promote research to better define the relationship between temperature and precipitation and shellfish water quality indicators and associated habitat (e.g., eelgrass beds).	New research objective.
	Objective 2.11. Support efforts to monitor water pH and carbonate and related impacts to shellfish and other living resources.	New research objective.
Action Plan 3 Managing Stormwater Runoff and Promoting LID	**Action Plan 3** Managing Stormwater Runoff and Promoting Low Impact Development and Green Infrastructure	Eliminated acronym. LID and GI are different scales but complimentary approaches
Goal 3.1. Prevent new or increased untreated stormwater flows to Buzzards Bay and contributing watershed areas that would adversely affect shellfishing areas, swimming beaches, water quality, and wetlands.	3.1. Prevent new or increased untreated stormwater discharges to Buzzards Bay and its watershed that would adversely affect water quality and habitat.	Reduce wordiness
Goal 3.2. Correct existing stormwater runoff flows to Buzzards Bay and contributing watershed areas that are adversely affecting shellfishing areas, swimming beaches, water quality, and wetlands, or exceeding watershed total pollutant load limits.	Goal 3.2. Remediate stormwater discharges contributing to degradation or impairments of water quality, resources, or beneficial uses.	Simplified.
Goal 3.3. Maintain and restore natural hydrologic conditions to provide base flow conditions to streams, wetlands, and estuaries.	Goal 3.3. Manage stormwater infiltration to help maintain and restore natural hydrologic conditions, recharge groundwater, and provide improved base flow conditions to streams and wetlands.	Revised for clarity.
Goal 3.4. To encourage low impact development (LID) techniques in new development and redevelopment, in order to minimize impacts from stormwater.	Goal 3.4. Encourage low impact development and green infrastructure approaches to minimize stormwater impacts from new development and redevelopment.	Eliminated acronym. Simplified and active voice.
	Goal 3.5 Eliminate combined sewer overflow discharges to New Bedford waters.	reintroduction of a goal from 1991 CCMP New Bedford Action Plan
Objective 3.1. To adopt and implement local and state stormwater LID laws and regulations.	Objective 3.1. Build local capacity to adopt and implement local and state low impact development and green stormwater infrastructure laws and regulations.	reworded and expanded with green infrastructure
Objective 3.2. To implement effective stormwater pollution remediation projects that include proper design, construction, operation, and maintenance.	Objective 3.2. Implement effective stormwater pollution remediation projects that include proper design, construction, operation, and maintenance.	Dropped the word "To."
Objective 3.3. To provide guidance and incentives for LID that reduces and re-uses stormwater runoff, and reduces the need for structural practices.	Objective 3.3. State agencies should provide guidance and incentives to promote municipal adoption of low impact development techniques that reduces stormwater runoff and the need for structural practices.	Eliminated acronym, reworded and simplified

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 3.4. To improve compliance with federal, state, and local stormwater regulations and meet watershed total pollutant load limits.	Objective 3.4. Regulators should ensure that federal stormwater discharge permits meet all watershed total maximum daily waste load allocations.	Simplified to focus on the most pressing issue with respect to stormwater permits and TMDLs
	Objective 3.5. By 2030, municipalities should complete illicit discharge detection and elimination investigations on all stormwater discharges identified as high priority by the municipality.	New objective.
	Objective 3.6. Strengthen state and local stormwater treatment performance standards, and designs that accommodate system maintenance to best address climate driven degradation and better meet pollution reduction targets.	New objective.
	Objective 3.7. MassDEP should update the 2008 Stormwater Handbook to reflect MS4 and watershed total maximum daily load requirements and other updated regulations, priorities, and understandings.	New objective. MassDEP proposed new performance standards in Spring 2024
	Objective 3.8. Evaluate new cost-effective monitoring methods to identify intermittent illicit discharges to stormwater networks.	New research objective to speed up completion of municipal investigations to identify illicit discharges to stormwater networks.
	Objective 3.9. Support efforts to eliminate combined sewer overflow discharges in the City of New Bedford.	Reintroduced objective from the 1991 CCMP
Action Plan 4 Improving Land Use Management and Promoting Smart Growth	**Action Plan 4** Improving Land Use Management, Promoting Smart Growth, and Encouraging Climate Resilience	Added climate resilience to the title
Goal 4.1. To improve land use management through the use of smart growth strategies in the Buzzards Bay watershed to maintain and improve the natural resources and ecology of Buzzards Bay.	Goal 4.1. Improve land use management and increase protection of natural resources through smart growth, climate resilience development, and strategies to offset impacts of new development.	Added climate resilience, dropped the word "To."
Objective 4.1. To encourage smart growth techniques in less developed Buzzards Bay watershed communities to preserve open space, revitalize urban and village centers, focus development on growth centers, and protect natural resources and the environment.	Objective 4.1. Encourage municipalities to adopt smart growth and climate resilience approaches through local zoning, subdivision, health, and wetlands laws and regulations to protect natural resource areas.	Added climate resilience and simplified the wording.
Objective 4.2. To improve local zoning, subdivision, health, and wetlands regulations to manage future growth in a way that protects the environment of Buzzards Bay and its watershed.	Objective 4.2 Encourage municipalities to focus redevelopment and cluster development in village centers and existing urbanized growth centers and couple with rule changes to encourage greater protection of open spaces, endangered species, and natural resources.	Reworded and added climate resilience
Objective 4.3. Promote sustainable agriculture that does not adversely affect water quality.	Objective 4.3 Promote sustainable agriculture and forest management practices that do not adversely affect water quality.	revised to improve clarity and intent

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	Objective 4.4 Avoid the placement of large scale solar developments on undeveloped lands.	New objective.
Action Plan 5 Managing Onsite Wastewater Disposal Systems		
Goal 5.1. Prevent public health threats and environmental degradation from on-site wastewater disposal systems.	Goal 5.1. Prevent public health threats and reduce environmental degradation from on-site wastewater disposal systems.	Still relevant because failing systems often not caught until property transfer, and the N-loading problem.
Objective 5.1. Enforce the provisions contained in Title 5 regulations such as, siting and design, inspection and upgrades, training, maintenance, mapping and designation of nitrogen sensitive areas, etc.	Objective 5.1. DEP and Boards of Health must ensure compliance with and enforcement of Title 5 regulations.	Modified comma use.
Objective 5.2. Where special local conditions exist, encourage boards of health to adopt local regulations to ensure and/or improve environmental and public health protection.	Objective 5.2. Support development of local watershed plans and encourage boards of health to adopt local regulations to improve environmental and public health protection and to meet local needs.	Simplified and more direct.
Objective 5.3. Improve management and oversight by municipalities of onsite wastewater disposal systems.	Objective 5.3. Improve management and oversight by municipalities of onsite wastewater disposal systems.	no change
Objective 5.4. In areas where advanced nutrient removal is required, encourage community scale alternative technology systems as a preference over individual alternative systems.	Objective 5.4. In areas where the state requires advanced nutrient removal, evaluate and compare the benefits and costs of centralized sewering, community scale satellite treatment systems, and individual alternative systems.	Community scale may not always be the preferred alternative
	Objective 5.5. Encourage towns to track septic tank pumping frequencies and to remind homeowners to pump their septic tanks at MassDEP recommended frequencies.	New objective.
	Objective 5.6. Encourage and promote ongoing research on new alternative onsite wastewater disposal systems that more effectively remove nutrients.	New objective.
	Objective 5.7. In areas around freshwater ponds, where excess phosphorus is causing reductions in surface water quality, promote technology and setback strategies to reduce the phosphorus loading from septic systems reaching the pond.	New objective.
Action Plan 6 Managing Impacts from Boating, Marinas, and Moorings	**Action Plan 6**Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging	Added dredging from deleted Action Plan 15 Managing Coastal Watersheets, Tidelands, and the Waterfront
Goal 6.1. Eliminate the discharge of wastewater from all boats in Buzzards Bay.	Goal 6.1. Enforce the Buzzards Bay No Discharge Area to ensure there are no illegal wastewater discharges from boats.	Enforcing the No Discharge area is the more appropriate goal
Goal 6.2. Eliminate or minimize impacts of discharges from marina operations.	Goal 6.2. Eliminate or minimize impacts of pollutant discharges from marina operations and from maintenance and repair activities performed directly by boaters.	Increased specificity

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Goal 6.3. Eliminate adverse environmental impacts associated with mooring fields such as chain scars and sediment suspension.	Goal 6.3. Eliminate adverse environmental impacts associated with mooring fields.	Simplified
	Goal 6.4. Minimize negative impacts of dredging activities on water quality, physical processes, marine productivity, and public health.	Moved from the deleted watersheet zoning action plan.
Objective 6.1. To ensure there is an adequate number of pumpout facilities in Buzzards Bay.	Objective 6.1. Municipalities should ensure that each embayment has at least one boat waste pumpout facility.	Clarified the objective
Objective 6.2. To promote the use of pumpout facilities by educating boaters, making facilities more accessible, and enforcing the regulations.	Objective 6.2. Promote the use of pumpout facilities by educating boaters, making facilities more accessible, and enforcing the regulations.	Dropped the word "To."
Objective 6.3. Achieve full compliance of marinas with the Phase II stormwater and MSGP discharge permits.	Objective 6.3. EPA should ensure that marinas, boat building, and boat maintenance facilities are in full compliance with industrial site stormwater discharge permits.	Eliminated acronyms and jargon, added boat building facilities.
Objective 6.4. Ensure compliance of marina power washing activities with applicable state and federal laws.	Objective 6.4. Regulators and municipalities should ensure compliance of marina power washing activities with applicable state and federal laws and encourage the use of products that meet the EPA Safer Choice Standard.	Added specificity and responsible entities.
Objective 6.5. Deploy mooring systems that minimize environmental impacts to habitat and water quality.	Objective 6.5. State and federal agencies should encourage and support municipal efforts to pilot, demonstrate, and require conservation moorings for boat mooring fields.	expanded and clarify the approach
	Objective 6.6 Encourage municipalities and marinas to educate boaters about how to reduce fuel spills and minimize impacts and require best management practices around fueling facilities.	New objective.
	Objective 6.7. Encourage the use of the least environmentally damaging cleaners, and bottom paints by marinas and do-it-yourself boaters.	New objective.
	Objective 6.8. Maximize the beneficial use of dredged sediments on land rather than disposing at sea.	New objective.
	Objective 6.9 Municipalities should encourage the adoption of shared docks to reduce the number of future docks.	New objective.
	Objective 6.10. Municipalities should adopt with public input local harbor and watersheet plans and policies to better manage coastal watersheet uses, structures, natural resources, and tidelands habitats. Strategies should help increase shoreline resilience to storms and rising sea level, ensure dredging is protective of natural resources and habitats, and designate	New objective.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	areas appropriate for sustainable uses including aquaculture and alternative energy. Towns must provide plans and policies to the MassDEP Waterways Program.	
Action Plan 7 Protecting and Restoring Wetlands		
Goal 7.1 Long-term increase of high-quality wetlands in Buzzards Bay and its surrounding watershed.	Goal 7.1 Protect existing wetlands to ensure no unpermitted losses.	broke apart the original single goal into two separate goals
	Goal 7.2 Promote the long-term increase of high-quality wetlands in Buzzards Bay and its surrounding watershed.	as above
Objective 7.1. To protect existing wetlands.	Objective 7.1. Improve the protection of existing wetlands through laws, regulations, and government policies.	added specificity for clarity
Objective 7.4. To upgrade the effectiveness of local conservation commissions to protect wetlands.	Objective 7.3. Enhance the effectiveness of local conservation commissions to protect wetlands by adequately staffing municipal commissions and reinitiating DEP-developed and sponsored training programs for conservation commissions and staff.	Order of objectives changed, refined wording, Added clarity as to who is responsible and what needs to be done.
Objective 7.3. To improve enforcement of wetlands laws.	Objective 7.2. Municipalities and DEP should strengthen enforcement of state wetlands laws and municipalities adopt local wetland bylaws and regulations to meet their needs.	Increased specificity and call out the need for local regulations
Objective 7.2. To encourage restoration of degraded wetlands.	Objective 7.4. Encourage restoration of degraded and filled wetlands.	Order of objectives changed, refined wording
Objective 7.5. To create new wetlands habitat, especially habitat that can be used by threatened, rare and endangered coastal species and anadromous and catadromous fish.	Objective 7.5 Create new wetlands habitat, and enhance existing wetland habitat, especially habitat directly supporting threatened, rare and endangered coastal species and anadromous and catadromous fish.	Clarified and less passive.
	Objective 7.6. Ensure that adopted coastline climate resilience strategies are compatible with the migration of wetlands and barrier beaches.	New objective.
	Objective 7.7. Restore hydrology to tidally restricted salt marshes.	New objective.
	Objective 7.8. Promote land management, land protection, and restoration that supports potential marsh migration.	New objective.
	Objective 7.9. State and federal agencies should assist municipalities to identify and map marsh migration areas, and barriers to marsh migration and expansion.	New research objective.
	Objective 7.10. Prioritize management actions for wetlands of rare or threatened species most vulnerable to climate impacts (with US endangered roseate tern habitat prioritized; see related recommendations in Action Plan 11).	New objective.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	Objective 7.11. State and federal agencies should support research to better understand how climate stressors adversely affect essential wetland habitat and threatened species.	New objective.
	Objective 7.12. Support efforts to increase in eelgrass bed acreage by 15% by 2035 (to 7,000 acres as documented in the MassDEP long-term monitoring program) through water quality and habitat improvements, such as use of conservation moorings.	New objective.
Action Plan 8 Restoring Migratory Fish Passage and Populations		
Goal 8.1. Ensure that the migration of fish species between salt and fresh water is unimpeded.	Goal 8.1. Remove barriers that prevent fish from migrating between salt and fresh water habitats.	Simplified wording
Goal 8.2. To restore degraded stream habitat and stream functions to ensure the diversity and abundance of fish in Buzzards Bay streams.	Goal 8.2. Restore degraded stream habitat and functions to ensure the diversity and abundance of fish species in Buzzards Bay streams.	Reworded for clarity
Goal 8.3. To manage fishing pressures on anadromous fish populations to ensure the fish harvest and bycatch are sustainable.	Goal 8.3. Manage fishing impacts on anadromous fish populations to ensure fish harvest and bycatch are sustainable.	Minor word changes
Objective 8.1. Ensure adequate funding of state fisheries restoration programs.	Objective 8.1. The legislature and DMF should ensure adequate funding of state fisheries restoration programs.	Identified primary responsible entities.
Objective 8.2. Ensure that local, state, and federal fisheries regulators manage better the catch and bycatch of river herring and other diadromous fish to promote their recovery and population sustainability.	Objective 8.2. Local, state, and federal fisheries regulators should continue to monitor and improve the management of the catch and bycatch of river herring and other diadromous fish to promote their recovery and population sustainability.	Reworded.
Objective 8.3. Improve passageways and remove impediments and obstructions to fish migration.	Objective 8.3. DMF, DER, municipalities, and property owners should improve passageways and remove impediments and obstructions to fish migration.	Identified primary responsible entities.
Objective 8.4. Ensure adequate stream flow for fish migration.	Objective 8.4. Ensure adequate stream flow for fish migration.	No change.
	Objective 8.5. Regulators should strengthen drinking water and agriculture withdrawal regulations to ensure adequate flow for the passage of adult migratory fish in the spring and juveniles in the fall, especially during drought conditions.	New objective.
	Objective 8.6. Support monitoring and assessments of stressors affecting anadromous fish populations including stream flow, temperature, and mapping of obstructions and reproductive habitat.	New research objective.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	Objective 8.7. Promote measures for nutrient control in freshwater habitats to ensure adequate water quality for diadromous fish spawning and recruitment.	New objective.
	Objective 8.8. Support efforts to restore historic fish passage to the Weweantic River above Tremont Dam, and the other major biologically disconnected streams and rivers in the watershed.	New objective.
	Objective 8.9 Encourage and aid conservation commissions to aggressively protect stream wetland habitat to protect flow volumes, prevent sediment inputs and reduce thermal warming of the streams.	New objective.
Action Plan 9 Protecting Bio-Diversity and Rare and Endangered Species Habitat	**Action Plan 9** Protecting Biodiversity, Natural Communities, and Endangered, Threatened, or Special Concern Species	Added threatened species; wording made consistent with NHESP.
Goal 9.1. Conserve and protect vital fish and wildlife habitats of Buzzards Bay and in its surrounding watershed.	Goal 9.1. Conserve, protect, and enhance the native biological diversity of Buzzards Bay and in its surrounding watershed.	Changed wording to be more encompassing.
Objective 9.1. Ensure that rare and endangered species areas and vernal pools continue to be mapped and this information made publicly available.	Objective 9.1. Support implementation of the State Wildlife Action Plan to conserve biodiversity - specifically, Species of Greatest Conservation Need and their habitats.	Original objective met, new objective to reflect current state goals.
Objective 9.2. Ensure that rare and endangered species habitat is considered in the relevant permit review process.	Objective 9.2. Support implementation of land conservation goals identified in the Clean Energy and Climate Plan for 2050.	Original objective met, new objective to reflect current state goals.
Objective 9.3. Ensure that important biological and core habitat is protected and conserved.	Objective 9.3. Support NHESP efforts to identify and map BioMap Core Habitats to help guide state and municipal protection and conservation efforts	Changed wording with more explicit action and agency lead.
Objective 9.4. Ensure that the public and government officials are aware of the importance of rare and endanger species and core bio-habitat through effective education efforts.	Objective 9.4. Improve the awareness of the public and government officials of the importance of protecting species considered endangered, threatened, or of special concern.	Changed wording to clarify meaning.
	Objective 9.5. Support studies that promote a better understanding of how climate change and sea level rise will affect marsh dependent nesting species like the diamondback terrapin, marsh sparrow, and coastal nesting birds.	New research objective added to identify a specific need.
	Objective 9.6. Support efforts to protect and restore island nesting habitat of the federally- and state-listed Endangered roseate tern, as well as the state-listed Special Concern common and least tern populations in Buzzards Bay.	New objective added to address a coastal bird nesting habitat.
	Objective 9.7 Support efforts to protect and restore habitats of all state- and federal-listed species.	New objective.
	Objective 9.8. Support efforts to follow Executive Order No. 618 to conserve biodiversity in Massachusetts.	New objective to meet the goals of a 2023 Massachusetts Governor Executive Order.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Action Plan 10 Managing Water Withdrawals to Protect Wetlands, Habitat, and Water Supplies	**Action Plan 10**Managing Freshwater Withdrawals and Recharge to Protect Wetlands, Habitat, and Water Supplies	Added specificity to the title.
Goal 10.1. Protect and preserve groundwater and surface water supplies in order to ensure a sustainable supply of high-quality drinking water.	Goal 10.1. Manage drinking, irrigation, and industrial water withdrawals to protect and preserve groundwater and surface water supplies to ensure a sustainable supply of high-quality drinking water.	Improved wording and added irrigation and industrial withdrawals explicitly to clarify scope of objectives.
Goal 10.2. Protect and restore the natural flows of rivers and the natural waters of ponds, lakes, and wetlands and the habitat that depend on them.	Goal 10.2. Protect and restore the natural recharge of the Buzzards Bay watershed, and manage drinking, irrigation, and industrial withdrawals to protect and restore the natural flows of rivers and the natural waters of ponds, lakes, estuaries, and protect the wetlands and habitat that depend on them.	Improved wording and added irrigation and industrial withdrawals explicitly to clarify scope of objectives.
~~Goal 10.3. Maintain natural hydrology.~~	[deleted]	Redundant with goal 10.2.
Goal 10.4. Protect and preserve estuarine and brackish surface water habitats in river mixing zones.	Goal 10.3. Protect and preserve estuarine and brackish surface water habitats in river mixing zones.	Changed number.
Objective 10.1. Encourage water use conservation and increase utilization efficiency to minimize water withdrawals, system losses, and associated impacts.	Objective 10.1. Encourage water conservation, reduce water distribution losses, and increase utilization efficiency to minimize environmental impacts from water withdrawals.	Simplified and clarified wording.
Objective 10.2. Encourage water reuse for irrigation, industrial process water, and other non-potable uses within public health constraints.	Objective 10.2. Encourage water reuse for irrigation, industrial process water, and other non-potable uses within public health constraints.	No change.
Objective 10.3. Update state regulations to reduce the potential of affecting wetlands, surface waters, and other public water supplies.	Objective 10.3. Update state water withdrawal regulations to reduce the potential of affecting wetlands, surface waters, and other public water supplies.	Improved clarity
~~Objective 10.4. Encourage LID techniques for enhanced stormwater recharge to maximize groundwater recharge.~~		Deleted. Addressed in stormwater action plan
~~Objective 10.5. Manage water withdrawals and wastewater discharges from existing and new development to help maintain recharge to the aquifers.~~		Deleted. Redundant with Objectives 10.1, 10.2, and 10.3.
Objective 10.6. Manage equally both public and private water withdrawals in a subwatershed, including the adoption of water use rates that encourage conservation.	Objective 10.4. Municipalities must develop and implement integrated water resources plans and assess water rate structures, policies, and regulations to encourage conservation of both public and private water withdrawals and maximize local recharge of stormwater and wastewater.	Simplified and clarified.
Objective 10.7. Limit non-essential water use during droughts.	Objective 10.5. Water managers should limit non-essential water use during droughts.	New number and clarified.
Objective 10.8. Develop new water supplies and improve infrastructure to improve distribution and reduce redundancy to avoid over utilization of existing wells.	Objective 10.6. Improve the efficiency and resiliency of water supply infrastructure and minimize potential impacts on natural resources.	Simplified and broadened meaning, eliminated "redundancy".

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 10.9. Identify and protect open space for future water supplies, when needed, located as far from significant surface water resources as possible to minimize potential impacts on natural water resources.	Objective 10.7. Identify and protect open space to support existing and potential future water supplies	Simplified to make clearer, the concept of distance depends upon the type of aquifer, so best to keep simple.
Objective 10.10. Incorporate new information, when available, from ongoing or planned state studies on water budgets and sustainable yields into local water resources planning and regulation.	Objective 10.8. Incorporate new information from studies on water budgets, water withdrawals, and sustainable yields into local water resources planning and local and state water withdrawal regulations, and the Massachusetts Interbasin Transfer Act regulations.	Revised to make clearer.
Objective 10.11. Encourage accurate tracking of water use by agricultural users and promote agricultural BMP practices for water conservation.	Objective 10.9. Encourage accurate tracking of water use by agricultural users and promote agricultural management practices for water conservation.	Eliminated acronyms and jargon.
Objective 10.12. If and when desalinization occupies a water supply role in the watershed, encourage control technologies and operational measures that minimize entrainment and impingement impacts at intakes and preserve the natural salinity structure of receiving water bodies at outlets.	Objective 10.10. Minimize entrainment and impingement impacts at intakes of any future desalinization facilities, exclude intakes and discharges from brackish water mixing zones of rivers or streams, and preserve the natural salinity of receiving waters.	Simplified wording.
Objective 10.13. Collect and maintain water use data in support of this action plan and for tracking success.	Objective 10.11. Collect and maintain water use data in support of this action plan and for tracking success.	New number.
	Objective 10.12. Encourage revisions to the Interbasin Transfer Act to reflect impacts to individual river basins, like the Mattapoisett River basin, rather than addressing only transfers in or out of the Buzzards Bay basin.	New objective.
	Objective 10.13. Promote research to understand drinking water and groundwater availability and impacts of withdrawals.	New objective to generate information for government action in objective 10.8.
Action Plan 11 Managing Invasive and Nuisance Species	**Action Plan 11** Managing Invasive Species	Nuisance species are problematic non-native species and redundant with "invasive."
Goal 11.1. Minimize the potential introduction of new invasive and nuisance species to Buzzards Bay and its surrounding watershed.	Goal 11.1. Minimize the potential introduction of new invasive species to Buzzards Bay and its watershed.	Changed wording.
Goal 11.2. Reduce the extent and limit the spread of existing invasive and nuisance species that are degrading habitats of Buzzards Bay and its surrounding watershed.	Goal 11.2. Reduce the extent and limit the spread of existing invasive species that are degrading habitats of Buzzards Bay and its watershed.	Changed wording.
Objective 11.1. Adopt and enforce laws, regulations, and policies that will reduce the potential spread of invasive species.	Objective 11.1. Adopt and enforce laws, regulations, and policies that will reduce the potential introduction of invasive species.	

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 11.2. Educate the public, farmers, nursery owners, fisherman, pet storeowners, shipping industry, and other relevant sectors about individual actions that can be taken to reduce the threat of introducing invasive and nuisance species to the environment.	Objective 11.2. Educate the public, farmers, nursery owners, fisherman, pet-store owners, shipping industry, and other relevant sectors about possible actions to reduce the threat of introducing invasive species to the environment.	Changed wording
Objective 11.3. Fund and promote actions and studies to control and reduce existing populations of invasive and nuisance species.	Objective 11.3. Fund and promote actions, research, and innovative methods to control and reduce existing populations of invasive and nuisance species.	No change.
Objective 11.4. Monitor existing and new invasives in order to help discern introduction pathways and to identify species in early stages of introduction where there may be a slight potential for containment.	Objective 11.4. Monitor existing and new invasive species to help discern introduction pathways and to identify species in early stages of introduction to improve the chance for containment.	Simplified wording.
	Objective 11.5. Support studies that aim to understand how climate change influences the establishment of introduced species, facilitates species' range expansions, and worsens invasive species impacts to ecosystems within the Buzzards Bay watershed.	New research objective.
	Objective 11.6. Prioritize or support efforts to control invasive species where control is likely to be effective.	New objective to limit efforts and funding to where it can make a difference.
	Objective 11.7. Support the development and implementation of rapid response plans for invasive species.	New objective.
Action Plan 12 Protecting Open Space		
Goal 12.1. Preserve the ecological integrity of Buzzards Bay and its watershed by increasing the amount of permanently protected open space.	Goal 12.1. Preserve the ecological integrity of Buzzards Bay and its watershed by increasing the amount of permanently protected open space.	No change.
Objective 12.1. Improve and protect coastal and inland surface water quality through land protection.	Objective 12.1. Protect coastal and inland surface water quality and drinking water supplies through land protection.	No change.
Objective 12.2. Protect biodiversity in the watershed.	Objective 12.2. Permanently protect land that supports species biodiversity and priority habitats.	Corrected wording.
~~Objective 12.3. Protect the region's groundwater supplies.~~	[deleted].	Incorporated in 12.1
Objective 12.4. Improve the land conservation community's ability to protect open space.	Objective 12.3. EEA, the Buzzards Bay NEP and the BBC should continue to support local land trusts and municipalities in their efforts to protect open space by assisting with grant applications and through direct grant funding for land protection projects.	Changed number and clarified wording. Capacity reflects changes in laws, funding, technical support, etc.
	Objective 12.4 Protect land which will allow for the migration of salt marshes with sea level rise or provide connectivity to other habitats.	New objective.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	Objective 12.5 Manage protected open space to meet objectives 12.1 to 12.4.	New Objective
Action Plan 13 Protecting and Restoring Ponds and Streams		
Goal 13.1. Ensure that beneficial water uses will not be lost, nor ecosystems adversely affected, by pollution discharges, nuisance species, or alterations of flow to fresh surface waters in the Buzzards Bay watershed.	Goal 13.1. Protect beneficial water uses100F58F70F73F73F74F and ecosystems in the Buzzards Bay watershed from pollution, Invasive species, climate change, and flow changes.	Added climate change.
Goal 13.2. Restore any beneficial water uses and ecosystem functions lost in watershed freshwater systems caused by pollution discharges, nuisance species, or alterations of flow and volume.	Goal 13.2. Restore beneficial water uses and ecosystem functions in freshwater systems of the watershed affected by pollution discharges, invasive species, or changes in flow.	No change.
Objective 13.1. Help adopt TMDLs for all freshwaters.	Objective 13.1. Support MassDEP efforts to adopt total maximum daily loads for all freshwaters.	Clarified responsibility
Objective 13.2. Help ensure that plans are developed and implemented to meet recommended TMDLs.	Objective 13.2. Help ensure that watershed plans are developed and implemented to meet recommended total maximum daily loads.	Eliminated acronym.
Objective 13.3. Help restore impaired wetlands habitat.	Objective 13.3. Help restore impaired wetlands habitat.	No change.
Objective 13.4. Protect open space that enhances and protects lakes, ponds, and streams.	Objective 13.4. Protect open space that enhances and protects lakes, ponds, and streams.	No change.
	Objective 13.5. Support studies that result in a better understanding of threats to ponds and streams.	New objective
	Objective 13.6. Assess uses and impairments for all ponds and streams not yet assessed in the state integrated list of impaired waters	New objective
	Objective 13.7 Encourage wastewater and stormwater management strategies that minimize direct and indirect phosphorus discharges to surface waters and groundwater.	New objective
	Objective 13.8. Support studies to find new and innovative phosphorus removal methods from freshwater sediments.	New objective
Action Plan 14 Reducing Beach Debris, Marine Floatables, and Litter in Wetlands	**Action Plan 14** Reducing Trash in Wetlands and Waterways	Floatables is a redundant term, and trash a more commonly used term now
Goal 14.1. To ensure that Buzzards Bay beaches, coastal waters, and inland wetlands habitat are clear of harmful and degrading levels of marine debris.	Goal 14.1. Ensure that Buzzards Bay beaches, coastal waters, and inland wetlands habitat are clear of harmful, degrading, and nuisance levels of trash.	Dropped the word "To."
Objective 14.1. Ensure an adequate number and capacity of waste disposal barrels be provided at public beaches and public and private marinas, and boat haul-outs.	Objective 14.1. Municipalities should ensure property owners provide and maintain waste disposal barrels at public beaches, marinas, parks, and boat haul-outs.	simplified and clarified

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 14.2. Stormwater discharge BMPs should include strategies to reduce or eliminate discharges of debris and floatables.	Objective 14.2. Manage stormwater and CSO networks to reduce or eliminate trash discharges.	Eliminated acronym, simplified, clarified, CSOs were added as a concern
Objective 14.3. Encourage fishermen to not dispose of fishing lines, nets, cables, and trash at sea or on shore.	Objective 14.3. Encourage fishermen and recreational boaters to not dispose of fishing lines, nets, cables, and trash at sea.	Reworded, clarified
Objective 14.4. Educate the public and businesses on the importance of reducing litter and marine debris discharges and involve them in the potential solutions.	Objective 14.4. Educate the public and businesses on the importance of reducing trash inputs to the environment and involve them in the potential solutions.	Reworded, clarified
Objective 14.5. Ensure that state and local officials work in concert to reduce litter on public lands, beach debris, and marine floatables.	Objective 14.5. Support state and local efforts to reduce plastic waste streams and trash on beaches and in wetlands.	Reworded, clarified
Objective 14.6. Identify and map important debris location sites, natural collection points, and potential remediation strategies.	Objective 14.6. Find and map important trash sites, natural collection points, encourage and support clean-up and remediation efforts and implement strategies that reduce future debris.	Revised for clarity and intent.
Action Plan 15 Managing Coastal Watersheets, Tidelands, and the Waterfront		This action plan was deleted and goals and objectives were either moved to other action plans or deleted as noted.
Goal 15.1. To manage the uses and activities in the waters and on the tidelands of Buzzards Bay in an integrated manner using sound assessments of natural resources, habitat, and water quality, to ensure sustainable recreational and commercial activities while protecting and improving ecosystem health and values.		Deleted. This goal is very broad and generalized and covered in more detail in the shellfish, wetlands, and other action plans
Goal 15.2. Ensure that the effects of dredging activities are minimized on water quality, physical processes, marine productivity, and public health, and that the beneficial use of dredged sediments is maximized.	Goal 6.4. Minimize negative impacts of dredging activities on water quality, physical processes, marine productivity, and public health.	Goal was split into two ideas and moved to two action plans as Goal 6.4 in Action Plan 6 Managing Impacts from Boating, Docks, Marinas, Moorings and as Objective 17.9 below.
Objective 15.1. Develop and improve upon geographic databases identifying habitat, natural resources, seabed characteristics, and contamination or impairment hotspots of lands under the ocean to establish a strong technical basis for embayment watersheet planning and management.	Objective 17.9. Assist municipalities to identify municipal infrastructure most threatened by sea level rise and coastal storms and support efforts to improve resilience or move assets to less vulnerable locations.	Moved to Action Plan 17 to support vulnerabilities and resilience
Objective 15.2. Promote the development and implementation of municipal embayment management plans to manage the watersheet, protect water quality, vital natural resources, and tideland habitat, and increase shoreline resilience to storms and rising sea level, while allowing sustainable uses.	Objective 6.10. Municipalities should adopt with public input local harbor and watersheet plans and policies to better manage coastal watersheet uses, structures, natural resources, and tidelands habitats. Strategies should help increase shoreline resilience to storms and rising sea level, ensure dredging is protective of natural resources and habitats, and designate areas appropriate for sustainable uses including aquaculture	Moved to Action Plan 6 Managing Impacts from Boating, Docks, Marinas, Moorings, and Dredging The importance of geographic databases added to the text of management approaches in Action Plan 7 Protecting and Restoring Wetlands and Action Plan 17 Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
	and alternative energy. Towns must provide plans and policies to the MassDEP Waterways Program.	
Objective 15.3. Ensure that dredging methods and timing be conducted to minimize adverse impacts, and where appropriate, transfer sensitive resources out of areas to be dredged.	Objective 8.10. Regulatory agencies should ensure dredging methods are acceptable and are completed at a time of year to minimize adverse impacts to migrating fish populations and other natural resources. Where needed, require relocation of shellfish from the planned dredge area.	Moved to Action Plan 8 Restoring Migratory Fish Passage and Populations
Objective 15.4. To maximize the beneficial uses of dredged material by creating opportunities by pre-designating or pre-permitting receiving areas (e.g., beach nourishment zones) to expedite permitting, and through increased funding.	Objective 7.10. Prioritize management actions for wetlands of rare or threatened species most vulnerable to climate impacts (with recommendations in Action Plan 11).Protecting and Restoring Wetlands	Moved to Action Plan 7 Protecting and Restoring Wetlands
Action Plan 16 Reducing Toxic Pollution	Renumbered as Action Plan 15	This and subsequent plans renumbered to account for deleted old Action Plan 15
Goal 16.1. Protect public health and the bay ecosystem from the effects of toxic contamination.	Goal 15.1. Protect public health and the Buzzards Bay ecosystem from the effects of toxic contamination.	Now listed as Goal 15.1 to account for the deleted action plan,
Objective 16.1. To reduce the amount of toxic contamination entering Buzzards Bay and water bodies listed under the 303(d) program.	Objective 15.1. Complete the clean-up of all designated federal superfund sites and state-designated hazardous waste sites according to approved clean-up schedules.	Dropped the word "To" and clarified wording.
Objective 16.2. To eliminate hazardous discharges of toxic contaminants from point sources into the bay.	Objective 15.2 Reduce toxic contaminant discharges and loads to toxic impaired water bodies listed under section 303(d) of the Clean Water Act.	Dropped the word "To." Added non-point from former objective 16.4
Objective 16.3. To reduce the discharge of toxic contaminants and contaminants of emerging concern into wastewater systems (both septic and sewer).	Objective 15.3. Support efforts to manage and reduce toxic chemicals to the environment through source reduction programs. These efforts include industrial pretreatment programs, hazardous waste pickup programs, reduction of pesticide releases through integrated pest management on agricultural lands, improved boating and marina practices, and proper recycling of hazardous waste by consumers.	Dropped the word "To" and wording of public and private wastewater systems is more encompassing.
~~Objective 16.4. To reduce hazardous discharges from nonpoint sources of toxic contaminants into the bay.~~	Objective 15.4. Assess discharges and pathways of toxic contaminants of emerging concern like PFAS and microplastics and develop strategies to limit inputs based on new state and federal guidelines.	Original 2013 objective combined into the renumbered objective 15.2, and new PFAS objective added.
Objective 16.5. To meet all state, federal, and local action levels for water and seafood.	Objective 15.5. Meet all state, federal, and local action levels for toxic contamination in water and seafood.	Dropped the word "To."
Objective 16.6. To improve local, state, and federal regulation and control of seafood and sediment quality to protect human health and the environment.	Objective 15.6 Encourage the use of products that meet the EPA Safer Choice Standard.	old objective 16.6 redundant with 16.5; created new objective.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Action Plan 17 Preventing Oil Pollution	**Action Plan 16**Preventing Petroleum Products Pollution	Action plan renumbered 17 to 16, title revised to account for expanded scope of chemicals in title
Goal 17.1. Reduce the amount of petroleum hydrocarbons released to Buzzards Bay.	Goal 16.1. Reduce the amount, frequency, and impacts of petroleum product spills and discharges to Buzzards Bay.	Action Plan renumbered and combined goals 17.1, 17.2, 17.3 into 16.1
~~Goal 17.2. Prevent the occurrence of oil spills in Buzzards Bay, both large and small.~~		Deleted as redundant with revised goal 16.1 and objectives
~~Goal 17.3. Minimize the environmental effects from oil inputs to Buzzards Bay.~~		Deleted as redundant with re-vised goal 16.1 and objectives
Objective 17.2. To promote a coordinated and effective regional strategy for responding to large oil spills.	Objective 16.1. Support DEP's emergency preparedness and response efforts to prevent and respond to oil spills and hydrocarbon discharges.	Action Plan renumbered and re-worded for conciseness and clarity
Objective 17.1. To promote a regional strategy for preventing oil spills and hydrocarbon discharges.	Objective 16.2. Support and encourage adoption of source-reduction plans for chronic inputs of hydrocarbons into Buzzards Bay.	Action Plan renumbered and re-worded for conciseness and clarity
Objective 17.4. To provide adequate facilities for the collection of waste oil from cars and boats.	Objective 16.3. Regulators and municipalities should ensure there are adequate facilities for the collection of waste oil from cars and boats.	Action Plan renumbered and dropped the word "To." plus minor rewording.
Objective 17.3. To implement a source-reduction plan for chronic inputs of hydrocarbons into Buzzards Bay.	Objective 16.4. Regulators must investigate and take enforcement actions against the illegal discharge of oil.	Re-worded for conciseness and clarity
Objective 17.5. To take enforcement actions against the illegal discharge of oil.	Objective 16.5. Regulators and municipalities should ensure vessel and boat refueling operations employ systems to prevent petroleum spills and report spills when required.	Action Plan renumbered and re-worded for conciseness and clarity
Action Plan 18 Planning for a Shifting Shoreline and Coastal Storms	**Action Plan 17** Planning for a Shifting Shoreline, Sea Level Rise, and Coastal Storms	Action Plan renumbered and sea level rise added to the to title.
Goal 18.1. Protect public health and safety from problems associated with coastal hazards including rising sea level, shifting shorelines, and damage from storms and storm surge.	Goal 17.1. Protect public health and safety and strengthen resilience to coastal hazards including rising sea level, shifting shorelines, and damage from storms and storm surge.	Action Plan renumbered and resilience added.
~~Goal 18.2. Reduce the public financial burden caused by the destruction of or damage to coastal property.~~	[deleted]	Deleted this goal. Reducing financial burdens are outside the realm of the CCMP mission.
Goal 18.3. Plan for shifting shorelines and the inland migration of buffering wetlands and shifting sand formations, and the species that utilize these habitats.	Goal 17.2. Plan for sea level rise, shifting shorelines and sand formations, and the inland migration of coastal wetlands and the species that use these habitats.	Action Plan renumbered and clarified and simplified wording.
Objective 18.1. To incorporate sea level rise, increased frequency and intensity of coastal flooding, and shoreline change phenomena into all relevant planning and management programs.	Objective 17.1. Incorporate sea level rise, increased frequency and intensity of coastal flooding and storms, and expected shoreline change into all relevant planning and management programs.	Improved wording.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 18.2. To develop a comprehensive strategy for handling existing structures in areas that will be affected by future shoreline changes and other coastal hazards.	Objective 17.2. Encourage coastal municipalities to evaluate existing and future vulnerabilities and develop hazard mitigation and climate adaptation plans and adopt near- and long-term coastal resilience strategies.	Action Plan renumbered and improved wording and specificity.
Objective 18.3. To adopt regulatory and non-regulatory measures for guiding growth and development in areas that will be influenced by coastal flooding and new shorelines.	Objective 17.3. Adopt regulatory and non-regulatory strategies to require resilient development and guide growth away from high hazardous areas.	Action Plan renumbered and clarified wording.
~~Objective 18.4. To encourage continued restructuring of the national flood insurance program to discourage development in flood prone areas.~~		Deleted, this is not a locally actionable objective.
Objective 18.5. To adopt emergency response plans to reflect additional needs and constraints caused by reduced access and increased flooding potential of developed coastlines.	Objective 17.4. Adopt state and local emergency response plans to address emergency conditions caused by reduced access and flooding of coastlines.	Action Plan renumbered and clarified and improved wording; new number.
	Objective 17.5. Support research and monitoring into the efficacy of management practices to prevent salt marsh loss.	New research objective.
	Objective 17.6. Encourage coastline climate resilience strategies that are compatible with the migration of wetlands and barrier beaches.	New objective.
	Objective 17.7. Promote land management, land protection, and restoration that support potential marsh migration or creation.	New objective.
	Objective 17.8. Help municipalities identify and map marsh migration areas, and barriers to marsh migration.	New objective.
	Objective 17.9. Assist municipalities to identify municipal infrastructure most threatened by sea level rise and coastal storms and support efforts to improve resilience or move assets to less vulnerable locations.	New objective.
Action Plan 19 Protecting Public Health at Swimming Beaches	**Action Plan 18** Protecting Public Health at Beaches	Title simplified, title, goals, and objectives renumbered as 18
Goal 19.1. Reduce or eliminate pollution sources contributing to beach closures.	Goal 18.1. Reduce or eliminate pollution sources that cause elevated bacteria levels in beach waters.	
Goal 19.2. Manage beach use to reduce human exposure and health risks based on site-specific conditions.	Goal 18.2. Manage beaches to reduce human exposure and health risks based on site-specific conditions.	improved clarity, new action plan number.
Objective 19.1. Reduce contaminated stormwater discharges to beach areas.	Objective 18.1. Reduce contaminated stormwater discharges to beach areas.	No change.
Objective 19.2. Increase public awareness about areas prone to contamination or conditions that may lead to elevated contaminant levels at beaches.	Objective 18.2. Increase public awareness about areas prone to contamination or conditions that may lead to elevated contaminant levels at beaches.	No change.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 19.3. Prohibit pet use of beaches and encourage pet waste collection in stormwater drainage areas.	Objective 18.3. Municipalities should adopt and enforces pet recreation prohibitions on beaches during the summer beach season.	Improved clarity
	Objective 18.4. Encourage pet waste collection and proper disposal in stormwater drainage areas around beach areas.	New objective
	Objective 18.5. For high use beaches, municipalities should adjust testing frequency and timing to better document rainfall effects on beach water quality, and if necessary, implement preemptive rainfall closures.	New objective.
Objective 19.4. Develop and implement more rapid assays to document existing conditions, and where necessary implement preemptive rainfall closures.	Objective 18.6. Support development and implementation of more rapid assays to document existing conditions and, where necessary, implement preemptive rainfall closures and advisories.	Added advisories, changed order, new Action Plan number
Action Plan 20 Monitoring Management Action, Status, and Trends		Action Plan title, goals, and objectives renumbered as 19
Goal 20.1. To document environmental trends of water quality and living resources in order to assess the effectiveness of management actions taken or identify the need for new actions.	Goal 19.1. Document environmental trends of water quality, living resources, and habitat to assess the effectiveness of management actions taken or identify the need for new actions.	Action Plan renumbered, dropped the word "To." Added habitat (rather than just marshes)
Goal 20.2. Identify research and monitoring needs to understand more clearly the causes of impairments, reduce uncertainties about health risks, and better define conditions in Buzzards Bay.	Goal 19.2. Identify research and monitoring needs to understand more clearly the causes of impairments, reduce uncertainties about health risks, and better define conditions in Buzzards Bay.	No change.
Objective 20.1. Collect and monitor programmatic actions to document implementation of CCMP recommended actions.	Objective 19.1. The Buzzards Bay NEP should monitor programmatic actions and support partners that monitor water quality and living resources to document the implementation of the Buzzards Bay Comprehensive Conservation and Management Plan and the success of management action taken.	Action Plan renumbered, eliminated acronym and simplified
Objective 20.2. Ensure that regulatory agencies define essential monitoring requirements and collect data necessary to evaluate program and project success.	Objective 19.2. Regulatory and granting agencies should define essential monitoring requirements that grant recipients must collect to evaluate restoration project success or new methods.	No change.
Objective 20.3. Ensure that funding is available to implement essential monitoring programs.	Objective 19.3. All levels of government must ensure that funding is available to implement essential monitoring programs.	No change.
Objective 20.4. Revise and adapt monitoring programs to meet changing needs and information gaps.	Objective 19.4. Organizations that monitor water quality and living resources must revise and adapt monitoring programs to meet changing needs and information gaps.	No change.

2013 CCMP Goal or Objective	2025 update changed wording	Comments (blank if unchanged)
Objective 20.5. Disseminate data and syntheses of information to scientists, managers, and the public.	Objective 19.5. Disseminate data and syntheses of information to scientists, managers, and the public.	No change.
Objective 20.6. Encourage scientists and agencies to evaluate emerging contaminants and other stressors to the environment.	Objective 19.6. Encourage scientists and agencies to evaluate emerging contaminants and other stressors to the environment.	No change.
	Objective 19.7. The Buzzards Bay NEP should track funding in meeting Massachusetts environmental justice goals.	Complies with EEA agency goals.
Action Plan 21 Enhancing Public Education and Participation		Action Plan title, goals, and objectives renumbered as 20
Goal 21.1. To expand the public's knowledge of the natural resources and water quality of Buzzards Bay and surrounding watershed and the threats they face.	Goal 20.1. Expand the public's knowledge of the natural resources and water quality of Buzzards Bay and surrounding watershed and the threats they face.	Simplified
Goal 21.2. To increase public participation in actions that support the goals, objectives, and recommendations in the CCMP.	Goal 20.2. Increase public participation in actions that support the goals, objectives, and recommendations in the Buzzards Bay Comprehensive Conservation and Management Plan.	Simplified and Eliminated acronym
Objective 21.1. To better convey concepts of watersheds and the flow of water from precipitation along the land surface and in the ground.	Objective 20.1. Improve the public understanding of watersheds and the flow of water from precipitation along the land surface and in the ground.	More direct wording.
Objective 21.2. To better convey an understanding of pollution sources and pathways in the environment.	Objective 20.2. Improve the public understanding of pollution sources and pathways in the environment.	More direct wording.
Objective 21.3. To improve the public understanding of human and natural effects on plant and animal populations and ecosystems.	Objective 20.3. Improve the public understanding of human and natural effects on plant and animal populations and ecosystems.	Dropped the word "To."
	Objective 20.4. Improve the public understanding of the adverse impacts of accelerated sea level rise and other climate impacts.	New objective.
	Objective 20.5. Promote community involvement in planning and environmental decision-making to support and enhance the environmental quality of their neighborhoods.	New objective.

Appendix C. EPA Approval Checklist for Updated CCMPs

The EPA does not prescribe specific formats for CCMPs, but a CCMP update must meet a content checklist of essential components. Below we summarize how we addressed each element of the checklist in the EPA guidance document[99].

1. Readability and linkage to the Clean Water Act

As stressed in Chapter 3, in The 2025 Update of the Buzzards Bay CCMP, we sought to make the CCMP clear and understandable, and tied to the purposes of the Clean Water Act in Section 320 320(b) (4).

2. Summary of changes in the update

In Chapter 3 and Appendix B Updates to the 2013 CCMP goals and objectives, the Buzzards Bay NEP identifies the changes from the previously approved CCMP so that reviewers and the public can easily determine what has changed and why.

3. Monitoring implementation and Bay Conditions

Chapter 1 Buzzards Bay and the National Estuary Program and Action Plan 19 Monitoring Management Action, Status, and Trends describe how the Buzzards Bay NEP meets its monitoring, tracking, and reporting mission through the BBC's State of Buzzards Bay reports, Buzzards Bay NEPs programmatic tracking, Government Performance and Results Act reporting, and various other monitoring efforts supported or followed by the NEP. Also described is how the NEP is helping map long-term salt marsh loss and develop watershed nitrogen TMDLs in partnership with the BBC, and stormwater discharge water quality and impacts in partnership with the Buzzards Bay Stormwater Collaborative.

4. NEP Management Structure

Chapter 1 describes the NEP's Management Conference structure and membership. The collaborative partnerships and partitioned responsibilities between the BBC, BBAC, and the Buzzards Bay NEP has been successful and no changes are proposed. As described in Chapter 5 Finance Strategy, the Buzzards Bay NEP will rely on federal funding to meet core responsibilities and the NEP's approach is to improve the financial strength of its partners, and to help municipalities secure funding for CCMP tasks.

5. Map of NEP study area

A map of the Buzzards Bay NEP study area is included in Chapter 1. The modest changes adopted in this CCMP update are described and based on the most recent watershed groundwater boundaries contained in EPA approved watershed nitrogen TMDLs studies of the past decade.

6. Description of Priority Problems

In Chapter 1, Chapter 3 and each Action item, priority problems are described as well as likely causes or sources of the problem. In Chapter 2 Climate Vulnerabilities Assessments we discuss how climate stressors and extreme weather events affect achieving the goals and objectives of the CCMP, and all relevant stressors, and their impacts, are described in each Action Plan.

7. Description of the Goals and Measurable Objectives

Each action plan states Goals and Measurable Objectives needed to address the priority problems. Where practical or meaningful, numeric values are included. As with the original CCMP, goals remain aspirational, and objectives represent key actions needed to make progress to the attain these goals. Annual NEP work plans describe tasks that support or make progress toward specific objectives.

8. CCMP actions.

Each Action Plan describes the priority problem, area and resources affected, and identifies steps needed (and at what scale) to address the problem. The Action Plans contain objectives, often with specific actions, and the responsible entity or entities are identified where applicable. The increased specificity in the objectives and actions are shown in the side-by-side comparison of objectives in Appendix B. More actions are described in the Management Approach of each Action Plan. Where applicable, a time frame is provided for specific actions. Each action plan identifies costs and financing, with additional information provided in

[99] The numbering of this section matches the document *FY 2025 – FY 2028 CLEAN WATER ACT SECTION 320 NATIONAL ESTUARY PROGRAM GUIDANCE, October 2024, Amended March 17, 2025*.

Chapter 5. Generally, all actions described in the CCMP are eligible for Clean Water Act Section 320 funding either through the NEP's grant programs or technical assistance programs described in the Buzzards Bay NEP's annual work plans. CCMP actions are also eligible for funding by other EPA programs, like SNEP. In Chapter 2, the NEP's companion Climate Change Vulnerability Assessment, and each action plan, we identify where climate stressors may make it more challenging to achieve goals and objectives.

9. Monitoring Plans

Each Action Plan contains a Measuring Success section that describes programmatic or environmental metrics that the NEP or its partners must monitor to track progress or detect changes or improvements, and the effectiveness of the CCMP Actions. This section describes the objectives, responsible party, frequency of monitoring, the distribution of information, and whether the monitoring is programmatic or environmental. An overview of needed monitoring and their costs are summarized in Action Plan 19 Monitoring Management Action, Status, and Trends.

10. Finance Strategy

Each action plan includes a costs and financing section, and more details and funding sources are included in Chapter 5. This chapter discusses current funding, priorities for new funding sources; and both short- and long-term resource needs, along with specific actions needed by the NEP, municipalities, and state agencies.

11. Habitat Protection and Restoration Strategy.

The protection and restoration of habitat is a core element of most Action Plans. Rather than completely reorganizing Action Plans to meet this requirement or creating a stand-alone but redundant document, Chapter 6 Habitat Protection and Restoration Strategy was created. This chapter describes how the NEP is meeting this new requirement for updated CCMPs and includes a Habitat Protection/Restoration strategy.

12. Communication and Outreach Strategy

Action Plan 20 Enhancing Public Education and Participation defines the Buzzards Bay NEP's Communication and Outreach strategy. An effective communication and outreach strategy is essential to increase public education and awareness of the ecological health and water quality conditions of the estuary and to ensure community involvement and ownership of CCMP goals and implementation. However, as stressed in Chapter 1 and Action Plan 20, the BBC, BBAC, and Buzzards Bay NEP have partitioned outreach responsibilities. The Buzzards Bay NEP and BBAC focus on education and outreach to municipal governments through meetings, workshops, websites, and the municipal grant program. In contrast, the BBC is the lead entity for communicating environmental issues to the public, and the BBC has a diverse range of events, environmental programs, school programs, and walking trails on protected lands, all supported by social media, newsletters, and websites. All three organizations tend to focus outreach on advancing specific projects, while the BBC captures broad awareness of Buzzards Bay issues through large public events like the Buzzards Bay Swim and Watershed Ride. A large fraction of the BBC's $10 million operating budget relates to public communication.

13. Vulnerability Assessments.

The NEP completed several climate change vulnerability assessments that are described in Chapter 2, including the Climate Change Vulnerability Assessment to determine how climate stressors might affect implementation of the CCMP. That assessment, completed in 2023, is a companion document to the 2025 CCMP update and required by CWA Section 320(b) (4) (B) [100].

14. Public Review

The Buzzards Bay NEP initiated a 60-day public review of the 2025 updated CCMP on July 30, 2025. This document was posted on the NEP website along with announcements on the CZM website, CZM newsletter, Southeastern Massachusetts Coastal Outreach listserv, and direct email announcements to municipal partners and NEP distribution lists.

[100] CCMPs and NEPs must address "the effects of recurring extreme weather events on the estuary, including the identification and assessment of vulnerabilities in the estuary and the development and implementation of adaptation strategies."