WATERSHED-BASED PLAN

Upper Mystic River (Excluding Malden River) Watershed

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Prepared By:

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Prepared For:

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

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Contents

Executive Summary

Introduction: The purpose of a Massachusetts Watershed-Based Plan (WBP) is to organize information about Massachusetts' watersheds, and present it in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows USEPA's recommended format for "nine-element" watershed plans. This WBP was developed by Geosyntec Consultants (Geosyntec) under the direction of the Mystic River Watershed Association (MyRWA) with funding, input, and collaboration with the Massachusetts Department of Environmental Protection (MassDEP).

This WBP focuses on the Mystic River watershed, which spans the municipalities of Arlington, Winchester, Somerville, Cambridge, Belmont, Medford, Lexington, Stoneham, Woburn, Burlington, Reading and Wilmington. The Mystic River Watershed is a heavily urbanized watershed located in the metropolitan Boston area that suffers from urban nonpoint-source pollution, a long history of industrial pollution and sanitary and combined sewer overflows. The watershed includes 44 lakes and ponds and ultimately discharges into the Boston Harbor. Major subwatersheds within the Mystic River watershed include the Aberjona River subwatershed and the Alewife Brook subwatershed.

Impairments and Pollution Sources:
The MassDEP's water quality assessment indicates that nutrients and pathogens are the primary causes of water quality impairments in the freshwater portion of Mystic River watershed. Cultural eutrophication–the degradation of aquatic environments by nutrient pollution caused by human activity and urban development–is a major cause of impairments in the watershed as evidenced by excessive algal and macrophyte growth and harmful cyanobacteria blooms. Regular occurrences of severe algal blooms, within different parts of the watershed, during the summer months reduce water clarity and contribute to anoxic bottom waters that do not support aquatic life (ERG, 2020). Algal blooms and macrophyte growth degrade the aesthetic quality of the Mystic River, reduce water clarity, and impair designated uses such as fishing and boating (ERG, 2020).

Stormwater pollution from the Aberjona River and Alewife Brook strongly influences the water quality of the Mystic River. The Mystic River, Aberjona River and Alewife Brook are listed as Category 5 in the Massachusetts Year 2016 Integrated List of Waters for multiple parameters. The MyRWA has developed a 19 year-long baseline dataset that indicates the Mystic River, Aberjona River, and Alewife Brook have a history of elevated Total Phosphorus (TP) and *E. Coli* levels in the watershed. Among the most important causes of impairment of these streams is stormwater nutrient loading and resulting eutrophication. Cyanobacteria blooms, suppressed dissolved oxygen (DO) values and abundant macrophytes are also leading to degraded waterways. Inadequately controlled stormwater runoff from developed land uses have been demonstrated to be the predominant source of nutrient loads–specifically phosphorus loads–to the surface waters of the Mystic River watershed (ERG, 2020), and previous studies have estimated that 80% of TP that enters Mystic water bodies originates from stormwater runoff (MyRWA, 2018; MyRWA, 2016b).

Goals, Management Measures, and Funding: Water quality goals for this WBP are based on the goals for TP presented in the Mystic River Alternative Total Maximum Daily Load (TMDL) (ERG, 2020) and on the E. *Coli* goals presented in the "Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds" (MassDEP, et al. 2018). It is expected that TP reductions will result in improvements to the other listed impairments for the Mystic River as well. This WBP includes an adaptive sequence to establish and track specific water quality goals. As future monitoring results become available, the goals may be revisited and adjusted.

It is expected that goals will be accomplished primarily through installation of structural BMPs to treat stormwater runoff and reduce pollutant loading, implementation of non-structural BMPs (e.g., street sweeping, catch basin cleaning), and watershed education and outreach.

It is expected that future funding for management measures will be obtained from a variety of sources including Section 319 Grant funding, Coastal Zone Management Coastal Pollution Remediation (CZM-CPR) funding, Town Capital funds, volunteer efforts, and other sources.

Public Education and Outreach: Goals of public education and outreach are to provide information about proposed management measures and their anticipated benefits and to promote watershed stewardship. The MyRWA aims to engage watershed residents and businesses through educational signage, educational mailing, online resources, tours of recent green infrastructure projects, public presentations, and a variety of other means. It is expected that these programs will be evaluated by tracking coverage from local media, number of mailers distributed, online resource user activity, and other tools applicable to the type of outreach performed.

Implementation Schedule and Evaluation Criteria: Project activities will be implemented based on information outlined in the following elements for monitoring, implementation of best management practices (BMPs), and public education and outreach activities. It is expected that continued water quality monitoring will enable direct evaluation of improvements over time. Other indirect evaluation metrics are also recommended, included quantification of potential pollutant load reductions from non-structural BMPs (e.g., street sweeping). The long-term goal of this WBP is to de-list the impaired segments in the Mystic River watershed from the 303(d) list. The WBP will be re-evaluated and adjusted as needed with a minimum of once every three years.

Introduction

What is a Watershed-Based Plan?

Purpose & Need

The purpose of a WBP is to organize information about Massachusetts' watersheds, and present it in a format that will enhance the development and implementation of projects that will restore water quality and beneficial uses in the Commonwealth. The Massachusetts WBP follows the USEPA's recommended format for "nine-element" watershed plans, as described below.

All states are required to develop WBPs, but not all states have taken the same approach. Most states develop watershed-based plans only for selected watersheds. MassDEP's approach has been to develop a tool to support statewide development of WBPs, so **that good projects in all areas of the state may be eligible for federal watershed implementation grant funds** under Section 319 of the Clean Water Act.

USEPA guidelines promote the use of Section 319 funding for developing and implementing WBPs. WBPs are required for all projects implemented with Section 319 funds, and are recommended for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both.

Watershed-Based Plan Outline

This WBP for the Mystic River watershed includes nine (9) elements (a through i) in accordance with USEPA Guidelines:

a. An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this WBP (and to achieve any other watershed goals identified in the WBP), as discussed in item (b) immediately below.

b. An **estimate of the load reductions** expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time).

c. A **description of the nonpoint source (NPS) management measures** needed to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this WBP), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d. An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, United States Department of Agriculture's (USDA) Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

e. An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

f. A **schedule for implementing the NPS management measures** identified in this plan that is reasonably expeditious.

g. A description of **interim, measurable milestones** for determining whether NPS management measures or other control actions are being implemented.

h. A set of **criteria to determine if loading reductions are being achieved** over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this WBP needs to be revised or, if a NPS Total Maximum Daily Load (TMDL) has been established, whether the TMDL needs to be revised.

i. A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Project Partners and Stakeholder Input

This WBP was developed by Geosyntec Consultants (Geosyntec) under the direction of the Mystic River Watershed Association (MyRWA) with funding, input, and collaboration from the MassDEP. This WBP was developed using funds from the Section 319 program to assist grantees in developing technically robust WBPs using MassDEP's Watershed-Based Planning Tool. The MyRWA was a recipient of Section 319 funding in Fiscal Year 2017 and Fiscal Year 2019 to implement water quality improvements in the Mystic River watershed.

Core project stakeholders include:

- Patrick Herron – Executive Director, MyRWA
- Andrew Hrycyna – Watershed Scientist, MyRWA
- Matt Reardon – Environmental Analyst – Nonpoint Source Program Manager, MassDEP

This WBP was developed as part of an iterative process. The Geosyntec project team collected and reviewed existing data from the MyRWA. This information was then used to develop a preliminary WBP for review by core project stakeholders. A stakeholder conference call was then held to solicit input and gain consensus on elements included in the plan (e.g., water quality goals, public outreach activities, etc.). The WBP was finalized once stakeholder consensus was obtained for all elements.

Data Sources

This WBP was developed using the framework and data sources provided by MassDEP's Watershed-Based Plan Tool and supplemented by information provided in the Egerton Road Green Infrastructure Demonstration Project and the Stormwater Mitigation at Aberjona River in Winchester, MA Section 319 Nonpoint Source Pollution Grant Program applications (MyRWA, 2016; MyRWA, 2018). Additional data sources were reviewed and relevant information is summarized in subsequent sections of this WBP.

Summary of Past and Ongoing Work

Previous 604B-funded Projects (2012 and 2014)

The MyRWA was awarded funding through the Fiscal Year 2014 604B Grant Program to identify priority locations for BMP implementation in the Alewife Brook subwatershed. The study included GIS feasibility analysis, TP modeling, site prioritization and stakeholder engagement to identify the priority locations. Five BMP concepts were ultimately completed under the project (two in Belmont and three in Arlington). Another key element of the project was to develop an improved understanding of the scale of nutrient pollution to Alewife Brook (MyRWA, 2015). An additional 604-B funded planning project and green infrastructure feasibility analysis was also conducted in 2012 for Woburn, Winchester and Burlington. The recommendations from these projects are no longer considered high-priority due to conclusions and recommendations, which resulted from the Alternative TMDL (ERG, et al., 2020), described in more detail below.

Egerton Road Green Infrastructure Demonstration Project

The MyRWA, in collaboration with the Town of Arlington, was awarded Section 319 funding in Fiscal Year 2017 to construct two bioretention structures in the Alewife Brook subwatershed. The project site was previously identified as best meeting technical criteria and community needs by the 604b-funded BMP prioritization study described above. The site is located at the intersection of Egerton and Herbert Road in Arlington. Runoff is diverted into two curb extensions on either side of the street, each containing a sediment forebay and bioretention basin. These structures beautify the streetscape, decrease crossing distance for pedestrians, and reduce the discharge of pollutants into Alewife Brook. The drainage area of the bioretention structures is approximately 1.14 acres and the BMPs were estimated to remove 1.0 lbs/yr of TP, 367 lbs/yr of TSS, and 4.5 lbs/yr of TN (MyRWA, 2019).

Mystic River Watershed Alternative TMDL Development for Phosphorus Management - Final Report

EPA is supporting MassDEP in piloting an alternative TMDL designed to address nonattainment of nutrient related water quality standards over time. The approach, based on rigorous data gathering, scientific analysis, and modeling, provides guidance to communities based on a scientific understanding of conditions. The agencies have already begun working with communities to develop stormwater management (SWM) strategies to begin progress on implementing effective stormwater control measures (SCMs) to restore the river and degraded lakes and ponds. This "adaptive management" approach for the Mystic will be an iterative process of implementing control actions over an extended period while progress is monitored, and new information is gathered to further inform management needs for attaining water quality standards. The objectives of the technical analysis, conducted between 2017 and 2019, were to: estimate annual loadings of TP; relate TP loads to response variables in critical surface water reaches of the watershed; estimate the load reductions needed to improve water quality and attain water quality standards; and introduce a pilot Opti-Tool analysis that demonstrates cost-effective and opportunistic stormwater load reduction strategies that communities can consider adopting (ERG, et al., 2020) . A key recommendation from the Alternative TMDL was that:

- Highly urbanized areas often have limited opportunities for implementing large-scale SCMs for treating stormwater runoff. Distributed green infrastructure practices can provide cost-effective solutions that achieve load reduction numeric targets while effectively integrating within urbanized landscapes. In New England, almost 50 percent of daily rainfall events are less than 0.3 inches. The relatively small size of distributed green infrastructure facilities substantially increases the feasibility to provide treatment to runoff from impervious surfaces in constrained developed spaces and achieve meaningful water quality benefits in receiving waters. Strategically optimizing the selection and placement of distributed SCMs within highly urbanized settings can also help to develop management strategies that are more cost-effective than the traditional approach of sizing BMPs at fixed locations to treat a design storm.

Element A: Identify Causes of Impairment & Pollution Sources

Element A: Identify the causes and sources or groups of similar sources that need to be controlled to achieve the necessary pollutant load reductions estimated in the watershed based plan (WBP).

General Watershed Information

The Upper Mystic River Watershed is a heavily urbanized watershed located in the metropolitan Boston area that suffers from urban nonpoint-source pollution, a long history of industrial pollution and sanitary and combined sewer overflows. The watershed ultimately discharges into the Boston Harbor. Major subwatersheds within the Mystic River watershed include the Aberjona River subwatershed and the Alewife Brook subwatershed. The delineation for this WBP includes the area of the Upper Mystic River watershed excluding the Malden River subwatershed.

Table A-1 presents the general information for Upper Mystic River watershed (excluding Malden River subwatershed) and the subwatersheds of Aberjona River and Alewife Brook. **Figures A-1—A-3** includes maps of the watershed.

Table A-1: Upper Mystic River (Excluding Malden River) Watershed - General Information

Watershed Name (Assessment Unit ID):	Aberjona River (MA71-01)[1]; Alewife Brook (MA71-04)[2]; Brooks Brook; Cummings Brook (MA71-10) [1]; Floyds Brook; Fowle Brook[1]; Halls Brook[1]; Horn Pond Brook[1]; Little Brook[1]; Little River[2]; Mill Brook (MA71-07); Munroe Brook; Mystic River (MA71-02); Shaker Glen Brook (MA71-11); Smelt Brook; Sucker Brook[1]; Sweetwater Brook[1]; Unnamed Tributary (MA71-13); Willow Brook[1]; Winn Brook (MA71-09)[2]
Watershed Area:	33,093 acres
Major Subwatersheds	Aberjona River (15,743 acres); Alewife Brook (5,672 acres)

1. Within Aberjona River subwatershed
2. Within Alewife Brook subwatershed

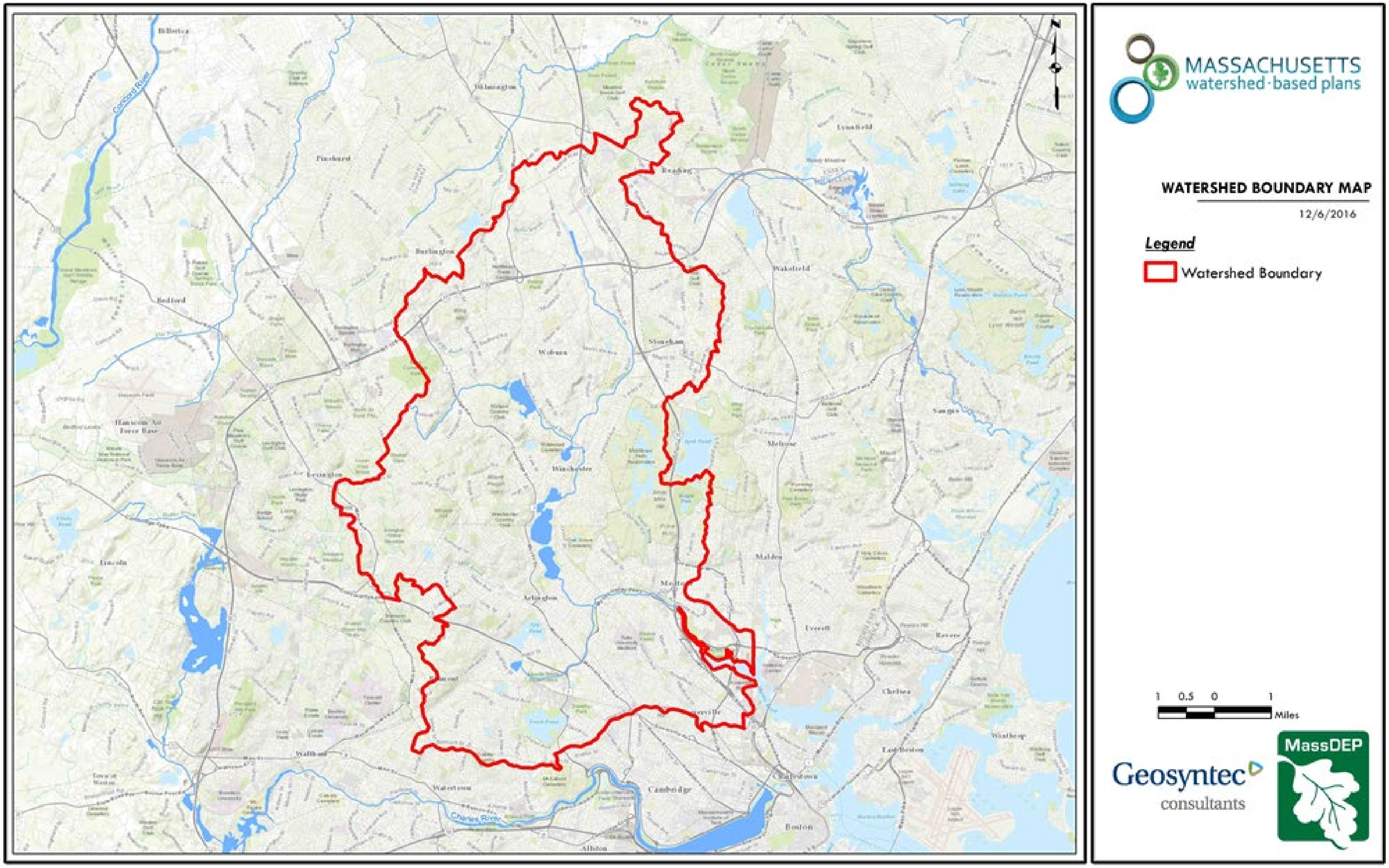


Figure A-1: Upper Mystic River Watershed Boundary Map
(MassGIS, 1999; MassGIS, 2001; USGS, 2016)

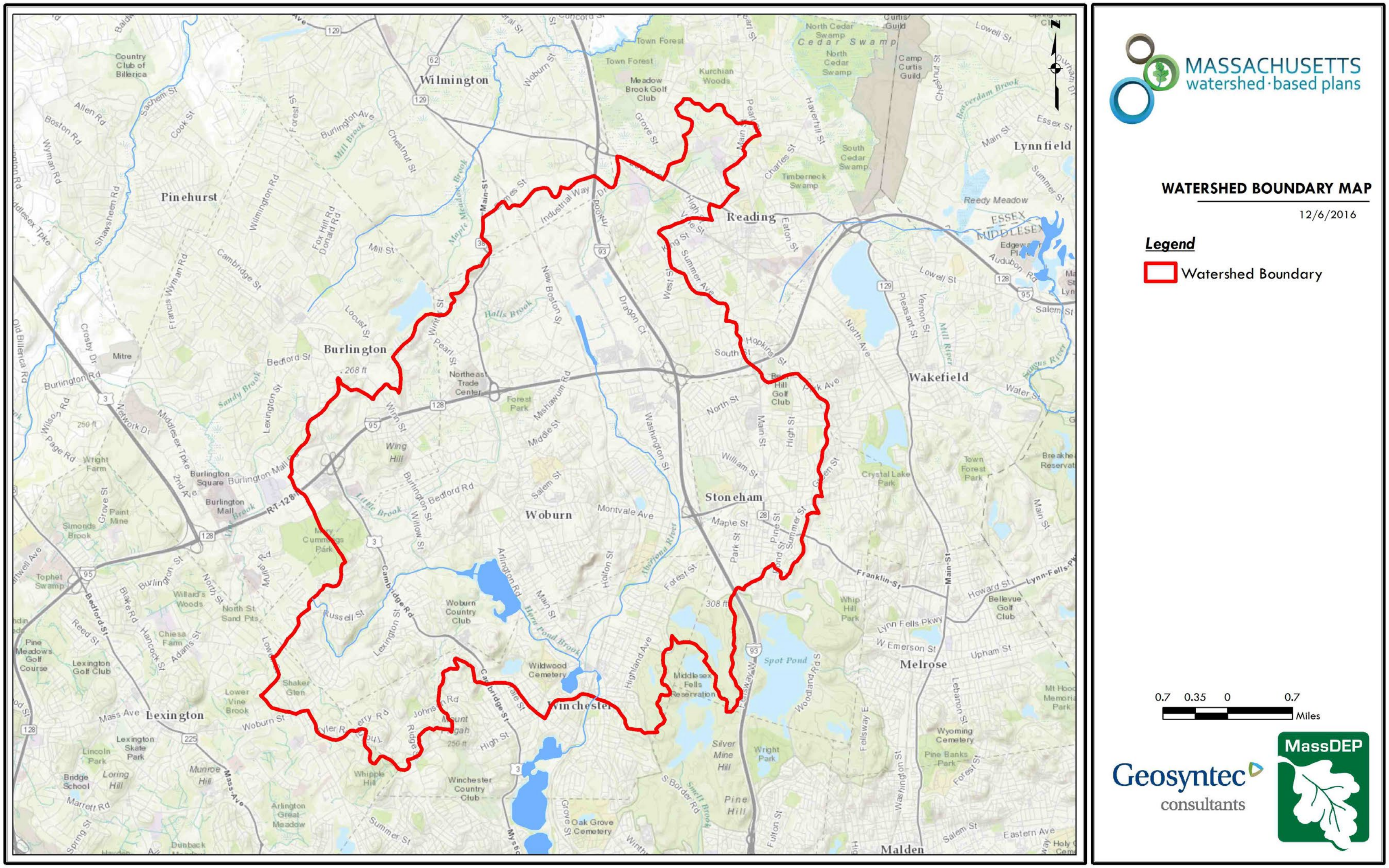


Figure A-2: Aberjona River Subwatershed Boundary Map

(MassGIS, 1999; MassGIS, 2001; USGS, 2016)

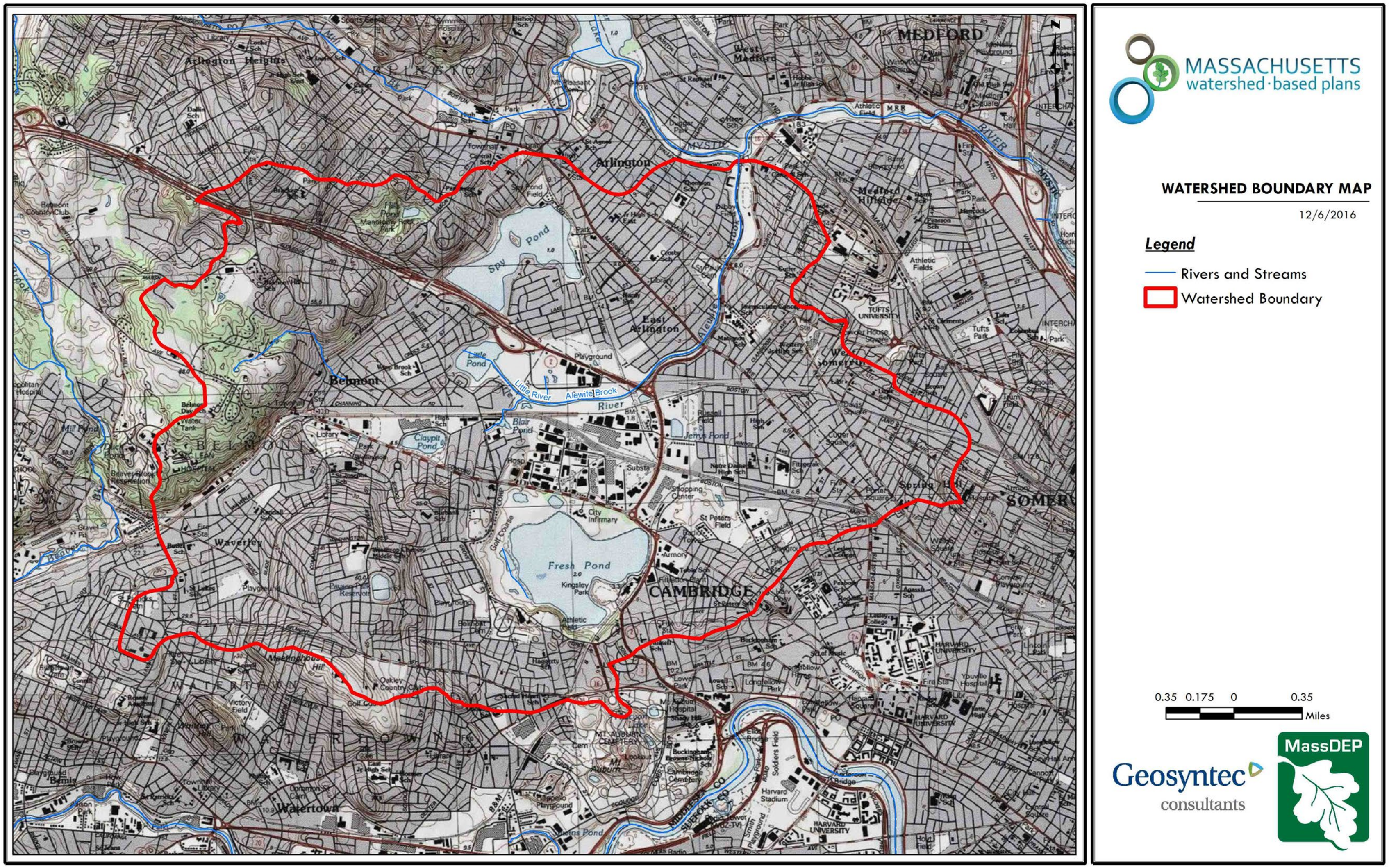


Figure A-3: Alewife Brook Subwatershed Boundary Map

(MassGIS, 1999; MassGIS, 2001; USGS, 2016)

MassDEP Water Quality Assessment Report and TMDL Review

The following reports are available:

- Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds
- Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report

Select excerpts from the Water Quality Assessment Report relating to the water quality in the Mystic River are included in Appendix B (note: relevant information is included directly from these documents for informational purposes and has not been modified).

Water Quality Impairments

Known water quality impairments, as documented in the MassDEP 2016 Massachusetts Integrated List of Waters, are listed below in **Table A-3** for waterbodies in the Mystic River watershed area. Impairment categories from the Integrated List are included in **Table A-3**.

Table A-3: 2016 MA Integrated List of Waters Categories

Integrated List Category	Description
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 requiring calculation of a Total Maximum Daily Load (TMDL), including: 4a: TMDL is completed 4b: Impairment controlled by alternative pollution control requirements 4c: Impairment not caused by a pollutant - TMDL not required
5	Impaired or threatened for one or more uses and requiring preparation of a TMDL.

Table A-4: Water Quality Impairments

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Ammonia (Un-ionized)	Municipal Point Source Discharges
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Aquatic Macroinvertebrate Bioassessments	Source Unknown
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Arsenic	Source Unknown
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Oxygen, Dissolved	Source Unknown
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Phosphorus (Total)	Source Unknown

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Physical substrate habitat alterations	Channelization
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	CERCLA NPL (Superfund) Sites
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Contaminated Sediments
MA71-01	**Aberjona River**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Unspecified Urban Stormwater
MA71-01	**Aberjona River**	**5**	Primary Contact Recreation	Escherichia coli	Source Unknown
MA71-01	**Aberjona River**	**5**	Primary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-01	**Aberjona River**	**5**	Secondary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Aesthetic	Secchi disk transparency	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Fish Consumption	Chlordane	Source Unknown
MA71-02	**Mystic River**	**5**	Fish Consumption	DDT	Source Unknown
MA71-02	**Mystic River**	**5**	Fish Consumption	PCB in Fish Tissue	Source Unknown
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Arsenic	Source Unknown
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Chlorophyll-a	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Dissolved oxygen saturation	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Fish-Passage Barrier	Contaminated Sediments
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Fish-Passage Barrier	Hydrostructure Impacts on Fish Passage
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Fish-Passage Barrier	Source Unknown
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Phosphorus (Total)	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Contaminated Sediments
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Hydrostructure Impacts on Fish Passage
MA71-02	**Mystic River**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Source Unknown
MA71-02	**Mystic River**	**5**	Primary Contact Recreation	Escherichia coli	Combined Sewer Overflows
MA71-02	**Mystic River**	**5**	Primary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Primary Contact Recreation	Secchi disk transparency	Combined Sewer Overflows

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA71-02	**Mystic River**	**5**	Primary Contact Recreation	Secchi disk transparency	Unspecified Urban Stormwater
MA71-02	**Mystic River**	**5**	Secondary Contact Recreation	Secchi disk transparency	Combined Sewer Overflows
MA71-02	**Mystic River**	**5**	Secondary Contact Recreation	Secchi disk transparency	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Aesthetic	Debris/Floatables/Trash	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Aesthetic	Debris/Floatables/Trash	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Aesthetic	Foam/Flocs/Scum/Oil Slicks	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Aesthetic	Foam/Flocs/Scum/Oil Slicks	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Aesthetic	Secchi disk transparency	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Aesthetic	Secchi disk transparency	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Aesthetic	Taste and Odor	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Aesthetic	Taste and Odor	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Fish Consumption	PCB in Fish Tissue	Source Unknown
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Copper	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Copper	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Lead	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Lead	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Oxygen, Dissolved	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Oxygen, Dissolved	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Phosphorus (Total)	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Phosphorus (Total)	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Contaminated Sediments
MA71-04	**Alewife Brook**	**5**	Fish, other Aquatic Life and Wildlife	Sediment Bioassays -- Chronic Toxicity Freshwater	Unspecified Urban Stormwater

Assessment Unit ID	Waterbody	Integrated List Category	Designated Use	Impairment Cause	Impairment Source
MA71-04	**Alewife Brook**	**5**	Primary Contact Recreation	Escherichia coli	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Primary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Primary Contact Recreation	Secchi disk transparency	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Primary Contact Recreation	Secchi disk transparency	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Secondary Contact Recreation	Escherichia coli	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Secondary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-04	**Alewife Brook**	**5**	Secondary Contact Recreation	Secchi disk transparency	Combined Sewer Overflows
MA71-04	**Alewife Brook**	**5**	Secondary Contact Recreation	Secchi disk transparency	Unspecified Urban Stormwater
MA71-07	**Mill Brook**	**5**	Fish, other Aquatic Life and Wildlife	Physical substrate habitat alterations	Unspecified Urban Stormwater
MA71-07	**Mill Brook**	**5**	Primary Contact Recreation	Escherichia coli	
MA71-07	**Mill Brook**	**5**	Secondary Contact Recreation	Escherichia coli	Source Unknown
MA71-09	**Winn Brook**	**5**	Fish, other Aquatic Life and Wildlife	Physical substrate habitat alterations	Habitat Modification - other than Hydromodification
MA71-09	**Winn Brook**	**5**	Primary Contact Recreation	Escherichia coli	Source Unknown
MA71-09	**Winn Brook**	**5**	Primary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-09	**Winn Brook**	**5**	Secondary Contact Recreation	Escherichia coli	Source Unknown
MA71-09	**Winn Brook**	**5**	Secondary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater
MA71-13	**Unnamed Tributary**	**5**	Primary Contact Recreation	Escherichia coli	Unspecified Urban Stormwater

Additional Water Quality Data – Total Phosphorus (TP)

TP data from the MyRWA's baseline monitoring program for Aberjona River (monitoring site ABR006), Mystic River (monitoring site MYR071), and Alewife Brook (monitoring site ALB006) are presented in **Figures A-4—A-6** (ERG, et al., 2020)[1]. Biweekly and monthly sampling of TP data at these monitoring sites were linearly interpolated in order to produce an estimated daily time series of TP concentrations, which are presented in the figures (ERG,

[1] The original data was slightly adjusted to account for discrepancies in laboratory Methods used. The TP data that used Method 365.1 was converted to Method 365.4 (ERG, et al., 2020).

et al., 2020). **Figure A-10** indicates where the monitoring sites are located within the Mystic River watershed. These data indicate elevated concentrations of TP compared to the water quality goal (see Table A-5 below). Data from Alewife Brook monitoring site ALB006 between 2000—2019 had a median TP concentration of 80 ug/L and a TP concentration range from 5—481 ug/L. The maximum TP concentration of 481 ug/L occurred in March 2018 and the minimum occurred in December 2004. Data from Aberjona River monitoring site ABR006 between 2000—2019 had a median TP concentration of 47 ug/L and a range from 2—518 ug/L. The maximum TP concentration of 518 ug/L occurred in October 2014 and the minimum occurred in December 2004. Data from Mystic River monitoring site MYR071 between 2000—2019 showed a median TP concentration of 30 ug/L and a range from 2—190 ug/L. The maximum TP concentration of 190 ug/L occurred in September 2004 and the minimum occurred in December 2004.

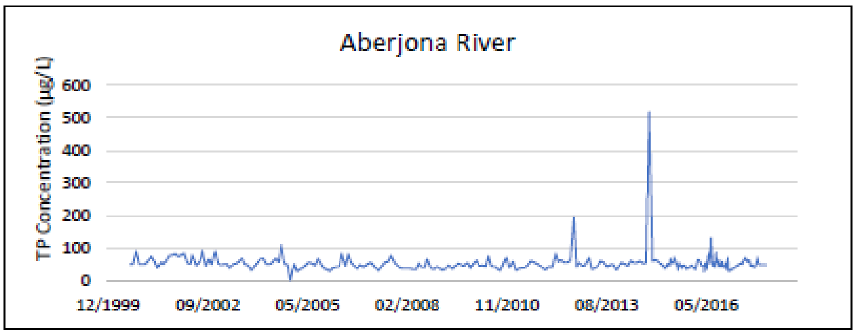


Figure A-4: Adjusted Total Phosphorus Concentrations in the Aberjona River (monitoring site ABR006)
(ERG, et al., 2020)

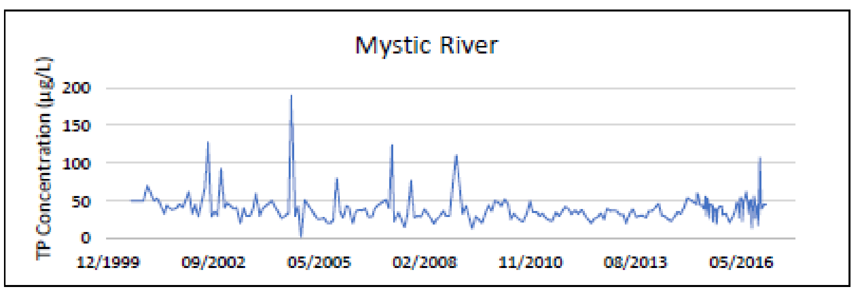


Figure A-5: Adjusted Total Phosphorus Concentrations in the Mystic River (monitoring site MYR071)
(ERG, et al., 2020)

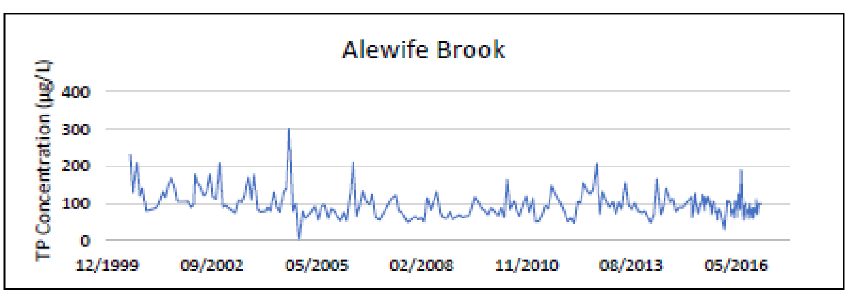


Figure A-6: Adjusted Total Phosphorus Concentrations in Alewife Brook (monitoring site ALB006)
(ERG, et al., 2020)

Additional Water Quality Data – *E. Coli*

E. Coli data from the MyRWA's baseline monitoring program for Aberjona River (monitoring site ABR006), Mystic River (monitoring site MYR071), and Alewife Brook (monitoring site ALB006) are presented in **Figures A-7—A-9**. Biweekly and monthly sampling of *E. Coli* data at these monitoring sites were linearly interpolated in order to produce an estimated daily time series of *E. Coli* concentrations, which are presented in the figures. These data indicate elevated concentrations of *E. Coli* compared to the water quality goal (see Table A-5 below). Concentrations at the Mystic River location have improved in recent years, but concentrations at the Aberjona River and Alewife Brook location have not shown significant improvement.

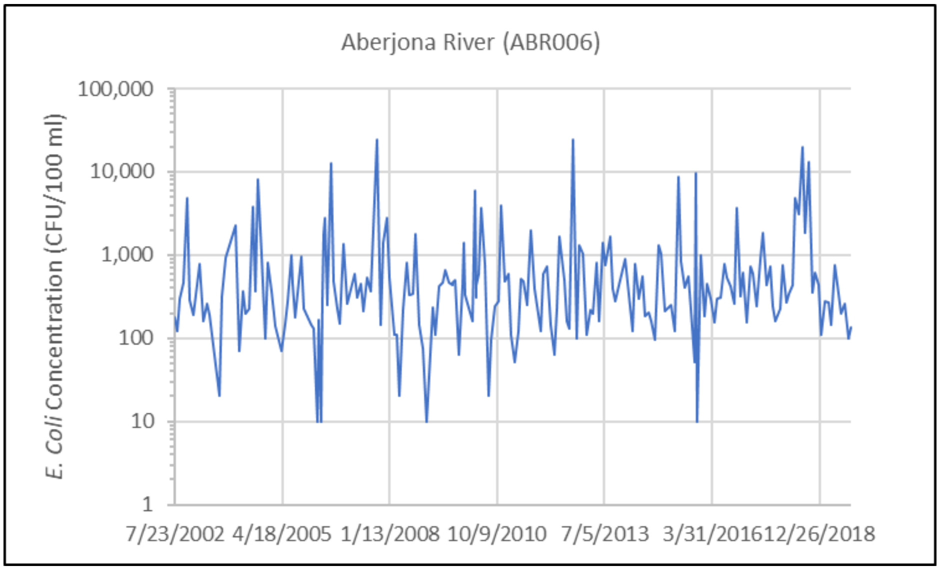


Figure A-7: *E. Coli* Concentrations in the Aberjona River (monitoring site ABR006)

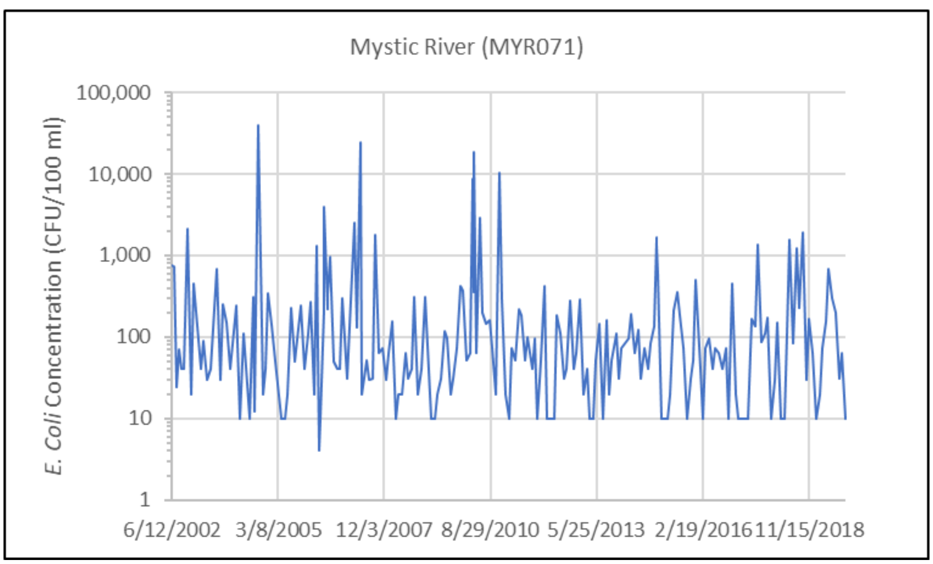


Figure A-8: *E. Coli* Concentrations in the Mystic River (monitoring site MYR071)

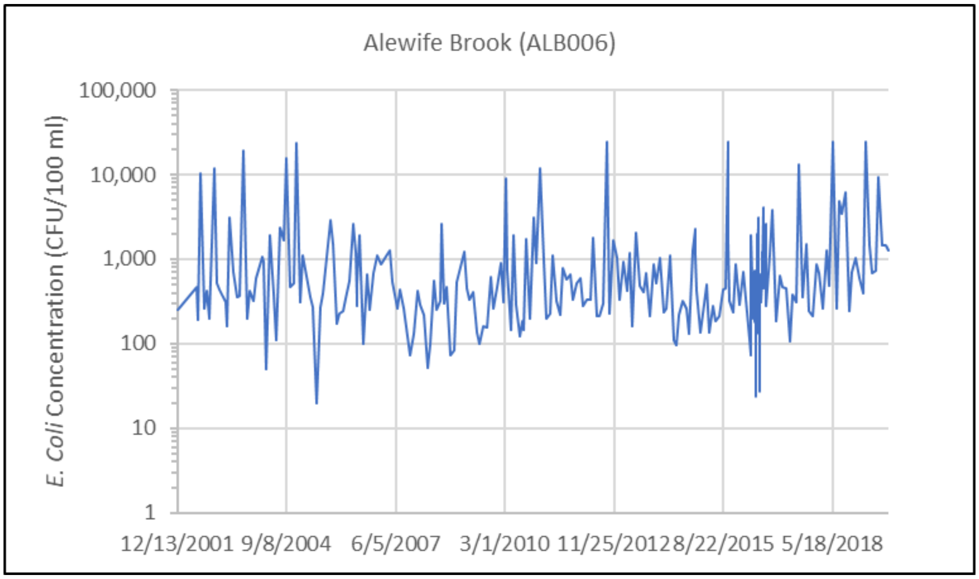


Figure A-9: *E. Coli* Concentrations in Alewife Brook (monitoring site ALB006)

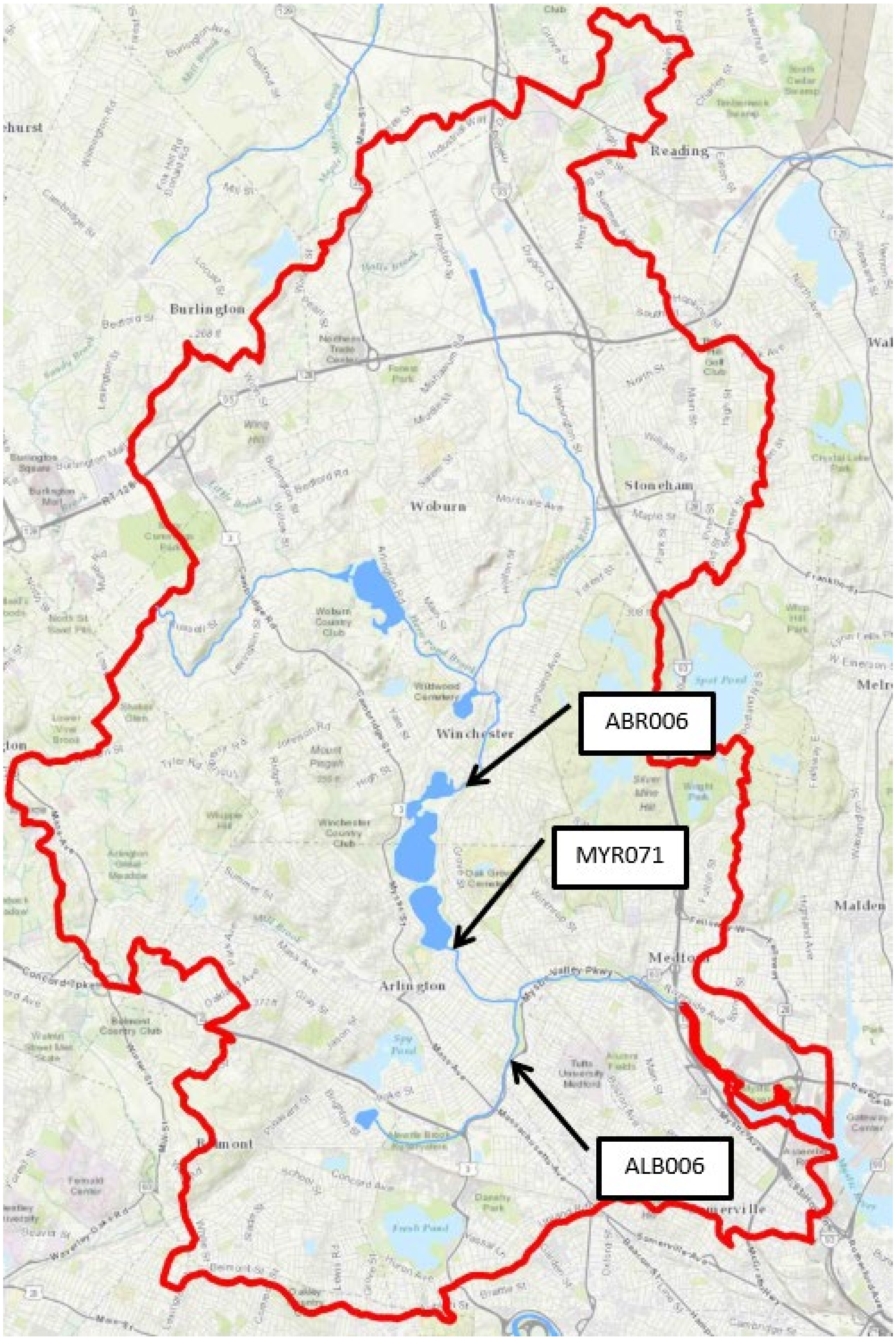


Figure A-10: Monitoring Site Locations in the Mystic River Watershed (adapted from ERG, et al., 2020)

Water Quality Goals

Refer to **Table A-5** for a list of water quality goals. Information from the Mystic River Watershed TMDL Alternative Development (ERG, et al., 2020) is included as the water quality goal. There are multiple impairments for the Mystic River; however, water quality goals are focused on reducing TP because it is expected that efforts to reduce loads of this common pollutant will also result in improvements to the other listed impairments for the waterbody (e.g., dissolved oxygen and secchi disk transparency).

Additionally, Massachusetts Surface Water Quality Standards (314 CMR 4.00, 2013) prescribe the minimum water quality criteria required to sustain a waterbody's designated uses. The waterbodies within the Mystic River watershed are Class 'B' waterbodies. The water quality goal for *E. Coli* is based on the goal for Class 'B' waterbodies presented in the "Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds)" (MassDEP, et al. 2018).

Table A-5: Water Quality Goals

Pollutant	Goal	Source
Total Phosphorus (TP)	TP should not exceed: 30 ug/L	Mystic River Watershed TMDL Alternative Development – Final Report (ERG, et al., 2020)
Chlorophyll-A (chl-a)	Chl-a should not exceed: 10 ug/L	Mystic River Watershed TMDL Alternative Development – Final Report (ERG, et al., 2020)
Bacteria	(1) the geometric mean of a representative set of fecal coliform samples shall not exceed 200 organisms per 100 mL; and (2) no more than 10% of the samples shall exceed 400 organisms per 100 mL.	Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds) (MassDEP, et al. 2018)

Land Use Information

Land use information and impervious cover is presented by the tables and figures below. Land use source data is from 2005 and was obtained from MassGIS (2009b).

As summarized by **Table A-6**, land use in the Mystic River watershed is approximately 50 percent residential (approximately 31 percent high density, approximately 16 percent medium density, and approximately 2 percent low density); approximately 22 percent of the watershed is forested; approximately 10 percent is commercial; approximately 9 percent is open land or water; approximately 5 percent is industrial; approximately 3 percent is designated as highways; and approximately 2 percent is agricultural. Table A-6 also presents the land use areas within the Aberjona River subwatershed as well as the Alewife Brook subwatershed. The Alewife Brook subwatershed is more densely settled than the Aberjona River subwatershed with approximately 53 percent high density residential and 5 percent medium residential; whereas Aberjona River is approximately 15 percent high density residential and 26 percent medium density residential.

Table A-6: Watershed Land Uses

Land Use	Area within Mystic River watershed (acres)	% of Watershed	Area within Aberjona River Subwatershed (acres)	% of Subwatershed	Area within Alewife Brook Subwatershed (acres)	% of Subwatershed
High Density Residential	10,079.2	30.5	2,414.9	15.3	3,016.0	53.2
Forest	7,191.4	21.7	4,202.6	26.7	457.1	8.1
Medium Density Residential	5,430.4	16.4	4,106.4	26.1	262.7	4.6
Commercial	3,281.0	9.9	1,438.2	9.1	704.1	12.4
Open Land	1,876.4	5.7	907.7	5.8	391.0	6.9
Industrial	1,702.9	5.1	1,290.5	8.2	165.6	2.9
Water	1,204.6	3.6	317.9	2.0	323.8	5.7
Highway	943.0	2.8	494.6	3.1	124.1	2.2
Low Density Residential	746.5	2.3	274.5	1.7	109.7	1.9
Agriculture	637.9	1.9	295.5	1.9	118.3	2.1

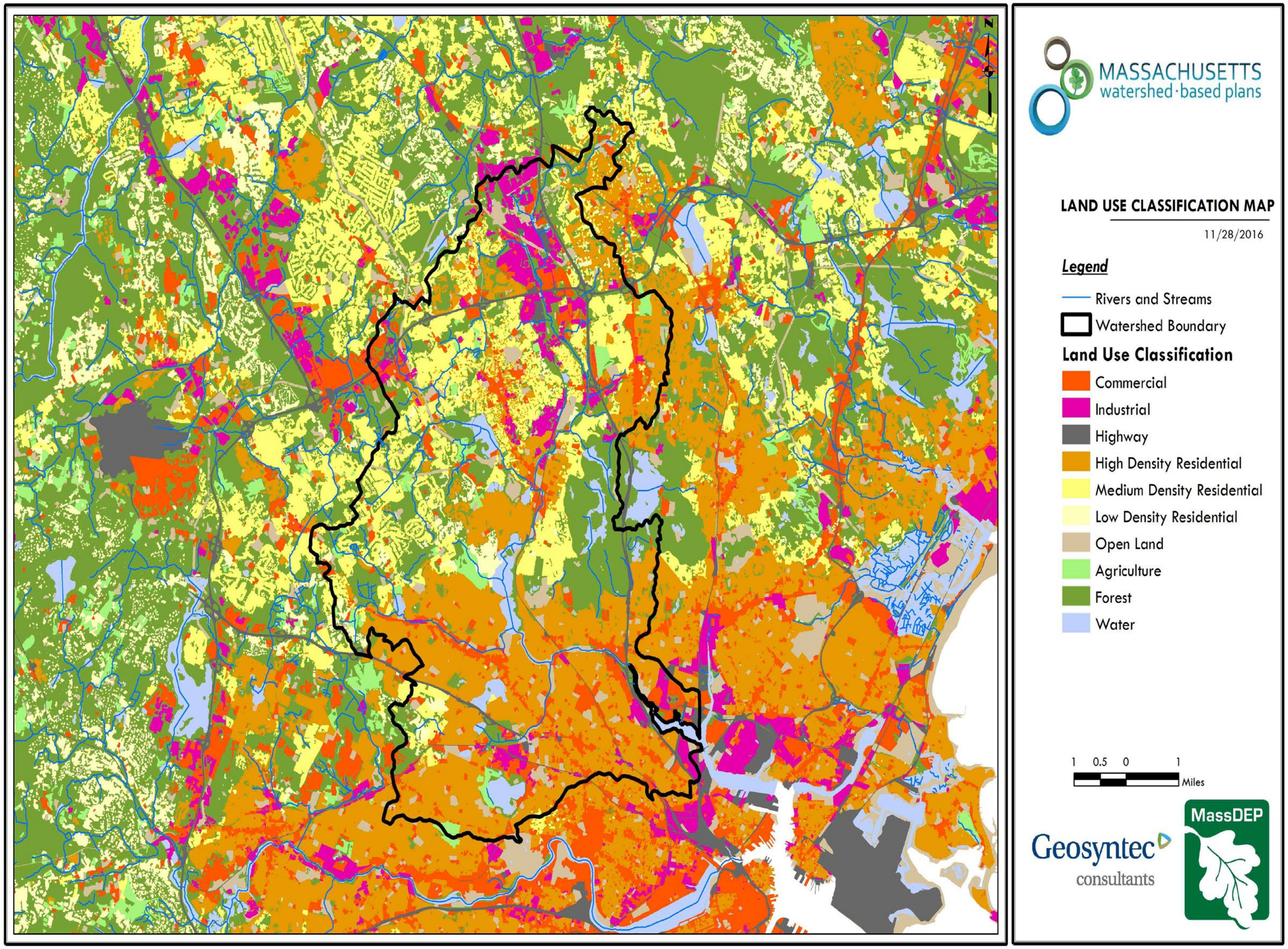


Figure A-11: Watershed Land Use Map

(MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

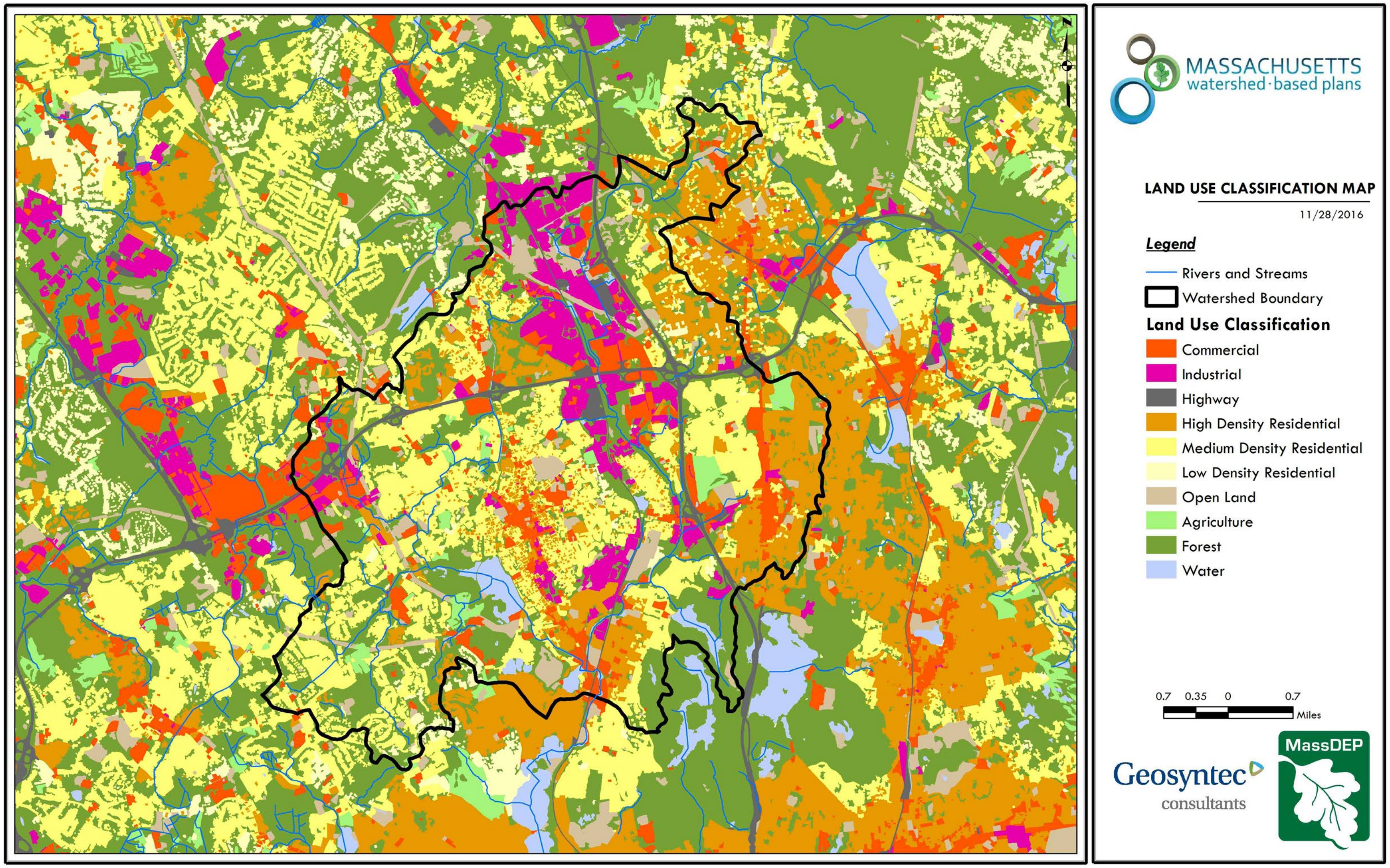


Figure A-12: Aberjona River Subwatershed Land Use Map
(MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

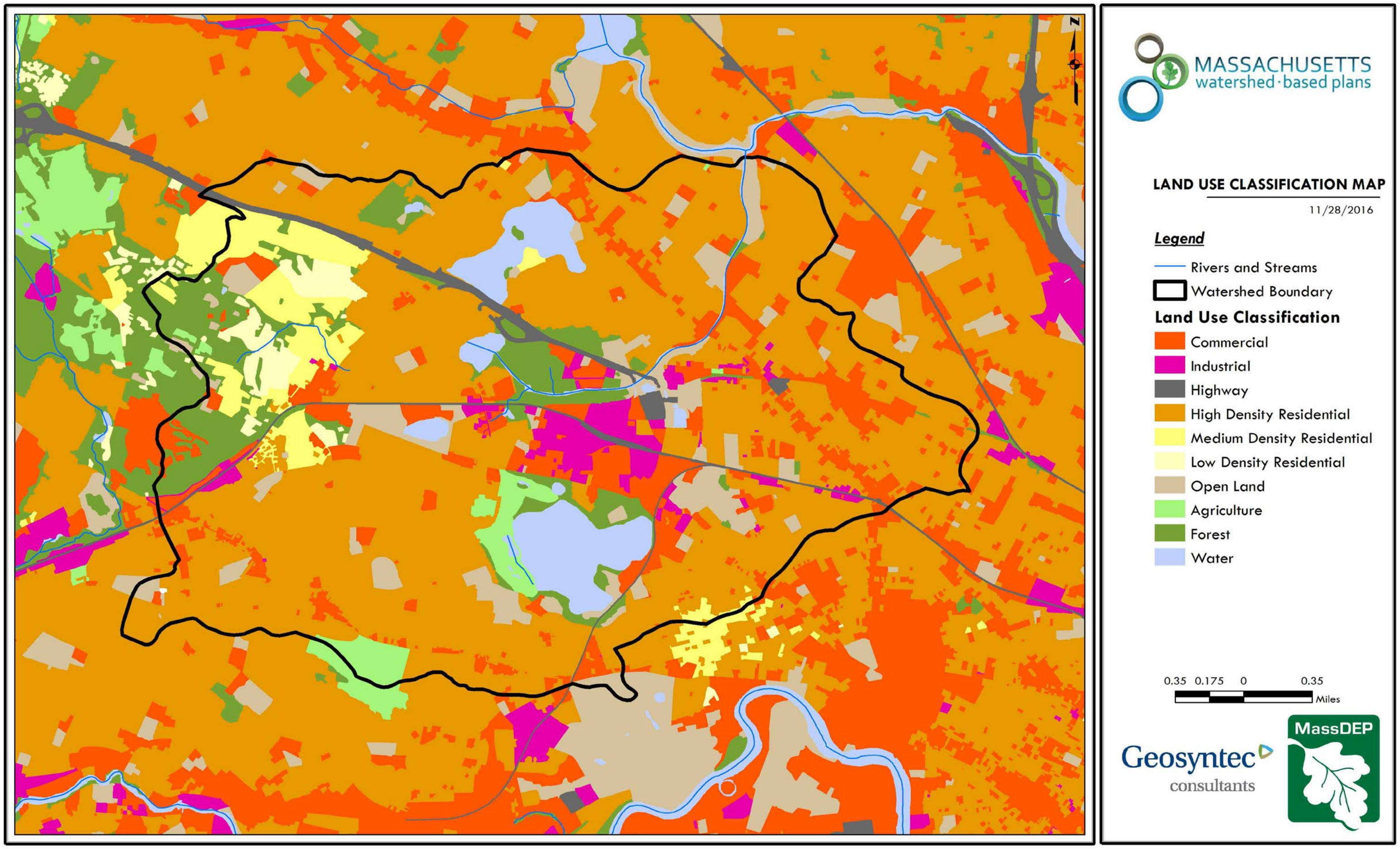


Figure A-13: Alewife Brook Subwatershed Land Use Map

(MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Watershed Impervious Cover

There is a strong link between impervious land cover and stream water quality. Impervious cover includes land surfaces that prevent the infiltration of water into the ground, such as paved roads and parking lots, roofs, basketball courts, etc. The Mystic River watershed has impervious area distributed throughout the watershed. As illustrated in **Figure A-7**, the densest impervious areas of the watershed are in the southeastern portion (in Somerville and Cambridge) and in the northern portion at the headwaters of the Aberjona River in Woburn.

Impervious areas that are directly connected (DCIA) to receiving waters (via storm sewers, gutters, or other impervious drainage pathways) produce higher runoff volumes and transport stormwater pollutants with greater efficiency than disconnected impervious cover areas which are surrounded by vegetated, pervious land. Runoff volumes from disconnected impervious cover areas are reduced as stormwater infiltrates when it flows across adjacent pervious surfaces.

An estimate of DCIA for the watershed was calculated based on the Sutherland equations. USEPA provides guidance (USEPA, 2010) on the use of the Sutherland equations to predict relative levels of connection and disconnection based on the type of stormwater infrastructure within the total impervious area (TIA) of a watershed. Within each subwatershed, the total area of each land use was summed and used to calculate the percent TIA (**Table A-7**).

Table A-7: TIA and DCIA Values for the Watershed

	Estimated TIA (%)	Estimated DCIA (%)
Mystic River Watershed	**37.1**	**31.4**
Aberjona River Subwatershed	34.4	27.6
Alewife Brook Subwatershed	44.9	40.2

The relationship between TIA and water quality can generally be categorized as listed by **Table A-8** (Schueler et al. 2009). The TIA value for the watershed is 37.2% (34.4% for Aberjona River subwatershed and 45% for Alewife Brook subwatershed); therefore, tributaries and waterbodies can be expected to show fair to poor water quality.

Table A-8: Relationship between Total Impervious Area (TIA) and water quality (Schueler et al. 2009)

% Watershed Impervious Cover	Stream Water Quality
0-10%	Typically high quality, and typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.
11-25%	These streams show clear signs of degradation. Elevated storm flows begin to alter stream geometry, with evident erosion and channel widening. Streams banks become unstable, and physical stream habitat is degraded. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.
26-60%	These streams typically no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and streambank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Biological quality is typically poor, dominated by pollution tolerant insects and fish. Water quality is consistently rated as fair to poor, and water recreation is often no longer possible due to the presence of high bacteria levels.
>60%	These streams are typical of "urban drainage", with most ecological functions greatly impaired or absent, and the stream channel primarily functioning as a conveyance for stormwater flows.

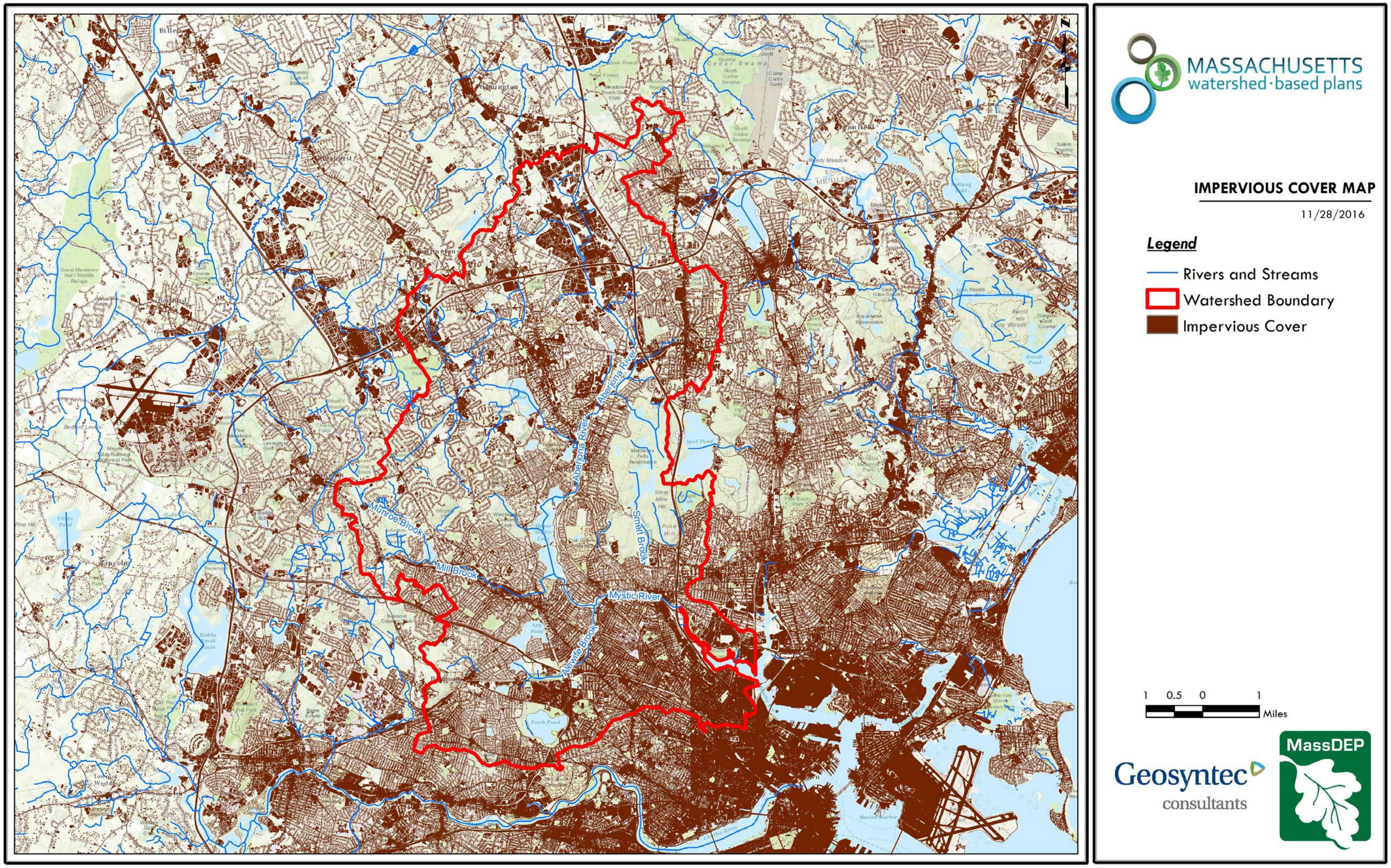


Figure A-14: Watershed Impervious Surface Map

(MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

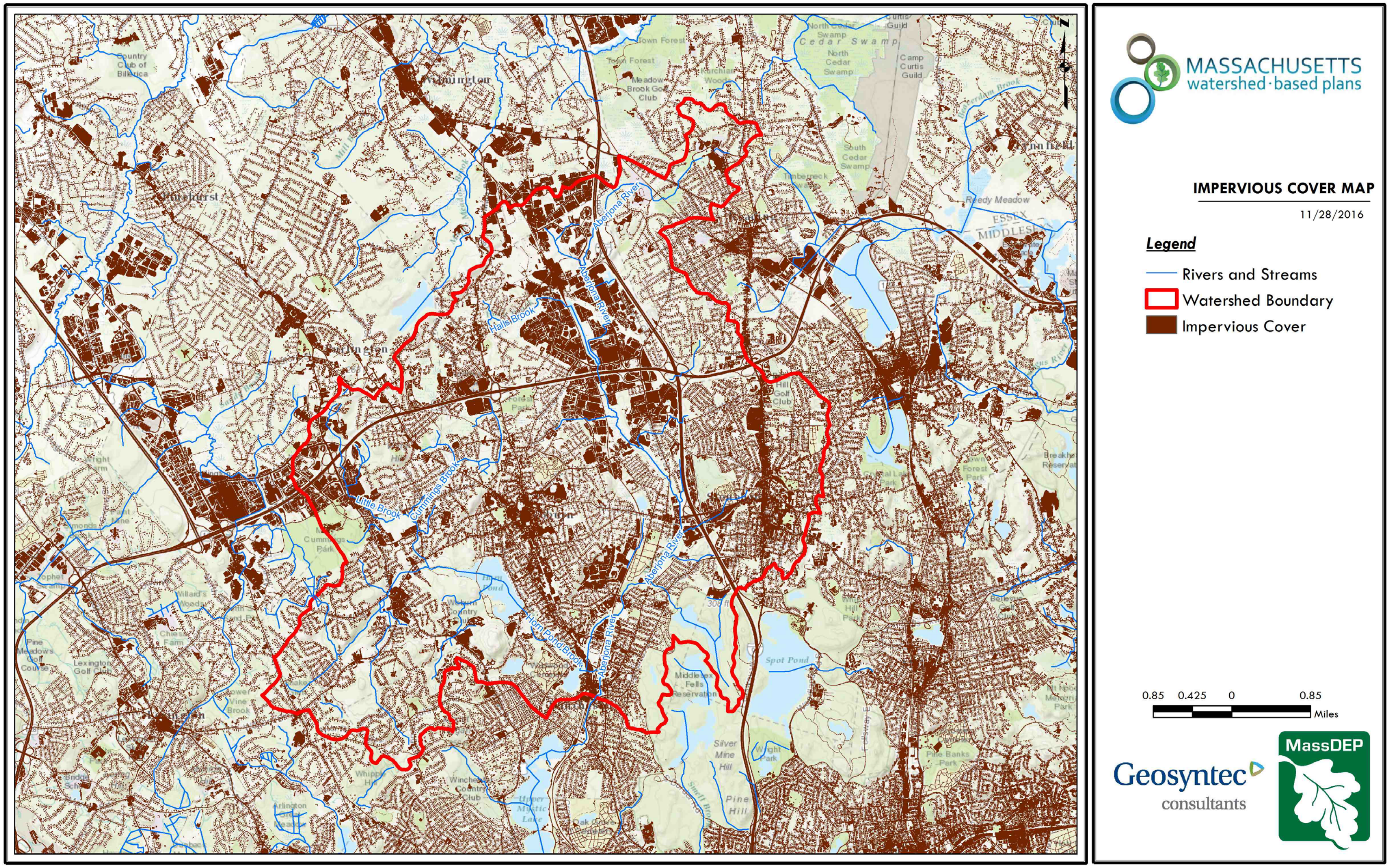


Figure A-15: Aberjona River subwatershed Impervious Surface Map
(MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

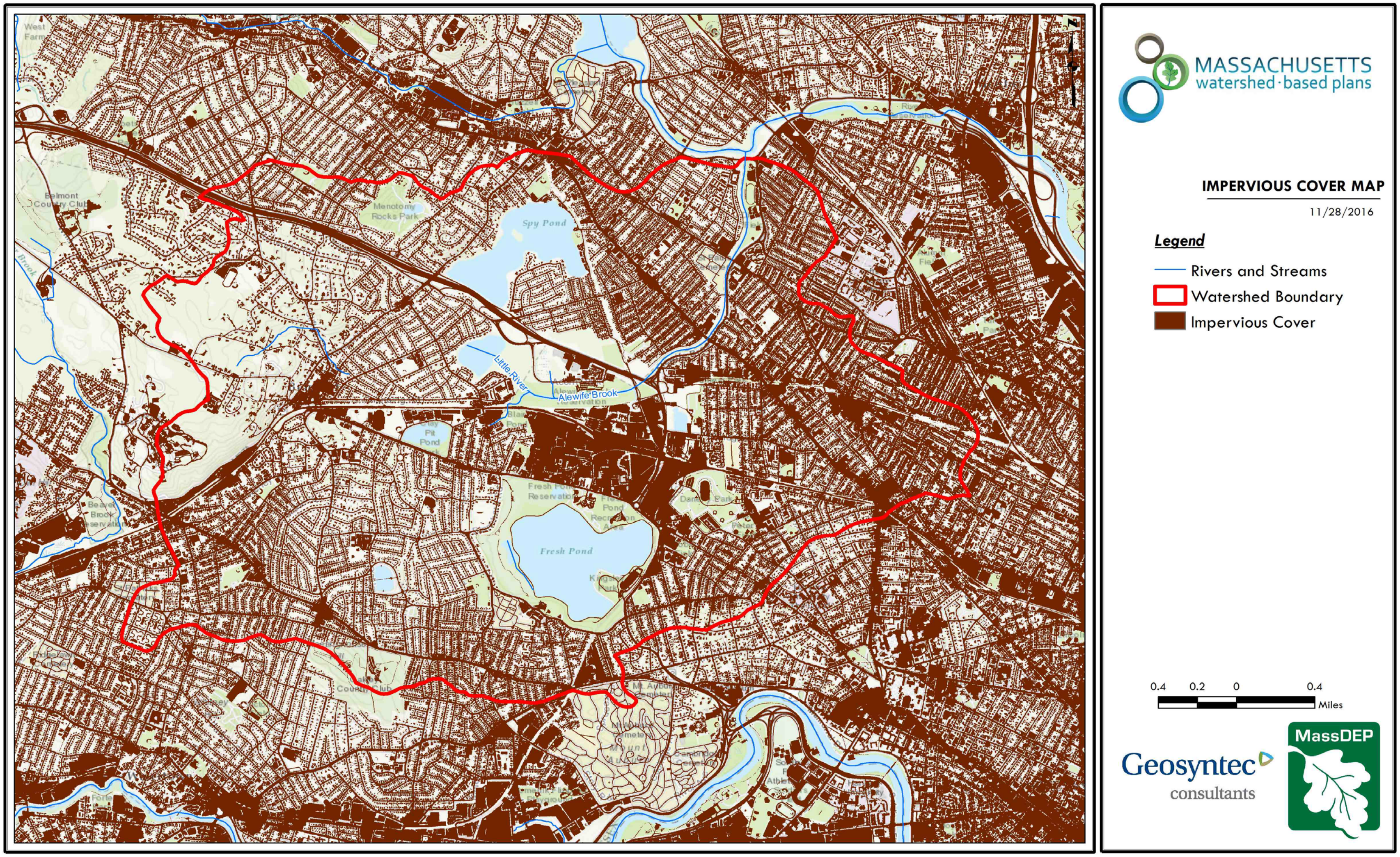


Figure A-16: Alewife Brook subwatershed Impervious Surface Map

(MassGIS, 2009b; MassGIS, 1999; MassGIS, 2001; USGS, 2016)

Pollutant Loading

The land use data (MassGIS, 2009b) was intersected with impervious cover data (MassGIS, 2009a) and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils data (USDA NRCS and MassGIS, 2012) to create a combined land use/land cover grid. The grid was used to sum the total area of each unique land use/land cover type.

The amount of DCIA was estimated using the Sutherland equations as described above and any reduction in impervious area due to disconnection (i.e., the area difference between TIA and DCIA) was assigned to the pervious D soil category for that land use to simulate that some infiltration will likely occur after runoff from disconnected impervious surfaces passes over pervious surfaces.

Pollutant loading for key nonpoint source pollutants in the watershed was estimated by multiplying each land use/cover type area by its pollutant load export rate (PLER). The PLERs are an estimate of the annual total pollutant load exported via stormwater from a given unit area of a particular land cover type. The PLER values for TN, TP and TSS were obtained from USEPA (Voorhees, 2016b) (see documentation provided in **Appendix A**) as follows:

$$L_n = A_n * P_n$$

Where L_n = Loading of land use/cover type n (lb/yr); A_n = area of land use/cover type n (acres); P_n = pollutant load export rate of land use/cover type n (lb/acre/yr)

The estimated land use-based TP loading from the watershed to the Mystic River is 25,077 pounds per year, as presented by **Table A-9**. The largest contributor of land use-based TP load originates from areas designated as residential (60% of the TP load). The second largest contributor of land-use based TP load originates from areas designated as commercial or industrial (27% of the TP load). There are usually opportunities for BMP implementation within residential, commercial and industrial land uses. **Table A-9** also presents the estimated loading values within the Aberjona River and Alewife Brook subwatersheds.

Table A-9: Estimated Pollutant Loading for Key Nonpoint Source Pollutants

Land Use Type	Pollutant Loading[1]								
	Mystic River			Aberjona River			Alewife Brook		
	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	TSS (tons/yr)
High Density Residential	**11,673**	**76,793**	**1,149.61**	2,435	16,180	241.25	3,655	23,987	359.43
Commercial	**4,416**	**37,757**	**472.38**	2,006	17,131	214.32	962	8,221	102.85
Medium Density Residential	**3,065**	**25,212**	**358.36**	2,338	19,233	273.4	136	1,139	15.94
Industrial	**2,301**	**19,710**	**246.55**	1,703	14,608	182.73	240	2,048	25.62
Forest	**1,164**	**6,395**	**317.92**	687	3,789	184.93	87	506	19.35
Highway	**922**	**7,263**	**463.84**	487	3,848	242.4	126	983	65.68
Open Land	**828**	**8,041**	**180.37**	359	3,698	79.35	178	1,837	40.25
Agriculture	**393**	**2,534**	**43.49**	185	1,199	21.03	66	413	6.57
Low Density Residential	**314**	**3,056**	**42.16**	125	1,210	16.9	34	330	4.48
TOTAL	**25,077**	**186,759**	**3,274.7**	10,324	80,895	1456.3	5,483	39,465	640.2

[1]These estimates do not consider loads from point sources or septic systems.

The alternative TMDL (ERG, et al., 2020) used EPA Region 1's Opti-Tool modeling package to estimate existing land use-based stormwater TP loading to the Mystic River. The alternative TMDL also estimated total existing TP load (including stormwater, groundwater, combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs), to the Mystic River. The modeled TP loads from the alternative TMDL (for years 1992—2017) are presented in **Figure A-17.** The modeled land use-based stormwater loads from the alternative TMDL ranged from approximately 10,000 lbs/yr—25,000 lbs/yr. A calibration of the model was completed by ERG, et al. (2020) for the alternative TMDL using data from 2015. The total calibrated TP load (including stormwater, groundwater, CSOs and SSOs) was 13,055 lbs/yr and the total calibrated land use-based TP load was 7,678 lbs/yr (ERG, et al. , 2020). The calibrated loading values were used for estimating the loading reduction needed (**see Element B**).

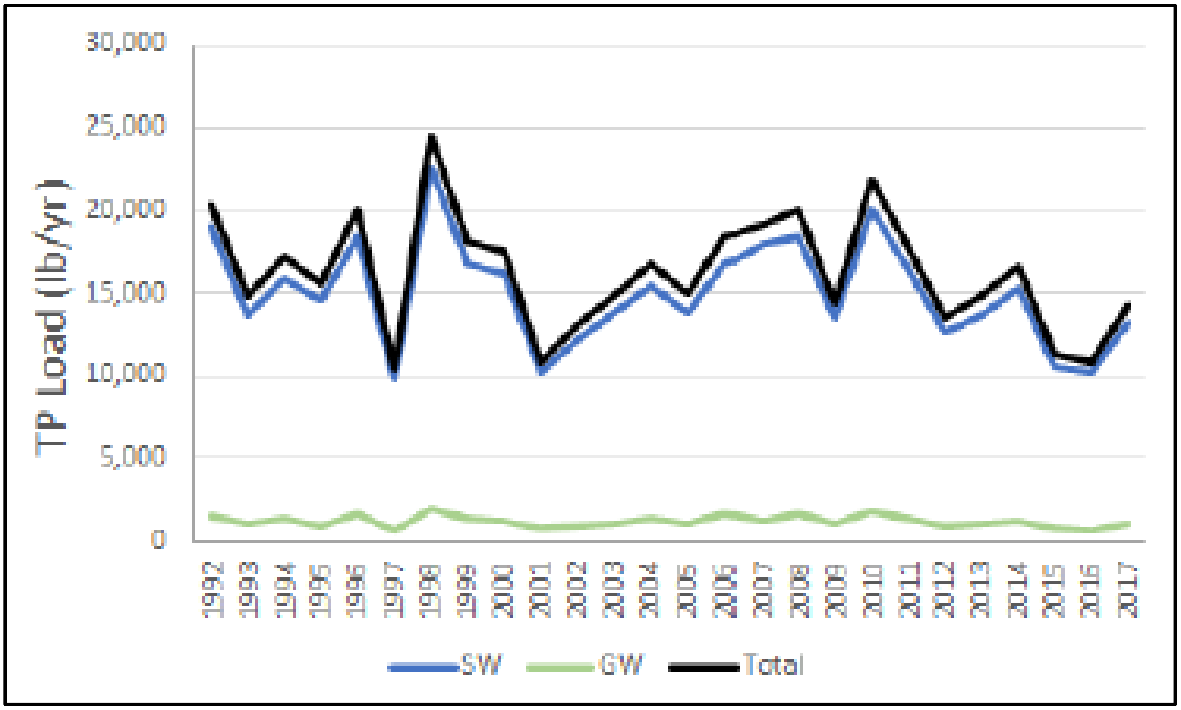


Figure A-17: Estimated Annual TP Load for the Mystic River
(Copied from ERG, et al. (2020))

Element B: Determine Pollutant Load Reductions Needed to Achieve Water Quality Goals

Element B of your WBP should:

Determine the pollutant load reductions needed to achieve the water quality goals established in Element A. The water quality goals should incorporate Total Maximum Daily Load (TMDL) goals, when applicable. For impaired water bodies, a TMDL establishes pollutant loading limits as needed to attain water quality standards.

Estimated Pollutant Loads

Estimated pollutant loads for TP (25,077 lbs/yr), TN (186,759 lbs/yr), and TSS (3,274.7 tons/yr) were previously presented in **Table A-9** of this WBP. *E. coli* loading has not been estimated for this WBP, because there are no known PLERs for *E. coli*. As is explained in Element A, the calibrated loading estimates from the alternative TMDL (ERG, et al., 2020) were used for estimating the TP load reduction needed (not the value presented in Table A-9). **Table B-1** presents the existing land-use based TP loading estimate of 7,678 lbs/yr (13,055 lbs/yr total including CSOs, SSOs, stormwater and groundwater) (ERG, et al., 2020).

Water Quality Goals

There are many methodologies that can be used to set pollutant load reduction goals for a WBP. Goals can be based on water quality criteria, surface water standards, existing monitoring data, existing TMDL criteria, or other data. As discussed in Element A, water quality goals for this WBP are focused on reducing TP loading to the Mystic River watershed); the water quality goals are presented in **Table B-1.**

Watershed analyses conducted in the Alternative TMDL study (ERG, et al., 2020) demonstrated that inadequately controlled stormwater runoff from developed landscapes are the predominant source of nutrient loads (specifically TP loads) to the surface waters of the Mystic River watershed. Under existing conditions, the study estimated that to meet the selected Chl-a water quality target for attaining water quality standards in the most impacted segment, the lower Mystic River, would require a 67 percent reduction of stormwater phosphorus loadings from the watershed. However, this estimate assumed all reduction would be achieved through stormwater control measures. This is the current long-term stormwater loading reduction goal presented in **Table B-1.**

Load reduction estimates were also modeled for future conditions to account for key variables: wet vs. dry years; future control of CSOs and SSOs and sediment load reduction. Overall, the analysis showed that elimination of CSOs and SSOs had minimal impact compared to reducing stormwater loads and internal loads released from bottom sediments of the river system. The difference between wet vs. dry years was significant, with much greater difficulty meeting water quality targets during dry years. The stormwater load reductions required to meet water quality targets under future conditions (which account for baseline stormwater management, CSOs/SSOs controls and an estimate of associated reductions in internal loads) were between 59 and 62 percent.

The following adaptive sequence is recommended to establish and track water quality goals.

1. Establish a long-term bacteria reduction goal of 90 percent based on the "Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds" (MassDEP, et al. 2018) (see Table B-1).
2. Establish an **interim goal** to reduce land use-based TP by approximately 20 percent (1,500 lbs/yr) over the next 10 years (by 2030) within the watershed.
3. Continue to implement the existing water quality monitoring programs described in Elements H&I. Use monitoring results to perform trend analysis to identify if proposed Element C management measures are resulting in improvements.
4. Establish **long-term goals** to meet all applicable water quality standards, leading to the delisting of the Mystic River (and the currently impaired waterbodies in the watershed) from the 303(d) list. The current long-term goal is 67 percent reduction in stormwater loads.

Table B-1: Pollutant Load Reductions Needed

Pollutant	Existing Estimated Total Load	Water Quality Goal	Required Land-use Based Load Reduction
Total Phosphorus	7,678 lbs/yr (land use-based) 13,055 lbs/yr (total) (ERG, et al., 2020)	Total Phosphorus should not exceed 30 ug/L within waterbodies of the Mystic River watershed, which would require a 67 percent reduction in stormwater loads (ERG, et al.,2020)	1,500 lbs/yr (interim goal) 5,100 lbs/yr (current long-term goal)
Bacteria	*N/A – Concentration based*	(1) the geometric mean of a representative set of fecal coliform samples shall not exceed 200 organisms per 100 mL; and (2) no more than 10% of the samples shall exceed 400 organisms per 100 mL.	>90%– Concentration based (See Note 1)
Chl-a	*N/A – Concentration based*	Total chl-a should not exceed 10 ug/L	Concentration based

Notes:

1: The required load reduction for bacteria is adapted from the "Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds" (MassDEP, et al. 2018), which states "Since accurate estimates of existing sources are generally unavailable, it is difficult to estimate the pollutant reductions for specific sources. For the illicit sources, the goal is complete elimination (100% reduction). However, overall wet weather indicator bacteria load reductions can be estimated using typical stormwater bacteria concentrations. These data indicate that in general two to three orders of magnitude (i.e., greater than 90%) reductions in stormwater bacteria loading will be necessary, especially in developed areas. This goal is expected to be accomplished through stepwise implementation of illicit discharge detection and elimination programs (IDDE), best management practices, such as those associated with the Phase I and Phase II control program for stormwater".

Element C: Describe management measures that will be implemented to achieve water quality goals

Element C: A description of the nonpoint source management measures needed to achieve the pollutant load reductions presented in Element B, and a description of the critical areas where those measures will be needed to implement this plan.

Existing Management Measures

The MyRWA, in collaboration with the Town of Arlington, constructed two bioretention structures, in the Alewife Brook subwatershed, during 2018 with funding assistance provided by the Fiscal Year 2017 Section 319 Nonpoint Source Pollution Grant Program. The project site was previously identified as best meeting technical criteria and community needs by a 604b-funded BMP prioritization study, which included GIS feasibility analysis, TP modeling, site prioritization and stakeholder engagement (MyRWA, 2014). The site is located at the intersection of Egerton and Herbert Road in Arlington. Runoff is diverted into two curb extensions on either side of the street, each containing a sediment forebay and bioretention basin. These structures beautify the streetscape, decrease crossing distance for pedestrians, and reduce the discharge of pollutants into Alewife Brook. The drainage area of the bioretention structures is approximately 1.14 acres and the BMPs were estimated to remove 1.0 lbs/yr of TP, 367 lbs/yr of TSS, and 4.5 lbs/yr of TN (MyRWA, 2019).

Ongoing Management Measures

The MyRWA was awarded funding through the Fiscal Year 2019 Section 319 Nonpoint Source Pollution Grant Program to implement a green infrastructure retrofit in the Town of Winchester on residential streets in the Aberjona River subwatershed. The proposed project will divert runoff into multiple stormwater tree trenches (bioswales) on Wildwood Street between Robinhood Road and Cambridge Street as well as in neighborhoods adjacent to Wedge Pond and Horn Pond. The stormwater tree trenches will improve stormwater management, reduce nonpoint source pollution, beautify the streetscape and contribute to reduction of localized flooding. Concurrently, the Town of Winchester is implementing a $3 million+ infiltration chamber and upland stormwater routing project, treating the first one-inch of runoff from the Wildwood neighborhood within the same subwatershed offering an ideal opportunity to incorporate green infrastructure into the project. This application of green infrastructure is expected to be an excellent model for local replication on local streets and small playgrounds in the local area. The proposed structures fit between the curb of the street and the sidewalk. The estimated pollutant load reductions that will be achieved by the BMPs are 6.6 lbs/yr of TP, 353 lbs/yr of TSS, and 37 lbs/yr of TN (MyRWA, 2018).

The Arlington Green Infrastructure Project (AGIP) is a Coastal Zone Management (CZM)-Coastal Pollutant Remediation (CPR) grant-funded project, which is close to being completed. The project includes two rain gardens at the intersection of Milton Street and Herbert Road as well as four street infiltration trenches, 14 green infiltration trenches, and 2 de-paving locations along Trowbridge Street. The estimated combined pollutant load reductions that will be achieved by the BMPs are 8.1 lbs/yr of TP, 35.4 lbs/yr of TN and 2,421 lbs/yr of TSS. A map of the AGIP sites is included in Appendix C.

Future Management Measures

The MyRWA was awarded funding through the Fiscal Year 2014 604B Grant Program to identify priority locations, in the Alewife Brook subwatershed, for BMP implementation and to develop multiple conceptual BMP designs for each community within the subwatershed (MyRWA, 2015). The locations identified in the 604B report are no longer considered priority based on recommendations from the more recent Alternative TMDL report (ERG, 2020). The Alternative TMDL urges distributed, small-scale green infrastructure, especially focusing on infiltration, as a cost-effective solution. Highly urbanized areas often have limited opportunities for implementing large-scale stormwater control measures for treating stormwater runoff. Distributed green infrastructure practices can provide cost-effective solutions that achieve load reduction numeric targets while effectively integrating within urbanized landscapes. In New England, almost 50 percent of daily rainfall events are less than 0.3 inches. The relatively small size of distributed GI facilities substantially increases the feasibility to provide treatment to runoff from impervious surfaces in constrained developed spaces and achieve meaningful water quality benefits in receiving waters. Strategically optimizing the selection and placement of distributed BMPs within highly urbanized settings can also help to develop management strategies that are more cost-effective than the traditional approach of sizing BMPs at fixed locations to treat a design storm (ERG, et al., 2020).

Emerging out of this recommendation from the Alternative TMDL, MyRWA has pursued several projects in 2020. Informed by technical assistance from USEPA and the University of New Hampshire Stormwater Center, these proposed projects were designed to plan for and implement small-scale cost-effective street trenches attached to catch basins in Hydrologic Soil Group (HSG) A soils across the Mystic River watershed. These street trenches were piloted in the AGIP, described above, which is currently in the final stages of implementation. MyRWA has submitted two grant proposals in 2020 to help expand this work to the watershed scale. These two proposed projects are detailed in **Table C-1**. The proposed projects were prioritized due to their estimated pollutant load reductions and feasibility for implementation.

Table C-1: 2020 Summary of Proposed Projects in the Mystic River Watershed

Project Title / Communities	BMP(s)	Project Goals	Estimated Water Quality Improvement
"Distributed small-scale street trenches for Phosphorus load reduction" (MyRWA, 2020a) / Medford, Arlington, Winchester	50 Distributed small-scale street trenches attached to catch basins	• Implement modular trench design that can be replicated in large numbers and can reduce engineering and construction costs for the most cost-effective approach to reduce nutrient loads • Reduce phosphorus loads to Mystic River water bodies by implementing the recommendation in the EPA Alternative TMDL report (2020) for distributed, cost-effective green infrastructure • Serve as a regional model for the benefits of distributed small-scale GI • Transfer knowledge and build capacity in municipalities to continue this work into the future, taking advantage of 3 future road work to make street trenches at catch basins a routine occurrence • Educate residents and key stakeholders on the mechanisms and importance of nutrient pollution controls, and describe these installations in the larger frame of need for investment in stormwater infrastructure	• 10,600 lbs/yr TSS removal • 42 lbs/yr TP removal • 253 lbs/yr TN removal
"Implementation of multiple, cost-effective infiltration trenches in two municipalities to address nutrient impairment impacting anadromous fish" MyRWA (2020b) / East Arlington and Lexington	18 Distributed small -scale street trenches attached to catch basins	• To improve the quality of spawning and juvenile habitat of river herring in Alewife Brook and Mystic Rivers through reduction of non-point source nutrient pollution • Reduce nutrient loading and eutrophication of two water bodies (Alewife Brook and Mystic River) as listed as impaired in the 2016 MA Integrated Waters List (303D) • Address nutrient loading and eutrophication of estuarine waters of Boston Harbor and Massachusetts Bay by addressing the source of that nutrient loading	• 3,834 lbs/yr TSS removal • 15 lbs/yr TP removal • 90 lbs/yr TN removal

Additional BMP Opportunities

MyRWA has also applied for a Fiscal Year 2020 604B grant (MyRWA, 2020c) to identify additional priority locations for these high efficiency, low-cost street infiltration trenches attached to catch basins in at least 8 municipalities within the watershed. The goal of this proposed planning project is to identify 250 street trench installation locations with conceptual design/sizing, cost estimates, and phosphorus load reduction calculations. This proposed effort will help inform realistic estimates of the costs of the phosphorus reduction in Mystic River watershed called for by the 2020 Alternative TMDL report. This proposed planning project is intended to prepare the watershed communities to take aggressive and achievable measures towards reducing phosphorus loads in the Mystic River watershed.

Once this proposed planning project has been completed and the recommended BMPs have been implemented and/or deemed infeasible for implementation upon further analysis, MyRWA may consider additional investigation with the following recommended general sequence to identify and implement future structural BMPs within the Mystic River watershed:

1. **Identify Potential Implementation Locations:** Perform a desktop analysis using aerial imagery and GIS data to develop a preliminary list of potentially feasible implementation locations based on soil type (i.e., hydrologic soil groups A and B); available public open space (e.g., lawn area in front of a police station); potential redevelopment sites where public-private partnerships may be leveraged; and other factors such as proximity to receiving waters, known problem areas, or publicly owned right of ways or easements. Additional analysis can also be performed to fine-tune locations to maximize pollutant removals such as performing loading analysis on specifically delineated subwatersheds draining to single outfalls and selecting those subwatersheds with the highest loading rates per acre. Additionally, the Alternative TMDL (ERG, 2020) for the Mystic River included an analysis using USEPA's Opti-tool, which provides guidance on which land use sources to target and what type of BMPs are suitable and how to size those BMPs.

2. **Visit Potential Implementation Locations:** Perform field reconnaissance, preferably during a period of active runoff-producing rainfall, to evaluate potential implementation locations, gauge feasibility, and identify potential BMP ideas. During field reconnaissance, assess identified locations for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g., roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.

3. **Develop BMP Concepts:** Once potential BMP locations are conceptualized, use the BMP-selector tool on the watershed-based planning tool to help develop concepts. Concepts can vary widely. One method is to develop 1-page fact sheets for each concept that includes a site description, including definition of the problem, a description of the proposed BMPs, annotated site photographs with conceptual BMP design details, and a discussion of potential conflicts such as property ownership, O&M requirements, and permitting constraints. The fact sheet can also include information obtained from the BMP-selector tool including cost estimates, load reduction estimates, and sizing information (i.e., BMP footprint, drainage area, etc.).

4. **Rank BMP Concepts:** Once BMP concepts are developed, perform a priority ranking based on site-specific factors to identify the implementation order. Ranking can include many factors including cost, expected pollutant load reductions, implementation complexity, potential outreach opportunities and visibility to public, accessibility, expected operation and maintenance effort, and others.

Prioritized BMP concepts should focus on reducing TP loading to the Mystic River, as summarized by the water quality goals (**Element B**).

Non-Structural BMPs

Planned BMPs can also be non-structural and can include practices such as street sweeping and catch basin cleaning to reduce TP, TSS, and TN loading; as well as Illicit Discharge Detection and Elimination (IDDE) to reduce TP, TSS, and TN loading and *E. Coli* concentrations. Implementation of non-structural BMPs may also results in cost savings. For example, the Alternative TMDL (ERG, 2020) estimated that the most cost-effective combination of BMP implementation would be if 15 percent of the required TP load reduction came from non-structural BMPs and 52 percent of the required TP load reduction came from structural BMPs. It is recommended that these municipal programs be further evaluated and potentially further optimized. First, it is recommended that potential removals from ongoing activities be calculated in accordance with Elements H&I. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology.

Additionally, stakeholders within the Mystic River watershed are currently working with the various communities in the watershed to update local bylaws/ordinances to encourage implementation of optimized BMPs (ERG, et al., 2020).

Element D: Identify Technical and Financial Assistance Needed to Implement Plan

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

Existing and Ongoing Management Measures

The funding needed to implement the existing and ongoing management measures as well as future management measures, which are presented in Element C of this WBP, are included in Table D-1.[2]

Table D-1: Summary of BMP Costs

Existing and Ongoing Management Measures			
BMP	**Total cost**	**Grant-funded portion of total cost**	**Grant**
Arlington, Egerton Road bioretention basins (MyRWA, 2019)	$91,985	$54,834	Section 319
Winchester, stormwater tree trenches (MyRWA, 2018)	$494,135	$194,135	Section 319
Town of Arlington Green Infrastructure Project – 2020	$180,000	$135,000	Coastal Zone Management-Coastal Pollution Remediation (CZM-CPR)
Proposed Future Management Measures			
BMP	**Total cost**	**Proposed grant-funded portion of total cost**	**Grant proposal**
"Distributed small-scale street trenches for Phosphorus load reduction" (MyRWA, 2020a) / Medford, Arlington, Winchester	$868,715	$498,715	Section 319
"Implementation of multiple, cost-effective infiltration trenches in two municipalities to address nutrient impairment impacting anadromous fish" MyRWA (2020b) / East Arlington and Lexington	$235,000	$175,000	CZM-CPR
Future BMP Prioritization Planning			
BMP prioritization (MyRWA, 2020c)	$48,802	$40,450	604B

[2] Funding for future BMP installations to further reduce loads within the watershed may be provided by a variety of sources, such as the Section 319 Nonpoint Source Pollution Grant Program, town capital funds, state grants such as Coastal Pollution Remediation grants, Municipal Vulnerability Preparedness or other grant programs such as hazard mitigation funding. Guidance is available to provide additional information on potential funding sources for nonpoint source pollution reduction efforts at:
http://prj.geosyntec.com/prjMADEPWBP_Files/Guide/Element%20D%20-%20Funds%20and%20Resources%20Guide.pdf

Element E: Public Information and Education

Element E: Information and Education (I/E) component of the watershed plan used to:

1. Enhance public understanding of the project; and
2. Encourage early and continued public participation in selecting, designing, and implementing the NPS management measures that will be implemented.

Step 1: Goals and Objectives

The goals and objectives for the watershed information and education program.

1. Provide information about proposed stormwater improvements and their anticipated water quality benefits.
2. Provide information to promote watershed stewardship.

Step 2: Target Audience

Target audiences that need to be reached to meet the goals and objectives identified above.

1. All watershed residents.
2. Businesses and local government within the watershed.
3. Watershed organizations and other user groups.

Step 3: Outreach Products and Distribution

The outreach product(s) and distribution form(s) that will be used for each.

1. Public presentations (examples include: Arlington Selectman meeting on 6/20/2017, Public Neighborhood meeting on 7/13/2017, Arlington Redevelopment Board Meeting on 6/3/2019, Arlington Conservation Commission Meeting on 6/21/2019, Arlington Town Day on 9/16/2018, and MyRWA committee meeting on 6/5/2018) (MyRWA, 2019))
2. Tours of installed green infrastructure measures (example includes tours conducted of the Egerton Road BMPs (MyRWA, 2019))
3. Announce BMP projects on Town of Arlington and MyRWA websites
4. Presentation of completed BMP projects on community cable access television
5. Social media postings on green infrastructure projects in the Mystic River watershed
6. Implement signage for green infrastructure projects describing the impacts of stormwater and the role of stormwater practices
7. Newsletter articles (printed and web-based)

Step 4: Evaluate Information/Education Program

Information and education efforts and how they will be evaluated.

1. Track the attendance at public presentations and tours
2. Track social media and website visits
3. Amount of printed newsletters distributed

Additional outreach products will be determined when future management measures and activities are planned for implementation in the watershed. This section of the WBP will be updated when the plan is re-evaluated in 2023 in accordance with Element F&G.

Elements F & G: Implementation Schedule and Measurable Milestones

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.

Element G: A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

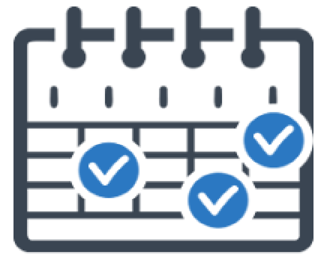


Table FG-1 provides a preliminary schedule for implementation of recommendations provided by this WBP. It is expected that the WBP will be re-evaluated and updated at least once every three (3) years, or as needed, based on ongoing monitoring results and other ongoing efforts.

Table FG-1: Implementation Schedule and Interim Measurable Milestones[3]

Category	Action	Estimated Cost	Year(s)
Monitoring	Perform annual water quality sampling per Element H&I monitoring guidance		Annual
Structural BMPs	Complete stormwater tree trenches in Winchester (Aberjona River subwatershed) and the The Arlington Green Infrastructure Project (AGIP)	$674,135	2020
	Obtain funding and implement 2 proposed street infiltration trench projects	$1,103,715	2020
	Obtain funding and implement additional BMP prioritization study	$48,802	2020
	Obtain funding and implement 2 additional BMP projects		2022
Nonstructural BMPs	Document potential pollutant removals from ongoing non-structural BMP practices (i.e., street sweeping, catch basin cleaning)		2020
	Evaluate ongoing non-structural BMP practices and determine if modifications can be made to optimize pollutant removals (e.g., increase frequency).		2021
	Routinely implement optimized non-structural BMP practices		Annual
Public Education and Outreach *(See Element E)*	Social media postings		periodical
	Public Presentations		periodical
	Newsletter articles		periodical
	Implement signage on green infrastructure projects		periodical
	Tours of implemented BMP projects		Annual
Adaptive Management and Plan Updates	Establish working group comprised of stakeholders and other interested parties to implement recommendations and track progress. Meet at least twice per year.		2020
	Re-evaluate Watershed Based Plan at least once every three (3) years and adjust, as needed, based on ongoing efforts (e.g., based on monitoring results, 319 funding, etc.). – Next update, December 2023		2023
	Use monitoring results to re-evaluate BMP effectiveness at reducing TP and/or other indicator parameters in the Mystic River watershed and establish additional long-term reduction goal(s).		**2023**
	Reach interim land use-based TP loading reduction goal of 1,500 lbs/yr		**2030**

[3] Note that goals and milestones of this WBP are intended to be adaptable and flexible. Goals and milestones are not intended to be tied to Municipal Separate Storm Sewer (MS4) permit requirements. Stakeholders will perform tasks contingent on available resources and funding.

Elements H & I: Progress Evaluation Criteria and Monitoring

Element H: A set of criteria used to determine (1) if loading reductions are being achieved over time and (2) if progress is being made toward attaining water quality goals. Element H asks "**how will you know if you are making progress towards water quality goals?**" The criteria established to track progress can be direct measurements (e.g., E. coli bacteria concentrations) or indirect indicators of load reduction (e.g., number of beach closings related to bacteria).

Element I: A monitoring component to evaluate the effectiveness of implementation efforts over time, as measured against the Element H criteria. Element I asks "**how, when, and where will you conduct monitoring?**"

The water quality target concentration(s) is presented under Element A of this plan. To achieve this target concentration, the annual loading must be reduced to the amount described in Element B. Element C of this plan describes the various management measures that will be implemented to achieve this targeted load reduction. The evaluation criteria and monitoring program described will be used to measure the effectiveness of the proposed management measures (described in Element C) in improving the water quality of the Mystic River watershed.

Indirect Indicators of Load Reduction

Non-Structural BMPs

Potential load reductions from non-structural BMPs (i.e., street sweeping and catch basin cleaning) can be estimated from indirect indicators, such as the number of miles of streets swept or the number of catch basins cleaned. As indicated by **Element C**, it is recommended that potential TP removal from these ongoing actives be estimated. Next, it is recommended that ongoing activities be evaluated to see if potential improvements can be implemented to achieve higher pollutant load reductions such as increased frequency or improved technology.

TP load reductions can be estimated in accordance with Appendix F of the 2016 Massachusetts Small MS4 General Permit as summarized by **Figure HI-1 and HI-2**

$$\text{Credit}_{sweeping} = \text{IA}_{swept} \times \text{PLE}_{IC\text{-}land\ use} \times \text{PRF}_{sweeping} \times \text{AF} \qquad \textbf{(Equation 2-1)}$$

Where:

$\text{Credit}_{sweeping}$	=	Amount of phosphorus load removed by enhanced sweeping program (lb/year)
IA_{swept}	=	Area of impervious surface that is swept under the enhanced sweeping program (acres)
$\text{PLE}_{IC\text{-}land\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
$\text{PRF}_{sweeping}$	=	Phosphorus Reduction Factor for sweeping based on sweeper type and frequency (see Table 2-3).
AF	=	Annual Frequency of sweeping. For example, if sweeping does not occur in Dec/Jan/Feb, the AF would be 9 mo./12 mo. = 0.75. For year-round sweeping, AF=1.0[1]

As an alternative, the permittee may apply a credible sweeping model of the Watershed and perform continuous simulations reflecting build-up and wash-off of phosphorus using long-term local rainfall data.

Table 2-3: Phosphorus reduction efficiency factors ($\text{PRF}_{sweeping}$) for sweeping impervious areas

Frequency[1]	Sweeper Technology	$\text{PRF}_{sweeping}$
2/year (spring and fall)[2]	Mechanical Broom	0.01
2/year (spring and fall)[2]	Vacuum Assisted	0.02
2/year (spring and fall)[2]	High-Efficiency Regenerative Air-Vacuum	0.02
Monthly	Mechanical Broom	0.03
Monthly	Vacuum Assisted	0.04
Monthly	High Efficiency Regenerative Air-Vacuum	0.08
Weekly	Mechanical Broom	0.05
Weekly	Vacuum Assisted	0.08
Weekly	High Efficiency Regenerative Air-Vacuum	0.10

Figure HI-1. Street Sweeping Calculation Methodology

$$\text{Credit}_{CB} = \text{IA}_{CB} \times \text{PLE}_{IC\text{-}land\ use} \times \text{PRF}_{CB} \qquad \textbf{(Equation 2-2)}$$

Where:

Credit_{CB}	=	Amount of phosphorus load removed by catch basin cleaning (lb/year)
IA_{CB}	=	Impervious drainage area to catch basins (acres)
$\text{PLE}_{IC\text{-}and\ use}$	=	Phosphorus Load Export Rate for impervious cover and specified land use (lb/acre/yr) (see Table 2-1)
PRF_{CB}	=	Phosphorus Reduction Factor for catch basin cleaning (see Table 2-4)

Table 2-4: Phosphorus reduction efficiency factor (PRF_{CB}) for semi-annual catch basin cleaning

Frequency	Practice	PRF_{CB}
Semi-annual	Catch Basin Cleaning	0.02

Figure HI-2. Catch Basin Cleaning Calculation Methodology

Project-Specific Indicators

Number of BMPs Installed and Pollutant Reduction Estimates

Anticipated pollutant load reductions from existing, ongoing, and future BMPs will be tracked as BMPs are installed. For example, the Egerton Road bioretention basins results in an estimated average annual TP load reduction of 1 lbs/yr (MyRWA, 2019). These BMPs may also be evaluated through measured changes in water quality documented by the on-going water quality monitoring programs (see below under "Direct Measurements").

TMDL Criteria

The long-term pathogen monitoring plan for the Boston Harbor watershed (including the Mystic River watershed) includes several monitoring components (MassDEP and USEPA, 2018):

1. continue with the current monitoring of the Boston Harbor watershed (MyRWA and other stakeholders),
2. monitor areas within the watershed where data are lacking or absent to determine if the waterbody meets the use criteria,
3. monitor areas where BMPs and other control strategies have been implemented or discharges have been removed to assess the effectiveness of the modification or elimination,
4. assemble data collected by each monitoring entity to formulate a concise report where the basin is assessed as a whole and an evaluation of BMPs can be made, and
5. add/remove/modify BMPs as needed based on monitoring results.

Direct Measurements

There are four main monitoring programs currently being implemented in the Mystic River watershed, which are summarized below. More detailed information on the monitoring programs is found in the Mystic River Watershed TMDL Alternative Development Final Report (ERG, 2020).

Baseline monitoring program

The baseline monitoring program has been in operation since 2000 and is used to monitor a variety of trends in watershed water quality. Collected constituents include pathogen indicators, nutrients, and physical-chemical water quality parameters (e.g., total suspended solids, pH, etc.).

Phosphorus monitoring program

The phosphorus loading monitoring program has been conducted since 2015 and is used to collect information on parameters that contribute to eutrophication impairments (e.g., TP) and response parameters, which could potentially be used as indicators of nutrient over enrichment.

Massachusetts Water Resources Authority (MWRA) water quality monitoring program

The MWRA water quality monitoring in general started in 1989, with the beginning of the CSO monitoring program. The Boston Harbor monitoring in the Harbor proper began in 1993, and in the rivers in 1995. This program was created to establish long-term water quality trends in the Harbor and tributary watersheds for pathogen indicators, nutrients, and physical-chemical water quality parameters.

CSO monitoring program

CSO monitoring is conducted to evaluate water quality risks associated with the discharge of untreated sewages and stormwater runoff into the watershed during CSO events. Monitoring is conducted on an ongoing basis in Alewife Brook, Chelsea River, Little River, and the Mystic River. Note that monitoring is not restricted to CSO discharge events. The CSO monitoring program collects data on pathogen indicators and on physical-chemical water quality parameters.

Data Gaps and Recommendations for Future Sampling Efforts

The following data gaps were identified in the Alternative TMDL (ERG, 2020), which could be addressed through future monitoring efforts:

Ecological/biological indicators of over-enrichment

Currently, little data is available on excess vegetative growth. Measurements are limited to chlorophyll-a and do not include macrophyte abundance, percent cover, or broader measures of species richness. MyRWA and EPA should consider including, at a minimum, percent of macrophyte cover in the water body during monitoring events for baseline and phosphorus loading.

Streamflow

There are few locations in the watershed where it is currently feasible to make direct flow measurements. To develop reliable estimates of nutrient loads through the watershed, measurements or reliable estimates of flows in the watershed will be needed. This task is further complicated by multiple impoundments. Should methods for reliable direct measurement prove infeasible, other approaches for estimating flow based on well-established modeling techniques (e.g., using climatological, land use, and soil type data available in GIS databases) may be explored to estimate precipitation driven flows.

Sediment

Sediment attributes (e.g., TP concentrations, sediment oxygen demand) would be useful for future modeling but was not available for the modeling portion of the project, and it is recommended to include these attributes in future watershed surveillance efforts, if feasible.

Adaptive Management

Long-term goals will be re-evaluated at least **once every three years** and adaptively adjusted based on additional monitoring results and other indirect indicators. If monitoring results and indirect indicators do not show improvement to the nutrient concentrations, as well as other indicators measured within the watershed, the management measures and loading reduction analysis (Elements A through D) will be revisited and modified accordingly.

References

314 CMR 4.00 (2013). "*Division of Water Pollution Control, Massachusetts Surface Water Quality Standards*"

Cohen, A. J.; Randall, A.D. (1998). "*Mean annual runoff, precipitation, and evapotranspiration in the glaciated northeastern United States, 1951-80.*" Prepared for United States Geological Survey, Reston VA.

Eastern Research Group, Inc. (ERG) (2020). "Mystic River Watershed Alternative TMDL Development for Phosphorus Management - Final Report". Prepared for U.S. Environmental Protection Agency. EPA Contract No. EP-C-16-003. January 2020.

Geosyntec Consultants, Inc. (2014). "*Least Cost Mix of BMPs Analysis, Evaluation of Stormwater Standards Contract No. EP-C-08-002, Task Order 2010-12.*" Prepared for Jesse W. Pritts, Task Order Manager, U.S. Environmental Protection Agency.

Geosyntec Consultants, Inc. (2015). "*Appendix B: Pollutant Load Modeling Report, Water Integration for the Squamscott-Exeter (WISE) River Watershed.*"

King, D. and Hagan, P. (2011). "*Costs of Stormwater Management Practices in Maryland Counties.*" University of Maryland Center for Environmental Science Chesapeake Biological Laboratory. October 11, 2011.

Leisenring, M., Clary, J., and Hobson, P. (2014). "*International Stormwater Best Management Practices (BMP) Database Pollutant Category Statistical Summary Report: Solids, Bacteria, Nutrients and Metals.*" Geosyntec Consultants, Inc. and Wright Water Engineers, Inc. December 2014.

MassDEP (2012). "*Massachusetts Year 2012 Integrated List of Waters Final Listing of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*"

MassDEP (2016a). "*Massachusetts Clean Water Toolkit*"

MassDEP (2016b). "*Massachusetts Stormwater Handbook, Vol. 2, Ch. 2, Stormwater Best Management Practices*"

MassDEP, USEPA, and ENSR (2018). "*Final Pathogen TMDL for the Boston Harbor, Weymouth-Weir, and Mystic Watersheds". October, 2018.*

MassGIS (1999). "*Networked Hydro Centerlines*" Shapefile

MassGIS (2001). "*USGS Topographic Quadrangle Images*" Image

MassGIS (2007). "*Drainage Sub-basins*" Shapefile

MassGIS (2009a). "*Impervious Surface*" Image

MassGIS (2009b). "*Land Use (2005)*" Shapefile

MassGIS (2013). "*MassDEP 2012 Integrated List of Waters (305(b)/303(d))*" Shapefile

Mystic River Watershed Association (MyRWA) (2018). “Stormwater Mitigation at Aberjona River in Winchester, MA”. Response, 319 Nonpoint Source Pollution Grant Program.

MyRWA (2015). “*Alewife 604B BMP Development Project, 2013-01/604, October 2013—April 2015, Final Report (Draft – April 2015*)”.

MyRWA (2016b). “*Egerton Road Green Infrastructure Demonstration Project in Arlington MA*”. Response, 319 Nonpoint Source Pollution Grant Program.

MyRWA (2019). “*Project Final Report, Egerton Road Green Infrastructure Demonstration Project*”. Project # 17-07/319. Dates: 4/3/2017—6/30/2019. Prepared for MassDEP and USEPA, Region 1.

MyRWA (2020a). “*Distributed Small-Scale Street Trenches for Phosphorus Load Reduction*”. Response, 319 Nonpoint Source Pollution Grant Program.

MyRWA (2020b). “*Implementation of multiple, cost-efficient infiltration trenches in two municipalities to address nutrient impairment negatively impacting anadromous fish*”. Response, Coastal Pollutant Remediation Grant Program FY 2020.

MyRWA (2020c). Response, 604b – Water Quality Management Planning Grant Program, Federal Fiscal Year 2020.

Eastern Research Group (ERG), Horsley Witten Group, Paradigm Environmental, Nigel Pickering, PG Environmental, Walker Environmental Research (2020). “Mystic River Watershed Alternative TMDL Development for Phosphorus Management – Final Report”. January 2020.

Schueler, T.R., Fraley-McNeal, L, and K. Cappiella (2009). "*Is impervious cover still important? Review of recent research*" Journal of Hydrologic Engineering 14 (4): 309-315.

United States Bureau of Labor Statistics (2016). "*Consumer Price Index*"

United States Geological Survey (2016). "*National Hydrography Dataset, High Resolution Shapefile*"

University of Massachusetts, Amherst (2004). "*Stormwater Technologies Clearinghouse*"

USDA NRCS and MassGIS (2012). "*NRCS SSURGO-Certified Soils*" Shapefile

USEPA (1986). "*Quality Criteria for Water (Gold Book)*" EPA 440/5-86-001. Office of Water, Regulations and Standards. Washington, D.C.

USEPA. (2010). "*EPA's Methodology to Calculate Baseline Estimates of Impervious Area (IA) and Directly Connected Impervious Area (DCIA) for Massachusetts Communities.*"

Voorhees, Mark, USEPA. (2015). "*FW: Description of additional modelling work for Opti-Tool Project*" Message to Chad Yaindl, Geosyntec Consultants. 23 April 2015. E-mail.

Voorhees, Mark, USEPA. (2016a). "*FW: EPA Region 1 SW BMP performance equations*" Message to Chad Yaindl, Geosyntec Consultants. 25 January 2016. E-mail.

Voorhees, Mark, USEPA. (2016b). "*FW: Description of additional modelling work for Opti-Tool Project*" Message to Chad Yaindl, Geosyntec Consultants. 23 April 2015. E-mail.

Appendices

Appendix A – Pollutant Load Export Rates (PLERs)

Land Use & Cover[1]	PLERs (lb/acre/year)		
	(TP)	(TSS)	(TN)
AGRICULTURE, HSG A	0.45	7.14	2.59
AGRICULTURE, HSG B	0.45	29.4	2.59
AGRICULTURE, HSG C	0.45	59.8	2.59
AGRICULTURE, HSG D	0.45	91.0	2.59
AGRICULTURE, IMPERVIOUS	1.52	650	11.3
COMMERCIAL, HSG A	0.03	7.14	0.27
COMMERCIAL, HSG B	0.12	29.4	1.16
COMMERCIAL, HSG C	0.21	59.8	2.41
COMMERCIAL, HSG D	0.37	91.0	3.66
COMMERCIAL, IMPERVIOUS	1.78	377	15.1
FOREST, HSG A	0.12	7.14	0.54
FOREST, HSG B	0.12	29.4	0.54
FOREST, HSG C	0.12	59.8	0.54
FOREST, HSG D	0.12	91.0	0.54
FOREST, HSG IMPERVIOUS	1.52	650	11.3
HIGH DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
HIGH DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
HIGH DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
HIGH DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
HIGH DENSITY RESIDENTIAL, IMPERVIOUS	2.32	439	14.1
HIGHWAY, HSG A	0.03	7.14	0.27
HIGHWAY, HSG B	0.12	29.4	1.16
HIGHWAY, HSG C	0.21	59.8	2.41
HIGHWAY, HSG D	0.37	91.0	3.66
HIGHWAY, IMPERVIOUS	1.34	1,480	10.2

INDUSTRIAL, HSG A	0.03	7.14	0.27
INDUSTRIAL, HSG B	0.12	29.4	1.16
INDUSTRIAL, HSG C	0.21	59.8	2.41
INDUSTRIAL, HSG D	0.37	91.0	3.66
INDUSTRIAL, IMPERVIOUS	1.78	377	15.1
LOW DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
LOW DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
LOW DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
LOW DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
LOW DENSITY RESIDENTIAL, IMPERVIOUS	1.52	439	14.1
MEDIUM DENSITY RESIDENTIAL, HSG A	0.03	7.14	0.27
MEDIUM DENSITY RESIDENTIAL, HSG B	0.12	29.4	1.16
MEDIUM DENSITY RESIDENTIAL, HSG C	0.21	59.8	2.41
MEDIUM DENSITY RESIDENTIAL, HSG D	0.37	91.0	3.66
MEDIUM DENSITY RESIDENTIAL, IMPERVIOUS	1.96	439	14.1
OPEN LAND, HSG A	0.12	7.14	0.27
OPEN LAND, HSG B	0.12	29.4	1.16
OPEN LAND, HSG C	0.12	59.8	2.41
OPEN LAND, HSG D	0.12	91.0	3.66
OPEN LAND, IMPERVIOUS	1.52	650	11.3
[1]HSG = Hydrologic Soil Group			

Appendix B – MassDEP Water Quality Assessment Report and TMDL – excerpts relating to water quality

Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report (MA71-10 - Cummings Brook)

Aquatic Life
MA DFG conducted fish population sampling in Cummings Brook on July 26th and July 27th 2004 at one station on each day (Station 1104 and Staton 1099). Twenty-six fish, representing seven species, were collected at Station 1104). The sample consisted of seventy-seven percent macrohabitat generalist, eight percent fluvial dependent and fifteen percent fluvial specialist species . All of the fish collected are considered moderately tolerant to tolerant of pollution. At Station 1099 seven american eel and two redfin pickerel, both characterized as macrohabitat generalists, were collected. American eel are considered tolerant to pollution while redfin pickerel are moderately tolerant to pollution. Given lack of sufficient data to make an assessment, the Aquatic Life Use is not assessed.

Fish Consumption
This waterbody does not have a site-specific fish consumption advisory. All applicable statewide fish consumption advisories issued by MA DPH due to mercury contamination apply to this waterbody (See Special Note 2).

Primary Contact
Insufficient data were available to assess the Primary Contact Use.

Secondary Contact
Insufficient data were available to assess the Secondary Contact Use.

Aesthetics
Insufficient data were available to assess the Aesthetics Use.

Report Recommendations:
NA

Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report (MA71-11 - Shaker Glen Brook)

Aquatic Life
MA DFG conducted fish population sampling in Shaker Glen Brook on July 26, 2004 (Station 1103). Fifty-three fish, representing six species, were collected. The sample consisted of seventy-five percent macrohabitat generalist species and twenty five percent fluvial dependent species. All of the fish collected are considered moderately tolerant to tolerant of pollution. The Aquatic Life Use is not assessessed due to insufficient information.

Fish Consumption
This waterbody does not have a site-specific fish consumption advisory. All applicable statewide fish consumption advisories issued by MA DPH due to mercury contamination apply to this waterbody (See Special Note 2).

Primary Contact
Insufficient data were available to assess the Primary Contact Use.

Secondary Contact
Insufficient data were available to assess the Secondary Contact Use.

Aesthetics
Insufficient data were available to assess the Aesthetics Use.

Report Recommendations:
NA

Mystic River Watershed and Coastal Drainage Area 2004-2008 Water Quality Assessment Report (MA71-01 - Aberjona River)

Aquatic Life
Multiple sources indicate sediment contamination and negative impacts to aquatic life sufficient to impair the Aquatic Life Use. MA DFG collected fish at two sites(Station 1102 and Station 1101) in July 2004. At Station 1102 they collected thirteen fish respresenting four species, all classified as moderately tolerant to tolerant of pollution. Macrohabitat generalist comprised seventy-seven percent of the sample while fluvial dependent species made up twenty three percent of the sample. At Station 1101 MA DFG collected sixteen fish representing four species, all classified as moderately tolerant to tolerant of pollution. The sample was dominated by macrohabitat generalists (six-nine percent) with the remainder of the sample classified as fluvial dependent. MyRWA observed dissolved oxgygen levels below standards in summer months each year. Total phosphorous concentrations were slightly elevated. Water quality was demonstrated to be of similarly poor quality as past samples, previously associated with an impaired benthic community.

Fish Consumption
This waterbody does not have a site-specific fish consumption advisory. All applicable statewide fish consumption advisories issued by MA DPH due to mercury contamination apply to this waterbody (See Special Note 2).

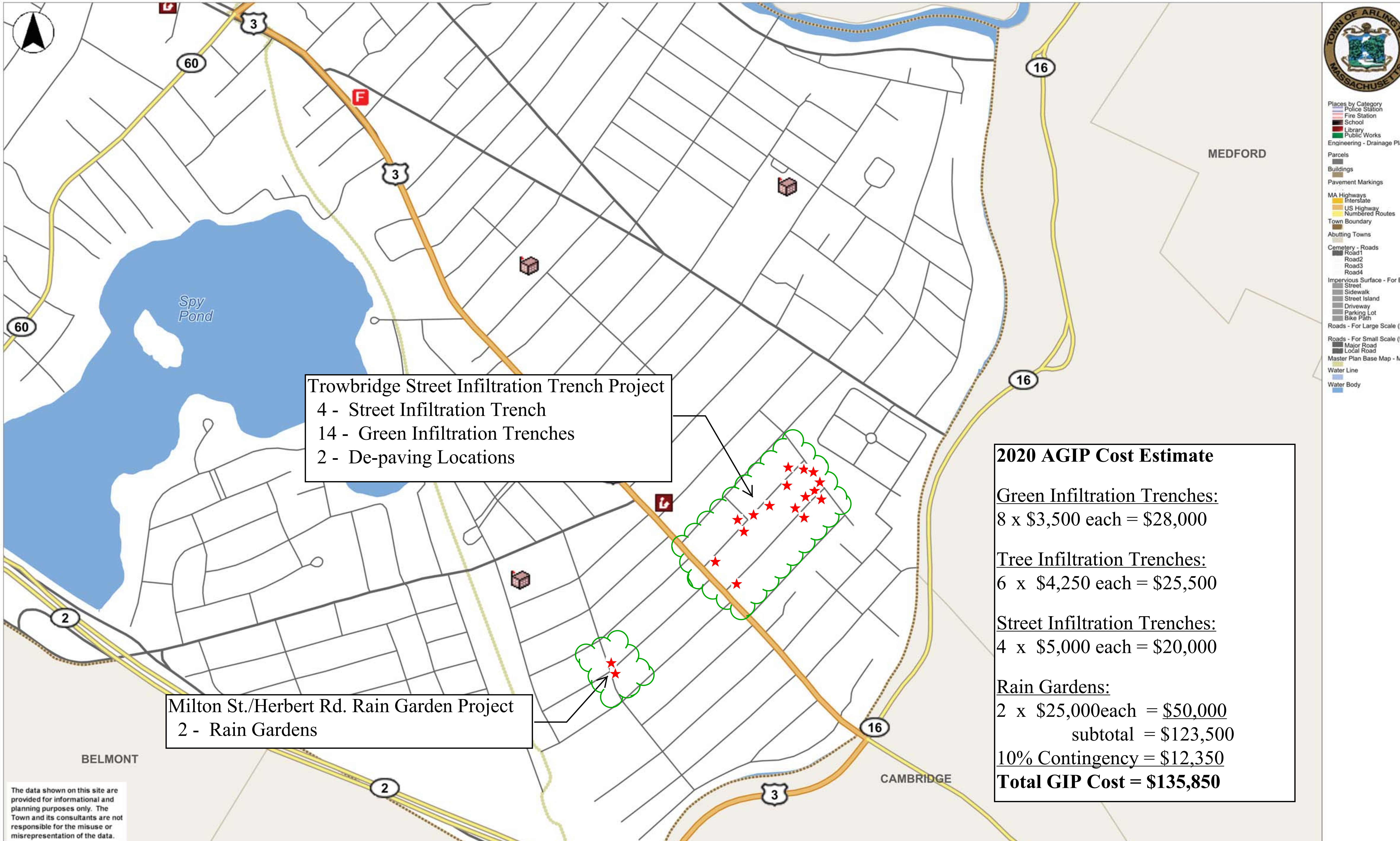
Primary Contact
Yearly Escherichia coli (E. coli) geometric means calculated for the Primary Contact Recreation season from 3 MyRWA baseline monitoring stations sampled monthly from 2002 to 2008 in this segment exceeded 126 cfu/100mL. 21 out of 21 Primary Contact Recreation geomeans exceeded standards, most recently in 2008. The Primary Contact Recreation Use is impaired due to E. coli and the impairment of the Aesthetics Use.

Secondary Contact
Yearly E. coli geometric means from 3 MyRWA baseline monitoring stations sampled monthly from 2002 to 2008 in this segment exceeded 630 cfu/100mL. 5 out of 21 geomeans exceeded standards, most recently in 2007. In addition, roughly 20% of samples in this segment were >1240 cfu/100mL. The Secondary Contact Recreation Use is impaired due E. coli and the impairment of the Aesthetics Use.

Aesthetics
The Aesthetics Use is impaired due to moderate turbidity consistently noted by DWM biologists in Judkins Pond and Mill Pond sections of the Aberjona River during surveys conducted in 2004.

Report Recommendations:
NA

Appendix C – Arlington Green Infrastructure Project (AGIP) BMP location Map



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Town of Arlington Green Infrastructure Project - 2020