Massachusetts Vision 2.0:
Clean Water Act Section 303(d) and
Total Maximum Daily Load Development



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https://www.mass.gov/total-maximum-daily-loads-tmdls

Massachusetts Department of Environmental Protection

MassDEP's mission is to protect and enhance the Commonwealth's natural resources – air, water, and land – to provide for the health, safety, and welfare of all people, and to ensure a clean and safe environment for future generations. In carrying out this mission MassDEP commits to address and advance environmental justice and equity for all people of the Commonwealth; provide meaningful, inclusive opportunities for people to participate in agency decisions that affect their lives; and ensure a diverse workforce that reflects the communities we serve.

Watershed Planning Program

The Watershed Planning Program (WPP) is a statewide program in the Division of Watershed Management, Bureau of Water Resources, at MassDEP. We are stewards of the water resources of Massachusetts. Together with other state environmental agencies, we share in the duty and responsibility to protect, enhance, and restore the quality and value of the waters of the Commonwealth. We are guided by the federal Clean Water Act and work to secure the environmental, recreational, and public health benefits of clean water for the residents of Massachusetts. The Watershed Planning Program is organized into five Sections that each have a different technical focus under the Clean Water Act: (1) Surface Water Quality Standards; (2) Surface Water Quality Monitoring; (3) Data Management and Water Quality Assessment; (4) Total Maximum Daily Load; and (5) Nonpoint Source Pollution.

Acknowledgements

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Disclaimer

References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendation by MassDEP.

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Introduction

Recently, through a collaborative process with states, the United States Environmental Protection Agency (EPA) identified a long-term vision to enhance program efficiency, focus on state priority waters, provide flexibility to use tools beyond total maximum daily loads (TMDLs), and encourage states to develop new measures to track success.

States have been charged with developing their own strategy following the long-term vision and five goals identified by EPA to improve the implementation of CWA 303(d) programs.

EPA's five goals are:

- Data and Analysis Goal
- Planning and Prioritization Goal
- Restoration Goal
- Protection Goal
- Partnerships Goal

Massachusetts Vision Strategy

The Watershed Planning Program (WPP) in the Massachusetts Department of Environmental Protection (MassDEP) developed a strategy to prioritize impaired surface waters to support Clean Water Act objectives (such as TMDLs, watershed-based plans, and long-term control plans) that is adaptive, builds on and improves existing 303(d) program activities, and based on quality assured data. Elements of the strategy will evolve over time as priorities change, technology improves, and information is updated. MassDEP's approach has three critical objectives that align with EPA's five goals:

1. Identify priority concerns;
2. Develop a process to assess, prioritize, evaluate, identify and fill information gaps;
3. Develop work plans and schedules to complete TMDLs or watershed plans (or other approaches where appropriate).

Priority Concerns

Priority concerns were determined by evaluating the type and relative frequency of impaired assessment units listed on the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle (MassDEP 2021). This Integrated List was used for planning purposes as its release coincided with this prioritization effort. MassDEP's priority concerns for 2024-2032 are therefore impairments caused by nutrients (nitrogen and phosphorus) and pathogens that affect public health.

Purpose

The purpose of this document is to describe the MassDEP WPP approach to implementing EPA's new Vision for

CWA 303(d) Programs and provide guidance to assist WPP staff who are responsible for planning, developing, and executing the Clean Water Act (CWA) Section 303(d) program. Public input on the TMDL prioritization process is solicited.

Prioritization Process

The prioritization process is flexible so that metrics may be revised or weighted depending on the priority concern, type of waterbody, or other variables.

The process entails:

1. Ranking waterbodies by priority (specific for each waterbody type)
2. Evaluating the level of impairment
3. Selecting waterbodies
4. Soliciting public input
5. Assessing feasibility
6. Analyzing selected waterbodies

Metrics used to assess and score the impaired waterbodies were selected based on MassDEP's priority concerns and data accessibility. The prioritization approach is adapted to the different waterbody types (estuary, river/stream, lakes). Each waterbody type may have unique prioritization metrics.

Examples of prioritization metrics include:

- Severity of impairment
- Nutrient and chlorophyll-*a* concentrations
- Ecological importance
- Incidence of harmful algal blooms (HABs)
- Active public water supply
- Public access to the waterbody

A prioritization approach for each waterbody type was generated and evaluated.

Workplan Development

Workplan development will be completed as part of the biennial integrated list and Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) commitments. The purpose of this document is to identify the prioritization schema and to produce a preliminary short list of high priority waterbodies for restoration plan development, including TMDL development for 2024-2032. The feasibility of restoration plan development will depend on staffing levels, public engagement, and funding.

Overview of EPA's Clean Water Act 303(d) Program Vision

EPA has identified five goals that will help to strategically improve and protect water quality by enhancing Clean

Water Act (CWA) 303(d) program implementation [1]. The five goals are enumerated below:

1. **Data and Analysis Goal** - The CWA 303(d) program coordinates with other government and non-governmental stakeholders to facilitate data production and sharing, and effectively analyzes data and information necessary to fulfill its multiple functions.
2. **Planning and Prioritization Goal** - States, territories, tribes develop a holistic strategy for implementation of Vision Goals and systematically prioritize waters or watersheds for TMDL and other plan development (restoration and/or protection) and report on the progress towards development of plans for priority waters.
3. **Restoration Goal** - States, territories, and tribes design TMDLs and other restoration plans to attain and maintain water quality standards, facilitate effective implementation, and drive restoration of impaired waters.
4. **Protection Goal** - In addition to recognizing the protection benefits that TMDLs and other restoration plans can provide; states, territories, and tribes may develop protection plans to prevent impairments and improve water quality, as part of a holistic watershed approach.
5. **Partnerships Goal** - The CWA 303(d) program meaningfully communicates and collaborates with other government programs and non-governmental stakeholders to effectively and sustainably restore and protect water quality.

In addition, EPA has identified four focus areas including:

- Program Capacity Building
- Environmental Justice
- Tribal Engagement
- Climate Change

MassDEP's Strategy to Implement EPA's Vision

MassDEP integrated EPA's five goals into an adaptive and systematic strategy to prioritize and develop restoration plans that will improve the quality of waterbodies included on the Massachusetts 303(d) list. MassDEP recognizes that elements of this strategy will evolve over time as priorities change.

The MassDEP strategy fosters opportunities for collaboration and integration with other CWA programs, particularly the nonpoint source (NPS) program, and has designed the approach to be flexible to meet the water quality priorities for restoration and protection. The TMDL Section and NPS Management Section, both within MassDEP's Watershed Planning Program (WPP), will work together to promote nine-element Watershed-Based Plans (WBPs) in areas where NPS pollution is the major cause of impairment. These nine-element WBPs can provide the foundation for an Advance Restoration Plan (ARP). An ARP is designed to address impairments for waters that will remain on the CWA 303(d) list (i.e., Category 5), as restoration activities are implemented prior to TMDL development. The purpose of ARP development is to encourage the use of the most effective and expeditious tool(s) to address water quality protection and restoration efforts and where possible, directly implement those efforts. While TMDLs remain the primary tool for addressing impaired waters, in certain cases there may be other restoration approaches in the near term that may achieve water quality goals as established in the Massachusetts Surface Water Quality Standards (SWQS, 314 CMR 4.00).

[1] see (EPA, 2022) for a detailed description of EPA's Vision for CWA 303(d) program

Stakeholder engagement is critical to all aspects of the MassDEP strategy. MassDEP's WPP organized a series of workshops in late 2016 and early 2017 and invited a wide variety of stakeholders to provide input on the development of a 10-year vision (the Vision) for the assessment, restoration, and protection of surface waters in Massachusetts. Four workshops were held, with the first three focusing on six elements of the Vision: prioritization, monitoring, assessment, alternatives, engagement, and integration.[2] The objective of the fourth workshop was to summarize stakeholder feedback received during the first three session. Stakeholders will continue to be engaged throughout this process as waterbodies are prioritized and selected and restoration plans are drafted.

In addition, MassDEP through this document seeks to solicit feedback on the identified prioritization approach, learn about specific waterbody concerns, evaluate data gaps, and gauge local interests to assess recovery potential.

Specifically, MassDEP may seek input from and, when possible, collaborate with multiple stakeholders, including, but not limited to:

- Local Municipalities
- Regional Planning Agencies
- Soil and Water Conservation Districts
- Community Watershed Groups
- Massachusetts Coastal Zone Management
- National Estuary Program
- EPA Southern New England Program
- Massachusetts Department of Fish and Game's Division of Ecological Restoration

Prioritization is a key goal of the Vision and is inextricable from the other four goals. The overall approach to incorporate the Vision goals are enumerated below (see also Figure 1):

1. Determine priority concerns based on the types of impairments on the 303(d) list,
2. Group waterbodies by type (estuary, river/stream, lakes),
3. Develop a strategy to assess, prioritize, evaluate, identify, and fill information gaps, and
4. Develop work plans and schedules to complete TMDL or watershed plans (or other approaches where appropriate)

[2] For more information see Appendix A

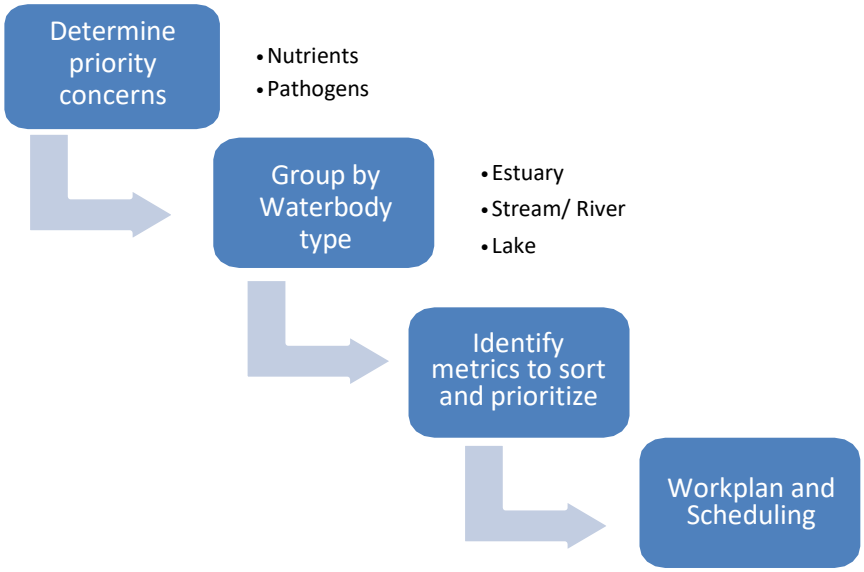

Figure 1 – An overview of MassDEP's strategy to implement EPA's new Vision for the CWA 303(d) program.

Determine Priority Concerns

Priority concerns were determined by evaluating the type and relative frequency of impaired segments listed on the 2018/2020 CWA 303(d) impaired waters list. There were 2742 listings with 72 possible impairment types. The 2742 listings were comprised of 1191 unique waterbody segments, including 618 segments that were listed for multiple impairments. Finally of the 2742 listings, 860 impaired segments currently have a TMDL.

Approximately 40% of the 1882 listings that require a TMDL are impaired due to nutrients while 12% were impaired due to pathogens (Figure 2). These impairments may be addressed at the watershed level where the likelihood of implementing a plan (or plans) that will achieve water quality improvements is greatest. The remaining 43% of the impairments are at the landscape level. These surface waters are polluted by legacy contamination (e.g., PCBs, metals, etc.), atmospheric deposition, or specific biological, habitat, and other impairments that are less suited for TMDL development.

MassDEP's priority concerns for 2024-2032 are impairments caused by nutrients (nitrogen and phosphorus) and pathogens that affect public health (Table 1, Table 2, and Table 3).

Table 1: Estuary Segment Impairments and TMDLs by Cause Group* and Area

Cause Group	Segment Count	Count of Segments with TMDL	Total Segment Size (square miles)	Total Segment Size with TMDL (square miles)	Area of Waterbodies Needing TMDL (square miles)
Nutrients	330	179	222.0	70.6	151.4
Toxics	54	0	122.7	-	122.7
Pathogens	265	227	253.8	216.7	37.1
Other	24	1	19.4	0.5	18.9
Metals	5	0	8.0	-	8.0
Petroleum/Oil	8	0	3.3	-	3.3
Biological	3	0	2.5	-	2.5
Temperature	3	0	0.4	-	0.4
Estuary Total	**692**	**407**	**632.2**	**287.8**	**344.5**

* A cause group organizes the approximately 70 distinct causes identified in Integrated List reporting to a smaller number of categories

Table 2: Lake Segment Impairments and TMDLs by Cause Group* and Area

Cause Group	Segment Count	Count of Segments with TMDL	Total Segment Size (acres)	Total Segment Size with TMDL (acres)	Area of Waterbodies Needing TMDL (acres)
Nutrients	454	81	43,660	7,172	36,488
Metals	161	107	54,579	47,732	6,847
Toxics	45	0	4,845	-	4,845
Pathogens	17	1	1,583	31	1,552
Aquatic Plants (Macrophytes)	47	6	1,473	180	1,293
Chloride	2	0	575	-	575
Biological	2	0	367	-	367
Other	4	0	235	-	235
Freshwater Lake Total	**732**	**195**	**107,317**	**55,115**	**52,202**

* A cause group organizes the approximately 70 distinct causes identified in Integrated List reporting to a smaller number of categories

Table 3: River Segment Impairments and TMDLs by Cause Group* and Length

Cause Group	Segment Count	Count of Segments with TMDL	Total Segment Size (miles)	Total Segment Size with TMDL (miles)	Length of Waterbodies Needing TMDL (miles)
Pathogens	418	169	1,824	580	1,244
Nutrients	323	86	1,566	493	1,073
Toxics	122	0	814	-	814
Other	121	2	504	5	499
Biological	117	0	491	-	491
Temperature	71	0	424	-	424
Metals	73	1	425	4	421
Habitat	30	0	108	-	108
Chloride	21	0	50	-	50
Petroleum/Oil	14	0	46	-	46
Aquatic Plants (Macrophytes)	8	0	42	-	42
River Total	**1,318**	**258**	**6,296**	**1,082**	**5,214**

* A cause group organizes the approximately 70 distinct causes identified in Integrated List reporting to a smaller number of categories

As illustrated in Figure 2, most impaired waters in Massachusetts are caused by excessive nutrients and pathogens. Given the priority concerns, waterbodies can be sorted by waterbody type to identify metrics best suited to rank and assess the waterbodies (Figure 1). For example, some metrics used to prioritize lakes were not applicable or meaningful for ranking estuarine waters. The next section includes a brief overview of the prioritization process. In addition, the Appendices provide the detailed prioritization analysis completed for each waterbody type.

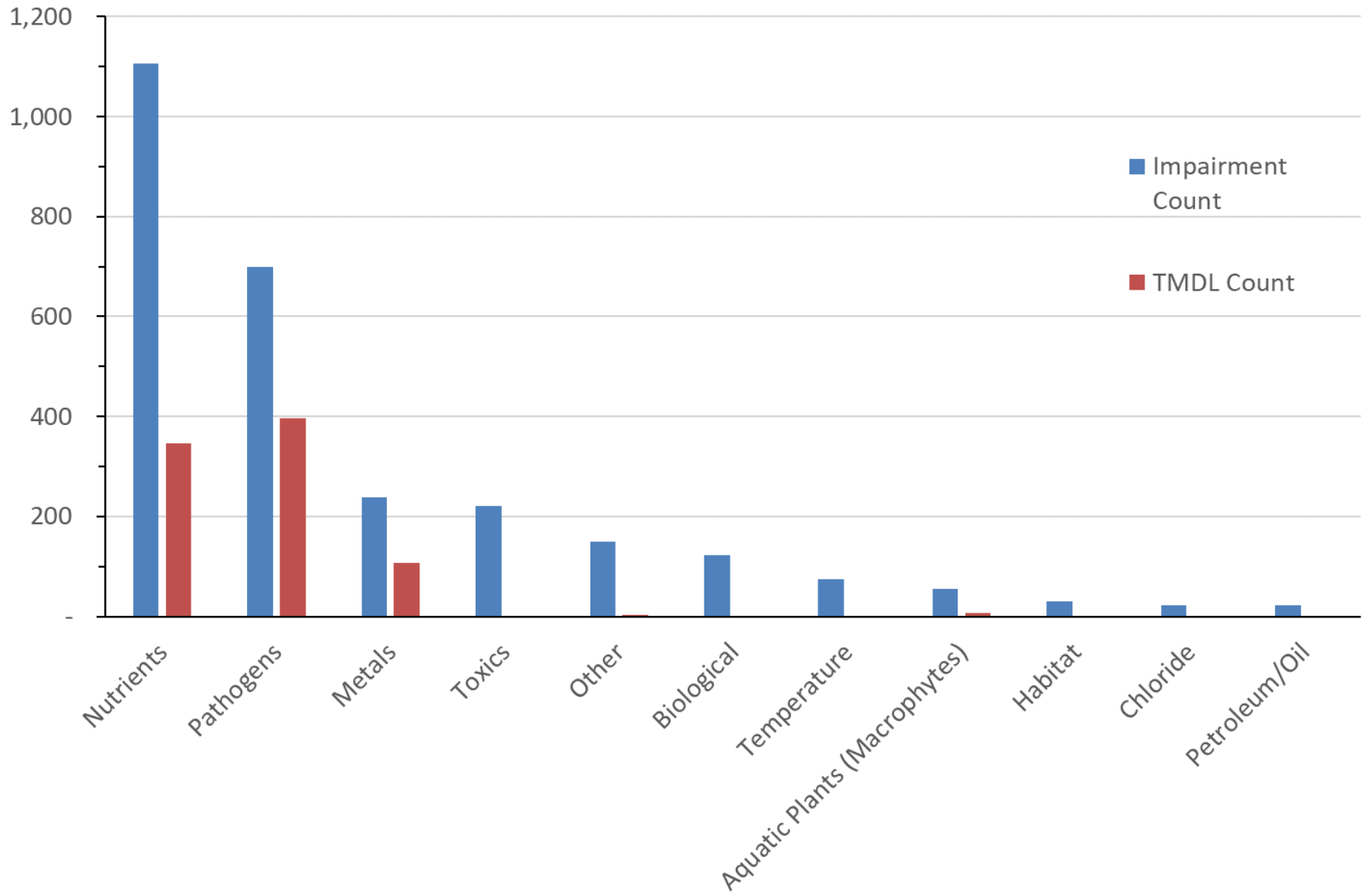

Figure 2. Count of Segment Impairments and TMDL Count by Cause Group (2018/2020 Integrated List of Waters)

Prioritization process

MassDEP developed a process to assess, evaluate, and identify data gaps and limitations to plan and schedule TMDL development. The process is flexible and will retain the ability to either update objectives or add weights to metrics dependent on the priority concern or type of waterbody.

The process includes:

1. Ranking waterbodies by priority (specific for each waterbody type)
2. Evaluating the level of impairment
3. Selecting waterbodies
4. Soliciting stakeholder input
5. Determining implementation feasibility
6. Analyzing selected waterbodies

An important step is to evaluate the level of impairment relative to the waterbodies within the classification. For example, a lake with a phosphorus concentration exceeding 50 µg/L may be ranked higher compared to a lake with a corresponding concentration of 25 µg/L.

The third step of the process involves reviewing and selecting from the ranked waterbody lists. This step may involve coordinating with other MassDEP programs, other state environmental programs, and interested stakeholders to identify the following: (1) data limitations and gaps; (2) partnership opportunities with other programs; (3) additional data sources; and (4) existing projects or activities. This information is documented for use in future planning.

In the fourth step, preliminary selected waterbodies are listed and public interest within these impaired watersheds is gauged. This step will require efforts to determine if existing plans or models are available, investigate other water quality activities within the waterbodies, and identify opportunities for collaboration.

After public interest is evaluated, the fifth step involves more detailed assessments that may include the following: (1) analysis of pollution sources; (2) identification of existing watershed plans or water quality improvement activities and (3) the available resources that could inform TMDL development feasibility.

See Appendix B, C and D for a more detailed description of the prioritization process steps and components for estuaries, lakes, and rivers respectively.

Public Participation

MassDEP through this document seeks to solicit feedback on the priority approach identified waterbody concerns and data, and local interest to assess recovery potential through engagement and where possible, integration with stakeholders connected to the impaired waterbodies. All comments should refer to “Vision 2.0” in the subject line cited and must be received by 5:00 p.m. on Friday, April 5, 2024. All comments should be sent to Mr. Timothy Fox by email at timothy.m.fox@mass.gov .

Written comments will also be accepted and should be addressed to:

Massachusetts Department of Environmental Protection
Watershed Planning Program
Attn: Timothy Fox (Vision 2.0)
8 New Bond St.
Worcester, MA, 01606

References

MassDEP. 2021. Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle. CN 505.1, Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA.

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U.S. Environmental Protection Agency. 2022. 2022 - 2032 Vision for the Clean Water Act Section 303(d) Program. Water Division, United States Environmental Protection Agency, Washington D.C. https://www.epa.gov/system/files/documents/2022-09/CWA%20Section%20303d%20Vision_September%202022.pdf

Appendix A: Vision 1.0 Workshop

Four workshops were held between November 2016 and November 2017 to describe EPA's Vision process and to receive public feedback on priorities for protection and restoration of Massachusetts waterbodies. The speakers and case studies presented in the workshops were intended to inform attendees on a range of successful partnerships, projects, and opportunities for collaboration. The information gained from these prioritization discussions assisted MassDEP in determining the focus for future TMDL development and to identify improvement targets for protection efforts. The workshops also provided the Watershed Planning Program an opportunity to showcase and inform the public on current projects.

For the agenda, speaker slides, and a list of resources compiled for each workshop, refer to MassDEP's Watershed Planning Program webpage: https://www.mass.gov/info-details/watershed-planning-vision-process-workshops.

Workshop 1 –Elements of the CWA Vision - November 2016

The kick-off to the workshop series provided an introduction to the six elements of the Clean Water Act Vision. The half-day workshop included panel speakers presenting examples and experiences related to each of the Vision elements, followed by a question-and-answer session. The workshop concluded with a wrap-up discussion and a written survey questionnaire. The results of the discussion and survey informed the planning process for subsequent workshops. The survey indicated a clear preference for a future focus on prioritization and protection of our waterways. In addition, the consensus was a preference to continue the Vision process using small groups and workshops, and smaller break-out sessions, with more opportunities for discussion and learning.

Workshop 2 –Prioritization for Protection and Restoration and Alternatives to TMDLs - March 2017

Our next workshop included panel discussions and group break-out sessions in a full-day format. A panel of four speakers presented successful projects and explained their prioritization approach to restoration/protection. The case studies included prioritizing headwater stream restoration and protection projects and diadromous fish habitat restoration. The Mystic River Watershed Association also described how they were able to receive funding and resources for an alternative restoration plan; the City of Worcester outlined their stormwater management prioritization plan.

Small groups consisting of 8 to 10 people participated in breakout sessions designed to encourage interaction. The first session was used to identify priority waters for protection, to list perceived threats to those waters, and to brainstorm possible actions that may prevent impairment. The second breakout session was used to identify priority waters for restoration, and similarly, identify existing and potential threats and subsequent actions to restore those waters. See Table A1 and Table A2 for a summary of the two breakout sessions.

Workshop 3 – Monitoring, Assessment, Integration, and Engagement - April 2017

This all-day workshop began with a panel discussion on developing a balanced monitoring program. Subjects included the process of designing an appropriate sampling plan, the importance of a quality assurance project plan (QAPP) for data usability and sharing, and data analysis and reporting relative to the Massachusetts Surface

Water Quality Standards (314 CMR 4.00). The session emphasized that quality data are essential for understanding the condition of our waters.

Again, breakout sessions were organized with roughly eight to ten people in a group to get feedback as well as share problems and successes with the various monitoring programs. Questions asked during these sessions included: What questions are you trying to answer with your data? Who do you share your data with and how? What obstacles do you encounter? What successful strategies can you share with others?
Three case studies were presented to highlight successful partnerships and collaborations. Partnerships at many levels, including those among multiple government entities, universities, and environmental groups are essential to address the broad range of problems impacting our waterways.

Workshop 4- Rolling out the Draft Vision – November 2017

The last workshop in our series focused on summarizing and synthesizing the feedback from the previous two all day workshops and presenting it to the group for further refinement or input. Each comment made by the workshop participants in the previous two workshops was thoughtfully considered and grouped with similar responses.
Stakeholders attending the Vision workshops identified several broad categories of coastal marine and freshwaters for protection and more specifically those waters of high societal value:

- Drinking waters (e.g., Quabbin, Wachusett and Middlesex Reservoirs)
- Outstanding Resource Waters (ORWs)/high quality waters
- Recreational areas (bathing beaches, state parks, river ways with bike paths)
- Wild/Scenic/Undeveloped areas (e.g., Taunton and Westfield Rivers)
- Flood storage and floodplains (e.g., Charles River)
- Waters of historical/cultural value
- Waters for education

Note that the overall ***themes*** that developed from the brainstorming sessions were more important than the actual number, or ranking, of responses in each category.

Workshop attendees also identified the need to protect critical and natural flows, headwaters and waters with specific habitat functions. Specifically, waters needing protection included:

- Coldwater fisheries
- Critical habitats (e.g., vernal pools, waters in Areas of Critical Environmental Concern, habitat for sensitive, threatened or endangered species)
- Biodiversity/native species (e.g., native mussel streams, indigenous fish)
- Diadromous fish runs (e.g., herring and alewife runs)
- Migratory bird areas
- Wildlife corridors/stream connectivity
- Dynamic systems (e.g., flood plains and wetlands)

Potential threats to the protection of these sensitive waters were identified; these ranged from general (nonpoint sources) to more specific threats (invasive aquatic plants and invertebrates). Categories of threats include the following, in order from those most noted by workshop participants to the least:

- Unsustainable development
- NPS/Stormwater pollution

- Habitat loss
- Water/flow alteration
- Climate change
- Construction barriers
- Water quality degradation (e.g., litter, nutrients, bacteria)
- Inadequate resource management
- Agriculture
- Non-integrated/outdated regulations
- Invasives

Summaries of Vision break-out sessions during Workshops 2 and 3, and discussions from Workshop 4 are provided in the following tables and graphs below.

There was a clear message from the participants of our CWA Vision Workshops: they consider ***all*** waters of the Commonwealth to be a priority for Protection and Restoration; including freshwater rivers, lakes, marine coastal waters, and also critical habitats protecting biodiversity. Waters with potential high public impact and environmental justice related issues, such as urban waters, public spaces, parks and beaches were identified as a high priority for restoration.

The major threats to our waters in need of both restoration and protection were identified as nonpoint source pollution, urbanization and unsustainable development, and financial limitations. These problems were identified as the cause of continued habitat loss, flow alteration, and water quality degradation. Climate change impacts were also identified as threats to our waterways, suggesting the need to continue to prepare for increasingly varied weather patterns and the resulting impacts.

The group was asked to identify actions in the break-out sessions to address threats to our waterways. These included inadequate regulatory coverage and enforcement of existing regulations, land use planning and zoning as protective measures, and education and outreach to constituents.

Regulatory barriers were frequently identified as both a threat to our waters and a path to protecting and restoring waters. Several participants commented that the current regulatory framework should be reviewed to identify areas where there is inadequate, or possibly, no protection available. This would potentially include land use planning, review of local bylaws and regulations, revisions to the Wetlands Protection Act, and strengthening protection of resources such as floodplains and ACECs. Some participants felt that reductions in budgets and staffing in recent years have resulted in less regulatory enforcement. Regulatory action was identified as the principal path to restoration of impaired waters. It was also recognized that regulatory review and revision, although potentially providing a high degree of protection and restoration, is labor intensive and time consuming.

Workshop participants indicated that lack of environmental awareness, and insufficient education and outreach to the public, contribute to degradation of our waters. Residents and park users need to understand the impacts of their actions to the watershed and ultimately to our waterways. Education, demonstration projects, and building local capacity were identified as providing significant “return on investment,” or providing a high benefit for relatively low effort.

Table A1: Summary of Prioritization for Protection & Implementation Measures Breakout Session

Question(s) Asked:	Response	# of Mentions by Participants
What are the resources in your area that drive the need for protection? How do you/would you rank these?	Critical Habitat	15
	Stream & River Systems	14
	Cold Water Fisheries/ Headwaters	13
	Freshwater Lakes and Ponds	12
	Drinking Water Resources	11
	Coastal Resources	11
	Least Disturbed/ High Cultural Value	8
	High Recreational Value	7
	Native/Biodiverse	4
What are the threats to protection?	Habitat Loss	12
	NPS/Stormwater Pollution	11
	Unsustainable Development	9
	Water Quality Degradation	7
	Water/Flow Alteration	7
	Inadequate Resource Management	6
	Climate Change	5
What measures will achieve protection goals in your watersheds?	TMDLs and Land Use Planning	18
	Protective Actions	18
	Regulatory	16
	Collaboration and Advocacy	11
	Education and Communication	9
	Provide Resources	9
	Data Collection and Management	9

Table A2: Summary of Prioritization for Restoration & Implementation Alternatives Breakout Session

Question(s) Asked:	Response	# of Mentions by Participants
How do you/would you prioritize restoration efforts?	Public Impact and Environmental Justice	19
	Special Habitat	17
	Watershed Planning	16
	River Systems	14
	Marine Salt Marshes/Estuaries/ Diadromous Fish habitat	14
	Lakes and ponds, wetlands	13
	Flow-impaired or flow-sensitive streams and their sources	11
What are the threats to water quality in your area? What are the barriers to implementation?	Point and nonpoint sources	22
	Urbanization	17
	Regulatory barriers	15
	Flow alteration	10
	Resource limitations	10
	Lack of awareness/outreach/education	9
	Climate impacts	8
	Biological threats	8
	Chemical threats	8
Who will plan and implement restoration actions? Identify partnership opportunities?	Regulatory	23
	Restoration Projects	19
	Education and Communication	13
	Data Collection and Management	12
	Research	11
	Collaborations	11
	Advocacy	10
	Permitting	9
	Providing Resources	9
	TMDLs and Land Use Planning	9

Table A3: Summary of Monitoring & Assessment Breakout Session

Question(s) Asked:	Response	# of Mentions by Participants
What questions are you trying to answer through your monitoring program?	Assessment and Comparison to Standards	16
	Required Monitoring	14
	Analyze Watershed Impacts	11
	Planning Purposes	6
With whom do you share your data	State, Federal and Inter-Agency Sharing	9
	Direct communication with stakeholders	8
	Municipal Networks	5
	Educational Networks	3
How do you share your data?	Online notification	10
	Required Reporting	6
	Shared Databases	4
	Public outreach & education	3
	Partnerships	3
	Offline (mail and phone) notification	3
	States	1
	Watersheds	1
What works?	Communication and Outreach	7
	Established Sampling Protocols	7
	Resource Sharing	5
	Volunteer resources	4
	Regular Reporting and Analysis	3
	Goal Setting	2
What doesn't work?	Limited Resources ($$, equipment, lab capacity)	5
	Limitations of Data Management, Sharing and Analysis	4
	Limitations in Sampling and Methodology	4
	Limited QAPP Development Support	3

Appendix B: Estuary Prioritization

MassDEP has shown a long-term commitment to the restoration of impaired estuaries. Nutrients (phosphorus and nitrogen) support the growth of aquatic plants, which in turn provide food for fish, shellfish, and other organisms. However, excess nutrients can negatively impact coastal ecosystems. In 2001, the Massachusetts Estuary Project (MEP) was created to help determine current nitrogen loads to southeastern Massachusetts estuaries and evaluate reductions necessary to support healthy ecosystems. Through a collaborative effort between MassDEP, UMass-Dartmouth, and southeastern coastal communities, evaluations were completed for 68 coastal estuarine systems. EPA has approved nitrogen TMDLs for 51 of the estuarine systems, and seven nitrogen TMDLs are either in draft form or require additional information to complete the TMDLs. Ten of the technical evaluations determined that nitrogen concentrations and habitat health did not require development of TMDLs.

MassDEP has engaged in policy efforts to reduce nitrogen pollution and implement EPA approved total nitrogen TMDLs on Cape Cod. In July 2023, MassDEP promulgated revisions to its septic system regulations (Title 5), 310 CMR 15.000, and new Watershed Permit regulations, 314 CMR 21.00, to compel nitrogen controls in 31 watersheds with EPA approved TMDLs on Cape Cod. MassDEP is working with municipalities to address nitrogen pollution in these watersheds through a variety of nutrient reduction strategies, including sewering, upgrades to septic systems to incorporate Best Available Nitrogen Reducing Technology (BANRT), permeable reactive barriers, restoration of wetlands to improve nitrogen attenuation, and other measures. MassDEP is engaged in planning efforts to address nitrogen pollution in other watersheds in estuarine waters.

Of the 222.0 square miles of estuarine area with a nutrient cause of impairment, approximately 70.6 square miles have a TMDL while approximately 151 square miles require a TMDL (Table 1). Any TMDL efforts will require adequate monitoring, data collection, and modeling to support a final TMDL document. This prioritization strategy will outline the rationale for the estuary TMDL prioritization and TMDL development strategy. The priority assigned in this document is only to provide indication of where WPP resources are first needed. The priority status may shift over time depending on complexities of the TMDL development process. MassDEP's Watershed Planning Program (WPP) will dedicate most focus and resources to the high priority embayments, but medium and low priorities will still require attention and resources.

In 2021, MassDEP worked with a consultant to investigate 19 estuarine systems. MassDEP's objective for this project was to compile existing data and information necessary to support the development of TMDLs or other restorative/protective plans for 19 estuarine systems that are potentially impacted by excess nutrients. These 19 systems can be organized in 17 clusters (Figure B1). Assembled data included nutrient related water quality data, bathymetric data, eelgrass habitat distribution, tidal fluctuations, and nitrogen land use loading including parcel specific information on wastewater treatment.

Based on a review of the existing data, a preliminary impairment status was identified and a recommended management approach (e.g., restorative TMDL, protective TMDL, alternative TMDL, TMDL not needed, etc.) was developed for each estuarine system. Data gaps were identified and modeling or other technical approaches to support the development of TMDLs or other plans were recommended for each estuarine system or group of systems.

By the end of the project a compilation of existing data from targeted estuaries, an evaluation of impairment

status, identification of data gaps, and modeling recommendations was completed. This work provided information in developing metrics TMDL staff then used to better prioritize next steps for TMDL development. All embayments identified in this strategy are targeted for restoration plan development. In general, based on compiled data, embayments fell into two categories, 1) insufficient data to determine impairment status or 2) data indicated impairment and TMDL or Advance Restoration Plan recommended (Table B1). Four waterbodies (Ellisville Harbor, Caleb's Pond, Oyster Pond, and Long Cove Pond) did not have sufficient data to prioritize and collecting additional information to assess water quality is needed.

An Advance Restoration Plan (ARP) is a plan designed to address impairments for waters that will remain on the CWA 303(d) list (i.e., Category 5), as restoration activities are implemented prior to TMDL development. While TMDLs remain the primary tool for addressing impaired waters, in certain cases there may be other restoration approaches that may meet water quality criteria established in the Massachusetts SWQS in the near term. Two systems (East Harbor Lagoon and James Pond) could potentially benefit from inlet stabilization and/or culvert enlargement (Advance Restoration Plan or Restorative TMDL recommended). For these two systems that could be considered for an Advance Restoration Plan, a hydrodynamic model will be necessary to evaluate the efficacy of water quality management actions (i.e., inlet stabilization, culvert development, and/or landscape nutrient management).

TMDL staff used the compiled data to develop an impairment score for each embayment to better evaluate the severity of the impairment. This included water quality data for dissolved oxygen, chlorophyll *a*, total nitrogen, and evaluation of percent eelgrass loss. Impairment scores for each embayment are included in Table B2. Embayments were clustered where combining assessment units (AUs) were appropriate. Impairment scores were averaged for embayment systems with multiple AUs in Table B3. Nitrogen loading estimates were calculated using GIS Land Use/Land Cover (MassGIS 2019), soil type (MassGIS 2021), and watershed delineation based on MEP. Nitrogen loading rates sourced from current Massachusetts MS4 general permit, Appendix F (EPA 2016), were used to calculate the loading and rates per embayment. The nitrogen loading numbers and loading rates were then divided into quartiles, with the highest loading rate scoring 4 and lowest scoring 1.

A TMDL priority designation of high, medium, or low was applied to each Coastal Cluster based on several factors, including: the watershed size, nitrogen loading estimates, cluster impairment score, hydrodynamic complexity, and consideration of ongoing TMDL development work by groups external to MassDEP (Table B3). High priority embayments are generally more impaired (greater eelgrass loss, lower DO, higher chlorophyll *a*, higher TN), and are reflected in the impairment score. These high priority embayments also have higher estimates of nitrogen loading. Low priority embayments for TMDL development are those embayments that have comparatively lower impairment severity scores, lower land-use derived TN loading estimates, or data gaps such that no impairment score was derived. WPP identified embayments as low priority for ongoing TMDL development work outside of WPP. For example, Pocasset Harbor is low priority as an external organization is working on a modeling effort in support of restoration plan development. Efforts will be made to coordinate WPP activities with external organizations, as possible.

It is the priority of WPP to address the more impaired waters first, while recognizing the priorities of municipalities, local watershed groups, or estuary programs are also factors in successful TMDL implementation. For this reason, local groups were consulted in the priority ranking and provided feedback on the initial priority status. The priority status designations were adjusted based on this local input and are reflected in Table B3.

Of the 17 embayment clusters, two embayment systems are assigned high priority. High priority systems include

the Onset Bay & Buttermilk Bay System and Weweantic River Estuary System both located in the Buzzards Bay watershed. While Edgartown Harbor Embayment System and Oyster Pond were identified as high priority when including local input, no waterbodies within these systems are currently listed as impaired (2018-2020 Integrated Report). Further work would be needed to ascertain the current assessment status of these waterbodies prior to TMDL development. Mattapoisett Harbor Embayment System (Mattapoisett Harbor and Eel Pond), Sippican Harbor Embayment System (Sippican "Inner" Harbor, Hammet Cove, Blankenship Cove, and Planting Island Cove), James Pond, and Clarks Cove are all medium priority. The remaining embayments are currently lower priority. This includes Apponagansett Harbor and Pocasset Harbor which are assigned low priority based on the work already in progress by Buzzards Bay Coalition, regardless of other scores indicating high priority. For a complete list of priorities see Table B3. The feasibility of TMDL and Advance Restoration Plan creation will depend on staffing levels, financial resources, policy initiatives, and stakeholder and public support.

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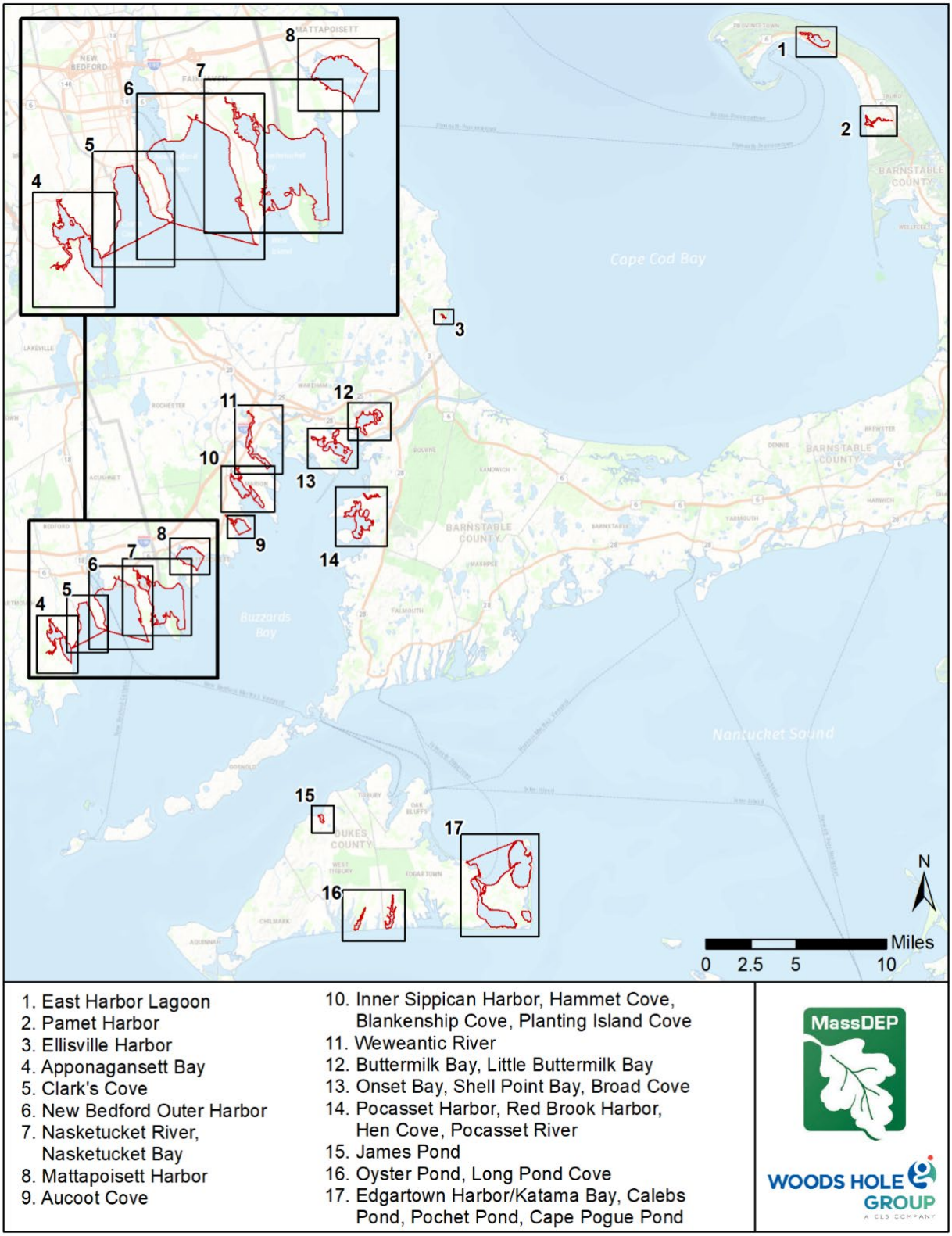

Figure B1. Embayment locations (excerpted from Woods Hole Group 2021)

Table B1: –Assessment Units and Recommended Restoration Action

AU ID*	Embayment(s)	Town	Major Basin	Recommended Restoration Action
MA95-39	Apponagansett Bay	Dartmouth	Buzzards Bay	Restorative
MA95-71	Aucoot Cove	Marion/Mattapoisett	Buzzards Bay	Restorative
MA96-83	East Harbor Lagoon (Pilgrim Lake)	Truro	Cape Cod	Restorative or Advance Restoration Plan
MA97-08	Cape Pogue Pond	Edgartown	Islands	Restorative
MA97-39	Calebs Pond	Edgartown	Islands	*Not enough data*
MA97-40	Pocha Pond	Edgartown	Islands	Restorative
MA97-16	Katama Bay/ Edgartown Harbor	Edgartown	Islands	Restorative
MA94-34	Ellisville Harbor	Plymouth	South Coastal	*Not enough data*
MA97-38	James Pond	West Tisbury	Islands	Restorative or Advance Restoration Plan
NO AU ID	Long Cove Pond	West Tisbury	Islands	*Not enough data*
MA95-35	Mattapoisett Harbor	Mattapoisett	Buzzards Bay	Restorative
MA95-61	Eel Pond	Mattapoisett	Buzzards Bay	Restorative
MA95-67	Nasketucket River	Fairhaven	Buzzards Bay	Restorative
MA95-38	Clark's Cove	New Bedford	Buzzards Bay	Restorative
MA95-63	New Bedford Outer Harbor	New Bedford	Buzzards Bay	Restorative
MA95-01	Buttermilk Bay	Bourne/Wareham	Buzzards Bay	Restorative
MA95-76	Little Buttermilk Bay	Bourne/Wareham	Buzzards Bay	Restorative
MA95-02	Onset Bay	Wareham	Buzzards Bay	Restorative
MA95-94	Shell Point Bay	Wareham	Buzzards Bay	Restorative
MA95-95	Broad Cove	Wareham	Buzzards Bay	Restorative
MA97-13	Oyster Pond	Edgartown	Islands	*Not enough data*
MA96-31	Pamet River/Harbor	Truro	Cape Cod	Restorative
MA95-17	Pocasset Harbor	Bourne	Buzzards Bay	Restorative
MA95-18	Red Brook Harbor	Bourne	Buzzards Bay	Restorative
MA95-18	Hen Cove	Bourne	Buzzards Bay	Restorative
MA95-16	Pocasset River	Bourne	Buzzards Bay	Restorative
MA95-70	Sippican "Inner" Harbor	Marion	Buzzards Bay	Restorative
MA95-56	Hammet Cove	Marion	Buzzards Bay	Restorative
MA95-100	Blankenship Cove	Marion	Buzzards Bay	Restorative
MA95-100	Planting Island Cove	Marion	Buzzards Bay	Restorative
MA95-05	Weweantic River	Wareham	Buzzards Bay	Restorative

*AU ID organized in order of grouping of embayments referred to as 'Coastal Clusters' shown in Table B2

Table B2. Coastal Clusters, Assessment Units, and Summary of Nutrient Associated Impairments

Coastal Cluster	AU ID	Embayment(s)	2018/2020 Integrated Report Nutrient Category 5	# of Seasons with > 10% DO <6 mg/l	# of Seasons with Chl-a >10 ug/l	# of Seasons with TN >0.5 mg/l	% Eelgrass Loss Since 1995	Impairment Score
Apponagansett Bay	MA95-39	Apponagansett Bay	Y	5/5	5/5	5/5	16%	0.79
Aucoot Cove	MA95-71	Aucoot Cove	Y	5/5	0/5	5/5	*NA*	0.50
East Harbor Lagoon (Pilgrim Lake)	MA96-83	East Harbor Lagoon (Pilgrim Lake)	N	5/6	0/6	5/5	*NA*	0.46
Edgartown Harbor System	MA97-08	Cape Pogue Pond	N	2/2	0/2	1/2	24%	0.44
	MA97-39	Calebs Pond	N	*NA*	*NA*	*NA*	*NA*	*NA*
	MA97-40	Pocha Pond	N	3/3	0/3	1/3	*NA*	0.33
	MA97-16	Katama Bay/Edgartown Harbor	N	4/5	3/5	1/5	*NA*	0.40
Ellisville Harbor	MA94-34	Ellisville Harbor	N	*NA*	*NA*	*NA*	*NA*	*NA*
James Pond (MV Ponds)	MA97-38	James Pond	N	4/4	3/4	4/4	*NA*	0.69
Long Cove Pond (MV Ponds)	NO AU ID	Long Cove Pond	N	*NA*	*NA*	*NA*	*NA*	*NA*
Mattapoisett Harbor System	MA95-35	Mattapoisett Harbor	Y	5/5	2/5	4/5	74%	0.79
	MA95-61	Eel Pond	Y	5/5	4/5	5/5	74%	0.89
Nasketucket Bay System	MA95-67	Nasketucket River	Y	5/5	5/5	5/5	*NA*	0.75
New Bedford Harbor & Clark's Cove	MA95-38	Clark's Cove	N	5/5	1/5	5/5	58%	0.70
	MA95-63	New Bedford Outer Harbor	Y	4/5	4/5	5/5	58%	0.80
Onset Bay & Buttermilk Bay System	MA95-01	Buttermilk Bay	Y	3/5	3/5	3/5	100%	0.80
	MA95-76	Little Buttermilk Bay	Y	2/5	4/5	4/5	100%	0.75
	MA95-02	Onset Bay	Y	0/5	0/5	1/5	47%	0.17
	MA95-94	Shell Point Bay	N	3/3	0/5	0/5	*NA*	0.25
	MA95-95	Broad Cove	N	2/5	0/5	3/5	98%	0.50
Oyster Pond (MV Ponds)	MA97-13	Oyster Pond	N	*NA*	*NA*	*NA*	*NA*	*NA*
Pamet Harbor	MA96-31	Pamet River/Harbor	N	6/6	3/6	4/5	*NA*	0.58
Pocasset Harbor Embayment System	MA95-17	Pocasset Harbor	Y	4/5	1/5	4/5	79%	0.65
	MA95-18	Red Brook Harbor	Y	5/5	2/4	3/4	100%	0.81
	MA95-18	Hen Cove	Y	2/5	0/4	3/4	100%	0.54
Pocasset River Estuary System	MA95-16	Pocasset River	N	5/5	0/5	5/5	*NA*	0.50
Sippican Harbor Embayment System	MA95-70	Sippican "Inner" Harbor	Y	5/5	4/5	4/5	50%	0.78
	MA95-56	Hammet Cove	Y	5/5	3/5	5/5	91%	0.88
	MA95-100	Blankenship Cove	N	4/5	*NA*	1/5	14%	0.29
	MA95-100	Planting Island Cove	N	4/5	0/5	2/5	-234%	0.30
Weweantic River Estuary System	MA95-05	Weweantic River	Y	5/5	5/5	5/5	78%	0.95

Table B3. Coastal Clusters, Estimated Nitrogen Loading, Complexity, and TMDL Priority

Coastal Cluster	# of Estuary AUs in Cluster	Cluster Watershed Area (acres)	Est. Nitrogen Loading (kg/year)	Est. Nitrogen Loading Rate (kg/acre/year)	N Loading Quartile	N Loading Rate Quartile	Average AU Impairment Score	Estimated Hydrodynamic Complexity	TMDL Priority
Apponagansett Bay	1	5,511	11,755	2.13	4	4	0.79	High	Low[1]
Aucoot Cove	1	3,136	4,584	1.46	2	3	0.50	Medium	Low
East Harbor Lagoon (Pilgrim Lake)	1	1,009	986	0.98	1	3	0.46	Medium	Low
Edgartown Harbor Embayment System	5	5,676	5,030	0.89	3	2	0.39	High	Med[2]
Ellisville Harbor	1	3,238	1,901	0.59	2	1	*NA*	High	Low
James Pond (MV Ponds)	1	414	159	0.38	1	1	0.69	Medium	Med[2]
Long Cove Pond (MV Ponds)	1	478	193	0.40	1	1	*NA*	Medium	Low
Mattapoisett Harbor System	2	20,408	27,446	1.34	4	3	0.84	High	Med[2]
Nasketucket Bay System	1	5,560	10,079	1.81	4	4	0.75	High	Med
New Bedford Harbor & Clark's Cove	2	2,709	8,364	3.09	3	4	0.75	High	Med[3]
Onset Bay & Buttermilk Bay System	5	10,785	9,861	0.91	3	2	0.49	High	High[2]
Oyster Pond (MV Ponds)	1	2,417	1,530	0.63	1	1	*NA*	Medium	Med[2]
Pamet Harbor	1	2,644	1,989	0.75	2	2	0.00	High	Low
Pocasset Harbor Embayment System	3	4,566	3,923	0.86	2	2	0.67	Medium	Low[1]
Pocasset River Estuary System	1	2,147	1,820	0.85	2	2	0.50	Low	Low
Sippican Harbor Embayment System	4	3,512	5,658	1.61	3	4	0.56	Medium	Med[2]
Weweantic River Estuary System	1	54,521	52,759	0.97	4	3	0.95	High	High

1- Low priority based on other work in support of TMDL development already in progress. Buzzards Bay Coalition is working on supporting work for Apponagansett Bay (SNEP funded) and Pocasset Harbor (CWA Section 604(b) funded). New Bedford Inner Harbor has MEP tech report and draft TMDL.

2- Local Input adjusted priority

3- Input from local groups indicated as medium priority therefore entire cluster will be considered medium. Future modeling efforts and current impairment status may impact whether the entire cluster or portions are done individually.

Appendix C: Lakes Prioritization

Nutrients are a priority concern for lake Total Maximum Daily Load (TMDL) development. There are approximately 43,660 acres of lakes impaired due to nutrient related causes, of which 7,172 acres have a TMDL and 36,488 acres require a TMDL (Table 2). To identify Massachusetts lakes in which to focus restoration planning and TMDL development, a preliminary prioritization effort was initiated. This project involved the creation of a prioritization tool, which provides TMDL analysts the ability to compare, contrast, and rank lakes by different metrics. Analyzed in the prioritization tool are 212 lakes and ponds which are listed as impaired due to nutrient pollution related causes within the Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle (MassDEP 2021a).

For the purposes of this prioritization analysis, a Nutrient Impaired Lake (NIL) is defined as a waterbody that has been listed as impaired for causes related to nutrient pollution in the Massachusetts Integrated List of Waters for the 2018/2020 Reporting Cycle (MassDEP, 2021a). Table C1 contains a complete list of the nutrient-related causes used in this analysis. Each waterbody in this prioritization effort is listed for one or more of these causes and was subsequently labeled as a category five: “Impaired or threatened for one or more uses and requiring a TMDL.”

Table C1. Causes Associated with Freshwater Nutrient Impairment

Cause	
- Algae	- Nutrients
- Chlorophyll-*a*	- Organic Enrichment (Sewage) Biological Indicators
- Dissolved Oxygen	- Phosphorus Total
- Dissolved Oxygen Supersaturation	- Total Suspended Solids (TSS)
- Harmful Algal Blooms	- Transparency / Clarity
- Nutrient/Eutrophication Biological Indicators	- Turbidity

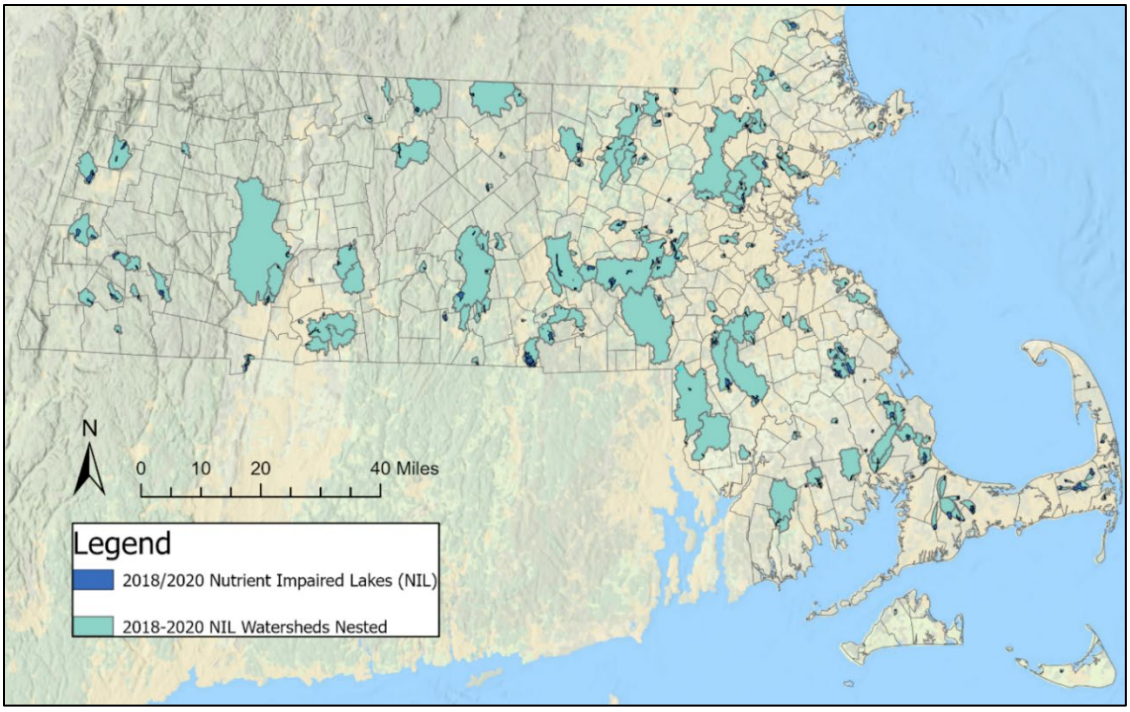

Figure C1. Location of Nutrient Impaired Lakes (NIL) and their associated Watersheds

The data collected for this prioritization effort reflect either the state of the waterbody, its watershed, or the surrounding community. Although TMDLs are written for a singular waterbody, characteristics in the surrounding area have a substantial impact on the TMDL implementation efforts and their potential for success. Accordingly, these characteristics must be considered. While each variable involved in the normalization schema was sourced and processed in an individual manner, there are seven main categories within which the data and metrics are grouped. The seven categories are:

1. Community Involvement
2. Impairment – Cause
3. Watershed Development
4. Waterbody Metrics
5. Water Quality Data
6. Watershed Metrics
7. Impairment – Use

The developed prioritization tool included 48 metrics across the seven groups that describe waterbody and watershed characteristics and allow analysts to rank waterbodies (MassDEP, unpublished). In addition, community involvement was gauged. Successful TMDL implementation almost always requires local involvement proceeding policy implementation, especially in areas with primarily nonpoint source pollution. Notably, local organizations and municipalities play a large role in implementing TMDL recommendations, through assisting in reducing pollutant loads. The level of community involvement surrounding water quality within each watershed was researched via a survey to help gauge which communities are prepared for TMDL implementation. One hundred and five organizations were contacted, and responses were received from 55 Non-Governmental Organizations (NGOs) and 24 towns.

Based on the results of this research, four metrics describing organizational involvement were included in the prioritization/ normalization process and are listed below.

- Waterbody/ watershed organization exists.
- Contact was made with organization.
- Organization preforms water quality monitoring.
- Organization preforms public outreach.

Amongst nutrient impaired lakes, there are a number of impairment causes that indicate nutrient pollution, and the type and number of impairment causes, may affect a lake's priority for TMDL development. An analysis of the count of impairment causes for the 212 NIL was conducted (Figure C2). Dissolved oxygen, turbidity, transparency, or total suspended solids (TSS) were the most common causes of impairment. Lakes with multiple impairments and those with total phosphorus, algae, chlorophyll a, and harmful algal bloom impairments were considered a higher priority for TMDL development.

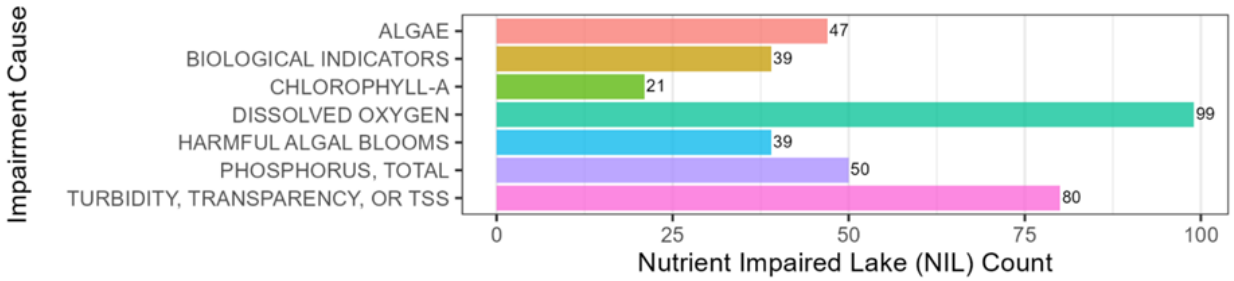

Figure C2. Count of impairment causes for 212 NIL

The state of a watershed's development provides crucial insight into the recoverability of a waterbody after TMDL implementation. In general, watersheds with greater human development can be more challenging to restore, while developed areas with larger amounts of forested or undeveloped areas may respond more readily to restoration efforts. However, water quality restoration in developed areas often benefits a larger population. An analysis of land use for NIL was conducted (Figure C3).

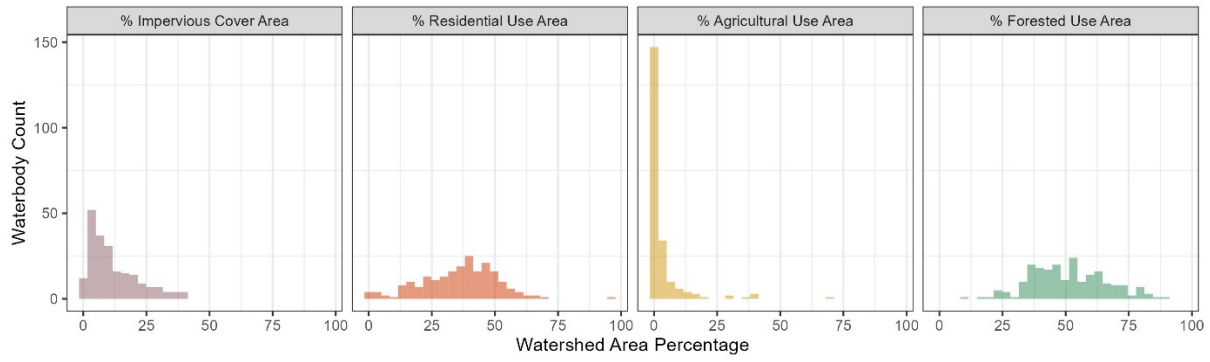

Figure C3. Select land cover and land use metrics for 212 NIL

A number of waterbody metrics were also considered including specific waterbody qualifiers in the Massachusetts Surface Water Quality Standards (SWQS) (MassDEP 2021b), such as Outstanding Resource Water

(ORW), Public Water Supply (PWS), High Quality Water (HQW) (Figure C4), and whether the waterbody had a dam or public access. The public access metric characterized waterbodies that possess some form of public access including boat launches, swimming beaches, or shore fishing locations. A total of 127 out of 212 waterbodies have some form of public access. Public access was considered as a positive factor in prioritizing TMDL development as many grant opportunities favor areas with public access.

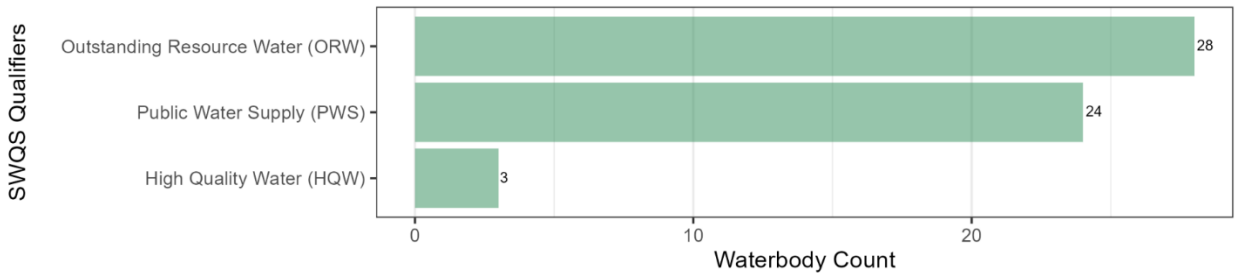

Figure C4. ORW, PWS, and HQW designations for 212 NIL

Water quality data were also investigated to describe the state of nutrient impairment for each waterbody. Understanding the level of pollution within a waterbody is crucial to understanding which lakes and ponds are in greatest need of water quality restoration plans. All water quality data variables were sourced from the MassDEP Watershed Planning Program (WPP) Water Quality Monitoring Program Data (MassDEP 2023). Metrics developed included: Total Phosphorus - Median Bottom Sample, Total Phosphorus - Median Surface Sample, Total Phosphorus - Median Bottom/Surface Difference, Chlorophyll *a* – Median Sample, Chlorophyll *a* - average sample, Secchi Depth – Median Observation, Secchi Depth – Average Observation. While potentially more challenging to restore water quality, waterbodies with greater total phosphorus concentrations, chlorophyll *a* levels and reduced Secchi depth could be considered more severely impacted and therefore a higher priority for restoration plan development efforts.

A number of watershed metrics were also considered including watershed area, watershed to waterbody area ratio, the number of nutrient impaired lakes (NIL) upstream to each waterbody, the number of MassDEP registered National Pollution Discharge Elimination System (NPDES) discharge permits in each NIL watershed, jurisdictional complexity as measured by the number of towns in each watershed, a waterbody's location outside an existing TMDL coverage, the percentage of Municipal Separate Storm Sewer System (MS4) area, the percentage of MassGIS designated Environmental Justice (EJ) area, and the percentage of the EPA designated disadvantaged community area (DCA). For the 212 waterbodies, 33 waterbodies had under 1% watershed MS4 area, while 85 waterbodies had upwards of 99%. The median % MS4 area value is 81.85%. For the 212 waterbodies, 101 waterbodies had 0% watershed EJ area, 79 waterbodies had greater than 0 % and less than 50% while 32 had greater than 50% watershed EJ area. In terms of the watershed percent EPA designated DCA, for the 212 waterbodies, 185 had 0% watershed EPA DCA, with 27 waterbodies with greater than 7% EPA DCA while only three waterbodies had above 90% DCA. Figure C5 has histograms for the percent MS4 Area, percent EJ area and percent EPA DCA. In general waterbodies with NIL upstream, NPDES permits upstream, lower jurisdictional complexity, being located outside an existing TMDL coverage as well as having higher % MS4 area, higher % EJ area and higher % EPA DCA in their watersheds rank higher for TMDL prioritization.

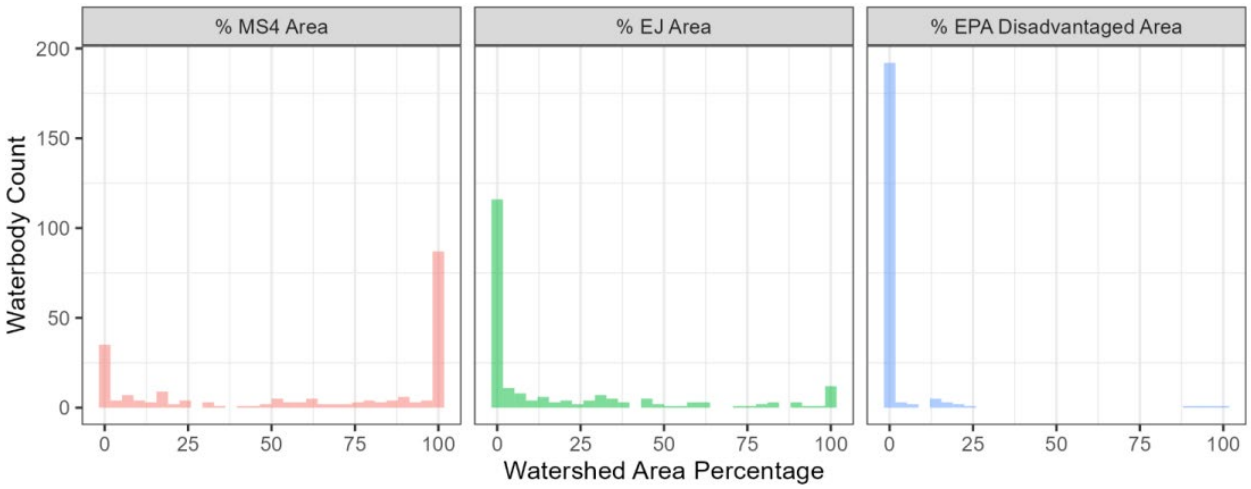

Figure C5. Distribution of MS4, EJ, and EPA disadvantaged watershed area percentages for NIL

While the 48 metrics in the developed prioritization tool could be used in an algorithmic fashion to create TMDL priority scores, this approach was not pursued as a more holistic consideration was deemed more appropriate. TMDL analysts in WPP used the prioritization tool independently to consider the factors above and individually prioritize waterbodies. TMDL staff then compared and discussed their prioritized waterbodies. The waterbodies identified in this document only provide an indication of where WPP resources could be first needed (Table C2). The priority status may shift over time depending on complexities of the TMDL development process, extent of local engagement, and TMDL development feasibility. Any TMDL effort will require adequate monitoring, data collection, and modeling to support a final TMDL document.

Table C2: Waterbodies for potential TMDL development

Major Watershed	Assessment Unit ID	Waterbody Name	Waterbody Description
Boston Harbor: Mystic	MA71040	Spy Pond	Arlington.
Boston Harbor: Mystic	MA71045	Wedge Pond	Winchester.
Boston Harbor: Mystic	MA71019	Horn Pond	Woburn.
Chicopee	MA36084	Lake Lorraine	Springfield.
North Coastal	MA93023	Flax Pond	Lynn.
Westfield	MA32021	Congamond Lakes	[Middle Basin] Southwick.
Shawsheen	MA83005	Fosters Pond	Andover/Wilmington.
Concord (SuAsCo)	MA82020	Lake Cochituate	[North Basin] Natick/Framingham/Wayland.
Concord (SuAsCo)	MA82125	Lake Cochituate	[Middle Basin] Natick/Wayland.
Concord (SuAsCo)	MA82127	Lake Cochituate	[South Basin] Natick.
Westfield	MA32012	Buck Pond	Westfield.
South Coastal	MA94007	Billington Sea	Plymouth.
Nashua	MA81122	Lake Shirley	Lunenburg/Shirley.
Concord (SuAsCo)	MA82112	Waushakum Pond	Framingham/Ashland.

Another potential restoration effort involves efforts by WPP to develop watershed-based plans which can be used as an Advance Restoration Plan (ARP). An ARP is a plan designed to address impairments for waters that will remain on the CWA 303(d) list (i.e., Category 5), as restoration activities are implemented prior to TMDL development. While TMDLs remain the primary tool for addressing impaired waters, in certain cases there may be other restoration approaches that may lead to compliance with the Massachusetts SWQS in the near term. A number of waterbodies were identified that may be better suited to watershed-based plan development (Table C3). Factors considered included the percent agriculture in a watershed, estimated TP loading, impairment cause(s), existence of a local watershed group, and WPP targeted assessment and monitoring schedule (Figure D1). The engagement of a local partner or interested party will be a key success factor in watershed-based plan development.

Table C3: Waterbodies for potential watershed-based plan development

Major Watershed	Assessment Unit	Waterbody Name	Waterbody Description
Connecticut	MA34099	Watershops Pond	Springfield.
Buzzards Bay	MA95080	Leonards Pond	Rochester.
South Coastal	MA94007	Billington Sea	Plymouth.
Hudson: Hoosic	MA11002	Cheshire Reservoir, North Basin	[North Basin] Cheshire.
Hudson: Hoosic	MA11019	Cheshire Reservoir, South Basin	[South Basin] Cheshire/Lanesborough.
Housatonic	MA21014	Lake Buel	Monterey/New Marlborough.
North Coastal	MA93060	Lake Quannapowitt	Wakefield.

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Appendix D: Rivers Prioritization

Pathogens and nutrients remain a priority concern. There are approximately 1,824 miles of rivers with pathogen impairments, of which 580 miles have a TMDL and 1,244 miles require a TMDL. There are 1,566 miles impaired for nutrient related causes, of which 493 miles have a TMDL and 1,073 miles require a TMDL (Table 3). WPP has a Draft Massachusetts Statewide TMDL for Pathogen-Impaired Waterbodies that will cover 228 pathogen-impaired segments across 288 municipalities. This is also an area where WPP will look to build program capacity, especially regarding technologies such as R programming to automate some aspects of pathogen TMDL creation.

The MassDEP WPP has several ongoing river monitoring efforts in Massachusetts. Sampling includes targeted assessment monitoring and chloride sampling conducted by the monitoring section and sampling in partnership with the United States Geological Survey (USGS). The current WPP Surface Water Quality Monitoring program is described in the *Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle* (MassDEP 2023). Work done in partnership with USGS includes projects in the Merrimack River, Connecticut River, and Taunton River watersheds. While TMDL development associated with these projects is not currently planned, these studies will provide a greater understanding of current water quality conditions in these watersheds and potentially guide future water quality restoration measures.

Partnership with USGS

Through a joint funding agreement with USGS, WPP initiated a multi-year monitoring network in 2021 to estimate contaminant loadings in the Merrimack River Watershed in Massachusetts to inform updated water quality assessments and support future development and implementation of pollution control measures. This network consists of three (3) sampling sites on the mainstem Merrimack River and nine (9) sites on major tributary streams. These sites are described in the table below. Eleven (11) sites are sampled monthly year-round while a single open-water site in the Merrimack River estuary is sampled at the surface and off the bottom twice monthly from May to October. Standard field parameters are measured during each site visit and discrete water samples are collected for the analysis of nutrients, major ions, metals, and *E. coli*. Chlorophyll *a* and pheophytin analyses are added from May to September. During this same timeframe, continuous measurements of pH, specific conductance, temperature, and dissolved oxygen are collected at the open-water estuary site using multi-parameter sondes deployed near the surface and off the bottom. Finally, stream discharge measurements are performed at the time of sampling at four (4) sites that are not co-located or near established USGS stream gauges. This monitoring program is scheduled to continue through September 2024. A summary report, including annual loads of nutrients, and data release of water quality data collected at the monitored sites will be prepared in 2025.

During spring 2017, the USGS, in cooperation with MassDEP, established a monitoring station for streamflow and water quality on the Connecticut River at Northfield, Massachusetts near the Massachusetts/New Hampshire/Vermont border. In the fall of that year the USGS, MassDEP, and the Springfield Water and Sewer Commission began a cooperative project to initiate continuous monitoring in the mainstem Connecticut River at the new Northfield gauge site and at Thompsonville, Connecticut, just downstream from the Massachusetts border. The objective of the monitoring was to quantify the mass discharge of nitrogen and other constituents in the Connecticut River as it flows in and out of Massachusetts, and ultimately to Long Island Sound (LIS). Monitoring continued through the fall of 2021, resulting in four years of water quality data from the two border sites.

Through a separate joint-funding agreement (JFA), USGS performed discrete monthly sampling from 2019 –

2021 at sites in four major watersheds draining to the Connecticut River in Massachusetts (Millers, Chicopee, Deerfield and Westfield), and at sites in four watersheds draining to Mount Hope Bay (Taunton, Mill, Three mile, and Segregansett). Data collected from this effort and from the monitoring described above for the Connecticut River border sites will be used for nutrient and organic carbon load estimation for the tributaries to the Connecticut River and Mount Hope Bay, and the mainstem Connecticut River as it flows in and out of Massachusetts. In addition, USGS will obtain loading data from wastewater treatment facilities (WWTFs) in Massachusetts from EPA's Enforcement and Compliance History Online (ECHO) database. By combining streamflow and instream water quality data with load data from WWTFs, pollutant loads from point and nonpoint sources will be quantified. The loading analysis will assist local, state, and federal water resource managers to prioritize areas for pollutant load reductions.

Chloride Monitoring

The presence of increased chloride concentrations in freshwater systems is a growing concern in Massachusetts. Chloride (Cl^-) is the anion formed when chloride-containing minerals (e.g. sodium chloride) are dissolved in water. While the presence of chloride in low concentrations is natural within freshwater systems, elevated concentrations can cause a range of detrimental ecological and environmental impacts and degrade the quality of water used for drinking, fishing, and irrigation. This process in which chloride and other dissolved salts accumulate is known as salinization.

At elevated concentrations exceeding the Massachusetts Surface Water Quality Standards (SWQS) numeric criteria (860mg/L acute and 230 mg/L chronic), chloride is a toxic contaminant that impacts aquatic life. The main source of excess chloride in rivers, lakes, wetlands and groundwater is deicing salts applied to roads, parking lots and walkways. Since 2015 MassDEP has been sampling selected Massachusetts (MA) rivers and streams, as part of WPP's surface water monitoring program to collect chloride data. Between 2015 and 2020, sampling has included 40 sampling sites across 26 waterbodies. The results of sampling conducted between 2015 and 2020 has been summarized by WPP in a data report (MassDEP, in progress).

MassDEP is responsible for monitoring the waters of the Commonwealth, identifying those waters that are impaired, and developing a plan to achieve compliance with the Massachusetts SWQS. The Massachusetts 2018/2020 Integrated List of Waters listed 23 waterbodies as impaired for chloride (MassDEP 2021a). Of those 23 waterbodies, eleven are classified as public water supplies. Table D1 details the major watershed, class, and qualifiers for those waterbodies impaired for chloride in the 2018/2020 Integrated List.

Table D1:Chloride Impaired Waterbodies in Massachusetts

Watershed	Waterbody	Assessment Unit	Class	Qualifiers[1]
Blackstone	Dark Brook	MA51-16	B	
	Unnamed Tributary	MA51-08	B	WW, CSO
	Unnamed Tributary	MA51-38	B	
Boston Harbor: Mystic River	Aberjona River	MA71-01	B	WW
	Alewife Brook	MA71-20	B	WW, CSO
	Little River	MA71-21	B	
Charles	Beaver Brook	MA72-28	B	
	Cambridge Reservoir	MA72014	A	PWS, ORW
	Cambridge Reservoir, Upper Basin	MA72156	A	PWS, ORW

Watershed	Waterbody	Assessment Unit	Class	Qualifiers[1]
Charles	Hobbs Brook	MA72-45	A	PWS, ORW
	Hobbs Brook	MA72-46	A	PWS, ORW
	Sawmill Brook	MA72-23	B	
	Unnamed Tributary	MA72-47	A	PWS, ORW
	Unnamed Tributary	MA72-48	A	PWS, ORW
Concord (SuAsCo)	Coles Brook	MA82B-22	B	
Ipswich	Unnamed Tributary	MA92-26	B	
Merrimack	Fish Brook	MA84A-40	A	PWS, ORW
Nashua	Gates Brook	MA81-24	A	PWS, ORW
	Scarletts Brook	MA81-25	A	PWS, ORW
	Unnamed Tributary	MA81-49	A	PWS, ORW
	Unnamed Tributary	MA81-54	A	PWS, ORW
Shawsheen	Unnamed Tributary	MA83-15	B	
	Unnamed Tributary	MA83-20	B	
*Acronyms: *CSO = Combined Sewer Overflow, ORW = Outstanding Resource Water, PWS = Public Water Supply, WW = Warm Water*				

1 - *Qualifiers and descriptions of the current Massachusetts Surface Water Quality Standards (SWQS) regulation included in this document are provided for informational purposes only, see the SWQS (MassDEP, 2021b). The actual SWQS regulation shall control in the event of any discrepancy with the description provided. As a result, no person in any administrative or judicial proceeding shall rely upon the content of this document to create any rights, duties, obligations, or defenses, implied or otherwise, enforceable at law or in equity.*

WPP intends to investigate the feasibility of TMDL creation for chloride impaired waterbodies. Another potential restoration effort involves efforts by the nonpoint management program to develop watershed-based plans. Pilot TMDLs or watershed-based plans will be investigated. Waterbodies classified as public water supplies will be a higher priority for these restoration efforts.

Nutrients

WPP hopes to balance emerging concerns such as chloride with nutrient impairments. One way to prioritize potential nutrient TMDLs for rivers is investigating the listed cause of impairment. Impairment causes which could indicate a priority for nutrient TMDL development include: 'Algae', 'Chlorophyll-*a*', 'Dissolved Oxygen', 'Dissolved Oxygen Supersaturation', 'Estuarine Bioassessments', 'Harmful Algal Blooms', 'Nitrogen, Total', 'Nutrient/Eutrophication Biological Indicators', 'Nutrients', 'Phosphorus, Total', 'Transparency / Clarity'. There are 145 segments listed for these causes in the Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle (MassDEP 2021). A smaller subset that only includes segments impaired by excess levels of Total Phosphorus includes 55 segments. The overall pollutant load of NPDES discharges and the percent MS4 area will also be considered with waterbodies that have higher wastewater loads and higher percent MS4 will be considered higher priorities. There has been a decline in phosphorus concentrations in a number of rivers in the state. This includes a documented decline in several rivers in Central Massachusetts (Wong *et al.* 2018). This highlights the need for updated assessments prior to TMDL development. TMDL development could also be coordinated with the targeted monitoring schedule (Figure D1).

The length of time since the most recent assessment, TMDL development feasibility and public engagement will also be considered.

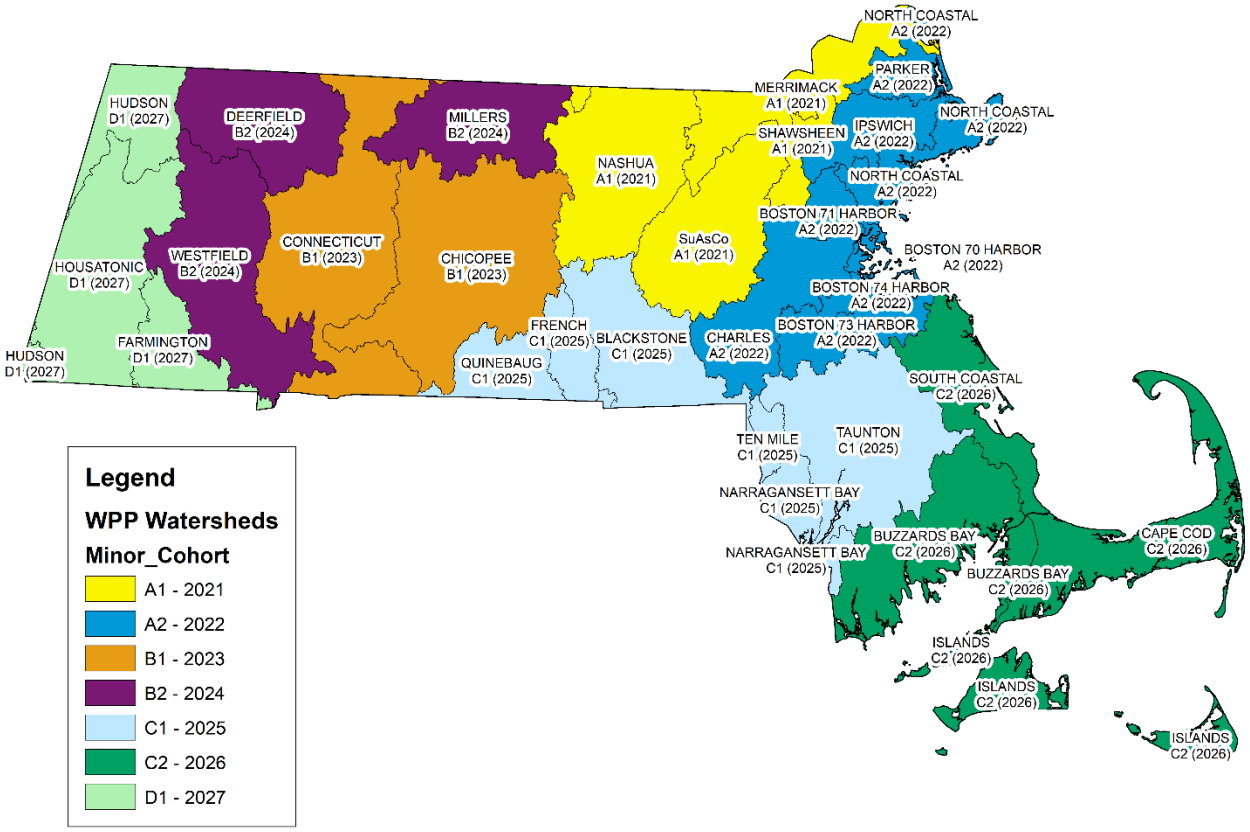

Figure D1. Rotating Basin Schedule for WPP Targeted Assessment Monitoring

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