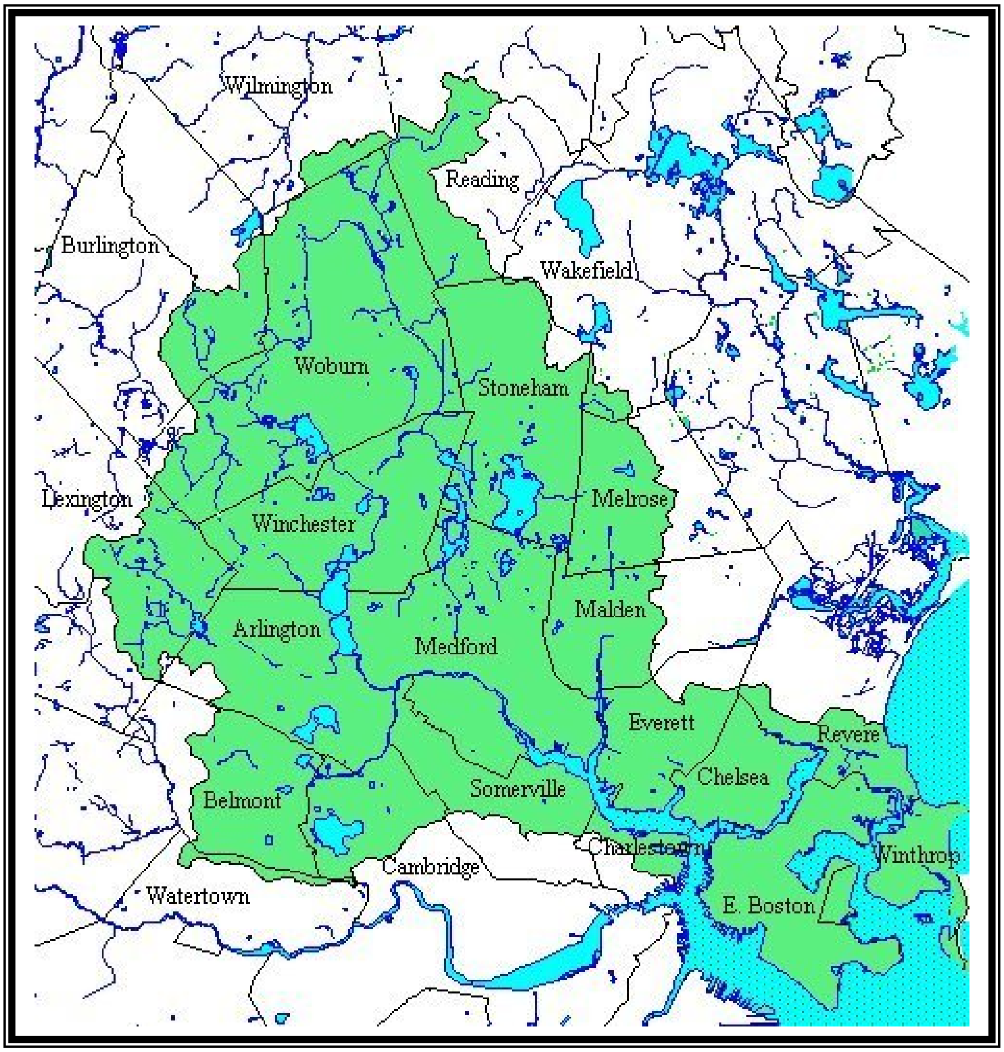
Mystic River Watershed
Watershed Assessment and Action Plan: 2004-2008



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Chapter 1: Introduction

Chapter Contents

1.1 Purpose and Overview

This document has a two-fold purpose: (1) to assess the current condition of the Mystic River watershed; and (2) to present an action plan for addressing continuing problems in the watershed. This report draws on the work of many people and groups, including the work of the Massachusetts Watershed Initiative's Mystic Basin Team. Its goal is to provide a shared vision of what needs to be done to protect and restore the resources of the watershed, and to lay out a plan for getting the required work done.

- Chapter 2 provides an **overview of the watershed** – its resources, history, and communities. This information provides a context for understanding the assessment and action plan presented here.

- Chapters 3 through 6 of this document present the results of the **Assessment**, organized by topic (Chapter 3 on Water Quantity and Flooding, Chapter 4 on Water Quality, Chapter 5 on Land Use and Open Space, Chapter 6 on Recreation, and Chapter 7 on Habitat.)

- Chapters 8 present the proposed **Action Plan**. Chapter 8 includes a summary of the Massachusetts Watershed Initiative Basin Team's previous work, and presents a proposed set of action items for the watershed.

- Chapter 9 discusses a process for **reviewing and implementing** the action plan.

The remainder of this chapter describes the Massachusetts Watershed Initiative program that sponsored this report.

1.2 The Massachusetts Watershed Initiative

The Massachusetts Watershed Initiative was formed in 1993 by community partners and the Executive Office of Environmental Affairs, with the following mission:

> The Massachusetts Watershed Initiative "preserves, protects, and restores the water resources and ecosystems of the Commonwealth using watersheds as the geographic unit within which diverse interests collaborate, establish priority activities, influence decisions, and achieve measureable results."

The program involved a five-year management process, which included Annual Work Plans culminating in development and implementation of a Five-Year Watershed Action

Plan.[1] The Watershed Initiative served to promote coordination and cooperation among various watershed interests, to assess conditions in the watersheds, to identify priority projects for addressing problems, and in some cases to provide funding for priority projects. Basin Teams included representatives of Federal, state and local government agencies, non-governmental environmental organizations, businesses and other stakeholders, and met on a regular basis. In addition to sharing information on on-going projects, the Teams identified and set priorities for projects to receive state funding in their Annual Workplans. More information on the MWI is provided in Appendix A.

Initially, the Mystic River watershed was included in the larger Boston Harbor watershed, along with the Neponset River watershed, the Weymouth-Weir watershed and Boston Harbor proper.[2] A sub-team for the Mystic River Watershed later was established later, and a separate EOEA Team Leader (Kwabena Kyei-Aboagye) was assigned to the Mystic River watershed. This change increased the team's ability to focus on the specific problems of this large and diverse watershed. The Watershed Initiative was discontinued in late 2002. Since then there has been no equivalent formal forum for coordinating activities and priorities across the watershed. As described in Chapter 8, the Mystic River Watershed Association (MyRWA), EOEA's Riverways Program, and City of Somerville staff have begun convening the team on an informal basis, under the name "Mystic Partners."

This Mystic River Watershed Assessment and Action Plan is an outgrowth of the Watershed Initiative. The demise of the Watershed Initiative resulted in the loss of the institutional structure that was intended to support preparation of this report. In addition, the schedule was compressed to combine the assessment and the action plan steps. As a result, this document has not had the extensive review and stakeholder input that was originally intended to inform development of the Watershed Action Plans. Much of this document draws on the Basin Team's work on assessing the watershed and on its Annual Work Plans and the projects therein, and therefore benefits from input from a large number of stakeholders. The report itself, including the recommended actions and priorities, has not been reviewed by the Basin Team, however. This report should therefore be viewed as a work in progress, rather than a final consensus-based plan. Chapter 9 recommends a process for sharing this document with various groups in the watershed, for compiling comments, and for convening discussion sessions. The goal of this effort is to improve the range of stakeholder involvement in developing a final plan that has strong commitment from the key actors in the watershed. In particular, it will be important to ensure that the players who will have to implement various portions of the plan are committed to undertaking specific tasks.

[1] The five-year basin cycle included a different focus each year: Outreach (Year 1), Research & Monitoring (Year 2); Assessment (Year 3); Watershed Action Plan Development (Year 4); and Implementation & Evaluation (Year 5). The state's watersheds were on staggered schedules, and once a watershed had completed one cycle it would start again with Year 1 of the process.

[2] The schedule for the Boston Harbor Watershed included Year 3 Assessment in 2000, Year 4 Preparation of an Action Plan in 2001, and Year 5 Implementation & Evaluation in Year 2002.

Chapter 2: Background

Chapter Contents

2.1 Overview of the Watershed

Watershed and Subwatershed Boundaries

The Mystic River watershed is a collection of rivers, streams, lakes and ponds that drains an area of approximately 76 square miles in the Boston metropolitan area. (See Figure 2-1.) The watershed is a subwatershed of the Boston Harbor, and the Mystic River watershed in turn includes a number of distinct subwatersheds.

The system was formed in large part by retreating glaciers more than 10,000 years ago, and is relatively flat. Originally, the system was tidal all the way up to the Lower Mystic Lake. Construction of the Craddock Dam in 1908 near Medford Square prevented the flow of salt water to Alewife Brook and the portion of the Mystic River upstream of the dam. The Amelia Earhart Dam was constructed in 1966 between Everett and Somerville, just below the confluence of the Malden and Mystic Rivers. This dam created a freshwater basin that enhanced public recreation opportunities, and again separated the watershed into a freshwater system above the dam and a saltwater system below the dam, emptying into the harbor.

As land uses in the watershed have developed, substantial portions of the waterbodies have been filled in, straightened, and sometimes culverted. In some locations, the rivers and streams are no longer visible, and alteration of the river courses has profoundly affected their characteristics.

Current land uses and open space resources in the watershed are discussed in Chapter 5. Recreation resources are discussed in Chapter 6, and wildlife habitat is discussed in Chapter 7. The next section of this chapter describes the nine subwatersheds that comprise the larger Mystic River watershed. The following section discusses the history of the watershed, as context for understanding the source of past contamination of the waters. The final section of this chapter describes the communities that are included in the watershed.

2.2 Description of Subwatersheds

For purposes of this report, we have defined eight subwatersheds within the larger Mystic River watershed, as described below.

Aberjona subbasin: The Aberjona is the largest subbasin in the Mystic watershed, comprising ~25% of the total watershed area. The nine-mile-long Aberjona River originates in Reading and flows south through Woburn and Winchester before discharging into the upper forebay of Upper Mystic Lakes (see Figure 2-2).[1] Along its course, the Aberjona receives inflows from Halls Brook, North Woburn Creek, Snyder Creek, Sweetwater Brook, and Horn Pond Brook (which drains the

[1] The subbasin maps in this chapter include locations of hazardous waste sites and water sampling sites, which are referred to in Chapter 5.

Horn Pond subbasin). The Aberjona is relatively slow moving and meandering in spots, particularly in north Woburn and Winchester Center, where there are many wetland areas and shallow ponds.

Horn Pond Subbasin: The two largest surface waterbodies in the watershed are Horn Pond in Woburn and Wedge Pond in Winchester (see Figure 2-3). Woburn draws ~60% of its municipal water from wells located on the west side of Horn Pond; therefore, land-uses in the subbasin (particularly right around the pond) are carefully controlled. Wedge Pond, located near Winchester center, is used for recreational activities (swimming and boating) and is impacted by stormwater runoff.

Mystic Lakes Subbasin: Upper and Lower Mystic Lakes were created in c.1873, when a dam was built at what is now the outlet of the upper lake. The upper lake is ~25 m at its deepest point and contains two shallow forebays at its northern end where the Aberjona River discharges. The lower lake is also about 25 m at its deepest point. Until 1908, when the Craddock Dam was built in Medford Center, the lower lake was tidal. A layer of saltwater is still present at the bottom of the lower lake, which may be impacting water quality in upper water layers. Both lakes are widely used for recreation, including fishing, boating and swimming. The Medford Boat Club owns a motorboat dock on the lower lake, and on the upper lake there are two more boat clubs, a public boat ramp and two swimming beaches (one public, one private). A map of the lakes and the surrounding watershed area is shown in Figure 2-4.

Mill Brook Subbasin: Mill Brook is fed by Sickle Brook, Munroe Brook (via the Arlington Reservoir) and Great Meadows. (See Figure 2-5) Sickle Brook and Munroe Brook drain farmlands in the southern part of Lexington. As it moves through Arlington Heights, Mill Brook is fed by steeply sloping uplands before reaching more gentle terrain near Arlington Center. Just before discharging into Lower Mystic Lake, the brook passes through a constructed wetland area adjacent to the Arlington Cemetery. For a ~1 km stretch upstream of the constructed wetland (between Grove Street and Mystic Avenue), the brook is culverted underneath several playing fields. Previously, this stretch of the brook sustained a series of seven mill-ponds. The brook is not widely used for recreational purposes, as it is difficult to gain access to it along much of its length.

Mystic River 1 Subbasin: The Mystic River 1 subbasin contains the portion of the Mystic River (and its contributing watershed area) that lies between Lower Mystic Lake and the Amelia Earhart Dam (see Figure 2-6). This section of the Mystic receives significant inflow from Lower Mystic Lake, Alewife Brook, and the Malden River, as well as minor inflows from Two Penny Brook and Town Meeting Brook in Medford.

As noted earlier, the Mystic River was tidal up to Lower Mystic Lake until c.1908, with the construction of the Craddock Dam in Medford Square. After the construction of the Amelia Earhart Dam in 1966, the Craddock Dam was taken offline; however, a portion of the dam remains in place and acts as a constriction during high flows. Flow out of this section of the Mystic is controlled by releases at the Amelia Earhart Dam. The dam is equipped with several large, diesel-powered pumps, which serve to prevent flooding by pumping water into the saltwater section of the Mystic (Mystic River 2) before and during significant precipitation events.

This part of the Mystic River – especially downstream of Medford Square – is widely used by recreational boaters. This reach contains two yacht clubs and a rowing club as well as the Blessing of the Bay Boathouse, where the Boys & Girls Club runs youth programs.

Alewife Brook Subbasin: Alewife Brook drains parts of Arlington, Belmont, Cambridge, and Somerville (see Figure 2-7). The main tributary to the Alewife, Little River, is fed by Little Pond in Belmont and Spy Pond in Arlington. Another important tributary is Wellington Brook, which is fed by Clay Pit Pond in Belmont. The topography of the subbasin is mixed: the uplands in Belmont and western Arlington are fairly steep, while parts of Cambridge and East Arlington are relatively flat, making these areas particularly susceptible to flooding.

Many changes in the surface hydrology and hydraulics have been made in this subbasin, some of them to address flooding and public health risks. For example, in the late 1800's sewage pipes were constructed in Cambridge and Somerville to carry wastes directly into the Alewife. When a wastewater treatment plant was built in Boston in the 1930s, many of the old discharge pipes were converted into combined sewage overflows (CSOs). Because the sewage system was designed to carry both sanitary sewage and stormwater, CSOs were needed to prevent excess stormwater from backing-up into homes during heavy rainstorms. Although many of the CSOs have since been removed or redesigned to surcharge less frequently, eight CSOs are still present – seven in Cambridge and one in Somerville.

A second significant change to this subbasin occurred when Craddock Dam was built in Medford Square in 1908. Designed to alleviate flooding in the Alewife area and combat periodic outbreaks of malaria (Freeman, 1904), the dam, and its replacement, the Amelia Earhart Dam, greatly reduced the rate of water movement in the brook. The combined effect of the CSO discharges and sluggish flows make the Alewife one of the most polluted waterbodies in the Mystic watershed.

Spy Pond is a "Great Pond" of the Commonwealth, and covers over 102 acres. The state filled in some 20 acres of the pond in the 1970s as part of the project to widen Route 2.

Malden River Subbasin: The Malden River originates in Melrose and flows south through Malden, Everett and Medford before discharging into the Mystic River (Figure 2-8). Spot Pond Brook, which receives discharges from Spot Pond in Stoneham, is a tributary to the Malden. Since the 1950s, the Malden has been altered along much of its length. North of Malden Square, the river was deepened and widened to increase discharge capacity and minimize local flooding. This alteration left the channel bank very steep along this reach, and so a chain-link fence was constructed on both sides of the river to discourage access. At Malden Square, the river was piped underground to prevent flooding of the city center. Between Malden Square and the confluence with the Mystic, the river was straightened and dredged to allow barge traffic (Nangle Consulting Associates, 1999). The banks of the Malden are heavily developed, particularly below Medford Square, where much of the land is zoned for industrial activity. Flow in the lower portion of the river (below Malden Square) is controlled by the Amelia Earhart Dam.

Mystic River 2 Subbasin: The Mystic River 2 subbasin extends from the Amelia Earhart Dam to the confluence with the Charles River in Boston Harbor. This reach of the river is tidal and is composed of saltwater except for inputs of freshwater from the Mystic River upstream of the dam, from Island End River, and from Chelsea Creek (see Figure 2-9). Land-use and water-use in the subbasin are markedly different from upstream of the dam. About 44% of the land in the subbasin is used for industry and transportation (vs. ~10% upstream of the dam), and of the remainder only ~16% is open space (vs. ~32% upstream of the dam).

Many industries occupy riverfront properties, including a major coal/oil-fired power station (Sithe Mystic), a gypsum-processing plant, a natural gas facility, and a shipping terminal. Large, ocean-going cargo ships, which deliver oil, coal, liquefied natural gas, gypsum, automobiles and other materials, are major users of the river. Recreational boaters also use the river as a means of getting from yacht clubs to Boston Harbor. Much of the waterfront in the subbasin is a Designated Port Area, which limits land uses to waterfront-dependent activities.

Despite its industrial character, the river supports many species of fish as well as marine mammals. For example, large populations of herring and alewives run upriver each spring to spawn, and they are fed upon by striped bass and harbor porpoises, the latter of which have been sighted many times in recent years (Jim Rice, New England Aquarium, personal communication, 2002).

Chelsea Creek Subbasin: Mill Creek, the headwaters to Chelsea Creek, rises out of a wetland area along the Revere/Chelsea border, runs due east and then turns 90 degrees to the south where it becomes Chelsea Creek. The Chelsea/Mill Creek system drains parts of Everett, Revere, Chelsea, and East Boston before discharging to the Mystic River just upstream of the confluence of the Mystic River and the Charles River (Figure 2-10). The Chelsea Creek subbasin is one of the most urbanized in the Mystic watershed. Only 9.5% of the subbasin is preserved as open space, compared to 27% for the watershed as a whole.

Much of the land along Chelsea Creek is zoned for industrial use and transportation, which greatly limits local access to the river. For example, there are several fuel tank-farms in Chelsea and East Boston that are served by barges and large, ocean-going tanker vessels. Like the lower Mystic, the Chelsea Creek waterfront is a Designated Port Area.

2.3 History of the Watershed

The Mystic River watershed has been settled for hundreds of years. The name “Mystic” is derived from the Indian “Missi-Tuk” or “great tidal river”, reflecting the Mystic River’s original status as a tidal river. For hundreds of years, Native Americans lived and fished along the Mystic. The area was settled by Europeans in the 1600s, and one of the Mystic area’s first European settlers was Massachusetts Bay Colony Governor John Winthrop. He built his summer retreat, the Ten Hills Farm, on the banks of the Mystic in what is now Somerville.

Human activities along the banks of the Mystic and its tributaries have had profound impacts on the watershed’s hydrology and water quality for many years. Native Americans and later Colonists used weirs to catch alewives and fertilize their crops. During the 1800s, factories replaced many farms, and the region attracted many new residents. By 1865, overfishing and pollution had all but eliminated commercial fishing.

Shipbuilding on the Mystic dates from earliest Colonial times and peaked in the 1840s. Schooners and sloops transported timber, molasses for rum distilleries, and other products, on the trade route between Medford and the West Indies. In 1631, the first ship built by Europeans in Massachusetts, the "Blessing of the Bay," was launched from the shores of the Mystic River. During the 19th century, 10 shipyards along the Mystic River built more than 500 clipper ships. Later, railroads and then a system of roadways replaced the river as a transportation route.

The waters of the Mystic were harnessed to power tide mills from early Colonial days until the end of the 19th century. Tide mills were built throughout the length of the Mystic on both sides of the shore. Their waterpower was used to grind grain and spices, saw wood, and process paints, cloth and other products. Mills, brickyards and tanneries along the river brought wealth, but also caused significant pollution of the waterways. Today, a mix of houses, businesses, parks and abandoned factories border the River.

The history of the Aberjona subwatershed illustrates the effect of industrialization on local water quality. The subwatershed was settled by Europeans in the mid-1600s. For over 300 years, leather tanning and finishing was a prominent industry, especially in Woburn. Between 1838 and 1988, tanning and finishing took place at 54 sites in Woburn (Durant et. al., 1990). Other industries in the subwatershed included chemical manufacturing, rendering, and tool and machine-making. Contamination of local waterbodies, including Horn Pond and Russell Brook, began being reported in the 1870s. Use of Upper Mystic Lake as a water supply for communities in the lower Mystic was discontinued in 1898, due to the contamination. (Durant and Abbasi, 2000). Chemical manufacturing was a significant source of water quality problems. Over time, seven different companies operated at the IndustriPlex site in Woburn, manufacturing sulfuric acid, lead arsenate pesticides, glue, and other products. This facility and others contributed substantial loadings of lead, arsenic and chromium to the local waters, and the sediments in the Aberjona are still contaminated by these toxic metals. IndustriPlex eventually became a major Superfund site, as did the Wells G & H site, also located in Woburn, which gained notoriety in the book "A Civil Action."

The history of the Alewife Brook subbasin illustrates earlier residents' view that alterations of the natural state of the waterways represented desirable progress. During the late 1800s and early 1900s, mosquitoes living in the wetlands and stagnant ponds contributed to numerous cases of malaria. Actions taken to address the malaria problems included filling in ponds, straightening and deepening Alewife Brook to improve flow, and construction of the Craddock Dam, to eliminate saltwater instrusion. Eliminating the tidal action also made former wetlands available for road and residential development. (Durant and Abbasi, 2000). As noted earlier, these actions had a major effect on the area's hydrology and water quality. The subbasin's waters were also contaminated by sewage and tannery wastes, and the Alewife was the site of clay-brick manufacturing.

While many of the historical changes in the watershed have had adverse impacts on its natural resources, there are now opportunities to reverse some of this damage. Direct discharges of pollution have been reduced dramatically by federal and state regulation, and non-point sources of pollution are now getting increased attention from state and local governments and residents. The decline of industry in some parts of the watershed presents an opportunity to reclaim land lost to industrial sites and restore open space and wildlife habitat. As abandoned and underused sites are redeveloped for commercial and residential uses, there is an opportunity to adopt Best Management and Low Impact Development practices, to reduce water use, stormwater pollution, and flooding, to reclaim open space, and to improve wastewater management.

2.4 Profile of Watershed Communities

Demographics

The Mystic is the most densely populated and urbanized watershed in Massachusetts, and includes numerous environmental justice communities. Table 2.1 shows population density for the communities in the watershed, ranging from Somerville (18,000 people per square mile of land area) to Wilmington (1,200 people per square mile.) All communities in the watershed are more densely populated than the statewide average (800 people per square mile.) Note that separate data are not available for Charlestown and East Boston, with are neighborhoods of Boston. Both are among the more densely populated areas in the watershed, however.

Table 2-1 Population and Population Density

	Land Area (sq. miles)	Population 2000	Population Density (persons per sq. mile land area, 2000)
Massachusetts Total	7,840.02	6,349,097	809.8
Arlington	5.18	42,389	8,179.6
Belmont	4.66	24,194	5,190.2
Burlington	11.81	22,876	1,936.4
Cambridge	6.43	101,355	15,766.1
Chelsea	2.19	35,080	16,036.8
Everett	3.38	38,037	11,241.1
Lexington	16.40	30,355	1,851.0
Malden	5.07	56,340	11,102.9
Medford	8.14	55,765	6,851.3
Melrose	4.69	27,134	5,779.8
Reading	9.93	23,708	2,388.3
Revere	5.91	47,283	7,994.2
Somerville	4.11	77,478	18,868.1
Stoneham	6.15	22,219	3,614.1
Wakefield	7.47	24,804	3,321.6
Watertown	4.11	32,986	8,025.7
Wilmington	17.13	21,363	1,247.0
Winchester	6.04	20,810	3,346.3
Winthrop	1.99	18,303	9,208.3
Woburn	12.67	37,258	2,939.6

Table 2.2 provides information on the income and racial/ethnic characteristics of the watershed's communities, and Table 2.3 shows information on immigrant status and English language capabilities. Table 2.2 shows a substantial range in median annual household incomes among the

watershed's communities, from over $96,000 in Lexington to $30,000 in Chelsea. Six communities (including Boston as a whole) had more than 10 percent of their residents living below poverty level in 1999, and Chelsea had more than 20 percent living in poverty. Watershed communities with substantial Black or African-American, Asian, or Hispanic/Latino populations include Chelsea, Boston as a whole, Cambridge, Everett, Malden and Somerville.

Table 2.3 shows that there are substantial immigrant communities in the same communities, as well as in Revere and Watertown. More than 20 percent of the populations in Boston, Everett, Malden, Revere, Somerville, and Woburn, and more than half the population in Chelsea, speak English "less than well".

Watershed communities that are characterized by low income, a high proportion of immigrant residents, and/or a high proportion of minority residents often suffer from disproportionate exposure to pollution and lack of access to environmental amenities. A study of environmental justice problems in Massachusetts identified 15 communities that are "most intensively overburdened" by cumulative environmental hazards.[2] Of the 15, eight are located in the Mystic River watershed. While this study addressed air pollution and hazardous waste sites, it is likely that a similar study of water-related problems and access to open space and recreational amenities would show the same disproportionate impacts on environmental justice communities. Figure 2-11 shows the communities in the watershed that have been designated as EJ communities under the state's Environmental Justice policy.

[2] "Unequal Exposure to Ecological Hazards: Environmental Injustices in the Commonwealth of Massachusetts", by Daniel R. Faber and Eric J. Krieg, Northeastern University, Jan. 9, 2001.

Table 2.2: Community Socio-Economic, Racial and Ethnic Characteristics

Community	Median Household Income ($, 1999)	Per Capita Income ($, 1999)	Percent Unemployed*	Percent of Individuals Below Poverty Level 1999	Percent of Population			
					White**	Black or African-American**	Asian**	Hispanic/ Latino***
Massachusetts Total	50,502	25,952	4.6	9.3	84.5	5.4	3.8	6.8
Arlington	64,344	34,399	2.2	4.1	91.0	1.7	5.0	1.9
Belmont	80,295	42,485	2.3	4.4	91.2	1.1	5.8	1.8
Boston@	39,629	23,353	7.2	19.5	54.5	25.3	7.5	14.4
Burlington	75,240	30,732	2.7	1.9	86.7	1.4	10.6	1.3
Cambridge	47,979	31,156	6.1	12.9	68.1	11.9	11.9	7.4
Chelsea	30,161	14,628	7.3	23.3	57.9	7.3	4.7	48.4
Everett	40,661	19,845	5.0	11.8	79.7	6.3	3.2	9.5
Lexington	96,825	46,119	2.5	3.4	86.1	1.1	10.9	1.4
Malden	46,315	22,004	4.0	9.2	72.1	8.2	14.0	4.8
Medford	52,476	24,707	3.6	6.4	86.5	6.1	3.9	2.6
Melrose	62,811	30,347	2.0	3.3	95.2	0.9	2.0	1.0
Reading	77,059	32,888	1.9	2.6	96.5	0.4	2.2	0.8
Revere	37,067	19,698	5.9	14.6	84.4	2.9	4.5	9.4
Somerville	46,315	23,628	3.5	12.5	77.0	6.5	6.4	8.8
Stoneham	56,605	27,599	21	4.1	95.0	0.9	2.5	1.8
Wakefield	66,117	30,369	3.1	3.1	96.9	0.4	1.4	0.8
Watertown	59,764	33,262	2.4	6.3	91.4	1.7	3.9	2.7
Wilmington	70,652	25,835	1.5	1.9	96.3	0.4	2.0	1.0
Winchester	94,049	50,414	2.4	2.6	93.1	0.7	4.6	1.0
Winthrop	53,122	27,374	4.1	5.5	94.4	1.7	1.1	2.7
Woburn	54,897	26,207	3.0	6.1	90.6	1.9	4.8	3.1

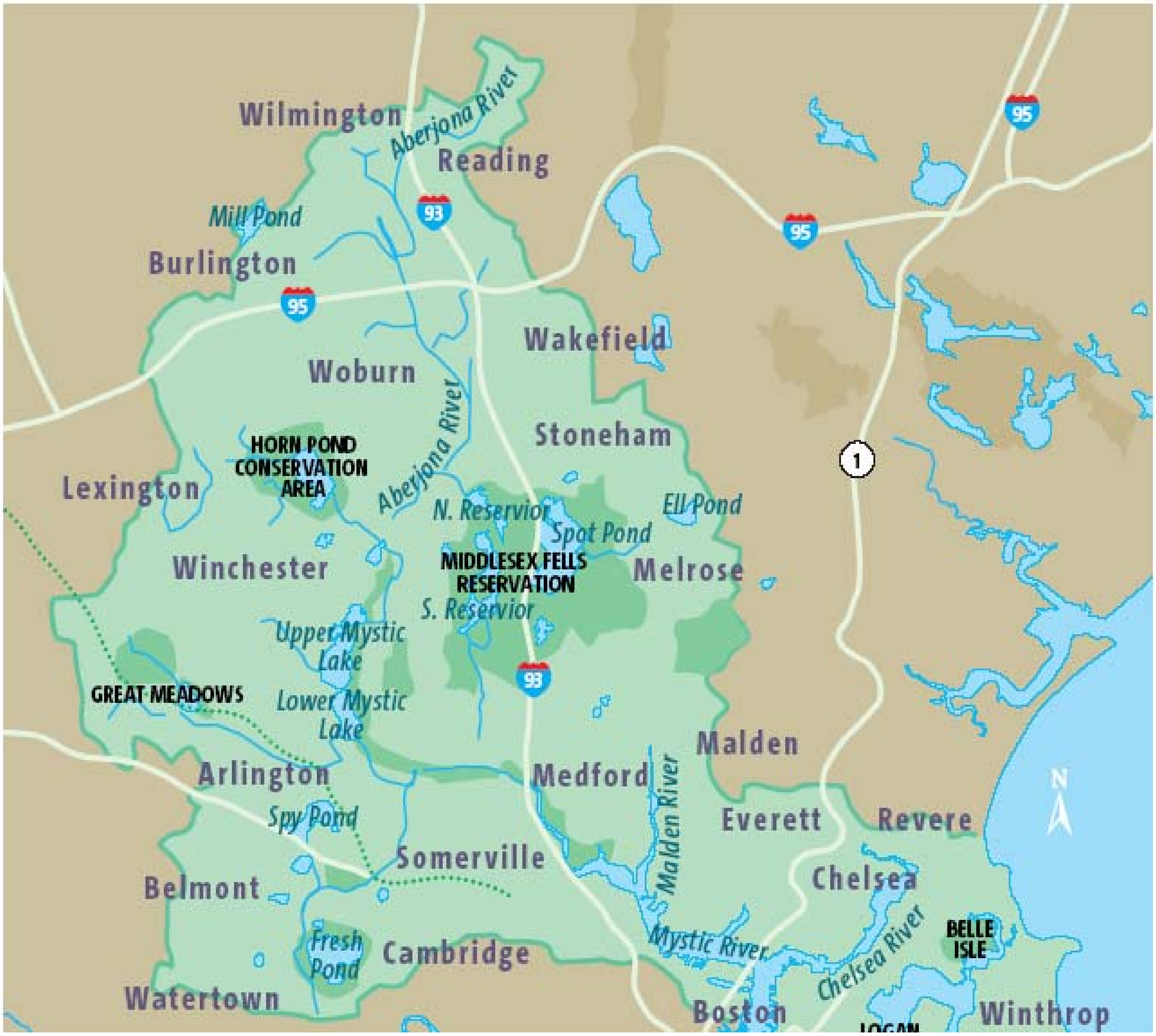
@ Includes entire city; only East Boston and Charlestown are in the watershed.
*Percent of civilian labor force 16 years old and over.
** Excludes persons who report two or more races. Communities with more than 2 percent reporting two or more races include Boston (4.4%), Cambridge (4.6%), Chelsea (6.6%), Everett (5.4%), Malden (3.5%), Medford (2.3%), Revere (3.8%), and Somerville (4.8%).
***Of any race.
Source: U.S. Census Bureau, 2000 Census of Population

Table 2.3 Immigrant Status and English Language Ability

Community	% Foreign-Born*	% Recent Immigrant (1990-March 2000)*	% Speaking English "Less Than Very Well"
Massachusetts Total	12	5	13
Arlington	12	6	8
Belmont	14	6	9
Boston@	26	13	27
Burlington	15	7	9
Cambridge	26	15	16
Chelsea	36	21	54
Everett	22	11	27
Lexington	16	6	7
Malden	26	13	24
Medford	16	6	16
Melrose	6	2	5
Reading	4	1	3
Revere	21	10	24
Somerville	29	14	30
Stoneham	8	2	8
Wakefield	5	1	3
Watertown	20	8	16
Wilmington	5	1	3
Winchester	11	3	5
Winthrop	9	4	7
Woburn	10	4	21

*% of population 5 years of age and older.
@ Includes all of Boston, not just East Boston and Charlestown.
Source: U.S. Census, 2000 Census of Population

Figure 2-1: Overview of the Mystic River Watershed



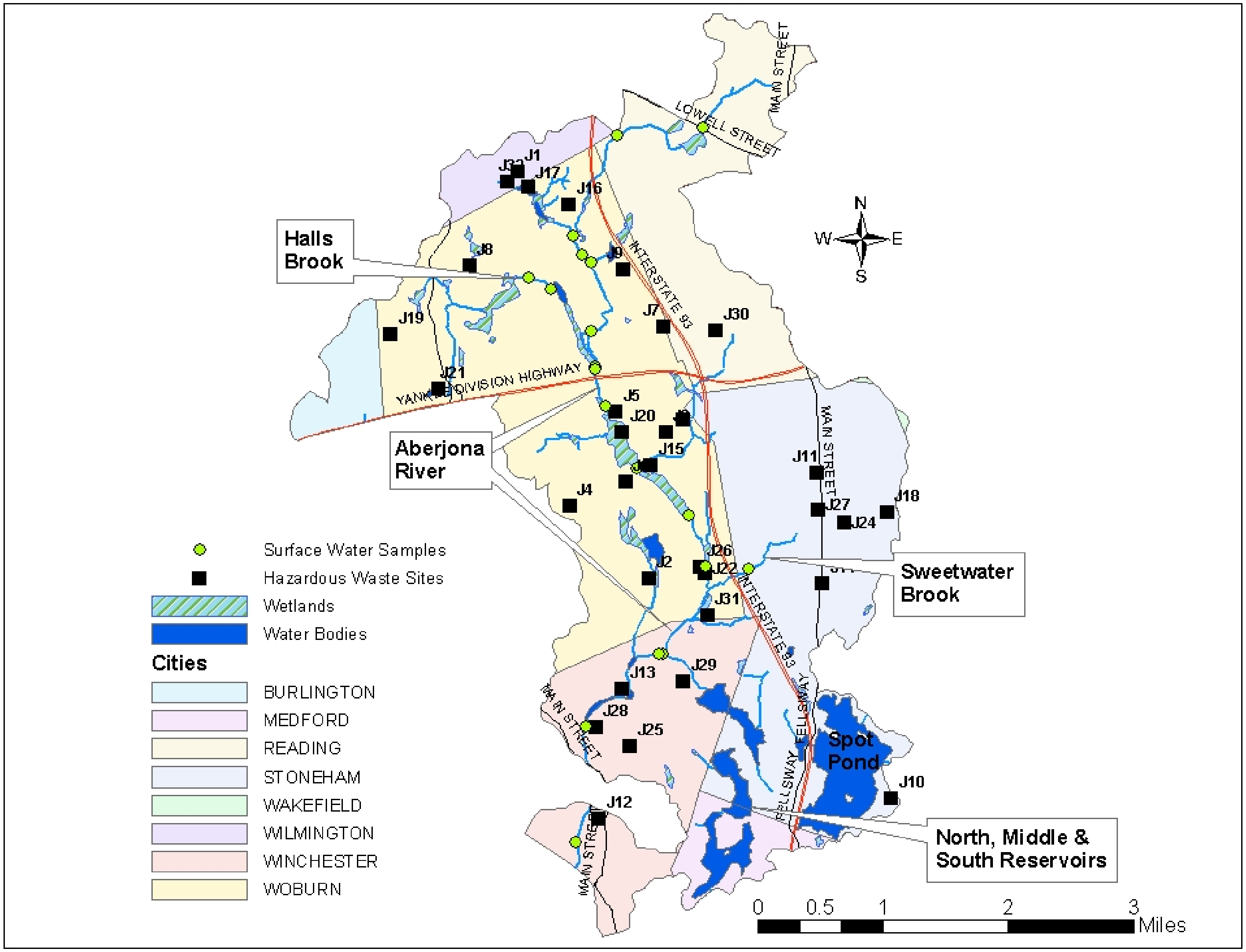


Figure 2-2: Aberjona Subwatershed

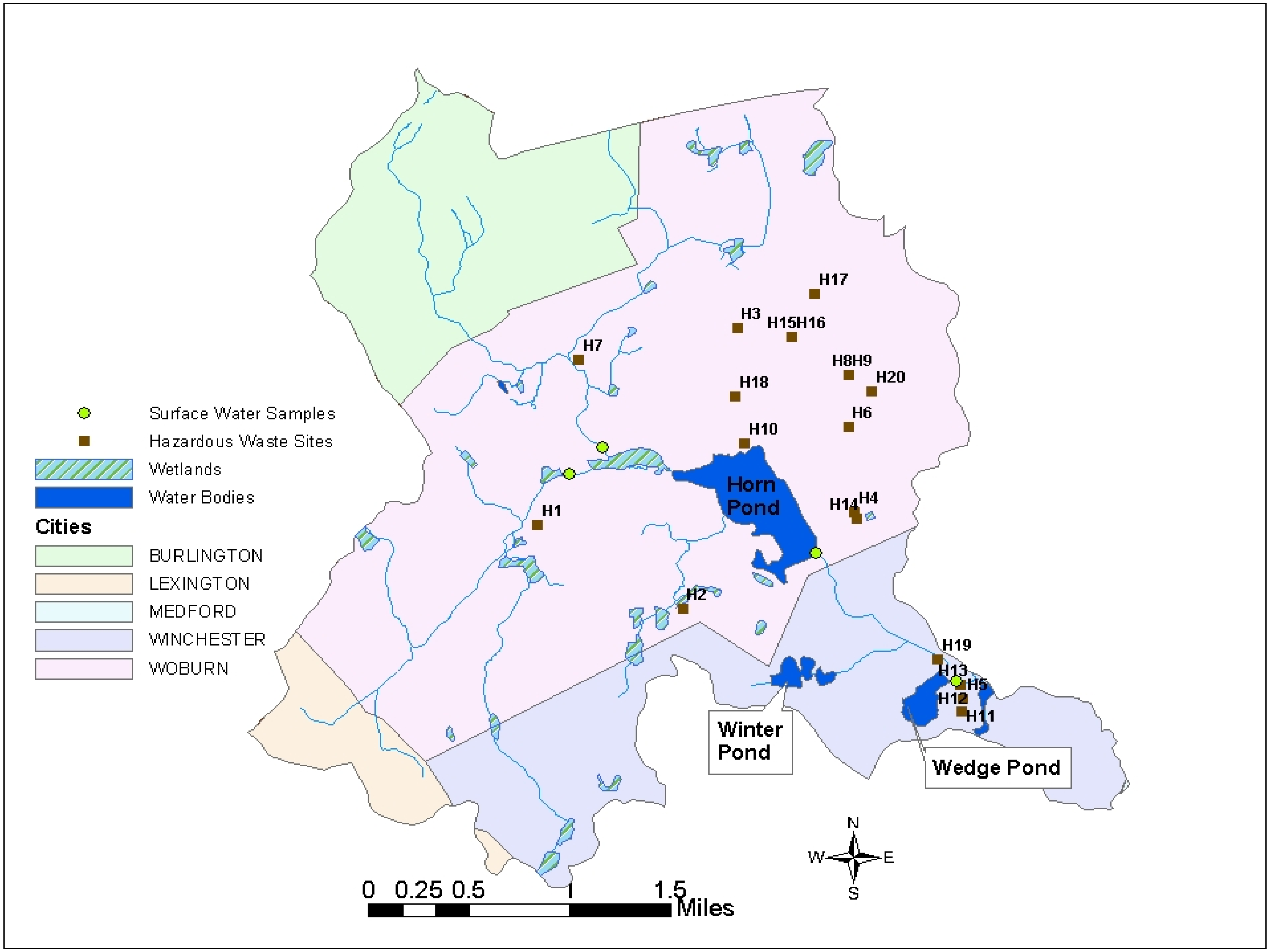


Figure 2-3: Horn Pond Subwatershed

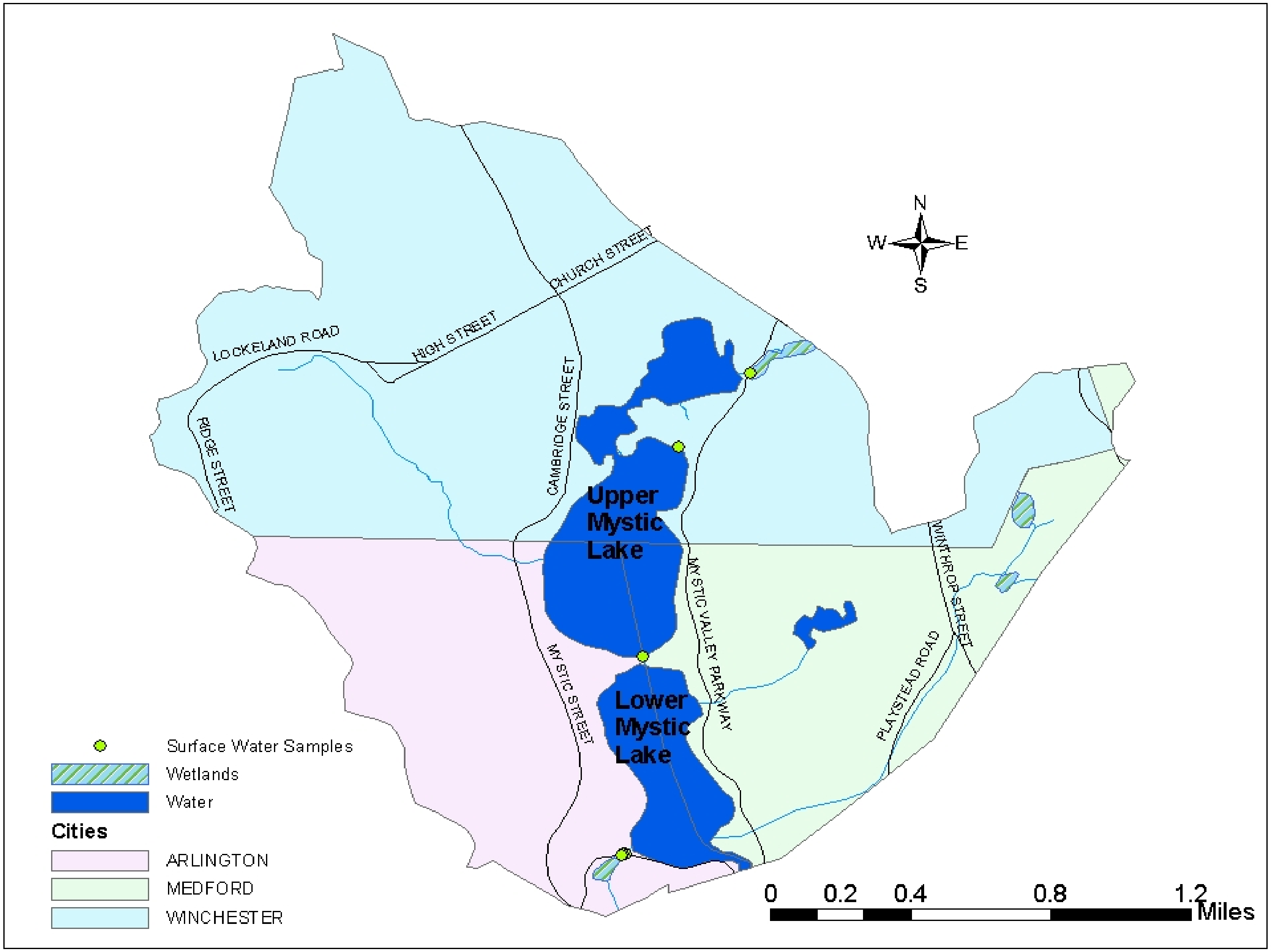


Figure 2-4: Mystic Lakes Subwatershed

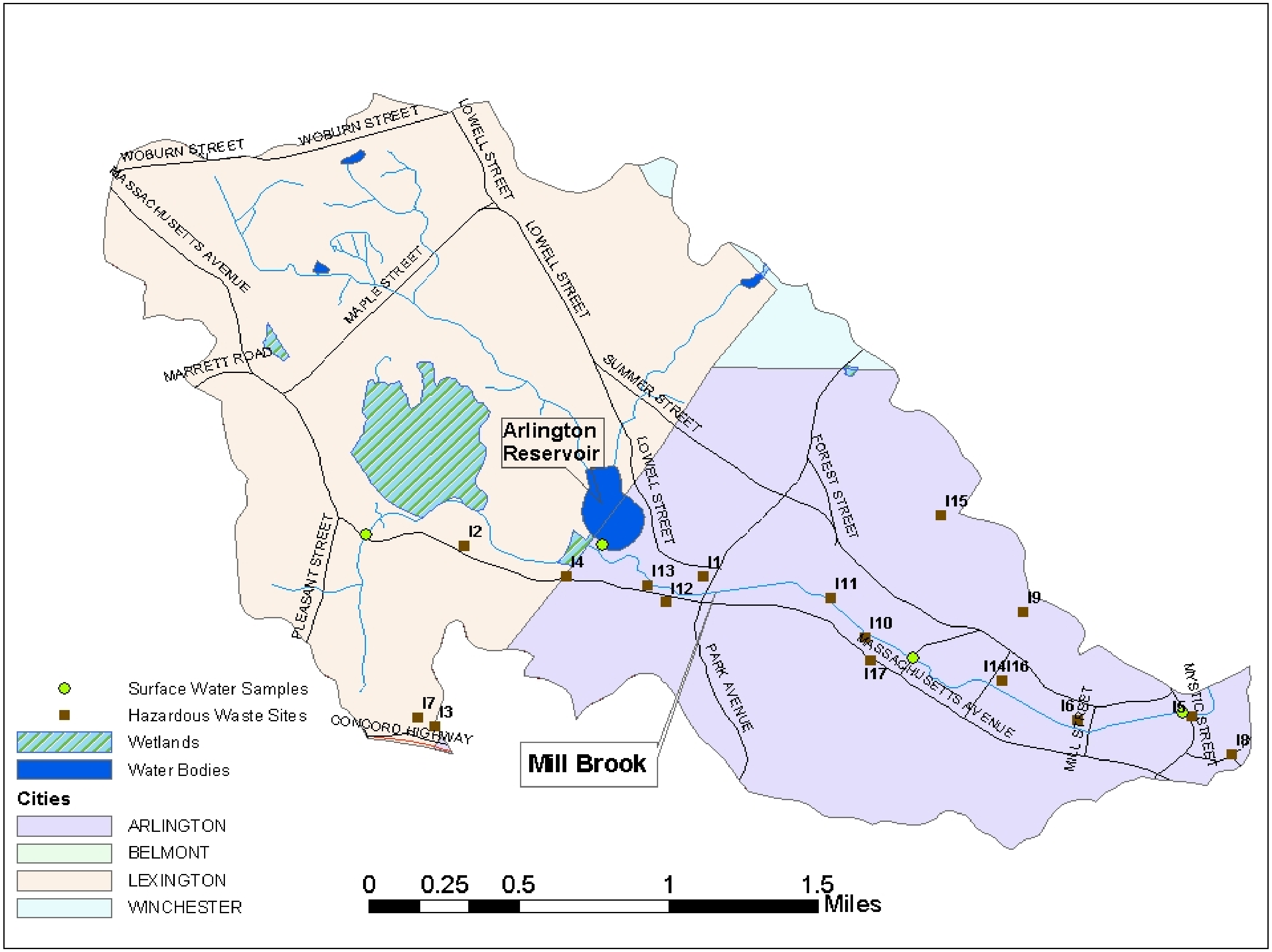


Figure 2-5: Mill Brook Subwatershed

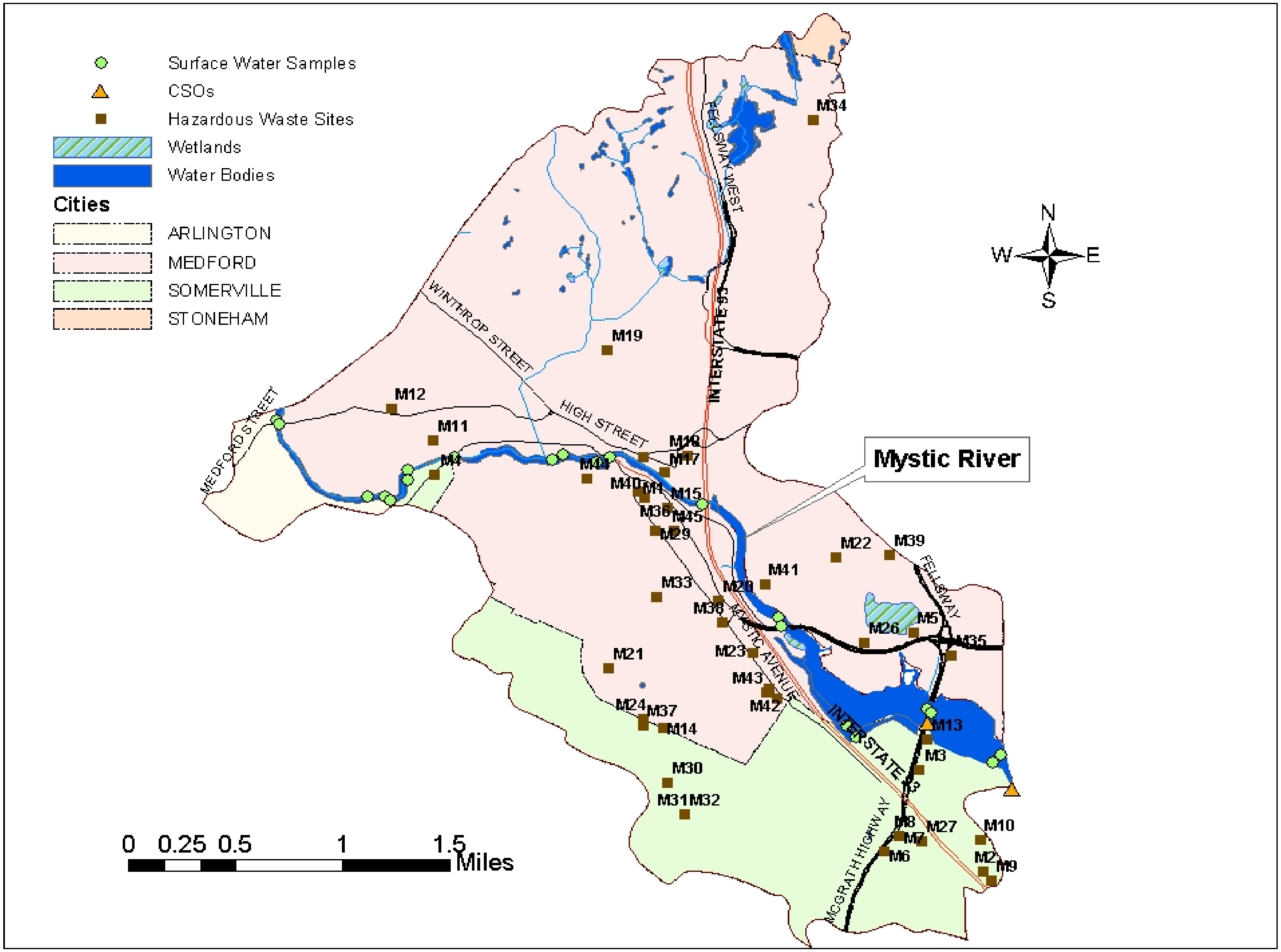


Figure 2-6: Mystic River 1 Subwatershed

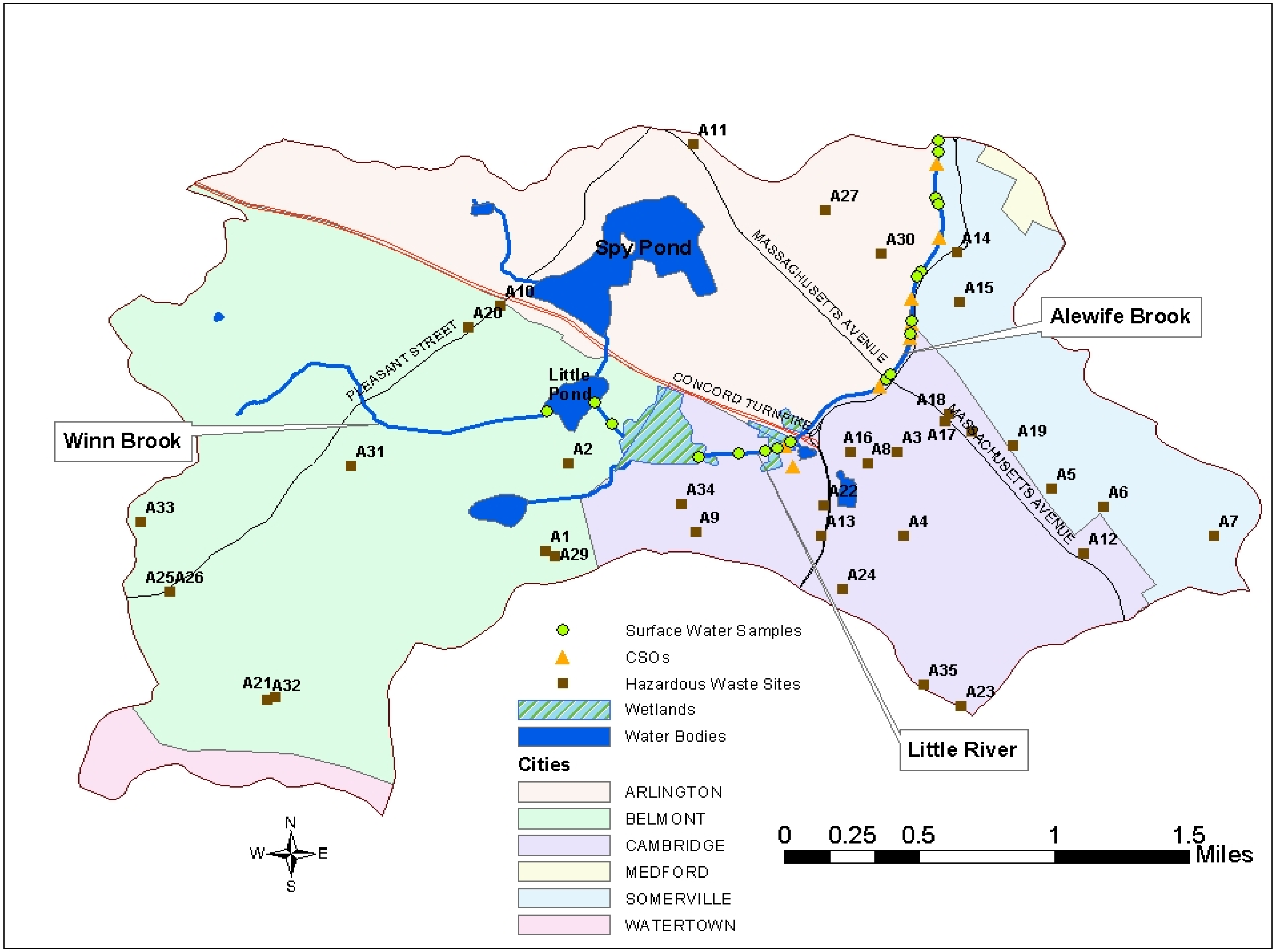


Figure 2-7: Alewife Brook Subwatershed

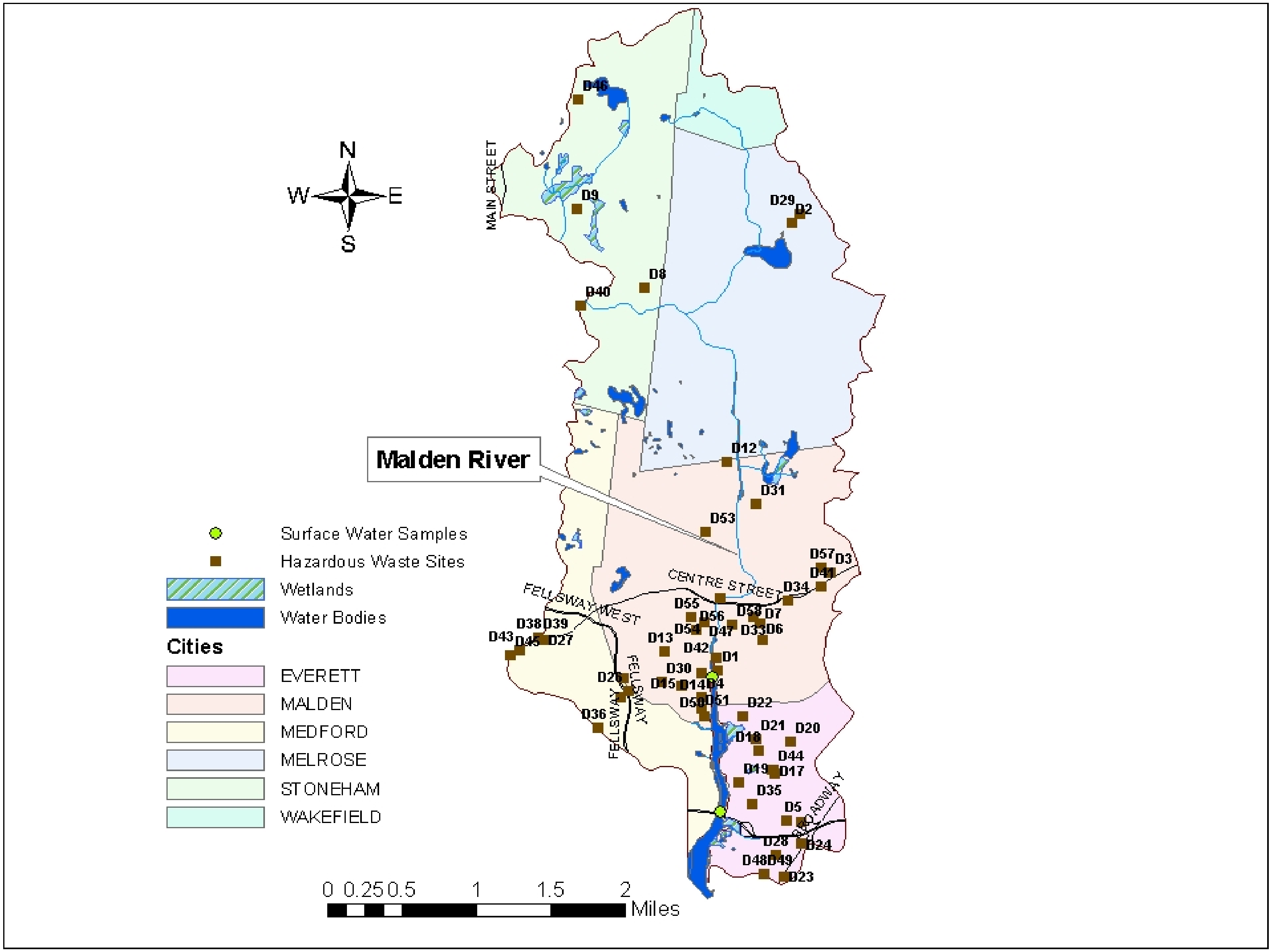


Figure 2-8: Malden River Subwatershed

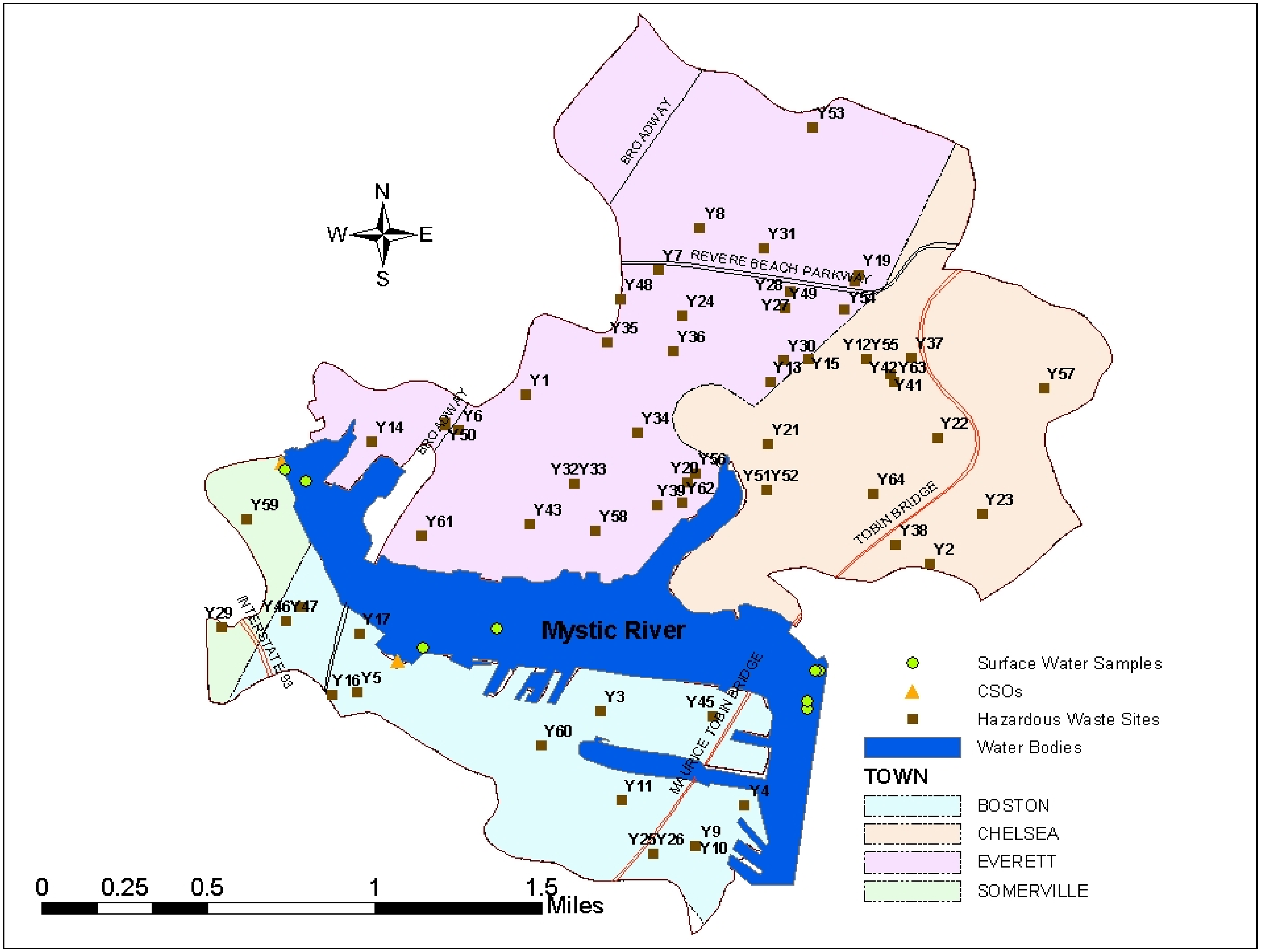


Figure 2-9: Mystic River 2 Subwatershed

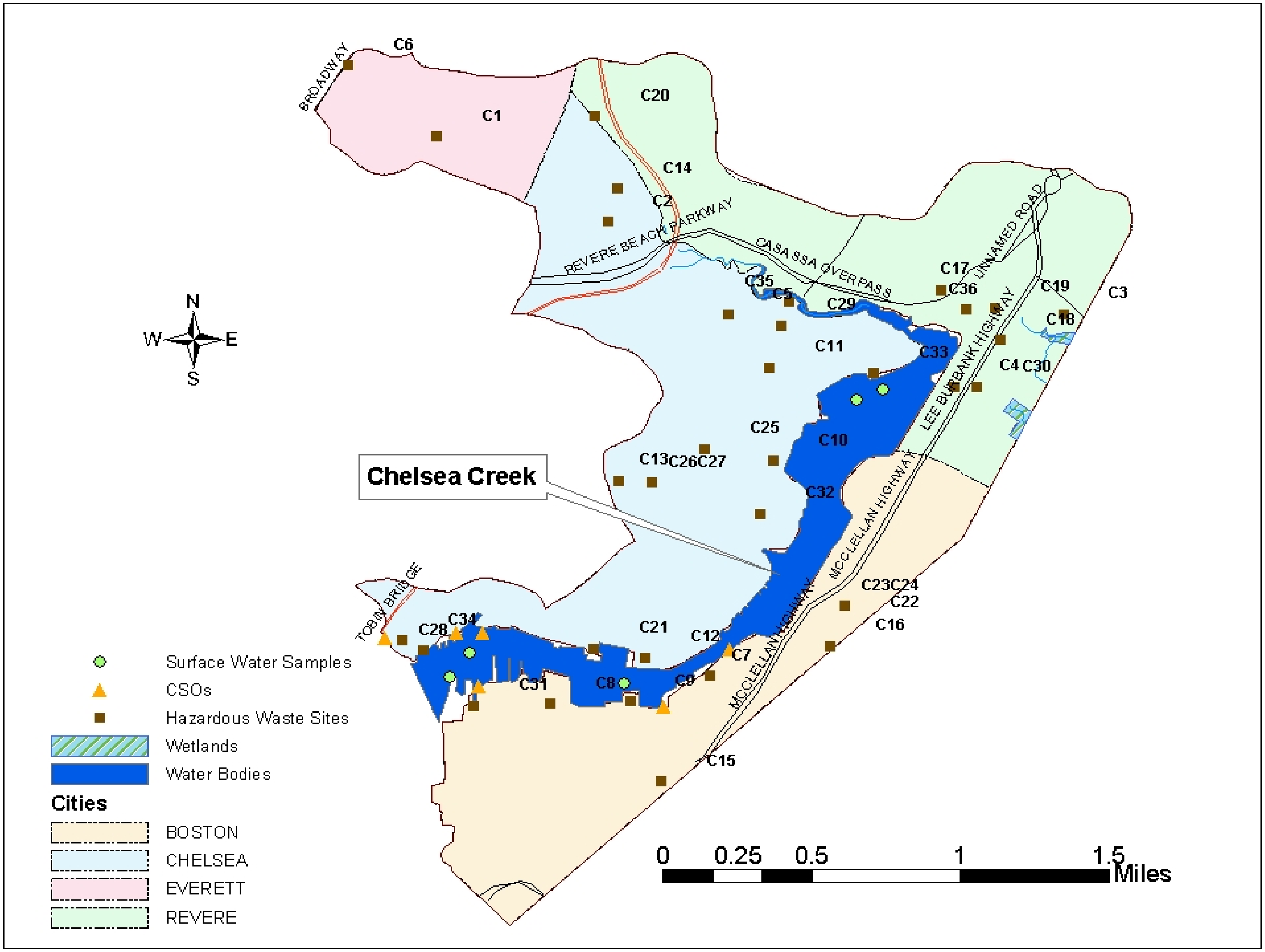
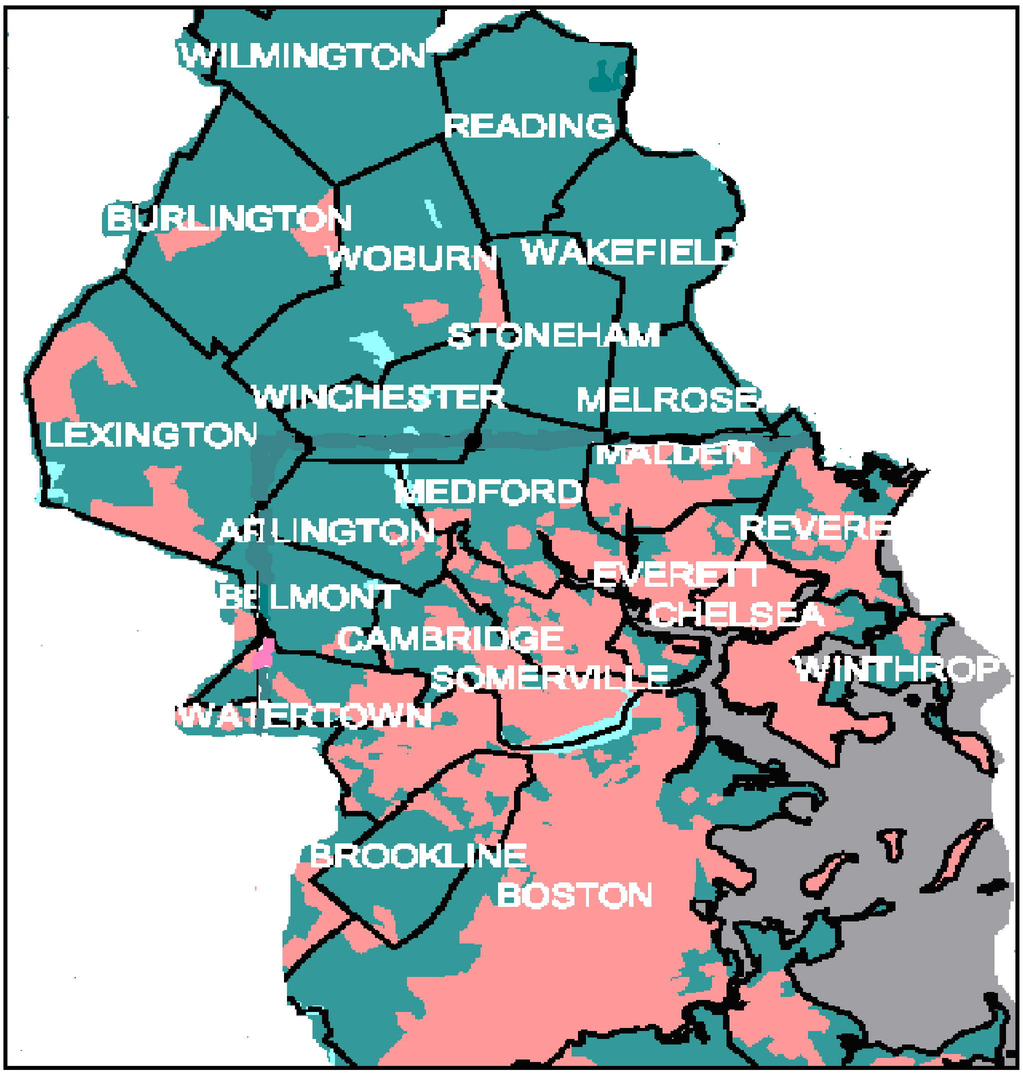


Figure 2-10: Chelsea Creek Subwatershed

Figure 2-11 Environmental Justice Communities in the Mystic River Watershed



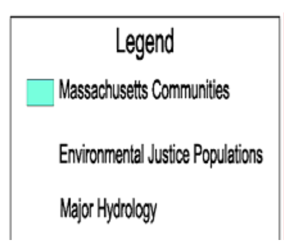
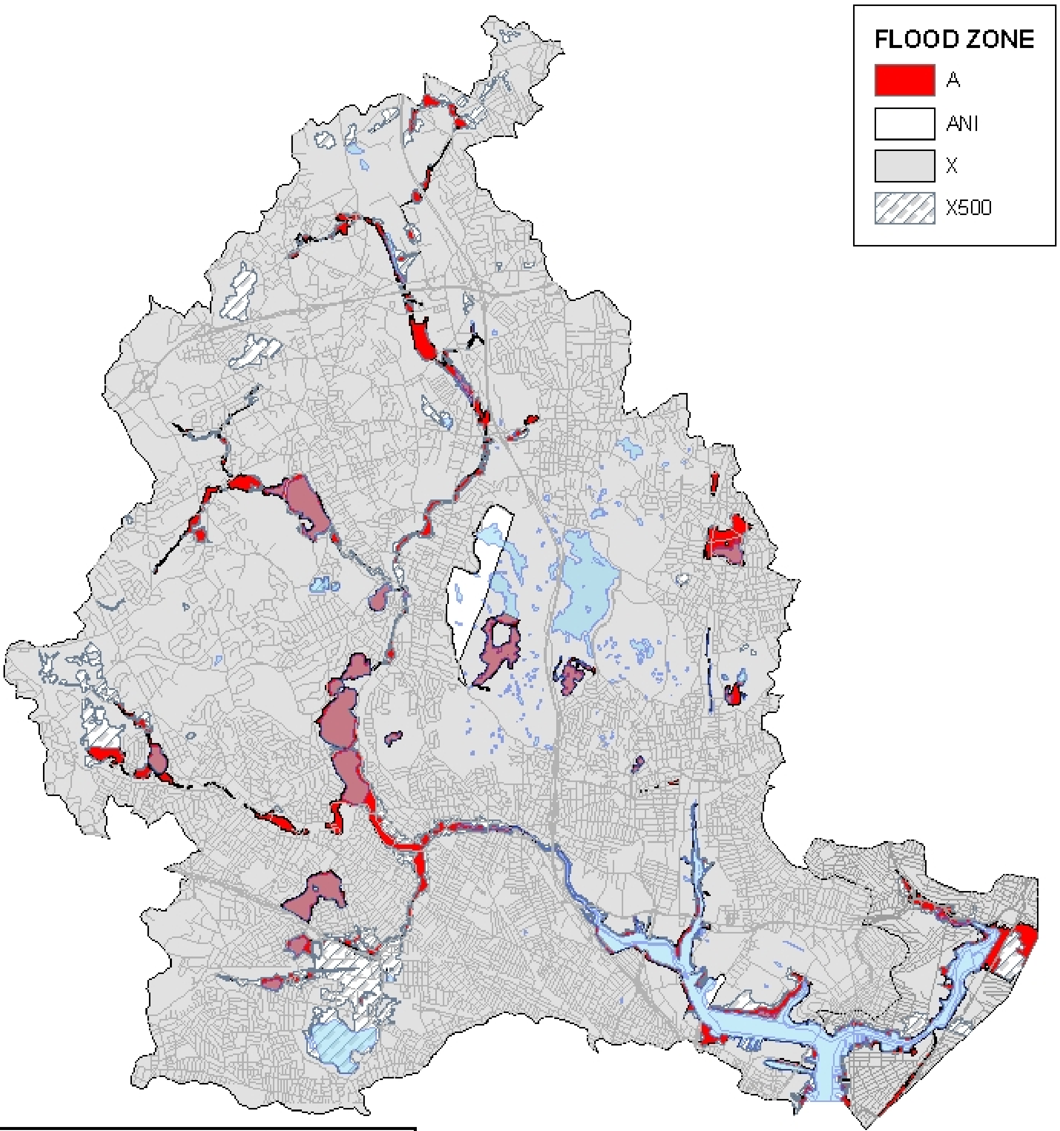


Figure 3-1

FLOOD ZONES IN THE MYSTIC RIVER BASIN

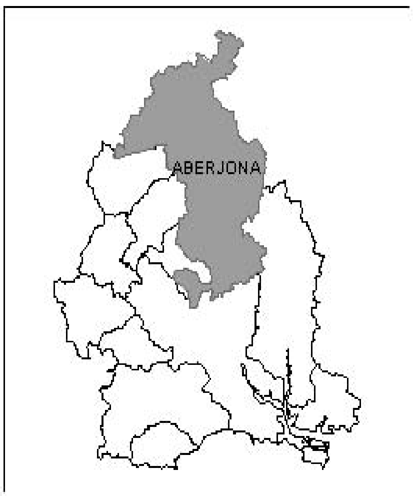


FloodPlain Description	Area (sq mi)
100-Year Flood	2.92
500-Year Flood	2.47
Not in FloodPlain	59.90
No Data	0.51
TOTAL	65.79

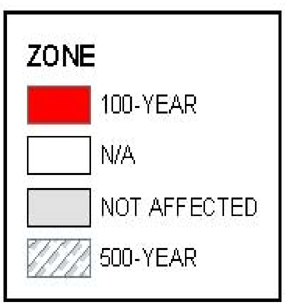
0 0.5 1 2 3 4 Miles

Figure 3-2 Floodplains:

ABERJONA SUBBASIN



ABERJONA SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.51
500-YEAR	0.53
NOT AFFECTED	14.96
NO DATA	0.00
TOTAL	**16.00**



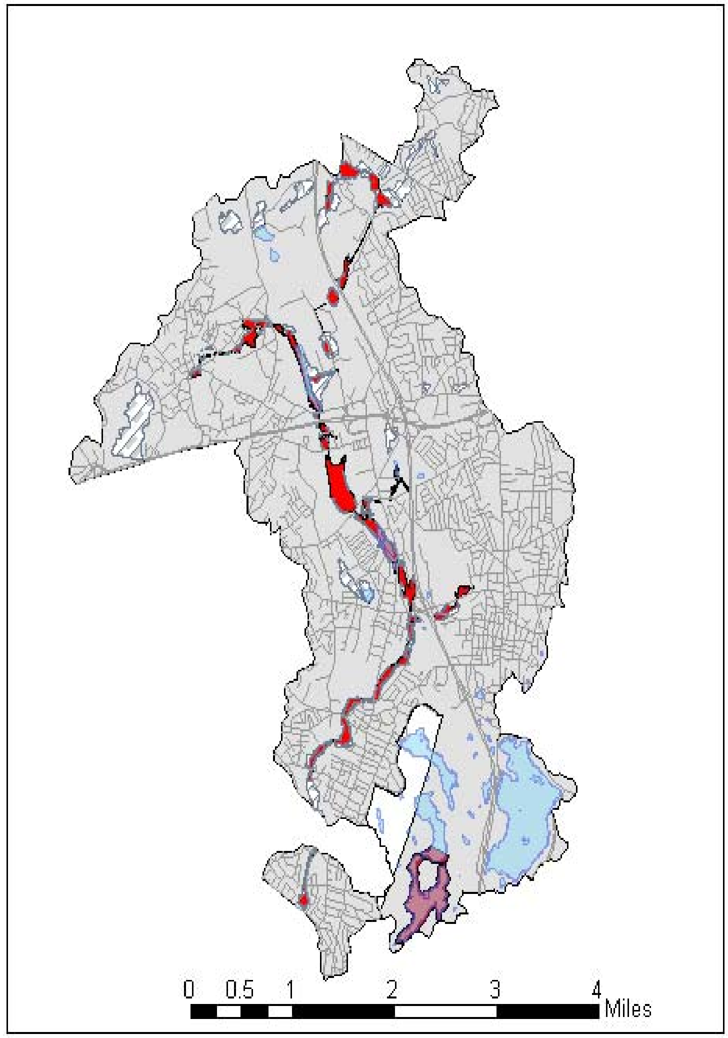
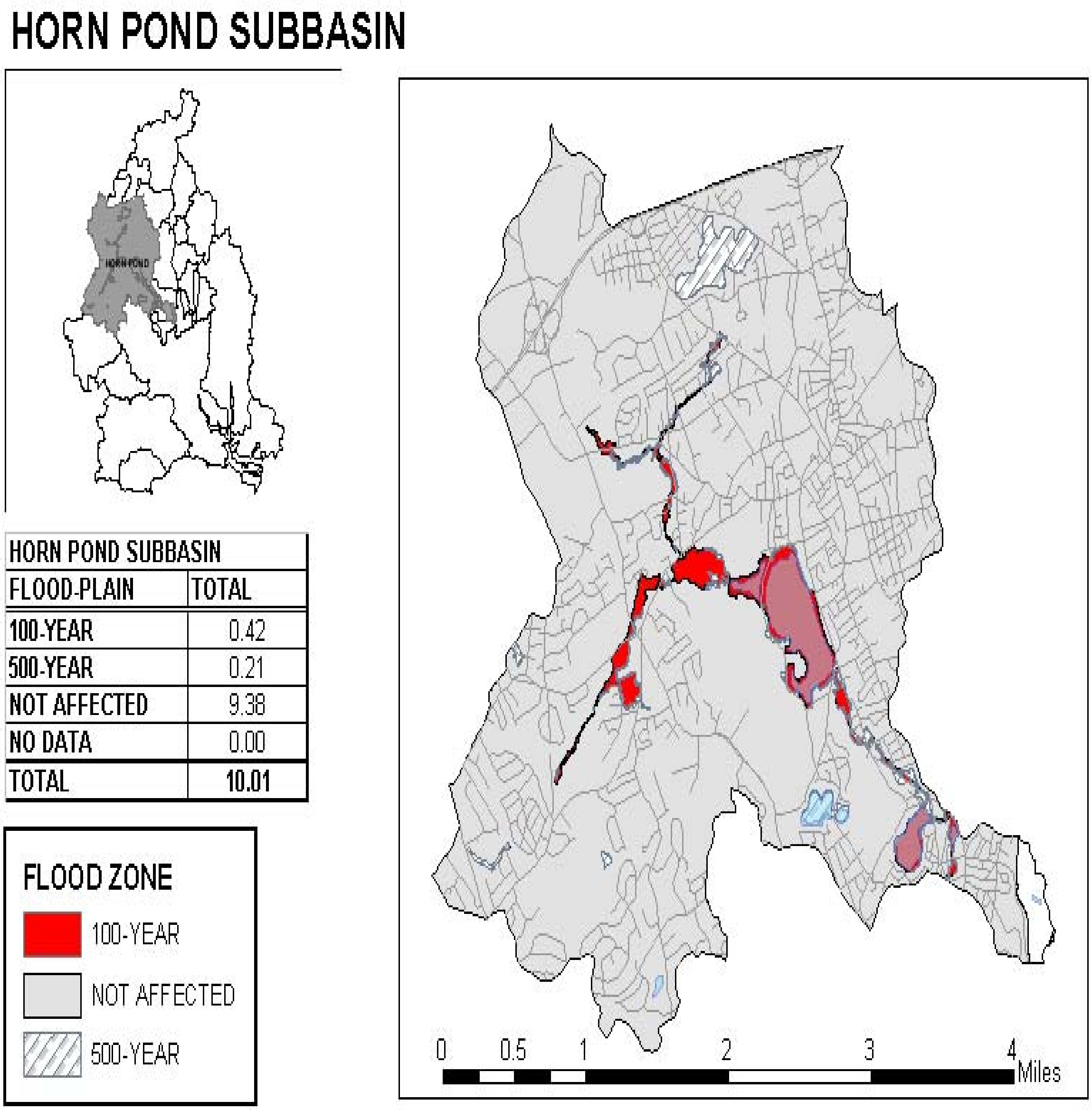
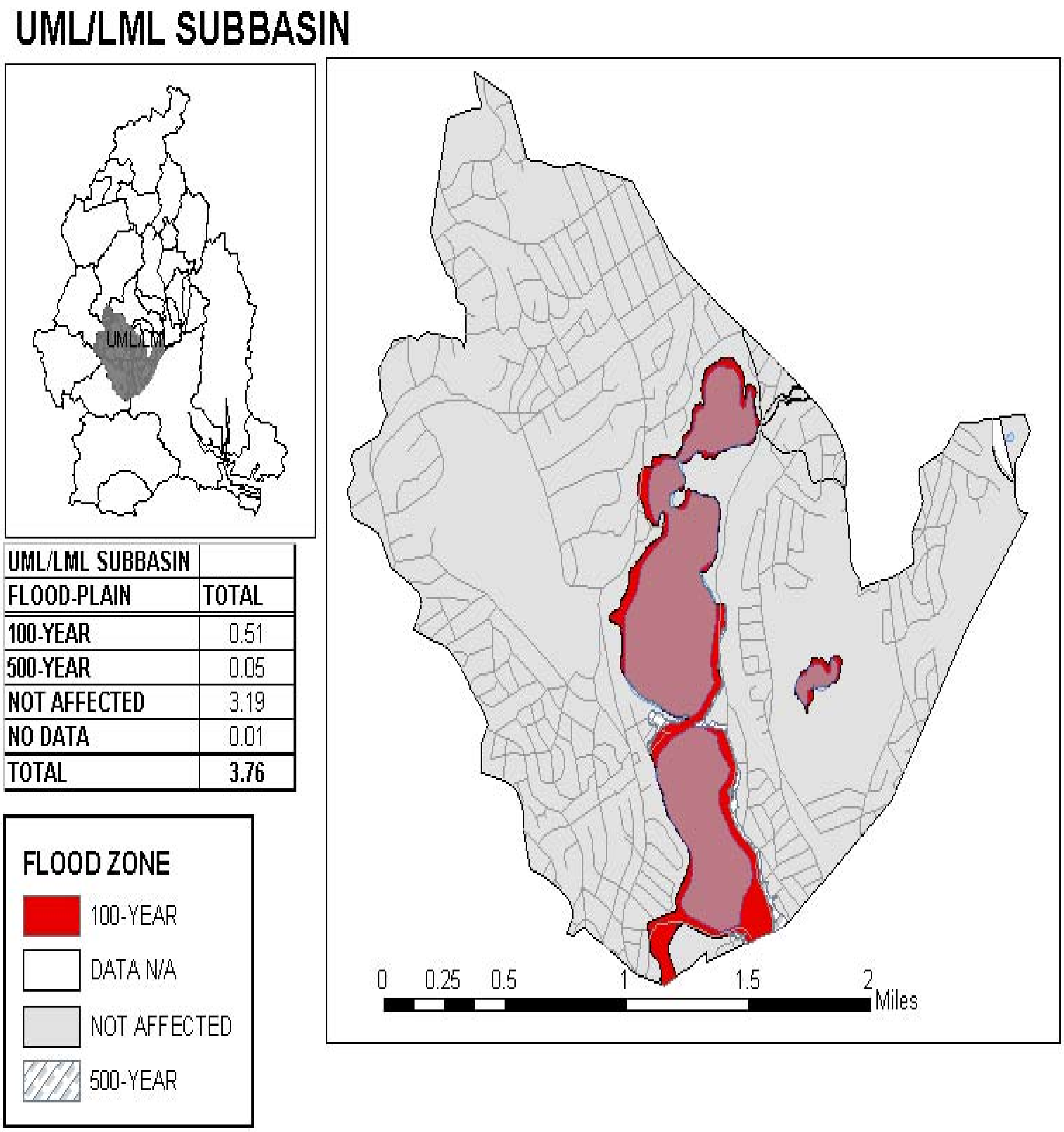


Figure 3-3 Floodplains:



HORN POND SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.42
500-YEAR	0.21
NOT AFFECTED	9.38
NO DATA	0.00
TOTAL	**10.01**

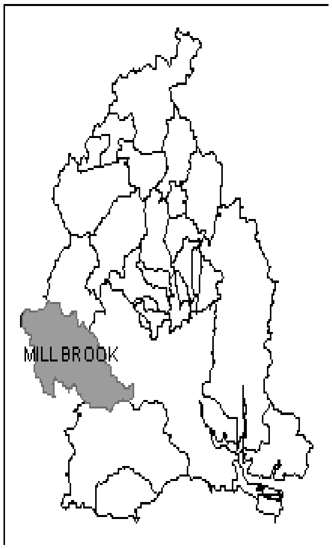
Figure 3-4 Floodplains:

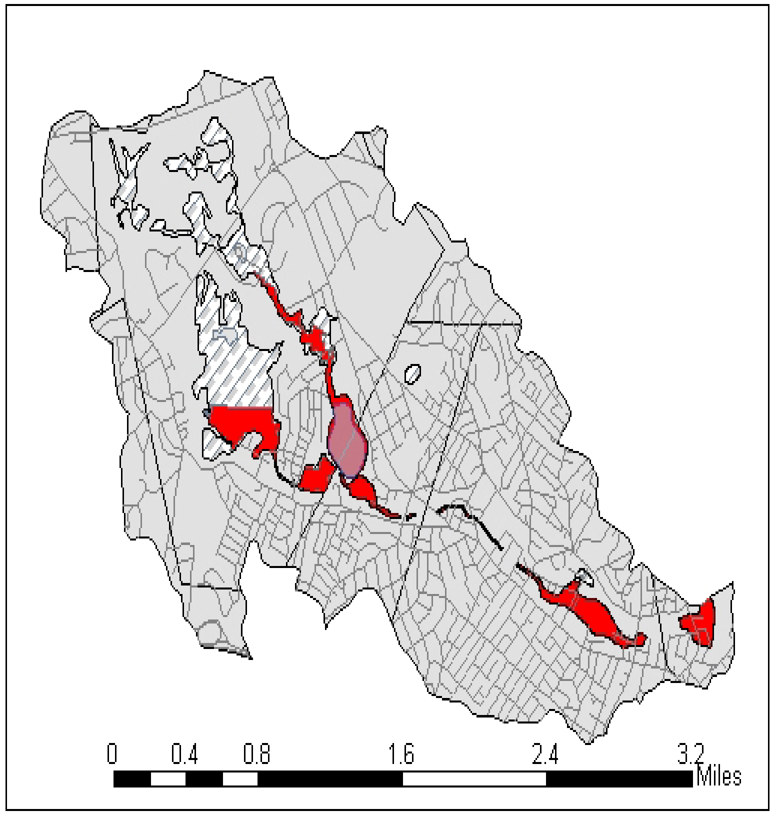


UML/LML SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.51
500-YEAR	0.05
NOT AFFECTED	3.19
NO DATA	0.01
TOTAL	**3.76**

Figure 3-5 Floodplains:

MILL BROOK SUBBASIN





MILL BROOK SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.23
500-YEAR	0.31
NOT AFFECTED	4.66
NO DATA	0.00
TOTAL	**5.20**

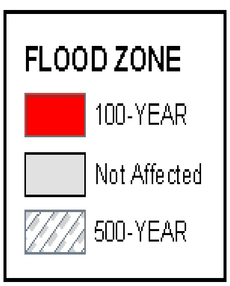
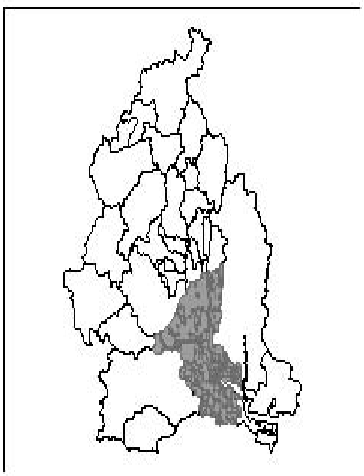
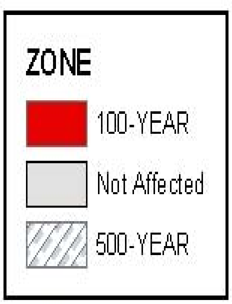


Figure 3-6 Floodplains:

MYSTIC RIVER 1 SUBBASIN



MYSTIC RIVER 1 SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.35
500-YEAR	0.17
NOT AFFECTED	7.38
NO DATA	0.00
TOTAL	7.90



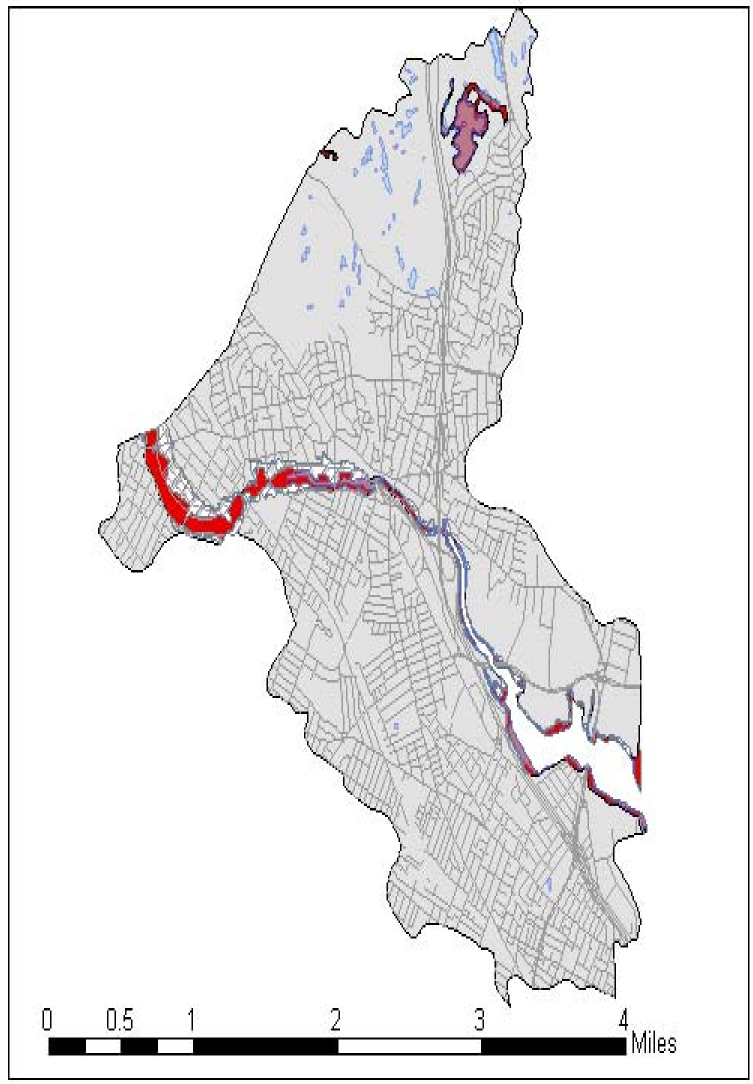
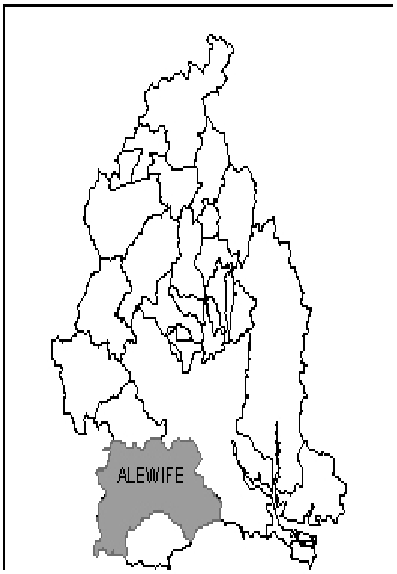
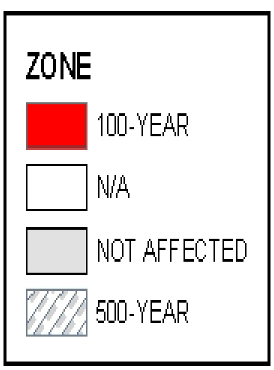


Figure 3-7 Floodplains:

ALEWIFE SUBBASIN



ALEWIFE SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.37
500-YEAR	0.64
NOT AFFECTED	6.03
NO DATA	0.00
TOTAL	**7.03**



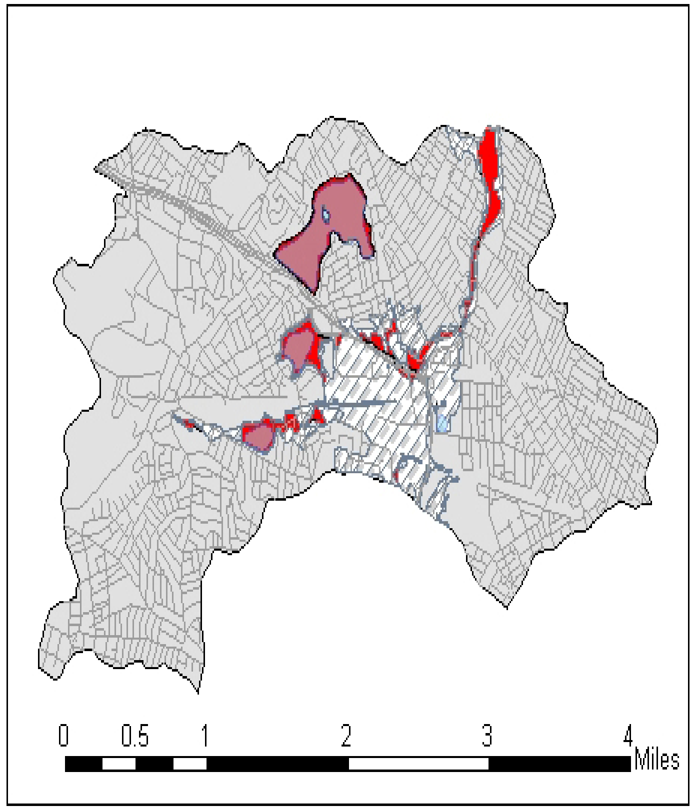
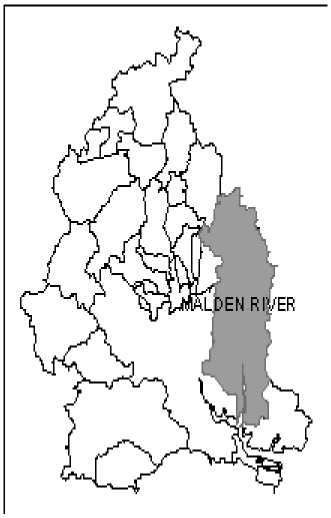
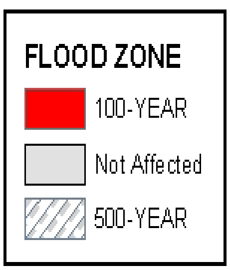


Figure 3-8 Floodplains:

MALDEN RIVER SUBBASIN



MALDEN SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.27
500-YEAR	0.17
NOT AFFECTED	9.42
NO DATA	0.00
TOTAL	**9.86**



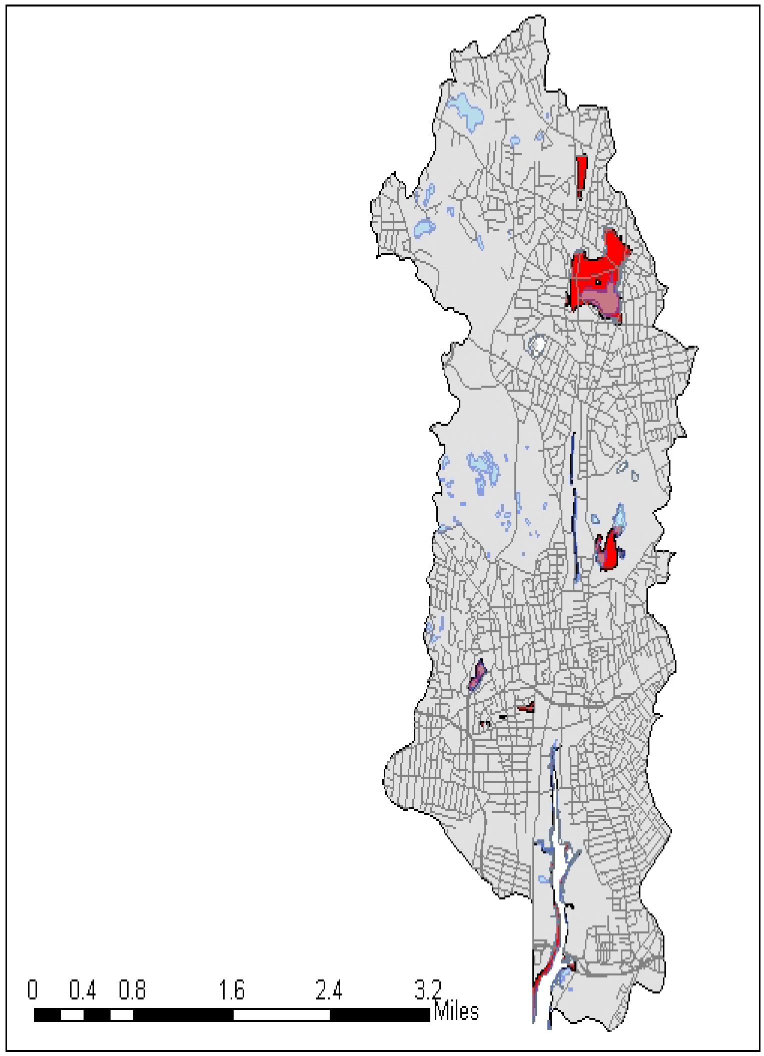
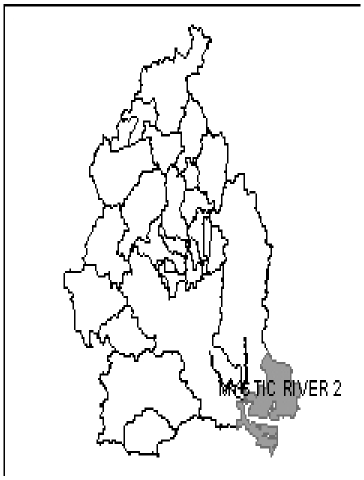
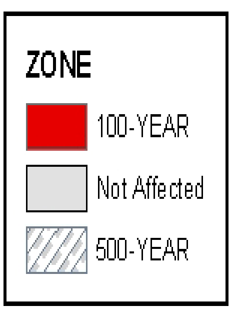


Figure 3-9 Floodplains:

MYSTIC RIVER 2 SUBBASIN



MYSTIC RIVER 2 SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.20
500-YEAR	0.13
NOT AFFECTED	2.90
NO DATA	0.00
TOTAL	**3.23**



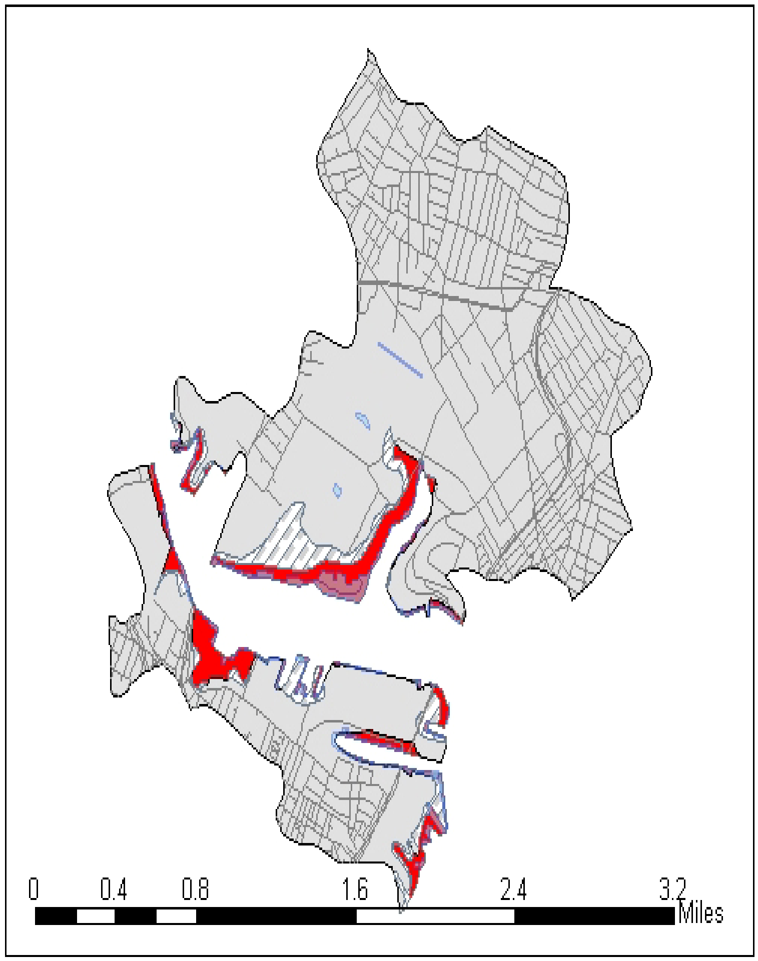
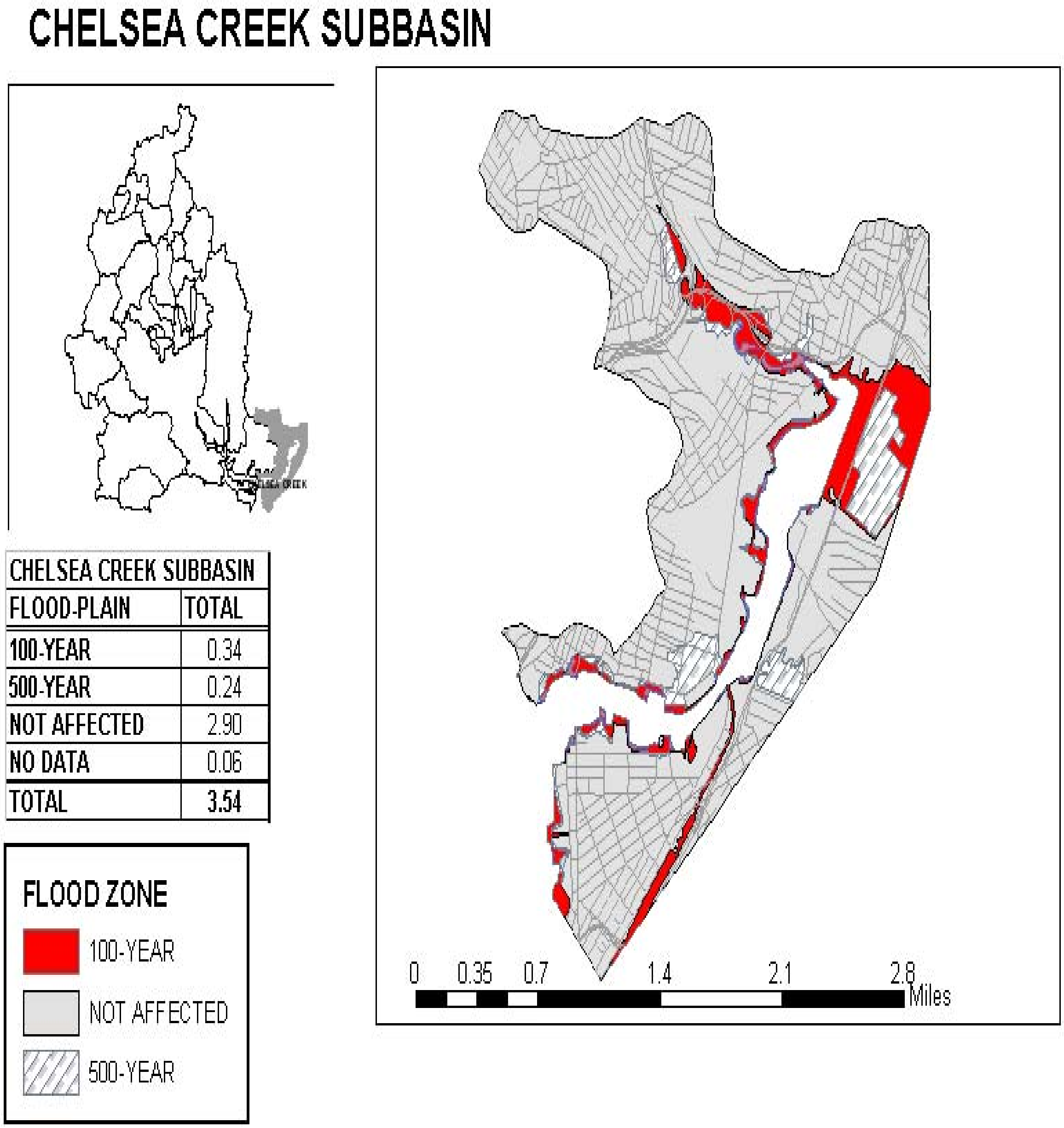


Figure 3-10 Floodplains:



CHELSEA CREEK SUBBASIN	
FLOOD-PLAIN	TOTAL
100-YEAR	0.34
500-YEAR	0.24
NOT AFFECTED	2.90
NO DATA	0.06
TOTAL	**3.54**

Chapter 3: Water Quantity and Flooding

3.1 Introduction

Many watersheds in Massachusetts are suffering from low flow and groundwater depletion. Issues related to lack of water have not received much attention in the Mystic River watershed, however. The primary difficulties related to water quantity in this watershed relate to flooding. The watershed is, with some exceptions, very flat and is prone to flooding in a number of locations. This chapter presents evidence on the extent and causes of flooding and recommends actions related to flooding. Section 3.2 also includes a brief discussion of the potential for low flow problems.

Chapter Contents

3.2 Water Quantity and Use

The Mystic River watershed communities obtain most of their drinking water from the Massachusetts Water Resources Authority (MWRA) system. The MWRA provides water from a system that draws from the Quabbin and Wachusett reservoirs.

Table 3-1 lists the MWRA customer communities and the services provided to each.

Table 3-1: MWRA Customer Communities in the Mystic River Watershed

	Services		MWRA Water Use 2003 (mgd)
	Water	Sewer	
Arlington	x	x	4.330
Belmont	x	x	2.224
Boston	x	x	80.131
Burlington		x	
Cambridge	*	x	
Chelsea	x	x	3.543
Everett	x	x	4.906
Lexington	x	x	5.039
Malden	x	x	5.968
Medford	x	x	5.371
Melrose	x	x	2.361
Reading		x	
Revere	x	x	4.555

Table 3-1: MWRA Customer Communities in the Mystic River Watershed			
	Services		**MWRA Water Use 2003 (mgd)**
	Water	**Sewer**	
Somerville	x	x	6.437
Stoneham	x	x	3.052
Wakefield	p	x	1.866
Watertown	x	x	2.945
Wilmington		x	
Winchester	p	x	0.947
Winthrop	x	x	1.523
Woburn	p	x	1.981

*water- emergency backup only
p = partially supplied
Source: MWRA, http://www.mwra.com/02org/html/whatis.htm#comlist

Table 3-2 lists permitted water withdrawals in the watershed.

Table 3-2: Permitted Water Withdrawals			
Facility	Source G = Ground S = Surface	Authorized Withdrawal (mgd)	1999 Average Withdrawal (mgd)
Winchester Water Department	S	1.06*	1.17
Woburn Water Department	G	4.07*	3.11
Kraft General Foods	G	1.0	0.75
Parkview Condominiums	NA	0.36	0.36**
Winchester Country Club	G,S	0.16 (180 days)	never installed

*systemwide withdrawal. ** estimated based on permit application.
Source: MA DEP 2002b.

All of these permitted water withdrawals are in the Aberjona subbasin or the Malden River subbasin.

Fourteen of the 21 communities in the watershed obtain all their **drinking water** from the MWRA. The exceptions are described below.

The City of Cambridge Water Department supplies approximately 15 mgd of drinking water to Cambridge customers. Most of the water is drawn from reservoirs in Cambridge and 5 other suburban communities, all outside the watershed. Water is piped to the Fresh Pond Reservoir in Cambridge, for storage prior to treatment. The finished water is then pumped to the Payson Park Reservoir in Belmont, from which it flows by gravity through the distribution system. (USGS, 1998)

Winchester's water supply comes from three town-owned reservoirs located in the Middlesex Fells Reservation. Winchester also purchases water from the MWRA to supply portions of the town.

Woburn gets approximately 27% of its water from the MWRA system, and the remaining 63% from groundwater – 9 wells in the Horn Pond subbasin. Woburn lost 24% of its water supply in 1979 when Wells G & H were permanently closed due to contamination. Well E is not used to full capacity, because a farm with livestock is located close to the well and is believed to be a source of elevated nitrate levels in the well.

Burlington's drinking water system contains two separate water treatment plants (with combined capacity of 9.3 mgd) drawing water from both surface (the Mill Pond reservoir) and groundwater (the Vine Brook Aquifer).

Wilmington provides drinking water to 99% of its residents and businesses, from groundwater sources. The town has been pumping from only 4 of its 9 wells, because NMDA (N-nitrosodimethylamine) has been detected in the Maple Meadow Brook aquifer wells.

Reading draws its drinking water from groundwater. All of the town's wells are located in the Ipswich River watershed. The town has outdoor watering restrictions in place, due to continuing stress in the Ipswich River basin.

Finally, Wakefield draws 85% of its water from the MWRA and 15% from Crystal Lake.

All of the communities in the Mystic River watershed rely on the MWRA for **wastewater treatment**. Sewage from homes and businesses in the watershed is discharged to local sanitary sewers that are owned and operated by municipal sewer departments. These local sewers transport wastewater into the MWRA interceptor system. The interceptor sewers in turn transport wastewater to the Deer Island Treatment Plant in Boston Harbor, where it receives primary and secondary treatment before discharge through an outfall tunnel into Massachusetts Bay.

Because so much of the watershed's water use draws on sources outside the region, the watershed households have not generally confronted problems related to low flow or depleted groundwater. Unlike many Massachusetts communities that rely on local sources for water, for example, the Mystic River watershed communities did not institute any water use restrictions in 2003.

Despite the lack of attention paid to water depletion in the Mystic River watershed, however, there is evidence of low flow problems. The only USGS flow gage in the watershed is located on the Aberjona River in Winchester. This was therefore the only Mystic subbasin considered in the 2001 Water Resources Commission study of stressed basins. This study classified basins by stress level based on 3 flow metrics: median of annual 7-day low flow, median of annual 30-day low flow, and median of low pulse duration. The Aberjona basin was classified as high stress for 2 of the 3 measures, and therefore classified as highly stressed overall. (WRC, 2001)

The extensive development that has occurred in the watershed over the past decades has most likely contributed to depleted groundwater, as well as reduced surface water flows. Increased impervious surface areas result in lower flows particularly in the late summer and early fall, as there is less groundwater recharge during rainfall periods.

During the summer of 2004, there have been very low flows in Alewife Brook. Further investigation is needed to determine the cause of the low water levels, including reduced groundwater flows, precipitation levels or the operation of the Amelia Earhart Dam.

3.3 Flooding

Flood History

Communties throughout the watershed, and especially those bordering the Aberjona, Alewife Brook and the Malden River, have experienced significant flooding problems. Floods are caused by the combination of spring rains and snowmelt, and by heavy rainfall from tropical storms in mid- to late summer. Major floods occurred in the Aberjona and Mystic River basins in 1936, 1955, 1962, 1968, 1969, 1979, 1996, 1998, and 2001. A particularly severe flood in October 1996 was caused by a large rainfall following a period of wet conditions, and the area received a Presidential Disaster Declaration as a result of the flooding. According to information collected for the Aberjona and Mystic Rivers Hazard Mitigation project (DEM and MEMA, 1997), the October 1996 storm had the following effects:

Arlington residents suffered basement flooding from sewage backup, due to high levels of inflow and infiltration and surcharging. Flooding was most severe in East Arlington and along Mill Brook.

Medford experienced only isolated flooding, but 200 people were evacuated from an apartment complex and housing project along the Mystic River, and Medford Square was flooded.

An estimated 600 homes in Winchester were damaged by flooding from Horn Pond Brook and the Aberjona River. The high school and the downtown area were also flooded.

Woburn experienced flooding from high water in Horn Pond Brook. The City was unable to draw down water behind the Horn Pond Dam sufficiently to prevent the flooding.

Route 2 and Alewife Brook Parkway have been closed due to Alewife Brook flooding three times in the last six years (October 1996, June 1998 and March 2001.)

The Amelia Earhart Dam was constructed in 1965, and had large pumps installed in the 1970s. The dam is operated to maintain water elevations in the basin above the dam, by sluicing water out of the basin at low tide and pumping water into the harbor during high tides. Water levels are drawn down in anticipation of storms to control flooding. The need to maintain adequate levels for boating and to protect spawning fish places constraints on how low the water levels can be taken before large storms.

The floodplains below the Amelia Earhart Dam are caused by coastal storm surges, rather than by freshwater flows. Major coastal flooding occurs during extra-tropical storms called Nor'easters and hurricane surges, generally in the fall and winter. Kaiser (2002) reports that the Army Corps of Engineers has modeled surge inundations for the lower basin. These studies should be reviewed for information on the frequency and severity of flooding problems in the coastal areas of the watershed.

Current Status

The most recent Federal Emergency Management Agency (FEMA) maps of the 100 and 500 year floodplains in the basin date from 1977-1980. Since that time, freshwater (riverine) floodplains are likely to have expanded because of continued loss of pervious surfaces and increased intensity of extreme rainfalls due to climate change. FEMA is currently conducting a study to update the floodplain maps for the Mystic River watershed, due to be finished in Spring 2004. Early indications are that the flood levels will be substantially higher, and the floodplains therefore larger, than reflected in current maps, at least in some areas. Until the update is completed, the 1977-1980 maps are still considered the "official" floodplain maps for FEMA regulatory purposes. The information summarized below is based on these maps, and therefore is likely to understate the extent of the floodplains in the watershed.

Figure 3-1 shows the 100 year and 500 year floodplains currently mapped by FEMA in the watershed. Figures 3-2 through 3-10 show the floodplains in each subbasin. Table 3-3 shows the land area flooded in the 100 year flood in each sub-basin floodplain. The 100 year coastal floodplains are either the VE or A zones.

As can be seen in Figure 3-1, there is flooding along the entire Mystic River and its major tributaries.

The damage caused by flooding depends on what kinds of land uses are affected. Table 3-3 shows that the land uses most affected by 100 year flooding varies by subbasin:

- Aberjona - industrial;
- Alewife Brook -- residential;
- Chelsea Creek - industrial and transportation;
- Horn Pond - residential;
- Malden River - commercial and residential;
- Mill Brook - commercial;
- Mystic River 1 - residential;
- Mystic River 2 - industrial; and
- Upper Mystic Lake/Lower Mystic Lake - residential.

Table 3-3: Areas in 100-Year Floodplains by Subwatershed and Land Use (square miles)

Subwatershed	Total Subwater-shed Area	Area in 100-Year Floodplain (square miles)						
		Commercial	Industrial	Open Space	Recreational	Residential	Transportation	Total in Floodplain
Aberjona	16.0	0.02	0.06	0.31	0.01	0.02	0.08	0.5
Alewife	7.0	0.00	0.01	0.24	0.08	0.03	0.00	0.36
Chelsea Creek	3.5	0.02	0.03	0.06	0.02	0.02	0.19	0.34
Horn Pond	10.0	0.01	0.00	0.32	0.01	0.08	0.00	0.42
Malden River	9.9	0.04	0.02	0.12	0.05	0.04	0.00	0.27
Mill Brook	5.2	0.03	0.00	0.13	0.04	0.02	0.00	0.22
Mystic River 1	7.9	0.07	0.01	0.12	0.06	0.08	0.02	0.36
Mystic River 2	3.2	0.00	0.06	0.05	0.01	0.00	0.08	0.2
Upper & Lower Mystic Lakes	3.8	0.00	0.00	0.47	0.01	0.03	0.00	0.51
Total	66.5	0.19	0.19	1.82	0.29	0.32	0.37	103.18

Source: Paul Kirshen, Tufts University, analysis based on MassGIS data layers.

In the 100 year floodplain, the Mystic River 1 subbasin, with the confluence of the Mystic River and Alewife Brook, accounts for the largest area of commercial flooding. The largest amount of industrial flooding is in the Aberjona River and the Mystic 2 sbubasin, and the largest amount of residential flooding is in the Horn Pond and Mystic 1 subbasins.

Mystic River 1 also has the largest total 100 year flooded area of industrial, commercial, and residential land combined (0.16 square miles, sqm), followed by Aberjona (0.10 sqm), Malden River (0.10 sqm), Horn Pond (0.09 sqm), Chelsea Creek (0.07 sqm), Mystic River 2 (0.06 sqm), Mill Brook (0.05 sqm), Alewife Brook (0.04 sqm), and Upper Mystic Lake/Lower Mystic Lake (0.03 sqm).

The highest percent of total area flooded in the 100 year flood are the Chelsea Creek, Mystic 1, and Mystic 2 subbasins, all with approximately 2 percent of their land area flooded. The other basins have approximately 1 percent of their area in the 100 year floodplain.

Despite the relatively larger portions of the area in the floodplain in the Chelsea Creek or Mystic 2, most of the attention given to flooding to date has been in the Upper and Middle watershed. This may reflect the fact that much of the affected area in the Lower Mystic is industrial as opposed to residential. It is also possible that more frequent floods are occurring in the freshwater areas of the watershed, causing more frequent damage than coastal floods. More investigation is clearly needed, however, to assess the problems caused by flooding in the Lower Mystic subbasins.

The floodplains are distributed differently in the different subbasins, as well as affecting different types of land uses. Floodplains are concentrated in some areas, and located along most of the river in others. In addition, each area is likely to differ in the factors contributing to flooding and the available options for managing flooding (storage, removal of constrictions, preserving or reclaiming pervious surfaces, etc.) These differences suggest that different flood management strategies might be needed in different areas. It is also be important, however, to look at hydrologic interconnections among the basins, since steps taken to reduce flooding in one community could increase flooding problems elsewhere.

There is substantial uncertainty about the specific factors contributing to flooding in various parts of the watershed – in particular, the extent to which constrictions contribute to flooding. Street flooding may occur because the hydraulic capacity of the drainage system in some locations is inadequate to convey the storm runoff. This is reported as a major concern in North Cambridge (Jacobs Consulting Services 2000) and Winchester (CDM, 1999), for example. Substantial additional work is needed throughout the watershed to develop a comprehensive understanding of the factors causing flooding and the potential solutions. Some efforts in this direction are described later in this chapter.

Flooding presents a public health concern, as well as causing safety hazards and property damage, in many areas of the watershed. Floodwaters can enter residential properties and basements where rising water levels in sewer pipes cause backups into basement drains, sinks and toilets, or via overland flooding. The floodwaters are often contaminated with sewage from Combined Sewer Overflows, and sewer surcharges and overflows through manholes in separate sewers in the basin, for example in the Horn Pond area. CSOs discharging into Alewife Brook are a particular concern in East Arlington and North Cambridge. Data presented in Chapter 4 show that wet weather bacteria contamination is a problem throughout the watershed.

Trends

The Mystic River watershed is generally quite flat, except near some of the basin boundaries where there are significant elevations (for example, the Fells in the east). As a result, flooding has always been a problem in this basin. Although several relatively large engineering projects have been constructed to attempt to manage water levels, flooding remains a problem and is likely to get worse in the future.

While there may be disputes as to the specific causes of increased flooding problems, there is an emerging view that flooding is in fact gotten worse in the Mystic River watershed. For example, Steve Kaiser's studies of flooding data for the Alewife area suggest that the 10-year flood elevation is 6.5 feet today, compared with FEMA's estimate for a 10-year flood 20 years ago of 5.6 feet. (Kaiser, 2002b) As described in Chapter 5, considerable open space has been lost in the basin over the past decades. The increase in impervious surfaces associated with this development has resulted in increased runoff and increased flooding over time.

It is now well accepted that long-term climate change has also increased the intensity of extreme rainfall events in the basin and will continue to in the future. One experimental estimate by Kharin and Zwiers (2000) found that, by 2050, the frequency of the present 100 year storm could decrease to 50 years and the present 500 year storm to 100 years. By 2100, the frequency of the present 100 year storm could decrease to 25 years and the present 500 year storm to 40 years. Coastal flooding will also get more severe in the future due to sea level rise caused by global warming and land subsidence. An increase of 2 to 3 feet in sea level is possible within 100 years (US EPA). A 1 foot rise would increase the frequency of the present 100 year flood to 10 years, and the present 500 year flood to 100 years (US Army Corps of Engineers).

Potential for increased flooding is also caused by work now underway to reduce Combined Sewer Overflows during storm events. Actions taken to separate storm drains from the sanitary sewers in North Cambridge will reduce CSOs by getting stormwater out of the sanitary sewers, but will increase the amount of stormwater being discharged to surface waters. Cambridge has proposed a constructed wetland in the Alewife Reservation to store the additional stormwater runoff resulting from the sewer separation. This proposal is currently under review.

Potential Solutions to Flooding

A number of studies have been completed or are now underway on flood management in the watershed (CDM, 2003). This section summarizes the most recent efforts.

As noted above, FEMA is updating floodplain maps for the watershed (Galvin, 2003). In the meantime, the MDC (now the DCR) developed updated floodplain maps for some areas, using FEMA's current flood level estimates and improved information on topography.

The most comprehensive recent studies in the Mystic Basin are the 1999 CDM study of the Aberjona for the Town of Winchester and the 2002-2003 hydrology and hydraulic study (H&H) by CDM for the Mystic River from the Mystic Lakes to the Amelia Earhart Dam.

CDM's 1999 study for Winchester addressed causes and possible management plans for flooding on the Aberjona River. The study concluded that the spillway elevation at Upper Mystic Lake dam does not significantly impact flooding in the basin upstream of the Wedgemere train station and thus is not a cause of concern. The study recommended that the town work with Woburn on the operation of Horn Pond dam during storms. The major cause of flooding was found to be an overall lack of hydraulic capacity in the river. To remedy this, CDM recommended 16 modifications to structures or channels in the Aberjona.

The Town of Winchester submitted a $13 million set of flood control projects for MEPA review in May 2003, based on the CDM recommendations. The town's request for a Phase I waiver for the entire project was denied, but a waiver has been granted for addition of a large storm pipe to an existing bridge abutment. The overall plan was criticized by some commenters as relying too heavily on engineering solutions. The town is now in the process of preparing a comprehensive Environmental Impact Review for its flood management plan, and may be considering additional alternatives beyond those proposed in the original MEPA filing, including land use policies and regional storage options.

The CDM (2003) H&H modeling study report concluded that:

- The Upper Mystic Lake dam and outlet works configuration do not provide sufficient storage to attenuate large stormwater inflows. Changes in the outlet works that would allow lowering lake levels at the beginning of large storms would be an effective way to lower flood levels in and around the lake.

- No major hydraulic constrictions were found on the Mystic River from Upper Mystic Lake (Upper Mystic Lake) Dam to the Amelia Earhart Dam that would cause high head losses and elevated flood profiles.

- Observed constrictions at the Craddock Dam might have been due to submerged debris at the dam. The DCR has since removed this debris.

- The modeling study also found constriction-related head losses in Alewife Brook at the Broadway and Massachusetts Avenues bridges. However, the combined losses are only 0.4 feet for a 50 year flood. Widening of these bridges might slightly reduce the severity and frequency of flooding along Alewife Brook and Little River, but would be very expensive.

The second phase of the CDM H&H study will focus upon rehabilitation or replacement of the Upper Mystic Lake dam and its possible operations in flood management.

There have been two major efforts to address flooding problems on a regional basis in recent years. Following the October 1996 flood, an effort was instituted by the Town of Winchester to develop a coordinated approach to flood hazard reduction in the Upper Mystic and Aberjona basins. This effort led to signing of a formal Joint Powers Agreement among the towns of Arlington, Burlington, Lexington, Medford, Reading, Stoneham, Wilmington, Winchester, and Woburn, forming the Upper Mystic River Watershed Board. A multi-stakeholder effort received support from FEMA's Project IMPACT program. While the effort resulted in development of additional information on flooding problems and solutions, no coordinated regional management plan for flooding resulted from the work of this group. (Miriam Anderson, FEMA, personal communication, April 22, 2003).

A second regional body, the Tricommunity Flooding Work Group, was formed in 2002. It consists of a formal Joint Powers Agreement among Arlington, Belmont and Cambridge, formed to address flooding problems in the Alewife subbasin. This group held a public forum in April 2003, and has been investigating what is known and not known about the causes and solutions to Alewife area flooding. As part of this effort, engineers from the 3 municipalities have been meeting as a group to share information. This group issued its report in the June 2004.

There have also been a series of more focused flood studies on particular problems. As reported by Kaiser (2002b), these include EIR/EIS reports for some developments and the Jacobs Consulting Services (2000) report for drainage and flooding issues in the North Cambridge area of Alewife Brook.

Data Gaps

The most significant data gap hindering improved understanding of flooding and floodplain management is the lack of reliable flood elevation measurements for much of the watershed. Steve Kaiser has documented significant discrepancies and gaps in the available data on flood elevations in the Alewife subbasin (Kaiser, 2002). He notes that measurements of flood levels have been irregular and often undocumented. The following are some of the available flow and flood level data:

- The longest source of flow data is the Aberjona Gage, which has provided continuous flow records since 1939. This is the only long-term site in the basin.

- The City of Cambridge has had continuous stage recorders at Alewife Brook at Broadway since 1998.
- The MDC/DCR records the continuous pool elevation at the Amelia Earhart Dam.
- The City of Somerville- MyRWA-Tufts EMPACT study has real-time reporting of stages at 5 locations in the basin during the river recreation season from approximately April to October starting in 2002. Locations include Sandy Beach, High Street, Alewife Brook near the Mystic Confluence, Blessing of the Bay Boathouse, and the Amelia Earhart Dam.
- In 2003, Tufts also started a nutrient management study of the watershed including and above the Upper Mystic Lake, where some stage-discharge measurements will be taken for several years.
- Kaiser (2002) reports that the Town of Belmont has stage measurements for Little Pond since 1928 but they have not been reviewed in recent years.
- The US Army Corps of Engineers collected some high water marks resulting from the October 1996 storm (then estimated by the USGS to have a recurrence interval of 50 years). Some have questioned the accuracy of the Corps data (Kaiser, 2002).

In contrast to the lack of consistent data on flood levels, good sources of rainfall data are available for use in evaluating trends in the relationship between rainfall and flooding. The best source of rainfall data is the US National Weather Service site in Boston (covering 130 years). There is also a rain gage at the Aberjona USGS streamflow gage. The Massachusetts Water Resources Authority has been collecting data at some sites in the basin for several years. Finally, there are some data collected by the former State Climatologist in Reading.

Hourly sea level records in Boston are available from The National Oceanographic Survey since at least 1920.

3.4 Priorities for Action

The available information suggests that flooding is the most important hydrologic problem in the Mystic River watershed. Some of the specific problem areas were noted by the 1997 Aberjona and Mystic Rivers Hazard Mitigation Workshop (Winchester, 1997), as follows:

- Limited Data – lack of reliable river elevation data limits analyses of flood management options.
- Outdated Studies – FEMA’s flood insurance studies and the MDC’s hydrology study for the Aberjona and Mystic Rivers were last updated in the early 1980s, and do not reflect land use changes along the river since then.

- Structural Controls – The current inability to use the Upper Mystic Dam to regulate water levels in the lake results in higher water upstream of the lakes.

- Other Concerns -- The role played by groundwater in flood conditions has not been well-studied. In addition, there is limited information on potential risks to downstream areas from dam failure.

While these findings focused on the Upper Watershed, similar problems exist in our current understanding and ability to manage flooding problems elsewhere in the watershed.

Based on the results of past regional flooding efforts, the following are the highest priority needs related to flooding in the watershed:

Take action to protect open space that still exists in the watershed from becoming less pervious, and to improve stormwater management where redevelopment occurs. (See Chapter 5.)

Complete studies of the present extent of flooding and poor drainage in the basin. As described above, there have been numerous flooding and drainage studies in the watershed - particularly in the portion of the watershed including and below the Aberjona. But they are out of date (such as the present FEMA floodplain maps), focused upon a particular reach (for example, the 1999 CDM Winchester study), or not conclusive (such as the CDM (2003) report). Additional study is needed to resolve discrepancies among metered data and between metered and modeling results.

- Determine the causes of river flooding and drainage problems throughout the watershed. Little attention has been paid to flood problems in areas other than Aberjona, Alewife Brook, and Mystic River from the Upper Mystic Lake to the Amelia Earhart Dam. In particular, more analysis is needed of the Malden River and Mystic 2 subbasins.

- Improve understanding of the hydrologic connections among the subbasins – for example, the effect of peak flood levels in the Mystic River on flooding in Alewife Brook.

- Develop flood and drainage management strategies. Watershed-wide and basin-specific strategies must consider the following factors:

- Effect of structural changes in each community that will move water through faster on the potential for flooding in adjacent communities.

- Options for cost-effective regional storage strategies.

- Effect of compliance with the Phase II Stormwater regulations and CSO projects on future flooding.

- The potential for increased coastal flooding due to land subsidence and climate change in the basin below the Amelia Earhart Dam.

- The potential for more CSO problems due to higher sea levels and greater storm intensities.

* Install additional gages in the watershed to improve information on potential low flows, as well as flooding.

* Investigate the causes of low flows in the Aberjona subbasin.

Specific actions to address these needs are recommended in Chapter 8.

Chapter 4. Water Quality

Chapter Contents

4.1 Introduction and Methodology

A substantial part of the assessment effort conducted for this report involved compiling and analyzing the available data on water quality throughout the watershed. Especially in some portions of the watershed, significant monitoring work has been done over the past 30+ years. This monitoring was performed for a variety of purposes, and has never been compiled in a way that would facilitate comparing water quality across sites and over time. For this assessment, we compiled all the water quality sources we could locate that represent more than isolated one-time studies. Data were subject to QA/QC review, and organized by location of sampling sites. An initial analysis of this database provided the basis for this assessment report. The database will prove very valuable in the future, as well, to support more detailed studies of particular pollutants and locations. The location of sites for which sampling data were compiled are shown in Figures 2-2 through 2-10.

Data were compiled from studies by the following parties over the period 1967 through 2002:

- United States Environmental Protection Agency – STORET Program
- United States Geological Survey (USGS)
- USGS National Ambient Water Quality Assessment (NAWQA) Program
- Massachusetts Water Resources Authority (MWRA)
- Massachusetts Department of Environmental Protection (MADEP)
- Massachusetts Water Resources Commission (MWRC)
- Metropolitan District Commission (MDC)
- Mystic Monitoring Network (MyRWA)
- Tufts University

Appendix B provides a more detailed discussion of the sources used, the sampling locations, and steps taken to create the database. Appendix C provides detailed results that support the summary data reported in this chapter for each subbasin.

4.2 Overview of Results

We assessed the watershed's water quality by comparing monitoring results with the state's water quality standards for specific pollutants and, where there are no numerical standards, with other guidelines. These standards and guidelines are listed in Table 4.1.

Table 4.1: Water Quality Standards for Class B Waters and Other Guidelines

Parameter	Criteria Denoting a Violation	Source
Dissolved Oxygen	Less than 5.0 mg/L Saturation less than 60%	Massachusetts Water Quality Standards 314 CMR 4.00
Temperature	Greater than 28.3 C	Massachusetts Water Quality Standards 314 CMR 4.00
pH	Below 6.5 or above 8.3	Massachusetts Water Quality Standards 314 CMR 4.00
Fecal Coliform	Greater than 200 colonies per 100 mL	Massachusetts Water Quality Standards 314 CMR 4.00
Enterococcus	Greater than 33 colonies per 100 mL	Massachusetts Minimum Standards for Bathing Beaches State Sanitary Code 105 CMR 445.000
E. Coli	Greater than 126 colonies per 100 mL	Massachusetts Minimum Standards for Bathing Beaches State Sanitary Code 105 CMR 445.000
Total Nitrogen	Greater than or equal to 0.30 mg/L (0.15 mg/L in lakes)	Massachusetts Water Watch Partnership Data Interpretation Manual
Total Phosphorus	Greater than or equal to 0.05 mg/L (0.025 mg/L in lakes)	Massachusetts Water Watch Partnership Data Interpretation Manual
Total Suspended Solids	Greater than 10.0 mg/L (guideline for aquatic life)	Massachusetts Water Watch Partnership Data Interpretation Manual

Massachusetts Department of Environmental Protection (May 12, 2000). *Massachusetts Water Quality Standards 314 CMR 4.00*.
Schoen, J. and Walk, M. (June 2002). *Data Interpretation Manual*, Massachusetts Water Watch Partnership, Amherst, MA.
Massachusetts Department of Environmental Protection. *Massachusetts Minimum Standards for Bathing Beaches State Sanitary Code 105 CMR 445.000.*

As might be expected in a watershed with the Mystic's history and current urban land use, many of the waterbodies frequently do not meet the standards for their designated uses or that exceed the other guidelines used in this report.. Table 4.2 shows the Mystic waterbodies that are currently listed as impaired on the Massachusetts 303(d) list, along with the pollutants causing the impairments. It is important to note that the guidelines used for nitrogen, phosphorus and TSS are not official state water quality standards, but rather have been suggested as a benchmark by the Massachusetts Water Watch Partnership for volunteer water quality monitoring programs.

Table 4.2: Waterbodies on the 2002 Clean Water Act §303d List of Impaired Waters

Subbasin	Waterbody	Segment #	Class[1]	Causes of Impairment
Aberjona River	Aberjona River	MA71-01	Class B (WW, CSO)	NH_3, organic enrichment/low DO, and pathogens
	Judkins Pond	MA71-021		nutrients, organic enrichment/low DO, pathogens
Alewife Brook	Alewife Brook	MA71-04	Variance (WW)	pathogens
	Spy Pond	MA71-040		nutrients, organic enrichment/low DO, noxious aquatic plants
	Clay Pit Pond	MA71-011		pesticides

Table 4.2: Waterbodies on the 2002 Clean Water Act §303d List of Impaired Waters

Subbasin	Waterbody	Segment #	Class[1]	Causes of Impairment
Chelsea Creek		MA71-06	Class SB (CSO)	NH_3, organic enrichment/low DO, pathogens, oil & grease, taste, odor & color, turbidity
Horn Pond	Horn Pond	MA71-19	Class B (WW)	nutrients, organic enrichment/low DO, noxious aquatic plants
	Wedge Pond	MA71-045		nutrients, noxious aquatic plants
	Winter Pond	MA71-047		noxious aquatic plants
Malden River	Malden River	MA71-05	Class B (WW)	organic enrichment/low DO, pathogens, suspended solids
	Ell Pond	MA71-014		nutrients, suspended solids, pathogens
Mystic River 1[2]	Mystic River	MA71-02	Variance	metals, nutrients, pathogens
	Bellevue Pond	MA71-004		noxious aquatic plants
Mystic River 2[3]	Mystic River	MA71-03	Class SB (CSO)	NH_3, organic enrichment/low DO, pathogens, oil & grease, taste, odor & color, turbidity

[1]Restrictions (shown in parentheses) may affect how water quality criteria are applied under 314 CMR 4.00. WW = warm water fishery, which indicates that dissolved oxygen and temperature criteria for warm water fisheries apply; CSO = combined sewer overflow, which indicates waters are impacted by the discharge of sewage mixed with stormwater.
[2]Mystic River 1 is from the outlet of Lower Mystic Lake to the Amelia Earhart Dam.
[3]Mystic River 2 is from the Amelia Earhart Dam to the confluence with the Charles River in Boston Harbor.

Sources http://www.epa.gov/iwi/303d/01090001_303d.html
http://www.state.ma.us/dep/bwp/iww/files/314004.pdf
http://www.mass.gov/dep/brp/wm/files/2004il2.pdf

In addition to the 303(d) listing, our analysis of the available water quality data and other evidence suggests that some additional 303(d) listings are appropriate. Recommendations for additional listings are presented in the discussion of each subbasin.

The most common pollutants are pathogens, nutrients, and organic enrichment/low dissolved oxygen (DO). Toxic metals and organics in the water column have not been assessed extensively, with some exceptions. Waters in the lower part of the watershed (the Mystic River 2 and Chelsea Creek subbasins) are also listed for oil & grease, odor & color, and turbidity, which suggests a more complex "soup" of pollutants than found elsewhere in the watershed.

Despite the large number of samples taken in the watershed between 1967 and 2002, it is difficult to discern significant long-term trends in water quality. To assess trends over time, we compared samples exceeding relevant water quality standards or other guidelines between the period 1967-1997 and the period 1998 – 2002. There were only a few cases where sufficient samples had been taken during both time periods at the same sampling sites to provide reasonable evidence of trends. Where there was sufficient consistency in sampling locations across the two periods, there were only a few locations where major trends were observed. Cases where trends were evident are discussed in the sections on each subwatershed, below.

Much more work is needed to analyze the available water quality data. For example, comparing sampling sites located close to each other, though not in identical locations, may provide additional insight into water quality trends. In addition, trends may be evident over shorter time horizons than evaluated here. Finally, the Mystic River Watershed Association's (MyRWA's) monthly baseline monitoring data at 10 sites, begun in 2000, will soon have enough sample observations to begin use for trend analysis. These MyRWA data have not yet been assessed for trends, since meaningful trend analysis will require enough observations to allow controlling for the effects of precipitation. An analysis of trends using the MyRWA data is planned for 2005.

Sediment data has not yet been compiled in a comprehensive and consistent database. Specific studies are discussed in the section on each subbasin. The Watershed Initiative Mystic Basin Team included among its priority projects sediment sampling by the USGS. That sampling has been completed, but the results had not been published at the time this report was prepared. Once those results are published, a systematic review of sediment quality should be done to assess impacts and identify priorities for potential remediation.

The most important current pollutant source throughout the watershed is likely to be general urban runoff and sewage discharges from Combined Sewer Overflows (CSOs) and inadequate stormwater and sanitary sewer systems. There are also a large number of hazardous waste sites throughout the watershed, as shown in Appendix D. These hazardous waste sites are generally not believed to be significant current contributors to water quality problems, although there are some notable exceptions. For example, the old coal gasification site on the Island End River is still discharging pollutants into the river. Appendix E lists the facilities holding NPDES permits to discharge directly into surface waters. Appendix F lists specific pipes that have been cited by EPA and DEP under their §308 actions against six municipalities, requiring investigation and remediation of defective sewers and illegal connections that contribute to bacteria loadings. The sources listed in these appendices should be investigated as possible sources of current pollutant loadings, as part of TMDL development throughout the watershed. The location of hazardous waste sites and CSOs are noted on the maps shown in Chapter 2 (Figures 2-2 through 2-10).

4.3 Results and Priorities for Action by Subbasin

4.3.1 Aberjona River Subbasin

Pollutant Sources

The Aberjona River and Judkins Pond in Winchester center are both on the §303d list of impaired waterways (Table 4-2). Both are listed for organic enrichment/low dissolved oxygen and pathogens. Judkins Pond is also listed for nutrients, and the Aberjona is also listed for unionized ammonia (NH_3). Other known sources of pollution in the watershed include wastewater discharges and hazardous waste disposal sites. There are 15 wastewater dischargers in the subbasin; of these, three are unpermitted and one is a major discharger, Olin Chemical in Wilmington, which dischargers to a tributary of the Aberjona.

Between the 1860s and the 1980s, the Aberjona subbasin was home to several chemical-intensive industries, including chemical manufacturing and leather tanning. The history of these industries has been well documented in the literature (e.g., Aurilio et al., 1995; Durant et al., 1990; Tarr, 1986). A significant chemical legacy remains from these industries and there are now many sites on the watershed that are contaminated with hazardous wastes. Two sites – IndustriPlex and Wells G&H – were so grossly contaminated that they are on the National Priorities List of sites eligible for funding under CERCLA (aka "Superfund"). The chemicals of concern at IndustriPlex included arsenic, chromium, and lead in the soil and plumes of toluene, benzene and dissolved arsenic in the groundwater.[1] Davis et al. (1994) reported that there has been significant offsite migration of arsenic and that a large amount of arsenic is accumulating in the sediments of Halls Brook Holding Area Pond, just south of the IndustriPlex site. The Wells G&H site is contaminated with trichloroethane, tetrachloroethane and other chlorinated solvents. In addition to the two Superfund sites, the state has identified 31 other sites in the subbasin where hazardous chemicals have been released (see Appendix D).

Water Quality Assessment

Table 4.3: Summary of Aberjona Water Quality Results

Parameter	Standard	1967-1997 (20 sites)		1998-2002 (4 sites)		Total Period 1967-2002 (20 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Fecal coliform	Class B >200 cfu/100 ML	279	45%	109	86%	388	56%
Fecal coliform	Class C > 1000 cfu/100 ML	279	16%	109	38%	388	22%
Enterococcus	>33 cfu/ML	0	-	56	100%	56	100%
E. Coli	>126 cfu/100ML	0	-	18	100%	18	100%
Dissolved Oxygen	<5 mg/L	299	8%	59	7%	358	8%
Dissolved Oxygen Saturation	<60+ %	316	4%	39	13%	355	5%
Dissolved Oxygen Sat. Calculated	<60%	9	40%	94	18%	103	20%
Temperature	>28.3^{o}C	298	0%	57	0%	355	0%
pH	<6.5 or >8.3	357	8%	59	0%	416	7%
Total Suspended	>10 mg/L	0	-	39	5%	39	5%

[1]http://www.epa.gov/region01/superfund/sites/industriplex/, accessed May 2003.

Table 4.3: Summary of Aberjona Water Quality Results

Parameter	Standard	1967-1997 (20 sites)		1998-2002 (4 sites)		Total Period 1967-2002 (20 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Solids (TSS)							
Total Nitrogen	>0.3 mg/L	0	-	112	100%	112	100%
Total Phosporous	>0.05 mg/L	373	71%	141	36%	514	61%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

A significant amount of water quality data exists for the Aberjona subbasin. In addition to studies done in conjunction with the cleanup of the two Superfund sites, EPA recently investigated a ten-kilometer section of the Aberjona for hazardous chemicals that have been transported downstream from the Superfund sites (Metcalf & Eddy, 2002). Also, in the last ten years Prof. Harold Hemond and his students at MIT have performed several chemical-specific fate and transport studies on the river. These studies have greatly expanded knowledge of the importance of the river in transporting chemicals (e.g., toxic metals) to Upper Mystic Lake into which the Aberjona discharges. A third significant source of water quality data is the United States Geological Survey. Since the 1930s, the USGS has maintained a flow gauging site on the river just south of Winchester center. For the last five years, the USGS has monitored this site for nutrients, pesticides, and volatile organic compounds under its National Ambient Water Quality Assessment (NAWQA) program (http://water.usgs.gov/; accessed May 2003).

Overall, a total of twenty sites in the Aberjona subbasin were monitored at least once during the period 1967 through 2002. The data show that a relatively high percentage of samples contained elevated levels of bacteria and nitrogen. In addition, a very high percentage of the samples exceeded the guideline level for used in this report for total phosphorus (0.05 mg/L).

As shown in Table 4-3, far fewer sites have been routinely monitored in the subbasin over the last five years than during earlier years. Table 4-3 also suggests that water quality over last five years has not significantly changed compared with the earlier period. In fact, a higher percentage of samples show exceedances for bacteria in recent years, although there has been a decline in the percentage of Total Phosphorous exceedances.

Sediment Quality

Although several studies have been done to characterize sediment quality in the Aberjona subbasin, the data from those studies have yet to be combined and analyzed as a whole. The most comprehensive study, in terms of chemicals analyzed and river-kilometers assessed, was recently completed by the EPA (Metcalf & Eddy, 2002). In this study, over 200 sediment samples from the river and wetland areas were analyzed for priority elements and organic compounds[2]. Previously, Knox (1991) analyzed sediment samples from over 100 sites for the presence of toxic elements (e.g., arsenic, chromium, lead, cadmium, copper, and zinc). Also, Davis et al (1994) report that there has been significant accumulation of arsenic, chromium, lead and other toxic elements in the sediments of Halls Brook Holding Area Pond, and Spliethoff and Hemond (1996) report similar findings for Upper Mystic Lake. Based on these studies, the picture that has emerged is that sediments near chemical disposal sites (e.g., Halls Brook Holding Area Pond), in depositional areas along the river (e.g., the Wells G&H wetland), and Upper Mystic Lake are grossly contaminated with toxic elements. The major transport mechanism for the elements appears to be transport of contaminated sediments from erosional to depositional areas along the river (Solo-Gabrielle, 1995).

Priorities

Based on the review of the available water quality and other information, the following priority actions are recommended for the subbasin:

1. Identify and control major sources of bacteria loadings to the Aberjona.

It has long been known that the Aberjona is contaminated with sewage bacteria. Development and implementation of a TMDL is needed to control sewage inputs to the river. High levels of *Enterococcus* are present in the river during wet weather and dry weather, suggesting that a two-part strategy may be necessary to identify the major sources of bacteria pollution. During dry weather, stormwater pipes that are actively discharging “dry-weather baseflow” should be sampled and analyzed for the presence of sewage bacteria. If pipe discharge is not found to be the major source, then the river should be analyzed in sections (reaches) to identify contaminated groundwater discharge areas, and tributary streams and brooks should be investigated to identify contaminated surface water inputs. A similar methodology should be adopted for identifying “hotspots” during wet weather. Ideally, sampling should be done before, during, and after peak wet-weather flows at a given pipe or river site to identify the sources of stormwater bacterial loadings.

2. Identify and control major sources of unionized ammonia (NH_3) loadings to the Aberjona.

A TMDL should also be developed for NH_3 in the river. A hotspot identification strategy similar to the one outlined above for bacteria could be used. It is possible that bacteria and NH_3 derive from the same sources (e.g., sewage); therefore, some economy may be achieved by sampling for both parameters simultaneously.

3. Add “metals” to the §303d list as a cause of water quality impairment.

There is evidence that arsenic and other metals are being transported in significant amounts by the Aberjona River. Therefore, it is recommended that this evidence (e.g., Aurilio et al., 1996; Solo-Gabrielle, 1995; Davis et al., 1994; EPA, 2002) be carefully studied by the MA-DEP to determine whether the river and contaminated ponds and lakes in the subbasin – Halls Brook Holding Area Pond, in particular – should be on the §303d list as being impaired with metals. If it is determined that waterbodies in the subbasin should be listed for metals impairment, then a

[2] The EPA study is currently available for public comment and was not analyzed as part of this report.

TMDL should developed in a timely manner to limit further impacts to receiving waters. The results of EPA's current risk assessment of the Aberjona, associated with the two Superfund sites, were not available in time for this assessment report, but should provide important information on the need for a metals 303(d) listing and TMDL.

In addition to these priority actions for improving water quality in the subbasin, three actions are recommended based on the preliminary sediment quality assessment: (1) the available sediment data should be compiled into a single database; (2) the database should then be assessed with respect to appropriate sediment quality guidelines (e.g., those used in USGS, 2002); and (3) based on the assessment, actions should be proposed for addressing priority sediment contamination issues.

4.3.2 Horn Pond Subbasin

The quality of the well water from the Horn Pond aquifer is generally excellent (Chute, 1999). In contrast, the surface water in the pond itself is on the §303d list for being impaired with nutrients, organic enrichment/low DO, and noxious aquatic plants (Table 4-2). Wedge Pond is on the §303d list as being impaired by nutrients and noxious aquatic plants (Table 4-2). Whitman and Howard (1988, 1986) performed limnological studies on both ponds and reported that the low DO levels and excessive plant growth were symptomatic of high nutrient loadings from the watershed. Limited monitoring data also suggest that bacteria pollution is a problem in this subbasin.

Pollutant Sources

With the exception of nutrients in Horn Pond and Wedge Pond, there is no evidence of significant water pollution in this subbasin, although monitoring has been limited and sediments may be contaminated. There are no NPDES-permitted wastewater dischargers in the subbasin. Although there are 20 hazardous waste disposal sites (Appendix D), only one site (H10), a former oil storage area, is listed in the Tier 1A category. The majority of the other sites are contaminated with small amounts of petroleum hydrocarbons. The subbasin is relatively developed, particularly around Wedge Pond; therefore, it is likely that urban runoff is a significant source of nutrients and other materials – sand, roadsalt, suspended solids – to the ponds. Tannery waste is a historical source of pollutants to Wedge Pond, having been discharged to Russell Brook, a tributary to Horn Pond Brook in Winchester (now a buried culvert). Between 1870 and 1930, nearly 25 tanneries were in business along the brook in Woburn and north Winchester. Tanneries use metals for tanning animal hides and for coloring and providing texture to finished leather (Durant et al., 1990). It is possible that tannery wastes may have contributed to the high levels of metals detected in the sediment cores from the pond.

Water Quality Assessment

Table 4.4 summarizes the limited available water quality results for the Horn Pond subbasin.

Table 4.4 Summary of Horn Pond Water Quality Results

Parameter	Standard	1980-1981 (4 sites) No. of Samples	1980-1981 (4 sites) Percent Exceeding Standard
Fecal coliform	Class B >200 cfu/100 ML	14	64%
Fecal coliform	Class C > 1000 cfu/100 ML	14	22%
Enterococcus	>33 cfu/ML	0	-
E. Coli	>126 cfu/100ML	0	-
Dissolved Oxygen	<5 mg/L	14	0%
Dissolved Oxygen Saturation	<60+ %	7	14%
Dissolved Oxygen Sat. Calculated	<60%	0	-
Temperature	>28.3^{o}C	14	0%
pH	<6.5 or >8.3	135	5%
Total Suspended Solids (TSS)	>10 mg/L	0	-
Total Nitrogen	>0.3 mg/L	0	-
Total Phosporous	>0.05 mg/L	14	93%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Relatively little information exists on water quality in the Horn Pond subbasin. As shown in Table 4-4, only four sites have been monitored, and the last time was in 1981. The results in Table 4-4 indicate that, with the exception of fecal coliform bacteria and total phosphorus, the water quality parameters were within acceptable limits for Class B waters. Relatively high levels of fecal coliforms (>1,000 cfu/100mL) were observed in some of the samples, and in all of the samples total phosphorus levels exceeded 0.05 mg/L. No data were found on hazardous chemicals (e.g., toxic metals, pesticides, hydrocarbons, solvents or other organic compounds) in surface waters.

Sediment Quality

Some effort has been made to characterize the sediments in Horn Pond and Wedge Pond. Knox (1991) collected shoreline surface sediment grab samples as well as sediment cores from Horn Pond, and analyzed the samples for toxic elements, including arsenic, chromium, copper, lead, cadmium, zinc and nickel. With the exception of the levels of lead, which were somewhat elevated in the sediment core, the concentrations of these elements in the sediments were not significantly different than regional background levels. Both Knox (1991) and Durant (1993) analyzed sediment core samples from Wedge Pond and reported that the levels of arsenic, lead, chromium, zinc, and copper were significantly elevated, particularly in the deeper sediment layers. Durant (1993) also reported that sediments in the deepest parts of the pond contained elevated levels of polycyclic aromatic hydrocarbons (as much as 10-fold higher than background).

Priorities

Based the available water quality data and other information that was reviewed for the subbasin, two priorities were identified:

1. Identify and control major sources of nutrients in Wedge Pond and Horn Pond.
A nutrient TMDL should be developed and implemented for this subbasin. As part of that effort, nutrient loading from major point sources as well as nonpoint sources should be quantified, including from the sediments of the two ponds. If the internal loading from pond sediments is a significant fraction of the total, then it may be necessary to implement measures to reduce the internal loading (e.g., by adding alum).

2. Conduct additional water quality sampling in Wedge Pond and Horn Pond.
Water quality in Horn Pond, Wedge Pond and their major tributaries has not been routinely assessed for many years. A program of regular monitoring (e.g., quarterly or semi-annual) is recommended to fill this data gap. Since Horn Pond and Wedge Pond are used for recreation, it would be particularly useful to assess bacteria levels in these waters. In addition, sampling of these ponds should be done as part of implementing the recommended bacteria TMDL for the Aberjona River.

4.3.3 Mystic Lakes Subbasin

Pollutant Sources

Although the lakes are not on the §303d list of impaired waterways, there are several known and suspected sources that contribute pollutants to the lakes. Upper Mystic Lake is the receiving water for the Aberjona River, which is on the §303d list for unionized ammonia (NH_3), organic enrichment/low DO and pathogens (Table 4-2). The Aberjona also contributes loadings of pesticides, volatile organic compounds, and toxic elements (e.g., arsenic, chromium, lead) to the upper lake (http://water.usgs.gov/, accessed May 2003; Solo, 1995). The sediments of both lakes, particularly Upper Mystic Lake, contain significantly elevated levels of lead, arsenic, chromium and other toxic elements which were released by chemical manufacturing and leather tanning companies on the Aberjona watershed (Knox, 1991; Spliethoff and Hemond, 1996). Under certain conditions, sedimentary metals may be remobilized into the water column. Sewage bacteria are also entering the lakes from several sources: a stormwater pipe in Winchester was issued a §308 information request related to discharge of sewage to Upper Mystic Lake (see Appendix F); Winchester has an NPDES permit to operate a CSO on the Upper Mystic (Appendix E); and Mill Brook appears to be a source of sewage bacteria loadings to

Lower Mystic Lake. It is suspected, but not proven, that Herb Meyer Brook, which drains the Winchester Country Club golf course, may be a source of nutrient loadings to Upper Mystic Lake.

Water Quality Assessment

Table 4.5 summarizes the available water quality results for the Mystic Lakes subbasin.

Table 4.5: Summary of Mystic Lakes Water Quality Results

		1967-1997 (2 sites)		1998-2002 (2 sites)		Total Period 1967-2002 (2 sites)	
Parameter	**Standard**	**No. of Samples**	**Percent Exceeding Standard**	**No. of Samples**	**Percent Exceeding Standard**	**No. of Samples**	**Percent Exceeding Standard**
Fecal coliform	Class B >200 cfu/100 ML	56	7%	70	26%	126	18%
Fecal coliform	Class C > 1000 cfu/100 ML	56	2%	70	6%	126	4%
Enterococcus	>33 cfu/ML	0	-	61	23%	61	23%
E. Coli	>126 cfu/100ML	0	-	0	-	0	-
Dissolved Oxygen	<5 mg/L	64	0%	20	0%	84	0%
Dissolved Oxygen Saturation	<60+ %	0	-	20	0%	20	0%
Dissolved Oxygen Sat. Calculated	<60%	0	-	30	0%	30	0%
Temperature	>28.3^{o}C	63	0%	19	0%	82	0%
pH	<6.5 or >8.3	38	6%	17	12%	55	8%
Total Suspended Solids (TSS)	>10 mg/L	0	-	18	0%	18	0%
Total Nitrogen	>0.3 mg/L	0	-	0	-	0	-
Total Phosporous	>0.05 mg/L	81	58%	17	6%	98	49%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Since the 1970s, water quality data have been collected at two sites on Upper Mystic Lake: Sandy Beach and the lake outlet. A summary of the last five years of water quality data in Table 4-5 indicates that water quality is generally good at the two sites, but about 25% of the samples collected from Sandy Beach exceeded the swimming standards for fecal coliform and *Enterococcus* bacteria. (Note: the beach was closed for 3 weeks during the summer of 2002 due to bacterial contamination (M. Doolittle, MDC, Boston, personal communication, 2003).) A large fraction of the samples (particularly those from before 1998) from both sites were also above the guideline limit of 0.05 mg/L used in this report for total phosphorus. No sites on Lower Mystic Lake have been regularly monitored for water quality. As in the Aberjona subbasin, fecal coliform exceedances are somewhat worse and Total Phosphorous exceedances are somewhat less common in recent years than in the earlier period.

Sediment Quality
Spliethoff and Hemond (1996) showed that the sediments of Upper Mystic Lake contain very high levels of toxic elements, including arsenic, chromium and lead. While the maximum concentrations of these elements (>2,000 ppm) are in excess of the action levels for soil, the most contaminated sediments appear to be deeply buried in areas far removed from human contact. Sedimentary arsenic can dissolve into the water column under anoxic conditions; thus, concerns have been raised that remobilized arsenic could pose a risk to recreational boaters and swimmers. However, research by Aurilio et al. (1994) and Spliethoff et al. (1995) has shown that arsenic levels in the lake, particularly near the lake surface, are very low (i.e., <2 ug/L on average). Senn and Hemond (2002) have demonstrated that arsenic remobilization from the sediments is controlled – even during long periods of anoxia in the summer – by high levels of nitrate in the lake water.

The sediments of Lower Mystic Lake are also contaminated with arsenic, chromium and lead, but the maximum levels appear to be much lower than in Upper Mystic Lake (Knox, 1991). Arsenic levels in the water column of the Lower Mystic Lake are generally higher than in the Upper Mystic (Aurilio et al., 1994). This may be attributable to the salty water layer at the bottom of Lower Mystic and other chemical differences between the two lakes. Mercury levels also appear to be elevated in the bottom waters of the Lower Mystic. Mercury is a concern because it tends to bioaccumulate in fish; however, fish collected from the lake appear to be within in the accepted limit of 0.5 µg/g (MA-DEP, 2002b).

Priorities
Based on the available water quality data and information for the subbasin, particularly the two lakes, a major priority is to identify and control the sources of bacteria that are impacting Sandy Beach.

1. Identify and control major source(s) of sewage bacteria loadings to Sandy Beach.
A plan of study should be developed and carried out to identify the sources of bacteria to the beach area. The list of potential sources includes the Aberjona River (which is on the §303d list for pathogens), stormwater pipes that discharge into the lake, leaky sewage pipes, and the beach sediments. Data from the EMPACT project analysis performed at Tufts University indicate that the majority of bacterial exceedences are associated with rainstorms

(http://www.mysticriveronline.org, accessed May 2003); therefore, stormwater sampling should be a major component of the source identification strategy.

4.3.4 Mill Brook Subbasin

Pollutant Sources

Mill Brook is not on the §303d list of impaired waterbodies, and with the significant exception of sewage bacteria, there is no current evidence that the brook is impaired by pollutants. As shown in Appendix D, there are seventeen hazardous waste disposal sites in the subbasin. However, most of the releases are relatively small and the waste chemicals have been contained on site. There is one minor NPDES-permitted discharger of wastewater in the subbasin (Appendix E).

Water Quality Assessment

Table 4.6 summarizes the available water quality results for the Mill Brook subbasin.

Table 4.6: Summary of Mill Brook Water Quality Results

Parameter	Standard	1967-1997 (5 sites)		1998-2002 (2 sites)		Total Period 1967-2002 (7 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Fecal coliform	Class B >200 cfu/100 ML	43	37%	30	97%	73	61%
Fecal coliform	Class C > 1000 cfu/100 ML	43	19%	30	63%	73	37%
Enterococcus	>33 cfu/ML	0	-	0	-	0	-
E. Coli	>126 cfu/100ML	0	-	8	100%	8	100%
Dissolved Oxygen	<5 mg/L	109	4%	29	0%	138	3%
Dissolved Oxygen Saturation	<60+ %	0	-	20	10%	20	10%
Dissolved Oxygen Sat. Calculated	<60%	0	-	42	7%	42	7%
Temperature	>28.3°C	108	0%	29	0%	137	0%
pH	<6.5 or >8.3	69	7%	30	3%	99	6%
Total Suspended Solids (TSS)	>10 mg/L	0	-	20	35%	20	35%

Table 4.6: Summary of Mill Brook Water Quality Results

Parameter	Standard	1967-1997 (5 sites)		1998-2002 (2 sites)		Total Period 1967-2002 (7 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Total Nitrogen	>0.3 mg/L	0	-	10	100%	10	100%
Total Phosporous	>0.05 mg/L	116	83%	29	72%	145	81%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Relatively few water quality data are available for Mill Brook. As shown in Table 4-6 and Appendix C, only one site (MIL0.062) on the brook is currently being monitored. This site was first monitored in 1999 by the USGS. It is now being monitored on a monthly basis by the Mystic River Watershed Association's Mystic Monitoring Network program. One other site was monitored in 1999-2000. Before 1999, four other sites were monitored on the brook, but the last time they were monitored was in 1981. According to the detailed data reported in Appendix C, the lower portion of the brook (just upstream of Lower Mystic Lake) is significantly impacted by sewage bacteria and nutrients. Between 1999-2002, thirty samples were collected at MIL0.062 and all but one exceeded the swimming standard for fecal coliform bacteria (200 cfu/100 mL) and 70% exceeded the boating standard (1,000 cfu/100 mL). The majority of these samples were collected during dry weather, which strongly suggests that improper discharges of sewage were the source of the bacteria. In addition, all of the samples exceeded the total nitrogen guideline and 72% exceeded the total phosphorus guideline used in this report. It is likely that the nitrogen and phosphorous also derived from sewage inputs to the brook.

Sediment Quality

Only one study was found that describes the sediment quality in Mill Brook. Ivushkina (1998) collected samples from 14 quiescent areas along the open (unculverted) sections of the brook – from Lower Mystic Lake to Great Meadows in Lexington. The samples were relatively free of toxic metals (e.g., lead, chromium, copper, zinc) and arsenic; however, the samples only contained small amounts of organic-rich, fine-grained sedimentary material that typically has a high affinity for metals. The relatively low amount of contaminated sediment in the brook is likely attributable to sediment scour rather than a lack of historic sources of contamination in the watershed. Background levels of metals in the sediments of urban ponds, lakes and depositional areas along rivers are typically higher than those found on Mill Brook.

Priorities

The most significant water quality problems in the brook are due to inputs of raw sewage; therefore, a priority for the subbasin is to identify and control the sources of sewage entering the brook.

1. Identify and control major source(s) of bacteria loadings to Mill Brook.

Because much of the sewage entering the brook appears to derive from dry-weather discharge, areas contributing to specific problem pipes should be investigated for cross-connections, illegal connections and inflow & infiltration (I&I) problems.

4.3.5 Mystic River 1 Subbasin

Pollutant Sources

Mystic River 1 is on the §303d list for nutrients, metals, and pathogens (Table 4-2). The sources of these pollutants have not been determined; however, due to the very urban character of this subbasin, it is likely that multiple sources are responsible. The majority of the pathogens derive from CSO and sanitary sewer discharges and from stormwater runoff released either directly to the Mystic or to its tributaries. There are seven active CSOs on the Alewife Brook. Treated stormwater is also occasionally released to Mystic River 1 from the Somerville Marginal treatment plant near Assembly Square. In addition, Arlington, Belmont, Cambridge, Medford, and Somerville have all received §308 letters requesting information on sanitary sewage discharges from stormwater pipes (see Appendix F). Nutrients (particularly certain forms of nitrogen) are also commonly found in sewage; phosphorus and various metals (e.g., zinc) are typically present in urban stormwater runoff. Because of the Amelia Earhart dam, the river is poorly flushed, and this has led to sediment accumulation along much of the length of the river. It is likely that the sediments are a source of nutrients and metals to the water column.

Another source of pollutants to the Mystic River is permitted discharges of wastewater. Including the CSO in Somerville, there are 10 NPDES-permitted wastewater discharges in the subbasin, and three known unpermitted discharges (Appendix E). Direct releases of hazardous chemical wastes are not known to be a problem in the subbasin. While there are 45 hazardous wastes sites in the subbasin that are currently under investigation by MA DEP (Appendix D), no evidence is available that indicates that chemicals from these sites have leached into the river.

Water Quality Assessment

Table 4.7 summarizes the available water quality results for the Mystic River 1 subbasin.

Table 4.7: Summary of Mystic River 1 Water Quality Results

Parameter	Standard	1967-1997 (21 sites)		1998-2002 (10 sites)		Total Period 1967-2002 (22 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Fecal coliform	Class B >200 cfu/100 ML	955	42%	1,019	38%	1,974	39%
Fecal coliform	Class C > 1000 cfu/100 ML	955	12%	1,019	10%	1,974	11%
Enterococcus	>33 cfu/ML	0	-	960	46%	960	46%
E. Coli	>126 cfu/100ML	0	-	9	44%	9	44%
Dissolved Oxygen	<5 mg/L	992	2%	891	10%	1,883	6%
Dissolved Oxygen Saturation	<60+ %	0	-	880	12%	0	-
Dissolved Oxygen Sat. Calculated	<60%	0	-	880	12%	880	12%
Temperature	>28.3^{o}C	1.021	0%	895	0%	1,916	0%
pH	<6.5 or >8.3	269	29%	781	19%	1,050	22%
Total Suspended Solids (TSS)	>10 mg/L			431	23%	431	23%
Total Nitrogen	>0.3 mg/L	95	98%	397	100%	492	100%
Total Phosporous	>0.05 mg/L	285	6%	436	68%	721	68%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Of all the subbasins in the Mystic Watershed, Mystic River 1 has received the most attention in terms of water quality monitoring. The oldest records are from a Massachusetts Water Resources Commission study in 1967. Since then, this section of the Mystic has been studied by several state and federal agencies as well as Tufts University. In all, a total of 22 sites have been monitored (see Table 4-7). According to the summaries in Tables 4-7 for the entire period of record (1967-2002), the water quality standards and guidelines for sewage indicator bacteria, nutrients and TSS are exceeded in a high percentage of the samples at many sites along the river. There is no evidence that water quality in the river has substantially improved (or worsened) in the last 5 years as compared to earlier years. The data in Table 4-7 are consistent with Mystic River 1 being on the §303(d) list for nutrient and pathogen impairment.

Sediment Quality

Relatively few historical sediment quality data are available for this subbasin. In the one study that was found (Downs, 1999), data from surface sediment grab samples collected in the river do not indicate significant contamination. Although, the levels of metals – e.g., arsenic, chromium, lead, and zinc – are elevated with respect to background, they are within the range that is typical of urban waterbodies. A study that included sediment core sample collection at the Amelia Earhart Dam was performed in 2002 by the USGS; however, the results of the study have not yet been published (Rob Breault, USGS, Marlboro, MA; personal communication, 2003).

Priorities

In terms of water quality, the most important priorities for the subbasin are to identify and control the major sources of bacteria, nutrients, and metals to the river. Another priority is to control the growth of nuisance aquatic weeds in Bellevue Pond in Medford.

1. Identify and control major source(s) of bacteria, nutrients, and metals to Mystic River.
Due to the multiplicity of pollutant inputs in this subbasin, it is reasonable to suggest that these three classes of pollutants may derive from the same general sources. In particular, it is likely that CSO discharges to the Alewife Brook and stormwater runoff are major contributors of bacteria, nutrients, and metals to the river. Therefore, considerable economies would be gained by developing a monitoring and implementation strategy to target all three classes of pollutants simultaneously.

2. Control the growth of aquatic weeds in Bellevue Pond
Because funding is not generally available at the state level for aquatic weed control, the City of Medford should be encouraged to fund a weed control effort in the pond.

4.3.6 Alewife Brook Subbasin

Pollutant Sources

Three waterbodies in the subbasin – Alewife Brook, Spy Pond, and Clay Pit Pond – are listed as impaired on the §303(d) list (Table 4-2). The Alewife is listed for pathogens, the known sources of which include CSOs, dry- and wet-weather discharges from sanitary sewer pipes, and stormwater runoff (which typically contains fecal material from diverse, nonhuman sources such as dogs, birds, and other warm-blooded animals). While the fraction of the total pathogen loading attributable to each of these sources is not known, loadings are expected to decrease in the future. Recent modifications to the CSOs by the City of Cambridge and the MWRA are predicted to reduce the number and volume of discharges per year. Also, Clean Water Act §308 notices have been issued to Cambridge, Belmont, Somerville, and Arlington, which, if complied with, should lead to reductions of sanitary sewage discharges (see Appendix F).

Spy Pond is on the §303(d) list as impaired for nutrients, organic enrichment/low DO, and noxious aquatic plants. The pond contains a north and south basin, which are separated by a shallow sill. Water quality in the south basin is generally poorer than in the north, in large part because the south basin receives considerable inputs of runoff from the Route 2 drainage area. It is also relatively shallow. High nutrient loadings and ample light penetration in the south basin have promoted the growth of substantial macrophyte populations, which in turn exacerbate the problems of organic enrichment/low DO. In addition to these problems, high levels of arsenic are present in the pond sediments. The arsenic appears to be the result of herbicide applications in the 1960s (Durant et al., 2003).

Clay Pit Pond is on the §303(d) list as impaired for pesticides. The pond sediment contains high levels of chlordane, and as a result warnings have been posted to alert anglers to the potential risks associated with eating the fish (MA-DPH, 2002).

Fish tissue testing was recently conducted for Spy Pond, in response to a community request. The Pond has been issued a fish consumption advisory for chlordane as a result.

Other known sources of pollutants in the subbasin include wastewater dischargers (other than CSOs) and hazardous waste disposal sites. As shown in Appendix E, there are seven NPDES-permitted dischargers in the subbasin and three more that are as yet unpermitted. There are 35 known hazardous waste disposal sites in subbasin (Appendix D); however, none are Tier IA sites.

Water Quality Assessment

Table 4.8 summarizes the available water quality results for the Alewife Brook subbasin.

Table 4.8: Summary of Alewife Brook Water Quality Results

		1973-1997 (17 sites)		1998-2002 (11 sites)		Total Period 1973-2002 (18 sites)	
Parameter	**Standard**	**No. of Samples**	**Percent Exceeding Standard**	**No. of Samples**	**Percent Exceeding Standard**	**No. of Samples**	**Percent Exceeding Standard**
Fecal coliform	Class B >200 cfu/100 ML	261	75%	576	93%	837	87%
Fecal coliform	Class C > 1000 cfu/100 ML	261	45%	576	59%	837	55%
Enterococcus	>33 cfu/ML	198	89%	450	96%	648	94%
E. Coli	>126 cfu/100ML			105	99%	105	99%

Table 4.8: Summary of Alewife Brook Water Quality Results

Parameter	Standard	1973-1997 (17 sites)		1998-2002 (11 sites)		Total Period 1973-2002 (18 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Dissolved Oxygen	<5 mg/L	255	46%	85	25%	340	40%
Dissolved Oxygen Saturation	<60+ %	0	-	73	38%	73	38%
Dissolved Oxygen Sat. Calculated	<60%	0	-	111	37%	111	37%
Temperature	>28.3°C	257	0%	93	0%	350	0%
pH	<6.5 or >8.3	74	8%	49	2%	123	6%
Total Suspended Solids (TSS)	>10 mg/L	36	9%	40	23%	76	16%
Total Nitrogen	>0.3 mg/L	12	83%	12	100%	24	92%
Total Phosporous	>0.05 mg/L	197	37%	47	98%	244	49%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Compared to other subbasins of the Mystic, a considerable amount of effort has been invested in monitoring water quality in the Alewife. As shown in Table 4-8 and Appendix C, records go back to 1973 when two sites were monitored on Alewife Brook. Since then an additional 16 sites in the subbasin have been monitored at least once. Summaries of the results in Table 4-8 indicate that bacteria levels consistently exceed Class B and Class C water quality standards at most of the monitoring sites. The summaries also indicate that DO levels are typically low at most sites. This may indicate organic enrichment caused by anthropogenic inputs. In addition, the summaries suggest that total nitrogen and phosphorus levels are consistently elevated at many of the sites.

Sediment Quality

Two studies have been conducted to determine the amounts and distribution of organic and inorganic pollutants in sediments samples collected from the subbasin. O'Shea and Kennedy (1989) collected sediments from 13 sites along Alewife Brook and Little Brook, and analyzed the samples for a suite of toxic elements (arsenic, chromium, copper, mercury, nickel, lead and zinc), polycyclic aromatic compounds (PAH) and polychlorinated biphenyls (PCBs). Their results indicate that several of the sediments, particularly those collected downstream of CSOs, were moderately contaminated with metals and PAHs. PCBs were also detected at parts per million levels at two of the sites. Ivushkina (1999) also collected sediment samples from along the main stem of the Alewife and Little Brooks, as well as from Little Pond and Spy Pond. The samples were analyzed for a broad suite of elements. Ivushkina's results were similar to those of O'Shea and Kennedy, indicating moderate metals contamination in the sediments, particularly in samples collected below Broadway Avenue. The sample from Little Pond was free of significant contamination; however, the samples from Spy Pond were found to contain significantly elevated levels of arsenic. Sediments from Little Pond and Spy Pond have not been analyzed for organic pollutants. The sediments in Clay Pit Pond in Belmont are contaminated with chlordane, an organic pesticide (MA-DPH, 2002).

Priorities

In this subbasin, the most important water quality priority is to identify and control the major sources of sewage bacteria (pathogens) entering the Alewife Brook. The water quality classification for the brook is currently subject to a "variance", pending a decision about the extent to which CSOs will be reduced or eliminated. In addition, priority actions are recommended for Spy Pond. Although Clay Pit Pond is contaminated with chlordane, the contamination appears to be most highly concentrated in the sediments and fish tissue. Because swimming is not allowed and the state Department of Public Health has issued a fishing advisory, the chlordane does not appear to be an imminent public health threat, and it is likely that the chlordane came from past pesticide use. No priority actions are recommended for Clay Pit Pond, although general efforts to discourage pesticide use near surface waters are warranted throughout the watershed, as part of general stormwater education efforts.

1. Identify major sources of sewage bacteria to Alewife Brook

Although there are just two major sources of bacteria entering the Alewife Brook/Little Brook system – sanitary sewers and nonpoint sources – it is useful to distinguish three distinct sources: dry-weather discharges from stormwater pipes, wet-weather discharges from stormwater pipes, and CSO discharges. Dry-weather discharges, which are typically due to connections between sanitary sewage and stormwater pipes, are illegal and are regulated under the Clean Water Act. Sewage bacteria that derive from the watershed (e.g., animal waste) and that enters the brook during wet-weather are regulated under Phase I/II of the NPDES stormwater regulations. Sewage discharges from CSOs are regulated by NPDES permitting process.

2. Add organic enrichment/low DO and nutrients for §303d list for Alewife

Based on the number of times that DO in Alewife Brook has been measured at levels below the water quality standard, it is recommended that organic enrichment/low DO be added to the §303(d) list for the brook.

3. Control nutrients entering Spy Pond.

While the growth of aquatic weeds in Spy Pond can be controlled through short-term measures such as chemical treatment and mechanical harvesting, the solution for the long-term is to minimize inputs of nutrients, particularly phosphorus, to the pond. Gawel et al. (2000) estimated that 250-510 kg/yr of phosphorus enters the pond in surface water inflows. As much as half of this enters the pond through the Route 2 storm drain. Because it is infeasible to use end of pipe controls on the Route 2 drain pipe, the most practical approach to reducing phosphorus is to employ best management practices (BMPs) on the Spy Pond watershed. Funding for structural

BMPs has been obtained by the Town of Arlington from a §319 grant. The town previously received funding from the Department of Environmental Management's Ponds and Lakes Program to control the internal loading of phosphorus from the pond sediments, as well as loadings from the portion of the watershed on the opposite side of the pond from the Route 2 storm drain.

4.3.7 Malden River Subbasin

Pollutant Sources

Two waterbodies in this subbasin are on the §303(d) list (Table 4-2): Ell Pond is listed for nutrients, suspended solids, and pathogens, and the Malden River is listed for organic enrichment/low DO, pathogens and suspended solids. Relatively little work has been done to identify the sources of pollutants to these waterbodies. The evidence suggests that the Malden River has received and is continuing to receive inputs of pollutants from diverse urban and industrial sources such as stormwater, sanitary sewers, and hazardous waste disposal sites. Because the subbasin has a very high percentage of developed land (69%), much of which is impervious, stormwater runoff and its associated pollutants (e.g., particles, fecal bacteria, nutrients) enter the river at high rates. Although there are no permitted CSOs on the Malden, pipes have been identified that carry high levels of sewage bacteria during dry weather (R. Frymire, personal communication, 2002). This strongly suggests the presence of illegal connections between sanitary and storm sewers. In addition to stormwater and discharges from pipes during dry weather, there are also four companies in the subbasin that have NPDES permits to discharge wastewater to the Malden (Appendix E). Two other companies that discharge wastewater to the Malden have to be issued NPDES permits. Another category of inputs that may be significant, particularly south of Malden Square, is chemicals leaching from soil and groundwater at hazardous waste disposal sites. As shown in Appendix D, there are 58 known hazardous waste disposal sites in the subbasin, and of these ten are located on riverfront properties. For example, at the Wellington Realty site, a former chemical manufacturing site that abuts Little Creek (D50), pure phase coal tar and high levels of arsenic and cyanide have been found in the subsurface (Norwood Engineering Co., 1988).

Water Quality Assessment

Table 4.9 summarizes the available water quality results for the Malden River subbasin.

Table 4.9: Summary of Malden River Water Quality Results

		1967-1997 (2 sites)		1998-2002 (1 site)		Total Period 1967-2002 (2 sites)	
Parameter	**Standard**	**No. of Samples**	**Percent Exceeding Standard**	**No. of Samples**	**Percent Exceeding Standard**	**No. of Samples**	**Percent Exceeding Standard**
Fecal coliform	Class B >200 cfu/100 ML	35	55%	18	61%	53	57%
Fecal	Class C	35	31%	18	22%	53	28%

Table 4.9: Summary of Malden River Water Quality Results

Parameter	Standard	1967-1997 (2 sites)		1998-2002 (1 site)		Total Period 1967-2002 (2 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
coliform	> 1000 cfu/100 ML						
Enterococcus	>33 cfu/ML	0	-	0	-	0	-
E. Coli	>126 cfu/100ML	0	-	0	-	0	-
Dissolved Oxygen	<5 mg/L	41	3%	19	0%	60	2%
Dissolved Oxygen Saturation	<60+ %	0	-	19	21%	19	21%
Dissolved Oxygen Sat. Calculated	<60%	0	-	32	19%	32	19%
Temperature	>28.3°C	41	2%	20	5%	61	3%
pH	<6.5 or >8.3	48	4%	16	6%	64	5%
Total Suspended Solids (TSS)	>10 mg/L	0	-	19	5%	19	5%
Total Nitrogen	>0.3 mg/L	0	-	0	-	0	-
Total Phosporous	>0.05 mg/L	50	83%	17	88%	67	84%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site..

Relatively few water quality data were found for this subbasin. Only one site – the Medford St. bridge (MAL2.570w) – has been routinely monitored for sewage bacteria and standard water quality parameters. The data in Tables 4-9 and Appendix C indicate that fecal coliform levels exceed the Class B water quality standard in about half the samples and exceed the Class C standard in about 20% of the samples. The data also indicate that total phosphorus levels exceed the guideline limit of 50 ppb used in this report in 88% of the samples. There has been little change in the percent exceedances found between the earlier period and more recent years' sampling.

In addition to the data summarized in Table 4-9, another one-time study of the Malden was reviewed. In August of 1999, the Malden was investigated as part of the Telecom City Redevelopment Project (now called River's Edge) and USEPA Brownfields Pilot Grant Program (Nangle Consulting Associates, 1999). In this study, standard water quality parameters (DO, temperature, pH, TSS, conductivity, salinity) were monitored at 15 sites in Little Creek and the Malden between Medford St. and Route 16. Most of the results were within acceptable limits for Class B waters; however, the bottom waters contained very low DO, particularly at sites where thermal stratification was strongest and where salinity was highest.

Sediment Quality

There has been very little data available on sediment quality in the Malden River, until recently. Only one dataset was found, which pertained to the southern part of the river between Medford St. and Route 16 and Little Creek (Nangle Consulting Associates, 1999). Surface sediment and sediment core samples were collected and analyzed for selected metals, volatile organic compounds (VOCs), phthalates, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons. The results showed that phthalates were elevated in several of the samples and that PAHs were elevated in samples collected near Little Creek. The levels of VOCs and metals were generally low, while the levels of PCBs were moderately elevated in one of the four samples analyzed for PCB content. A second sediment study of the river was performed by the USGS in the summer of 2002; however, the results have not yet been published (Rob Breault, USGS, Marlboro, MA; personal communication, 2003).

Currently, the Army Corps of Engineers is working with the Mystic Valley Development Corp. (the body responsible for the planned TeleCom City development) to assess sediments in the Malden River as part of a habitat restoration study. The results of this work were not available in time for inclusion in this report, but should provide useful new information on sediment quality in the Malden.

Priorities

In terms of water quality, there are several priorities for the Malden River subbasin. One of the highest is to identify and control inputs of pathogens into the Malden River. A second important priority is to identify and control inputs of both pathogens and nutrients into Ell Pond in Melrose.

1. Identify and control major sources of sewage bacteria loadings to the Malden River
Monitoring should be conducted to identify specific sources of pathogen loadings to the river. As part of the program, tributaries and stormwater discharge pipes should be sampled during both dry- and wet-weather to identify significant sources of pollution to the creek. If tributary streams are found to be major sources, additional investigation should be performed to identify specific sources on the tributaries.

2. Identify and control major sources of sewage bacteria and nutrient loadings to Ell Pond
It is recommended that both a pathogen and a nutrient TMDL be developed and implemented for the Ell Pond subbasin. Because it is likely that the pathogens and nutrients derive from many of the same sources (and/or source areas), some economy may be achieved by sampling for both parameters simultaneously. As part of the nutrient TMDL, an effort should be made to quantify the nutrient loadings from the pond sediments.

4.3.8 Mystic River 2 Subbasin (Amelia Earhart Dam to Charles River)

Pollutant Sources

The saltwater portion of the Mystic is on the §303(d) list as being impaired for high levels of unionized ammonia (NH_3), pathogens, oil and grease, and turbidity, and for having excessive organic enrichment and low DO (Table 4-2). The sources of these pollutants have not been identified and quantified; however, due to the nature of the land-uses in the subbasin, it is likely that multiple point and nonpoint sources are responsible. Point sources include stormwater runoff pipes and NPDES-permitted discharge pipes. There are more NPDES-permitted wastewater dischargers in this subbasin (22) than in any other in the watershed. There are three major dischargers, including the Sithe Mystic power plant, a CSO in Chelsea, and an oil terminal in Everett. Significant nonpoint sources include hazardous waste disposal sites (see Appendix D) and contaminated bottom-sediments. For example, at Island End River where there is a former coal tar processing facility (site Y20), a large amount of coal tar is buried under the river sediments and is continuing to release contaminants to the river (Stephen Spencer, MA-DEP, personal communication, 2002).

Water Quality Assessment

Table 4.10 summarizes the available water quality results for the Mystic River 2 subbasin.

Table 4.10: Summary of Mystic River 2 Water Quality Results

Parameter	Standard	1989-1997 (3 sites)		1998-2002 (4 sites)		Total Period 1989-2002 (4 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Fecal coliform	Class B >200 cfu/100 ML	903	53%	599	22%	1,502	41%
Fecal coliform	Class C > 1000 cfu/100 ML	903	20%	599	9%	1,502	16%
Enterococcus	>33 cfu/ML	0	-	674	21%	674	21%
E. Coli	>126 cfu/100ML	0	-	0	-	0	-
Dissolved Oxygen	<5 mg/L	1,224	13%	12	0%	1,236	13%
Dissolved Oxygen Saturation	<60+ %	590	6%	12	0%	602	6%
Dissolved Oxygen Sat. Calculated	<60%	0	-	12	33%	12	33%
Temperature	>28.3°C	1,254	0%	12	0%	1,266	0%
pH	<6.5 or >8.3	0	-	0	-	0	-

Table 4.10: Summary of Mystic River 2 Water Quality Results							
		1989-1997 (3 sites)		1998-2002 (4 sites)		Total Period 1989-2002 (4 sites)	
Parameter	Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Total Suspended Solids (TSS)	>10 mg/L			280	6%	280	6%
Total Nitrogen	>0.3 mg/L	132	99%	0	-	132	99%
Total Phosporous	>0.05 mg/L	112	57%	0	-	112	57%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Available water quality records indicate that the Mystic River 2 subbasin has not been widely monitored. According to the data in Table 4-10 and Appendix C, only four sites in the Mystic River have been monitored since 1989. The two sites that received the most attention are MYS2.787, which is just downstream of the outfall from the Somerville Margin CSO Treatment Facility, and MYS1.407, which is just upstream of the confluence with Chelsea Creek. Fecal coliform and *Enterococcus* bacteria have been routinely monitored at both sites by the MWRA; temperature, DO, pH, TSS and nutrients have also been monitored, but much less frequently than bacteria. As shown in Appendix C, bacteria levels exceed the swimming standards in 10-37% of the samples and the boating standard in 3-16% of the samples.

Sediment Quality

Several investigators have analyzed sediment samples from sites in the subbasin (Buchholtz ten Brink et al., 2002). The results show that the sediments contain relatively high levels of PAH, PCBs, lead, chromium, copper, and zinc. In addition, effort has been spent on characterizing the sediments on Island End River, near the coal tar waste disposal site (Stephen Spencer, MA-DEP, personal communication, 2002). These sediments are highly enriched in PAH and other coal tar waste products.

Priorities

Compared to other subbasins in the watershed, relatively little environmental quality data is available for the Mystic River 2 subbasin. In addition, relatively little is known about the possible risks people may face while recreating in this section of the river. Thus, while there are some obvious data gaps that need to be filled, it is also important that more information be gathered on the recreational uses of the river. Specific recommendations are described below.

1. Continue to assess the extent of recreational contact.

The Mystic River Watershed Association (MyRWA) conducted a preliminary river use survey on the Mystic in the summer of 2003. Analysis of this survey and further survey work is needed to determine who is recreating in or near the river. Preliminary results indicate that children swim and wade in the Little Mystic Channel, and that substantial boating (including use of jet skis that results in substantial direct exposure to the water) occurs in the Mystic. These findings are discussed in more detail in Chapter 6.

2. Develop a consistent water quality monitoring program.
The preliminary results of MyRWA's river use survey suggest that more frequent and widespread monitoring is needed to assess public health risks. The current MyRWA monitoring program should be expanded to include the salt water portion of the Mystic River, or other means found to monitor this subbasin on a regular basis.

3. Perform comprehensive sediment study.
Sediment sampling data should be analyzed to assess potential exposures, when the ACOE and USGS data become available. The samples should be analyzed for a broad range of organic (e.g., PAH, PCBs, pesticides, etc.) and inorganic (e.g., lead, arsenic, mercury, cadmium, copper, etc.) pollutants.

4. Analyze fish tissue for the presence of toxic chemicals
The preliminary results of the MyRWA river use survey indicate that some fishermen and others are consuming fish caught in the lower Mystic. Fish taken from the saltwater portion of the watershed should be analyzed for chemicals that tend to bioaccumulate (e.g., PAH, PCBs, mercury, pesticides). Fish consumption advisories may need to be established by the state department of public health if pollutants are detected at unsafe levels.

5. Develop TMDLs for parameters listed on the §303(d) list
To begin the process of reducing pollutant inputs to this section of the Mystic River and its tributaries, efforts should be made to quantify loadings from important sources. An efficient way of doing this is by developing TMDLs for the causes of impairment listed in Table 4-2.

4.3.9 Chelsea Creek Subbasin

Pollutant Sources

Chelsea Creek is classified as "SB" (saltwater B) with a CSO variance. It is on the **§**303(d) list as impaired for NH3, organic enrichment/low DO, pathogens, oil and grease, taste, odor and color and turbidity (Table 4-2). To date, relatively little work has been done to characterize and quantify pollutant loadings from sources, which include CSOs, industrial discharges, stormwater discharges and hazardous waste disposal sites. There are two NPDES-permitted wastewater dischargers in the subbasin: a CSO in Chelsea and an oil company in East Boston (Appendix E). Both are major dischargers. In addition to point sources, it is possible that chemicals leaching from hazardous waste disposal sites in Chelsea and East Boston may entering Chelsea Creek. As shown in Appendix D, there are 36 known hazardous waste disposal sites in the subbasin. Ten of these sites are located on riverfront properties and one (C12) is classified as a Tier IA site.

Water Quality Assessment

Table 4.11 summarizes the available water quality results for the Chelsea Creek subbasin.

Table 4.11: Summary of Chelsea Creek Water Quality Results

Parameter	Standard	1989-1997 (3 sites)		1998-2002 (2 sites)		Total Period 1989-2002 (3 sites)	
		No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard	No. of Samples	Percent Exceeding Standard
Fecal coliform	Class B >200 cfu/100 ML	316	47%	9	33%	325	38%
Fecal coliform	Class C > 1000 cfu/100 ML	316	18%	9	23%	325	11%
Enterococcus	>33 cfu/ML	0	-	9	33%	9	33%
E. Coli	>126 cfu/100ML	0	11%	0	-	0	-
Dissolved Oxygen	<5 mg/L	320	10%	10	0%	330	10%
Dissolved Oxygen Saturation	<60+ %	147	-	10	0%	157	7%
Dissolved Oxygen Sat. Calculated	<60%	0	-	10	0%	10	10%
Temperature	>28.3^{o}C	327	0%	10	0%	337	0%
pH	<6.5 or >8.3	0	-	0	-	0	-
Total Suspended Solids (TSS)	>10 mg/L	64	6%	0	-	64	6%
Total Nitrogen	>0.3 mg/L	21	100%	0	-	21	100%
Total Phosporous	>0.05 mg/L	36	78%	0	-	36	78%

Source: Tufts University Water Quality Analysis; see text and Appendix B and C for methodology and detailed results. Note that the sites sampled during each time period may not be at the same locations, and not all pollutants are analyzed at every site.

Few water quality data are available for the Chelsea Creek subbasin. As indicated in Table 4-11 and Appendix C, six sites in Chelsea Creek have been monitored, all by the MWRA; however, data were only available for three of the sites. The most recent data, from 1998 and 1999, are not sufficient to assess the quality in the river. Nonetheless, using data from sampling site CCK1.497m, which has been sampled more frequently than any other site on the river, general observations about water quality may be made. First, fecal coliform bacteria levels exceeded the primary and secondary contact standards in 30% and 12% of the samples, respectively. This is consistent with the fact that there are CSO and stormwater discharges into the creek. DO levels were generally high; levels were <5 mg/L in only 10% of the samples. In contrast, nutrient levels were elevated in a high percentage of the samples. The total nitrogen guideline used in this report was exceeded in all of the samples, while the total phosphorus guideline was exceeded in 85% of the samples.

Sediment Quality

Several investigators have analyzed sediment samples Chelsea Creek (Buchholtz ten Brink et al., 2002). The results show that the sediments contain relatively high levels of PAH, PCBs, lead and chromium. These results are not surprising, given the very urban and industrial nature of Chelsea Creek and its surrounding riverfront properties.

Priorities

Because of the scarcity of water quality data for this subbasin, a high priority is to collect data that could be used to address known and suspected causes of impairment. In addition, as was the case for the Mystic River 2 subbasin, there is little data on recreational activities that in the subbasin. For example, little is known about fish consumption habits among anglers. Such data, as well as data on other recreational activities in the subbasin, could be useful for informing the water quality data collection effort. Specific recommendations are given below.

1. Perform monthly water quality monitoring

To gain a better understanding of current water quality in the Chelsea Creek, it is recommended that routine monitoring be performed at least one site in the subbasin. Both dry- and wet-weather samples should be collected under varying tidal conditions to measure the range of conditions in the river. The parameters that should be measured include sewage indicator bacteria (*Enterococcus* is considered the most informative in saltwater), DO, NH_3, turbidity and oil and grease, all of which are on the §303(d) list.

2. Identify hotspots of pollution.

Hotspot monitoring should be conducted to help target specific areas for further detailed study. For example, tributaries (e.g., Mill Creek) and stormwater discharge pipes should be sampled during both dry- and wet-weather (and possibly at both low and high tide, depending on whether the tide greatly affects the source strength) to identify significant sources of pollution to the creek.

3. Perform a river-use survey

A river-use survey should be performed for Chelsea Creek to determine who is recreating in or near the river. The survey should be designed to identify what types of recreational activities are most common, as well as when and where they are occurring.

4. Analysis of sediment and fish tissue

If it is learned through the river use study that people are being exposed to river sediments in Chelsea Creek, then sediment sampling should be done in the areas where exposure occurs. The samples should be analyzed for a broad range of organic (e.g., PAH, PCBs, pesticides, etc.) and inorganic (e.g., lead, arsenic, mercury, cadmium, copper, etc.) pollutants. Similarly, if the river use survey shows that fishermen are eating fish from the subbasin, then fish muscle samples should be analyzed for chemicals that tend to bioaccumulate (e.g., PAH, PCBs, mercury, pesticides).

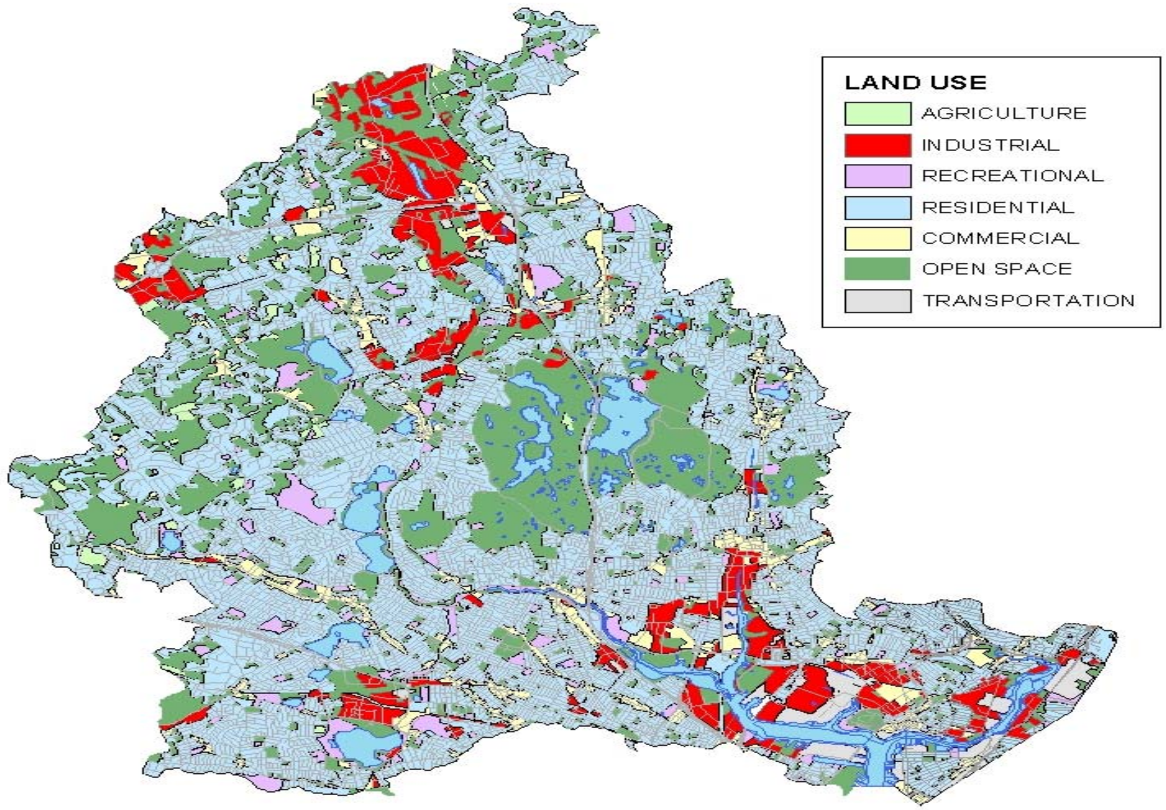
4.4 Conclusions

The analysis of water and sediment quality presented in this chapter shows substantial variation in the level of assessment that has been performed in different parts of the watershed. Aberjona River, Alewife Brook and the Mystic River 1 subbasin have been extensively studied for some pollutants. More work is needed to identify specific sources of pollutants, but the major problems have been identified and action on TMDLs is needed. Monitoring of lakes and ponds (except Upper Mystic Lake) has been less extensive, and there is a severe lack of water quality monitoring data for the lower part of the watershed (Mystic River 2, Malden River and Chelsea Creek.) These data gaps need to be addressed, especially because the number of different pollutants is likely to be greater in the lower watershed. Beyond data gathering, substantial work is needed to develop TMDLs for bacteria and nutrients throughout the watershed.

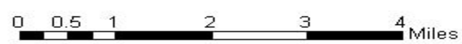
In addition, a sediment strategy is needed once more information on sediment quality becomes available from the forthcoming USGS study. Areas with highly-contaminated sediments should be assessed for exposure potential and effects on wildlife, and a strategy for remediating areas with high potential for exposure or habitat effects should be developed.

Finally, there is a serious lack of information on toxic organics and metals in the water column, except for a few extensively-studied locations like the Aberjona River Superfund sites. This is a problem given the large number of hazardous waste sites in the watershed, and the fact that the Massachusetts Contingency Plan did not include detailed assessment of impacts on adjacent waterbodies until relatively recently. The status of hazardous waste sites in the watershed should be reviewed to determine whether adequate monitoring and assessment of surface water impacts was conducted and whether realistic assumptions about potential human exposure were used, in selecting site remedies. This study should guide a strategy for selective monitoring for toxic pollutants around hazardous waste sites that have not yet been remediated or that were remediated without thorough analysis of surface water impacts. Any sites found to be potential continuing sources of pollutant loadings to the waterbodies should be subject to enforcement review and a public involvement process.

LAND USE IN THE MYSTIC RIVER BASIN



Land Use Category	Area (sq mi)
Agriculture	0.52
Open Space	17.90
Recreation	3.50
Commercial	5.67
Residential	30.53
Transportation	2.31
Industrial	5.18
TOTAL	**65.62**

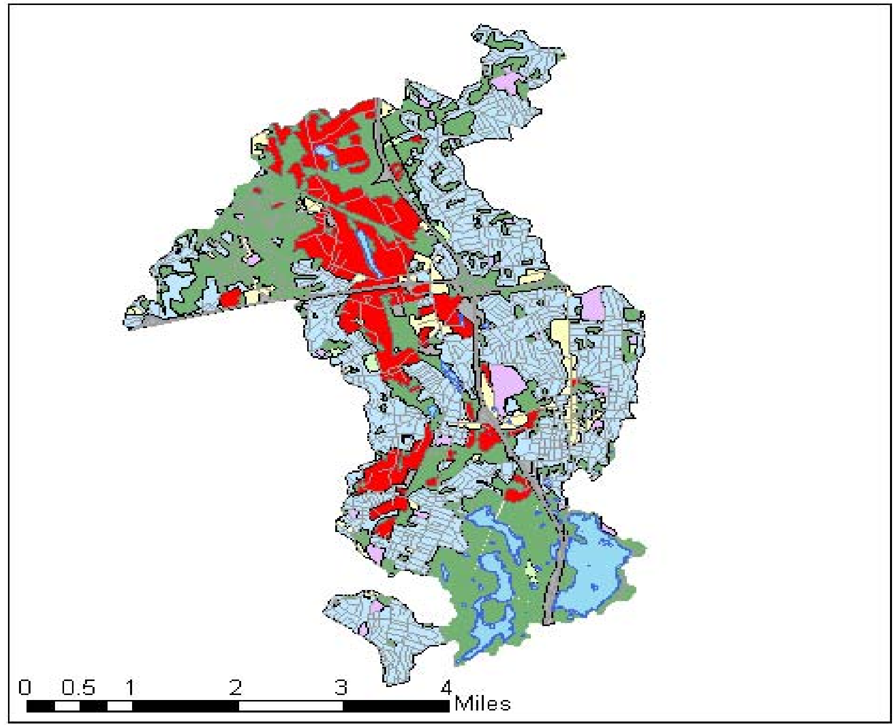


ABERJONA SUBBASIN

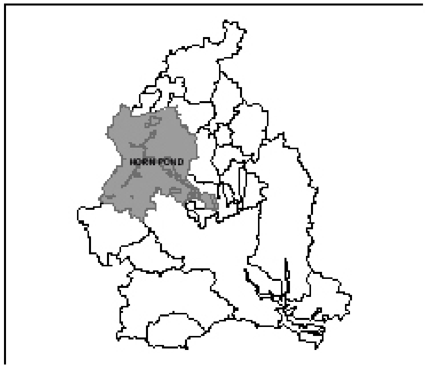
ABERJONA SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.01
COMMERCIAL	0.71
INDUSTRIAL	2.39
OPEN SPACE	5.59
RECREATIONAL	0.47
RESIDENTIAL	6.25
TRANSPORTATION	0.58
TOTAL	**16.00**

LAND USE CODE

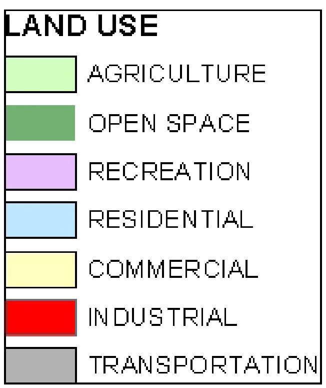
- AGRICULTURE
- OPEN SPACE
- INDUSTRIAL
- RECREATIONAL
- RESIDENTIAL
- COMMERCIAL
- TRANSPORTATION

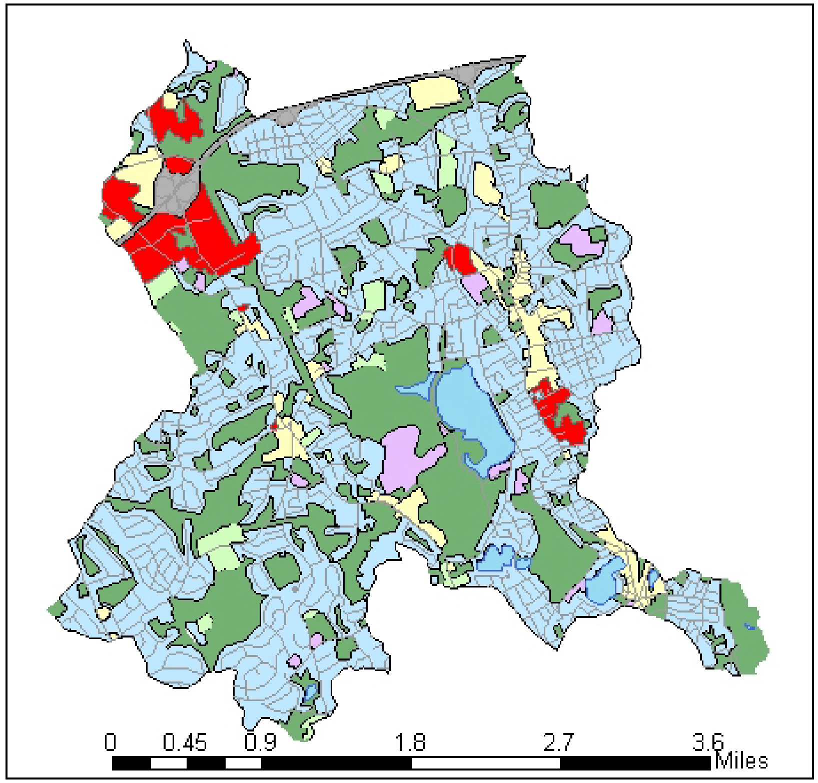


HORN POND SUBBASIN

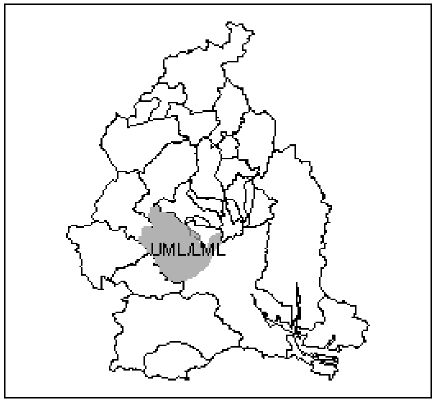


HORN POND SUBBASIN	
LAND USE	TOTAL
AGRICULTURE	0.24
COMMERCIAL	0.55
INDUSTRIAL	0.44
OPEN SPACE	3.01
RECREATIONAL	0.25
RESIDENTIAL	5.36
TRANSPORTATION	0.16
TOTAL	**10.01**

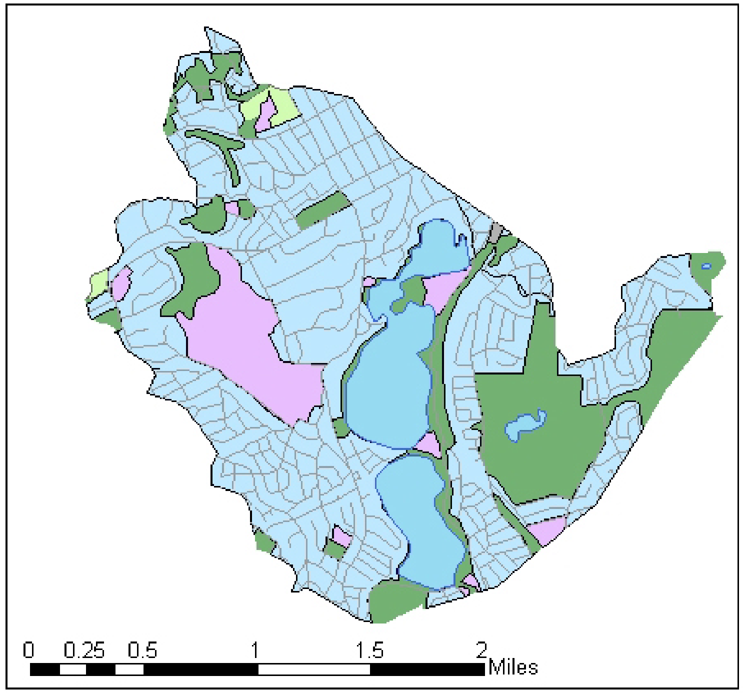




UML/LML SUBBASIN



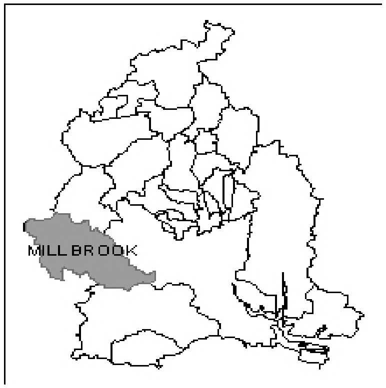
UML/LML SUBBASIN	
LAND USE	TOTAL
AGRICULTURE	0.03
COMMERCIAL	0.00
INDUSTRIAL	0.00
OPEN SPACE	1.15
RECREATIONAL	0.30
RESIDENTIAL	2.28
TRANSPORTATION	0.00
TOTAL	**3.76**

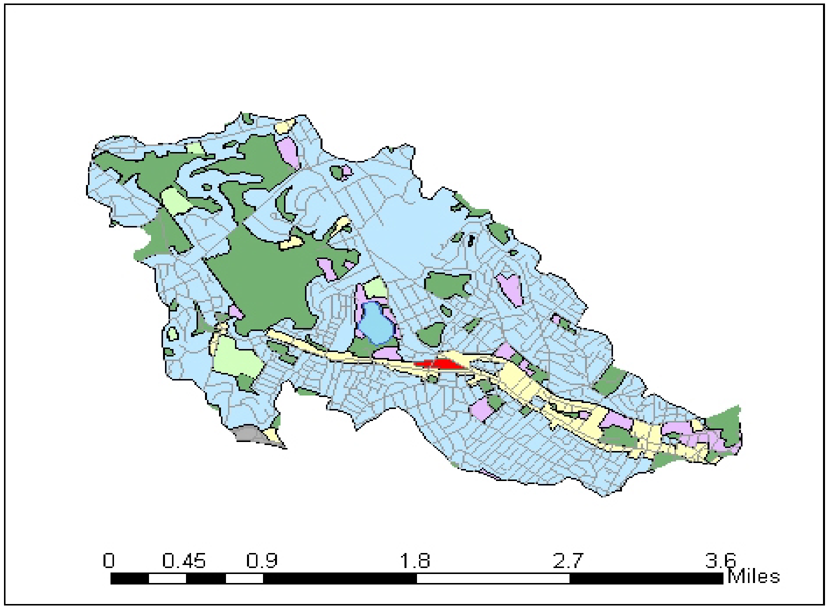


LAND USE CODE

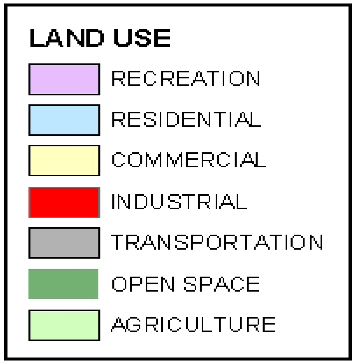
- AGRICULTURE
- OPEN SPACE
- INDUSTRIAL
- RECREATIONAL
- RESIDENTIAL
- COMMERCIAL
- TRANSPORTATION

MILL BROOK SUBBASIN

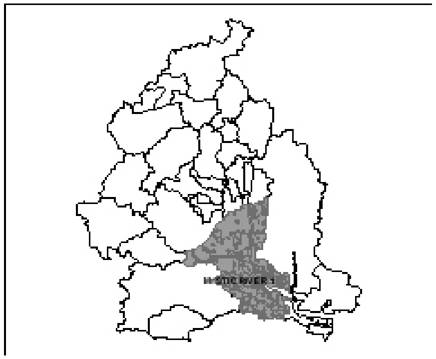




MILL BROOK SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.11
COMMERCIAL	0.36
INDUSTRIAL	0.01
OPEN SPACE	1.05
RECREATIONAL	0.21
RESIDENTIAL	3.44
TRANSPORTATION	0.02
TOTAL	**5.20**



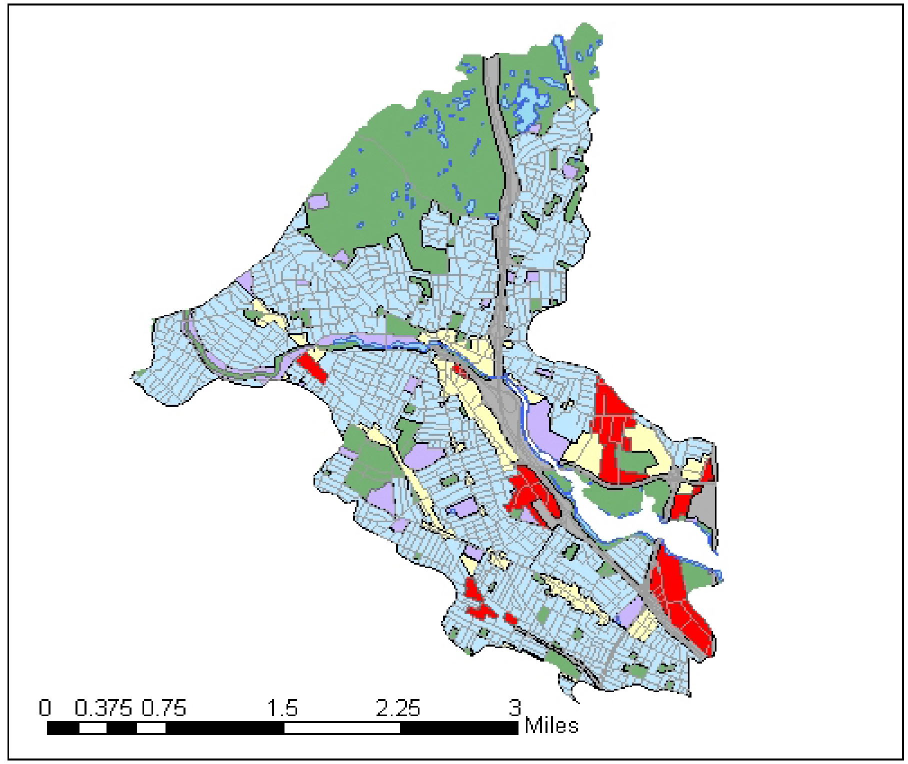
MYSTIC RIVER 1 SUBBASIN



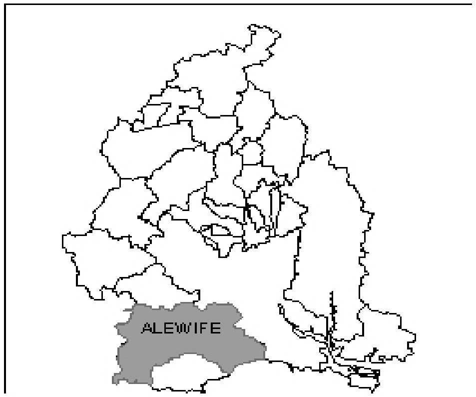
MYSTIC RIVER 1 SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.00
COMMERCIAL	0.54
INDUSTRIAL	0.39
OPEN SPACE	1.97
RECREATIONAL	0.37
RESIDENTIAL	4.09
TRANSPORTATION	0.54
TOTAL	**7.90**

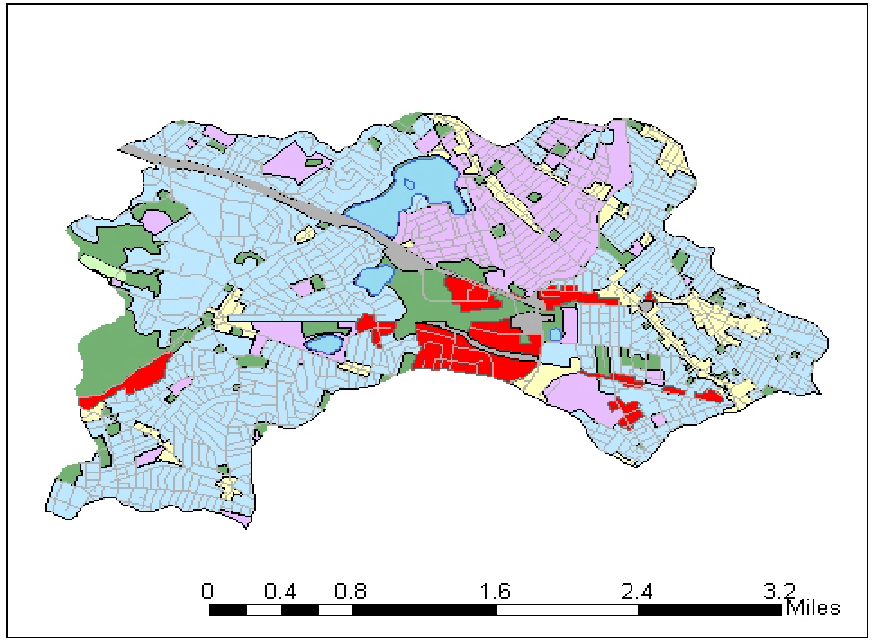
LAND USE

- RECREATION
- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- TRANSPORTATION
- OPEN SPACE
- AGRICULTURE



ALEWIFE SUBBASIN



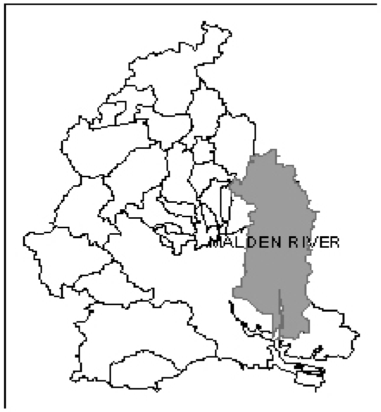


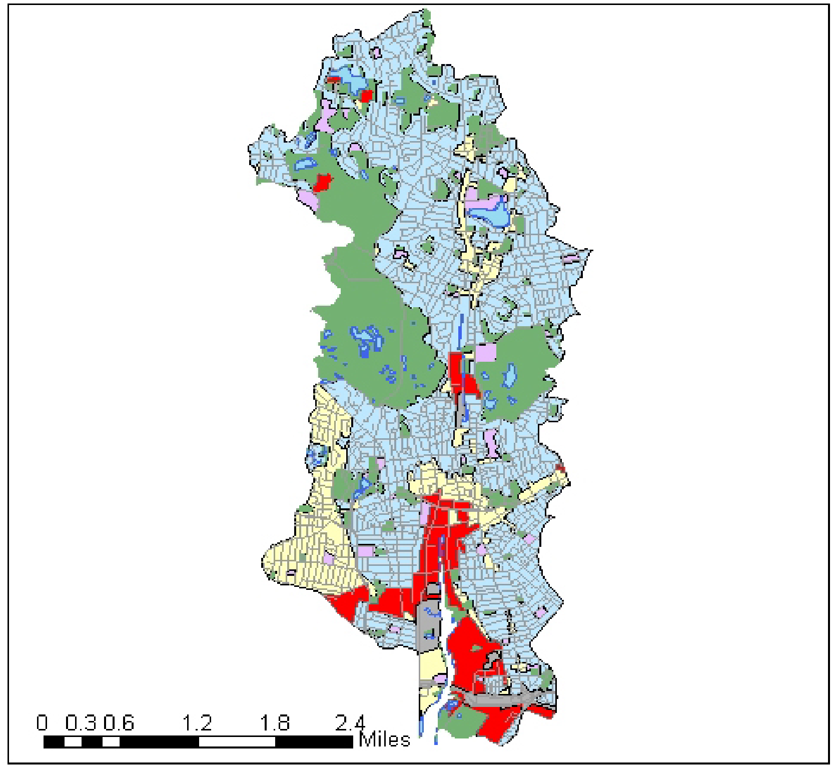
ALEWIFE SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.02
COMMERCIAL	0.48
INDUSTRIAL	0.41
OPEN SPACE	1.01
RECREATIONAL	1.14
RESIDENTIAL	3.80
TRANSPORTATION	0.18
TOTAL	**7.03**

LAND USE CODE

- AGRICULTURE
- OPEN SPACE
- INDUSTRIAL
- RECREATIONAL
- RESIDENTIAL
- COMMERCIAL
- TRANSPORTATION

MALDEN RIVER SUBBASIN



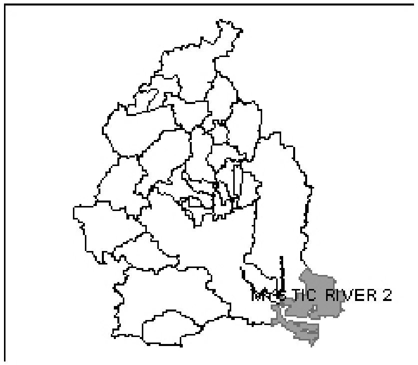


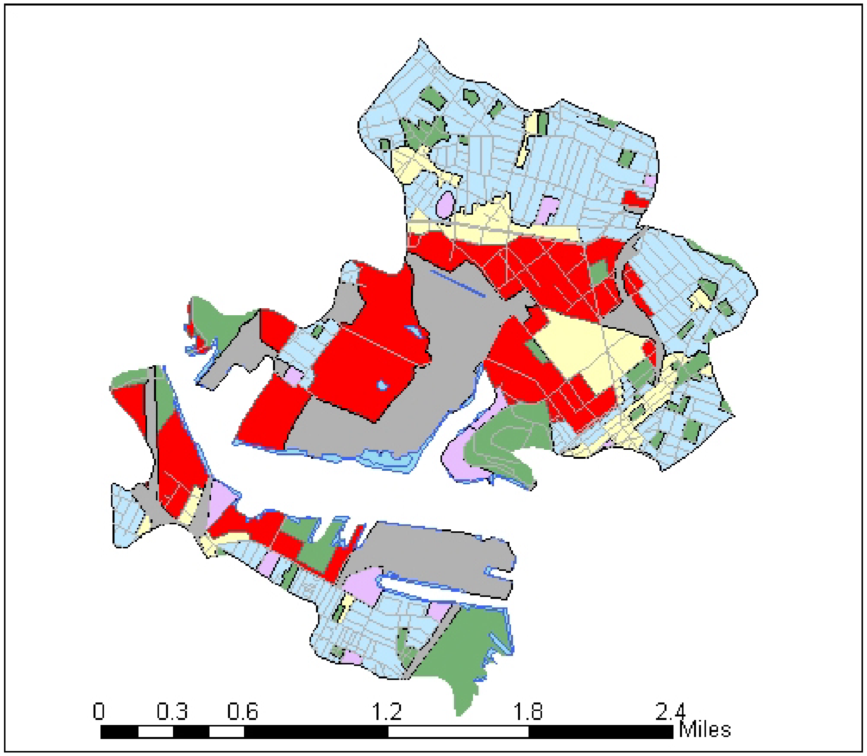
MALDEN SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.11
COMMERCIAL	1.19
INDUSTRIAL	0.75
OPEN SPACE	2.53
RECREATIONAL	0.27
RESIDENTIAL	4.81
TRANSPORTATION	0.21
TOTAL	**9.86**

LAND USE

- RECREATION
- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- TRANSPORTATION
- OPEN SPACE
- AGRICULTURE

MYSTIC RIVER 2 SUBBASIN



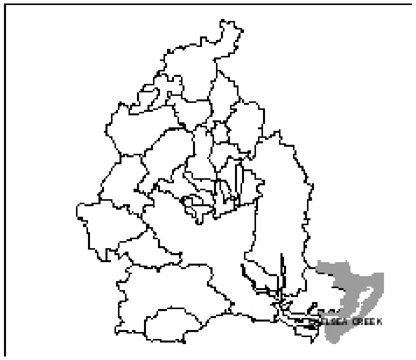


MYSTIC RIVER 2 SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.00
COMMERCIAL	0.29
INDUSTRIAL	0.79
OPEN SPACE	0.42
RECREATIONAL	0.11
RESIDENTIAL	0.99
TRANSPORTATION	0.63
TOTAL	**3.23**

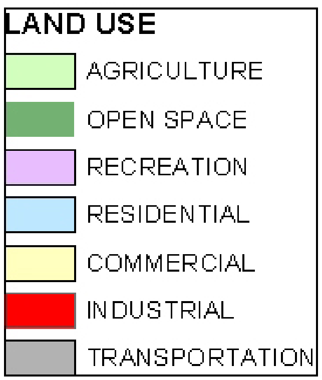
LAND USE

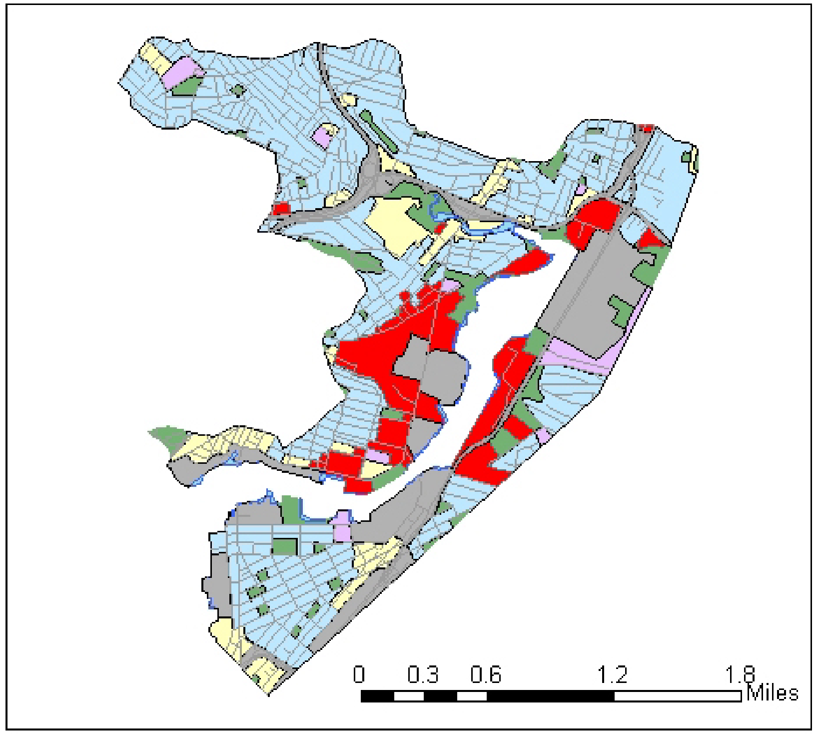
- RECREATION
- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- TRANSPORTATION
- OPEN SPACE
- AGRICULTURE

CHELSEA CREEK SUBBASIN



CHELSEA CREEK SUBBASIN	
LAND USE	**TOTAL**
AGRICULTURE	0.00
COMMERCIAL	0.30
INDUSTRIAL	0.41
OPEN SPACE	0.30
RECREATIONAL	0.10
RESIDENTIAL	1.73
TRANSPORTATION	0.69
TOTAL	**3.54**





Chapter 5: Land Use and Open Space

Chapter Contents

5.1 Introduction

This chapter discusses land uses and the availability and quality of open space in the watershed. Current land uses are both a problem, where they contribute to degraded water quality and where there is insufficient open space for recreation and wildlife habitat, and an asset, where there are valuable open space resources. The urban character of the watershed, and the specific uses that compete for the available land, make it a challenge to preserve open space and protect water quality from nonpoint source runoff in many parts of the watershed. Where open space is currently available, it is often under significant development pressure. On the positive side, the Mystic River watershed is home to substantial state-owned parklands along the water, which are our inheritance from the work of Charles Eliot in the late 1800s. In addition, the decline of industrial uses and opportunities to redevelop old industrial and commercial sites are offering opportunities to reclaim open space in many parts of the watershed.

This chapter first provides an overview of current land uses in the watershed, and discusses the water quality impacts associated with those land uses. The chapter then focuses on open space – where it is currently, where more is needed, and what the priorities are for preserving or restoring it. The final section of this chapter discusses priorities for action. The next two chapters focus specifically on two important values of open space: recreation (Chapter 6) and wildlife habitat (Chapter 7).

5.2 Land Use

Table 5-1 provides data on current land uses in the watershed, by subbasin. Figures 5-1 through 5-10 are maps showing the distribution of land uses by type for the watershed as a whole and for each subbasin. Residential uses predominate in the watershed (49% of total land area), followed by open space (26%) and industrial uses (8%). The mix of uses varies dramatically among subwatersheds, however.

The proportion of open space is substantially lower in the lower part of the watershed (8% in the Chelsea Creek subbasin and 13% in the Mystic 2 subbasin – the saltwater portion of the Mystic River), and higher in the upper, more suburban part of the watershed (35% in the Aberjona subbasin and 30% in the Horn Pond and Mystic Lakes subbasins.) Industrial uses are concentrated in the lower watershed, closest to Boston Harbor, and in the upper watershed in the Aberjona subbasin (as shown in red on Figure 5-1). The combination of commercial, industrial and transportation uses consumes more than half the available land in the saltwater portion of the Mystic River (Mystic 2 subbasin) and 40% of the land in the Chelsea Creek subbasin. In contrast, there are no commercial, industrial or transportation uses in the Mystic Lakes subbasin.

Table 5-1: Land Use by Subbasin

		Aberjona	Horn Pond	Mystic Lakes	Mill Brook	Mystic River 1	Alewife Brook	Malden River	Mystic River 2	Chelsea Creek	Total
Agriculture	acres	0.01	0.24	0.03	0.11	0	0.02	0.11	0	0	0.52
	%	*0.1%*	*2.4%*	*0.8%*	*2.1%*	*0.0%*	*0.3%*	*1.1%*	*0.0%*	*0.0%*	*0.8%*
Commercial	acres	0.71	0.55	0	0.36	0.54	0.48	1.19	0.29	0.3	4.42
	%	*4.4%*	*5.5%*	*0.0%*	*6.9%*	*6.8%*	*6.8%*	*12.1%*	*9.0%*	*8.5%*	*6.6%*
Industrial	acres	2.39	0.44	0	0.01	0.39	0.41	0.75	0.79	0.41	5.59
	%	*14.9%*	*4.4%*	*0.0%*	*0.2%*	*4.9%*	*5.8%*	*7.6%*	*24.5%*	*11.6%*	*8.4%*
Transportation	acres	0.58	0.16	0	0.02	0.54	0.18	0.21	0.63	0.69	3.01
	%	*3.6%*	*1.6%*	*0.0%*	*0.4%*	*6.8%*	*2.6%*	*2.1%*	*19.5%*	*19.5%*	*4.5%*
Residential	acres	6.25	5.36	2.28	3.44	4.09	3.8	4.81	0.99	1.73	32.75
	%	*39.1%*	*53.5%*	*60.6%*	*66.2%*	*51.8%*	*54.0%*	*48.7%*	*30.7%*	*49.0%*	*49.2%*
Recreation	acres	0.47	0.25	0.3	0.21	0.37	1.14	0.27	0.11	0.1	3.22
	%	*2.9%*	*2.5%*	*8.0%*	*4.0%*	*4.7%*	*16.2%*	*2.7%*	*3.4%*	*2.8%*	*4.8%*
Open Space	acres	5.59	3.01	1.15	1.05	1.97	1.01	2.53	0.42	0.3	17.03
	%	*34.9%*	*30.1%*	*30.6%*	*20.2%*	*24.9%*	*14.3%*	*25.6%*	*13.0%*	*8.5%*	*25.6%*
All Land Uses	acres	16	10.01	3.76	5.2	7.9	7.04	9.87	3.23	3.53	66.54
	%	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Analysis of MassGIS land use data (see maps in Figures 5-1 through 5-10.)

Open space (shown in green on Figure 5-1) is most prominent in the middle of the watershed (the Middlesex Fells) and smaller patches elsewhere, especially in the northwest areas of the watershed.

As in many other areas of the state, the portions of the Mystic that still have open space have been losing it to development. Table 5-2 shows the change in the percentage of undeveloped land from 1971 to 1999 for communities in the watershed. The table ranks communities from highest to lowest percentage of open space in 1971. It shows that many of the communities with the highest percentage of open space in the earlier period had lost a substantial portion of that space by 1999. With the exception of Cambridge, Everett, and Somerville (all of which are densely-developed and had small increases in open space), every other community in the watershed lost open space during this period.

Table 5-2: Change in Undeveloped Land Area 1971-1999

	Percent of Land Undeveloped		Change in Percent Land Undeveloped 1971-1999
	1971	1999	
Wilmington	61.0%	48.5%	-12.5%
Reading	49.7%	42.9%	-6.8%
Stoneham	47.2%	38.9%	-8.4%
Woburn	42.4%	27.7%	-14.7%
Wakefield	40.6%	34.1%	-6.6%
Burlington	39.5%	30.8%	-8.7%
Lexington	38.6%	34.9%	-3.7%
Medford	31.5%	30.2%	-1.3%
Winchester	30.6%	22.8%	-7.8%
Revere	24.4%	21.3%	-3.1%
Melrose	23.8%	23.0%	-0.8%
Belmont	18.8%	17.2%	-1.6%
Cambridge	13.2%	13.3%	0.1%
Malden	13.0%	9.9%	-3.1%
Boston	12.7%	11.6%	-1.0%
Winthrop	10.4%	8.3%	-2.2%
Arlington	9.2%	8.9%	-0.3%
Watertown	6.1%	5.6%	-0.5%
Chelsea	4.0%	1.3%	-2.7%
Everett	1.0%	2.0%	1.0%
Somerville	0.6%	0.9%	0.4%
Total Watershed	**28.2%**	**23.6%**	

Source: MassGIS, accessed December 2003.
Includes all land in these communities, not just the land within the Mystic River Watershed.

Another measure of the extent to which the watershed is already heavily developed is provided by the Massachusetts Executive Office of Environmental Affairs' Community Preservation Initiative build-out analyses. These analyses were prepared for every city and town in the state. They characterize the land available for additional development, and estimate additional numbers of residents, numbers of students, water use, solid waste, roadway miles and other impacts of expanding to full build-out. The estimates take into account the current zoning provisions in each town, and treat all parcels that are not permanently protected from development as potentially developable.

Not surprisingly, the build-out analyses show very little potential for expanded development in the Mystic River watershed communities. For all communities that are at least partially in the watershed, overall population could increase only by 3 percent over current levels, even if all communities were developed to the maximum extent permitted by current zoning and permanent constraints on development. For the 9 core watershed communities whose area is at least 50 percent within the watershed, the potential population increase is the same (a little over 3 percent.)[1]

5.3 Open Space

Overview of Watershed Open Spaces

The Mystic River watershed is home to a number of high-quality urban wilds and urban parks, and to other open spaces that could be high-quality resources with some restoration and improved maintenance. This section provides an overview of these resources.

DCR Reservations

The Mystic River watershed is blessed with a heritage of parklands, formerly owned by the Metropolitan District Commission (MDC) and now managed by the state Department of Conservation and Recreation (DCR). Table 5-3 lists these parklands.

Table 5-3: DCR Urban Parks and Reservations in the Mystic River Watershed

Park/Reservation	Acres	Description
Alewife Brook Reservation (Little Pond)	120 acres	Portions located in Arlington, Belmont, Cambridge, and Somerville. Abuts Little Pond, Little River and Alewife Brook. Little Pond is an urban pond surrounded by residences. The Reservation contains significant wetlands, and much of it is in the 100-year floodplain. Provides significant wildlife habitat as an urban wild. Master Plan completed June 2003. Site for a constructed 3½ wetland proposed by City of Cambridge,

[1] These figures exclude Cambridge, which conducted an analysis of redevelopment potential, rather than just the potential to develop currently-undeveloped land. This is a more useful analysis for urbanized communities like those in the Mystic.

Table 5-3: DCR Urban Parks and Reservations in the Mystic River Watershed

Park/Reservation	Acres	Description
		to retain additional stormwater discharged locally as a result of separating combined sewers.
Belle Isle Marsh Reservation	142 acres	Located in Chelsea & Winthrop. Largest, most significant wetland in the City of Boston; serves as an important wildlife and saltwater habitat in a highly-urbanized area. Reservation preserves 152 acres of the 241 acre Belle Isle Marsh, the last remaining salt marsh in Boston. 28 acres is landscaped with paths, benches and an observation tower. Donated to the state by MassPort in 1979.
Blair Pond/ Wellington Brook	6.8 acres	Located in Belmont. Mostly wooded. Master Plan completed in 1999. Forms corridor with Alewife Reservation.
Mary O'Malley Park	19 acres	Located in Chelsea (Admirals' Hill neighborhood). Abuts Mystic River (saltwater portion) and Island End River. Open grass & lawn, with tennis courts. Attractive views of river and harbor. Heavily used as a recreation site by local residents. Facilities need repair, and boat dock is in poor repair.
Gateway Center Mall Park	15 acres	Located in Everett, along east bank of the Malden River. Created as port of the restoration of the Monsanto/Solutia site in 1995 and as part of the Gateway Mall Development. Maintained by Developers Diversified.
Middlesex Fells Reservation	2,575 acres	Located in Medford, Malden and Melrose. Includes South and Middle Reservoirs, Spot Pond, Wright's Pond and Quarter-Mile Pond. Meadow converting to woodland. Offers hiking, rock climbing, mountain biking, cross-country skiing, horseback riding, and picnicking.
Mystic River Reservation	130 acres	Located in Somerville, along the Mystic River from the Mystic Lakes to the Malden River. Mostly grassland & meadow, some wooded.
Draw 7 Park	9 acres	Part of the Mystic River Reservation, in Somerville. Grass. Named for the Draw Number Seven Railroad Bridge, which once crossed the Mystic River. Build in cooperation with the MBTA. Provides two soccer fields, a bikeway/walkway, and a picnic area.
Mystic Lakes		Eastern shore of Upper and Lower Mystic Lakes, along the Mystic Valley Parkway in Medford and Winchester. Swimming at Sandy Beach on the Upper Mystic; boating available on both the Upper Mystic (non-powered boats only) and the Lower Mystic Lake (power boats with no wake allowed.)

These parklands have in some cases suffered in the past from lack of maintenance, and some facilities are in disrepair.

The DCR has completed Master Plans for Blair Pond and the Alewife Reservation, and is just beginning to implement the plan. In addition, the DCR is initiating a master planning process for the Mystic Reservation. The Mystic Reservation Master Plan has been delayed for some time by lack of funding, and should be a high priority for the near future.

Other Open Spaces

In addition to the state-owned open space resources described above, Table 5-4 lists other significant open space parcels in the watershed:

Table 5-4: Significant Non-DCR Open Spaces in the Mystic River Watershed

Open Space	City/Town	Description
Ell Pond	Melrose	City park, w. active & passive recreation
Horn Pond Conservation Area	Winchester	500 acres of wetlands, ponds and woods; boat and canoe access
Horn Pond Brook	Winchester	Walking trail along brook from Horn Pond to Wedge Pond
Winter Pond	Winchester	17 acres, with canoe access
Wedge Pond	Winchester	Canoe access at Elliot Park
Brooks-Parkhurst Town Forest	Winchester	29 wooded acres with trails
Brooks Estate	Medford	50+ acres of historic open space; trails, birding, and fishing in Brooks Pond
Arlington Reservoir	Arlington	1 mile walking trail around reservoir
Spy Pond	Arlington	Canoe and limited boat access
Clay Pit Pond	Belmont	½ mile path around pond
Fresh Pond Reservation	Cambridge	2.5 mile trail around Cambridge drinking water reservoir, plus add’l trails
Village Landing Park	Everett	New park adjacent to Malden River
Condor Street Urban Wild	East Boston	New 4.5 acre urban wild on Chelsea Creek, reclaimed from abandoned industrial land
Schrafft Center	Charlestown	Boardwalk and small park created on newly-filled land along the Mystic River during late 1980s renovations of the Schrafft Center.

While there are significant protected open space resources in the watershed, they are not evenly distributed, and some communities have substantially less access to nearby open space than do other communities. In general, residents in the lower watershed have less access to high-quality open space than do upper watershed communities, although there are exceptions to this generalization.

Watershed Priorities for Open Space Protection & Restoration

It is difficult to set priorities for open space protection in the watershed, because there is a need to protect or reclaim open space in every part of the watershed. In addition, emphasizing different benefits of open space would lead to different priorities. Two recent studies have addressed the challenge of setting priorities for open space protection.

Natural Cities in the Mystic River Watershed

The Urban Ecology Institute applied its Natural Cities Program suite of tools and services to the Mystic River watershed, in a study funded by the U.S. Forest Service.[2] The Natural Cities approach draws on Ecological Resources mapping, Rapid Ecological and Legal Assessments, and Social Surveys to select the most critical sites in an urban area and to target limited resources toward protecting and restoring those priority sites. (http://www.bc.edu/bc_org/research/urbaneco/program/natcit_components.html)

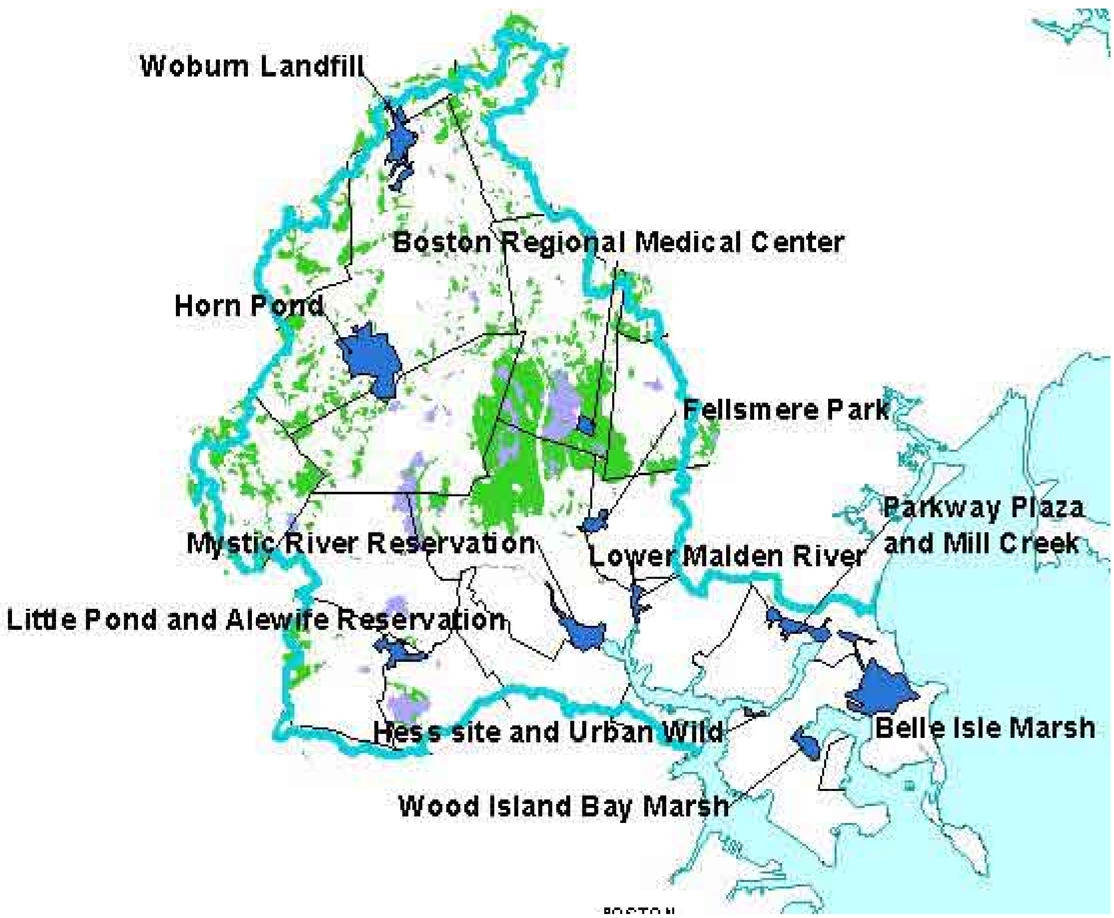
In the Natural Cities/Mystic project, the project team studied a Ecological Resources Map of the Greater Boston Harbor Region, and identified 114 sites of relative ecological importance within the Mystic River watershed. The sites ranged from half an acre to 1,600 acres in size. This list of sites was compared with the results of a Social Survey to identify 26 sites with both high ecological importance and social interest. Knowledge of these 26 sites was enhanced by applying the protocols of the Rapid Ecological and Legal Assessments. The project will create final Action Plans for 11 sites in Woburn, Chelsea, East Boston, Somerville, Malden, Cambridge, Burlington and Revere that are listed in Table 5-5 below and shown in the map below.

Table 5-5: UEI Natural Cities/Mystic Project Priority Sites

Sites	Cities	Community Concern
Hess Site and Condor Street Urban Wild	East Boston	Urban blight
Parkway Plaza and Mill Creek	Chelsea	Potential green space
Lower Malden River	Malden & Medford	Polluted waters
Belle Isle Marsh	East Boston	Wetland degradation
Woburn Landfill	Woburn	Leaching landfill
Burlington 'Native Forest'	Burlington	Preservation of overlooked resource
Boston Regional Medical Center	Stoneham	Development threat

[2] Partners in the project included the Chelsea GreenSpace and Recreation Committee, the Neighborhood for Affordable Housing (East Boston), the Mystic River Watershed Association, Eagle Eye Institute (Somerville), the Massachusetts Department of Environmental Management's (DEM) Urban and Community Forestry Program (now part of the Department of Conservation and Recreation), the Executive Office of Environmental Affairs' Watershed Initiative, the Tufts University WaterSHED Center, and the Boston College Environmental Studies Program.

Table 5-5: UEI Natural Cities/Mystic Project Priority Sites		
Sites	**Cities**	**Community Concern**
Little Pond and Alewife Reservation	Cambridge & Belmont	Flooding, natural area preservation
Wood Island Bay Marsh	East Boston	Pollution from the airport
Mystic River Reservation	Somerville	Reservation degradation
Source: Urban Ecology Institute website, http://www.bc.edu/bc_org/research/urbaneco/program/natcit_Lpartnerships.html		



MyRWA Open Space Report

The Mystic River Watershed Association (MyRWA) conducted an inventory of open space parcels in the watershed with potential watershed importance, and applied a series of criteria to set priorities for protecting or preserving these sites.[3] This project was funded by U.S. EPA Region 1.

[3] The study focused on watershed-wide values in ranking sites. Sites that may not be a high priority at the watershed level may nonetheless be a high priority for local communities for a variety of reasons.

Candidate sites were identified by municipal conservation agents and planners, by a review of municipal Open Space plans, and by analyzing maps.[4] The inventory covered 113 sites, totaling 2,366 acres, that are now or could become valuable recreational and habitat resources, and that may affect the quality of waterbodies. The smallest site in the inventory is less than half an acre, and the largest site (Great Meadow in Lexington) is 183 acres. Of the 113 sites, 76 were classified as candidates for preservation, 23 as candidates for restoration, and 14 as candidates for both (portions of the site needing to be preserved and portions needing restoration), based on their current condition. The MyRWA study did not include parks and reservations owned by the MA Department of Conservation and Recreation, which are assumed to be well-protected.

The sites were given scores representing a variety of characteristics, and priority rankings for protection or restoration were developed based on those scores. The priority rankings reflected the following site characteristics:

- Quality of current cover (wetland, forest/wooded, grassland/meadow, grass field/lawn, agricultural or impervious);

- Impact on watershed values (adjacent to water body, contributing to open space corridors, buferfing water from highways, providing wildlife habitat, including a vernal pool, affecting flooding, providing public access to the water, and/or having scenic or aesthetic value);

- Environmental justice priority (located in or adjacent to an EJ community); and

- Threat of development (high, medium or low), for currently-undeveloped sites.

Assigning scores and applying the ranking criteria identified 32 sites as high priority for preservation, and 23 sites as high priority for restoration. Tables 5-6 and 5-7 list the sites selected as high priority for protection and restoration, respectively.

[4] Three communities were excluded from the study because only a very small portion of their land area falls within the watershed. The excluded communities were Wakefield, Watertown and Wilmington.

Table 5-6: MyRWA Open Space Report – Priority Sites for Protection

Site name	City/town	Acres	Env Justice	Likelihood of Development
High combined quality and watershed importance				
O'Neill Properties	Belmont	12.17		high/current
Great Meadow	Lexington (Arlington)	183		moderate
McLean Hospital	Belmont	97		high/current
Fulgoni Parcel	Reading	3.9		high/current
Mugar Parcel	Arlington	17.26		high/current
MDC Skating Rink/Route 2 Land	Belmont	4.38		high
ADL/Bullfinch Property	Cambridge	36.6		high/current
Longwood Poultry Farms	Reading	35.43		high/current
MDC/Leased to American Legion	Stoneham	28		high
Northeastern Property	Woburn	75		high/current
Shannon Property	Burlington	30	x	moderate
Winning Farm	Lexington	9		moderate
Elizabeth Island	Arlington	2		moderate/low
Pansy Patch	Winchester	9.5		high
Cummings Estates	Burlington	49		high
Locke/Hamilton Farm	Winchester	19.5		high
Cummings Estates	Woburn	50		high
Malden Hospital Parcel	Malden	35	x	high
Gutierrez Company Land	Burlington	36		high/current
Eastman Property	Stoneham	4		high
Fishermen's Bend	Winthrop	7.5	x	moderate
High watershed importance, moderate or low quality				
Town Library	Belmont	1.9		high/current
Busa Farm/Sun Valley Farm	Lexington	10		high
Boston Regional Medical Center	Stoneham	40.7		high/current
Symmes Hospital	Arlington	18	x	high/current
Environmental justice priority				
Bainbridge Road Parcel	Malden	1	x	moderate
Coughlin Playground	Winthrop	9.8	x	moderate
Cambridge Health Alliance Property	Somerville	6	x	high/current
McKinney Property	Burlington	2.3	x	high
Pleasant Court	Winthrop	1.4	x	high
Public Landing	Winthrop	5	x	high
Little Mystic Channel	E.Boston/ Charlestown	1.5	x	high

Source: Mystic River Watershed Association, Open Space Priorities in the Mystic River Watershed, February 2004

The remaining 55 potential candidates for preservation were not ranked as having high watershed importance, were not considered a priority for environmental justice reasons, or were not thought to be candidates for development under current circumstances. A change in status regarding potential for development might make some of these sites a high priority. It is therefore important to continue tracking the status of such sites on a regular basis. Some of these sites might be considered as higher priorities for attention if they do not currently offer public access but could if acquired by a municipality.

The following are the 23 sites selected as high priority for restoration. Six of these sites were also selected as high priorities for preservation of a portion of their property.

Table 5-7: MyRWA Open Space Report – Priority Sites for Restoration

Site name	City/town	Acres	Env Justice	Likelihood of Development
High watershed value				
ADL/Bullfinch Property	Cambridge	36.6		high/current
W.R. Grace Property	Cambridge	14		medium
McLean Hospital	Belmont	97		high/current
Assembly Square Area	Somerville	131.18	x	high/current
Boston Regional Medical Center	Stoneham	40.7		high/current
Town Transfer Station	Winchester	8.91		low
Sheperd Brooks Estate	Medford	55		low
Gutierrez Company Land	Burlington	36		high/current
Martignetti Property	Cambridge	7.86		high
Salem Street Area and Junk Yards	Woburn	9.07	x	high
Triangle Area	Cambridge	33		high
Quadrangle Area	Cambridge	90		high
Environmental justice priority, moderate watershed value				
Malden Hospital Parcel	Malden	35	x	high
General Electric Park Site	Everett	8	x	high
Massachusetts Electric Parcel	Revere	5.5	x	low
Symmes Hospital	Arlington	18	x	high/current
East Boston Greenway	E.Boston/ Charlestown	8.5	x	low
Parkway Plaza	Chelsea	38	x	high
Telecom City Parcel	Malden	1.6	x	high
Telecom City Parcel	Medford	7	x	high
Forbes Site	Chelsea	17	x	high

Source: Mystic River Watershed Association, Open Space Priorities in the Mystic River Watershed, February 2004

The remaining 14 candidate sites for restoration were either ranked as low on watershed importance or ranked moderate on watershed importance but not as an environmental justice priority. Including sites that ranked low in watershed importance but were classified as environmental justice sites would have included an additional 13 sites, or virtually all of the restoration sites in the analysis. Some of the excluded environmental justice sites could become a higher priority, however, if opportunities arose to acquire the sites or to negotiate strong open space provisions in a proposed redevelopment.

Opportunities for Improved Land Use and Enhanced Open Space

There are a variety of opportunities for preserving and improving existing open space, reclaiming open space through redevelopment of already-developed areas, and reducing the impact of developed areas on water quality and flooding.

Unlike other watersheds in the state, which are seeing rapid conversion of undeveloped lands, the Mystic has relatively little undeveloped land left. Some developments are occurring or are proposed on land that is currently undeveloped, particularly in the upper part of the watershed. It is important that communities ensure that these developments do not reduce open space to an unacceptable level, and that they include adequate open space, stormwater management, and wastewater capacity.

Mystic River watershed communities also have the challenge of finding redevelopment options that will both recapture open space and reduce the impacts of land uses on water quality and flooding.

Finally, some of the open space resources in the watershed are in poor condition or are fragmented. Improving urban parks along the rivers and making better connections among them is an important open space priority.

This section comments on the challenges involved in improving land use and enhancing and expanding open space in the watershed. These include the need for strong municipal capacity to make effective land use decisions, the potential that public parklands will be converted to other uses, the impact of port uses on land use and open space options, and the relevance of various state and regional initiatives to land use and open space planning in the watershed.

Community Capacity for Promoting Sustainable Land Use

It is notable that only one of the cities and towns in the Mystic River watershed (Cambridge) has adopted the Community Preservation Act. This act allows communities to create a local Community Preservation Fund through a surcharge of up to 3% on the local real estate tax. The funds can be used for open space, historic preservation, and low- and moderate-income housing. The state provides matching funds as an incentive for communities to take advantage of the act's provisions. The state has distributed almost $76 million to 61 cities and towns in the state, based on a 100% match of local funds, over the past three years. (http://commpres.env.state.ma.us/).

Many Mystic River watershed cities and towns have taken advantage of state funding to develop Community Development Plans, through Executive Order 418. These plans develop maps to define future growth, including housing, open space, commercial and industrial development, and transportation improvements. Funding of up to $30,000 is provided to each community that applies and qualifies. Plans are being reviewed by the Department of Housing and Community Development, and can be viewed at http://commpres.env.state.ma.us/#. With the exception of Boston, Cambridge, Malden, Arlington and Revere, all of the watershed communities have approved Scopes of Work for a Community Development Plan, and are in various stages of completing them.

A key factor in a community's ability to control local land uses is its use of appropriate bylaws and ordinances. A study by the Massachusetts Historical Society, with funding from the National Park Service, provides a description of bylaws and ordinances that can be used to preserve important community assets, including open space. This report also lists current bylaws and ordinances by community.

Table 5.8 provides results from the Massachusetts Historical Society survey for the Mystic River watershed communities, along with information on local wetlands protection ordinances, Master plans, and Open Space plans.

Table 5.8: Community Plans, Bylaws and Ordinances

Community	Non-Zoning Wetland Protection By-Law/Ordinance (MACC)	Master Plan (completion date)	Open Space & Recreation Plan (expiration date)	Community Development Plan	Site Plan Review	Cluster Zoning	Overlay Zones
Arlington	Y	-	8/2007	-	x		x
Belmont	N	x (1988)	8/2006 c	x	x	x	x
E. Boston/ Charlestown	N	-	1/2007	-	x	x	x
Burlington	Y	-	expired	x			
Cambridge	N	x (1993)	9/2008 c	-	x	x	x
Chelsea*	N	-	11/2008	x	na	na	na
Everett	N	-	4/2009 c	x	x		x
Lexington	Y	x (2002)	expired	x	x	x	x
Malden	N	-	8/2005	-	x		
Medford	N	x (1977)	12/2006	x	x		
Melrose	N	x (1962)	expired	x			
Reading	Y	x (1991)	7/2006	x	x	x	
Revere	Y	-	12/2006 c	-	x	x	
Somerville*	N	-	9/2008 c	x	na	na	na
Stoneham*	N	-	expired	x	na	na	na
Wakefield*	Y	x (1987)	12/2004	x	na	na	na
Watertown	Y	x (1989)	expired	x	x	x	x
Wilmington	N	x (2001)	8/2007	x	x	x	
Winchester*	Y	-	expired	x	na	na	na
Winthrop*	Y	-	expired	x	na	na	na
Woburn	Y	x (1996)	expired	x	x	x	x

Table 5.8: Community Plans, Bylaws and Ordinances

Community	Non-Zoning Wetland Protection By-Law/Ordinance (MACC)	Master Plan (completion date)	Open Space & Recreation Plan (expiration date)	Community Development Plan	Site Plan Review	Cluster Zoning	Overlay Zones

* No information provided to Mass. Historical Commission survey.
c Indicates Open Space Plan is conditionally approved.

Sources:
Non-zoning Wetland Protection By-Law/Ordinance: Massachusetts Association of Conservation Commissioners (MACC), http://maccweb.org/wetlands_bylaw.html
Open Space Plans: Jennifer Soper, MA Department of Conservation Services, as of October 2004.
Community Development Plans: www.commpres.env.state.ma.us/#
All others: Massachusetts Historical Commission, 2003. "Please note that the information included is not meant to represent a complete and accurate list of community plans, bylaws and ordinances, but rather a representative survey to be updated and improved over time."

As Table 5-8 shows, a number of watershed communities do not currently have a local wetlands protection bylaw or ordinance, some do not have current Open Space plans, and most do not have a current Master Plan. While municipalities may employ different planning and regulatory tools to control land uses, and no single approach is necessarily best, it is important that each community have an effective tool kit of plans, bylaws and ordinances.

Potential Conversion of Parklands to Other Uses

In setting priorities for open space protection, it is important to recognize that parcels that are currently protected as parks or reservations may not remain protected in the future.

Open space is protected as public trust land under Article 97 of the Amendments to the Massachusetts Constitution, enacted in 1972, if:

- A municipality's Conservation Commission or water department owns it;
- It is owned by one of the State's conservation agencies or a nonprofit land trust;
- It was purchased or improved with state or federal funds;
- It is placed under an Agricultural Preservation Restriction (Chapter 61A) or a Department of Environmental Protection restriction (as part of the Wetlands Conservancy Program); or
- It is protected in perpetuity by a condition of a deed.

Under Article 97, this protected status can be overturned by a series of steps, including among others, a two-thirds vote by the Massachusetts legislature.[5] Unfortunately, recent cases have shown that acquiring a two-thirds vote in the legislature to change the land use of "Article 97 land" is not a difficult task. As stated in a *Sanctuary* magazine article,

[5] Charles River Watershed Association, *Streamer*, Vol. 32, No. 1, Spring 2001, p. 1.

"Although the measure [Article 97] was intended to provide a strong safeguard for conservation land, this open space protection is too often overridden by the legislature and municipalities through home-rule petitions sent to the General Court. Nearly every disposition or change-in-use proposal brought up for a vote has been approved unanimously as a courtesy to the sponsoring legislator. In the year 2000, land transfers constituted over 20 percent of all votes taken in the House of Representatives and over 15% of all votes taken in the Senate." [6]

Transfers of state parklands in the Mystic River watershed have occurred in the past. For example, approximately 47 acres in the Mystic River Bend Park were used to construct two schools in Medford. In general, such transfers require mitigation by provision of comparable open space elsewhere. Any proposals for such conversions should be viewed with great caution, to ensure that important parcels are not lost simply because they are attractive, inexpensive targets for development or other uses.

Implications of Port Uses for Land Use and Open Space[7]

Substantial portions of the waterfront in the lower Mystic River watershed are set aside for port uses as "Designated Port Areas" (DPAs).[8] The need to balance port uses with public access and other uses of the waterfront represents a particular challenge in achieving watershed open space and recreation goals. This section describes the current DPAs in the watershed, and discusses the implications of the DPA designations for competing uses in the lower watershed.

The following are the DPAs located in the Mystic River watershed:

- **Chelsea Creek DPA:** along Chelsea Creek.
- **East Boston DPA:** along Mystic River/Inner Harbor.
- **Mystic River DPA:** the saltwater portion of the Mystic River on both sides, Little Mystic Channel, Island End River, and the entrance to Chelsea Creek.

The DPA regulation (Chapter 301 CMR 25.00) was adopted as part of the Massachusetts Coastal Zone Management Program in 1978. It restricts activities in DPAs to those promoting and protecting marine industrial activities and certain supporting uses. While the Public Waterfront Act (Chapter 91) protects public access and natural resources in the state's other waterfront areas, a DPA designation makes maritime and industrial water-dependent uses the higher priority. Implementation of the DPA regulations is shared by

[6] Christopher Hardy, *"No Net Loss"*, Sanctuary Magazine, Massachusetts Audubon Society, March/April 2001, p. 22.
[7] Much of this section is based on a study by Tufts University Environmental Law class students completed in 2003 (Tufts University, 2003).
[8] A Designated Port Area (DPA) is defined as a "geographic area of particular state, regional, and national significance for commercial fishing, shipping, water-borne commerce, manufacturing, processing and production activities reliant on water-borne commerce, power generation, and wastewater treatment."

the MA Department of Environmental Protection (DEP), which reviews and issues licenses for waterfront projects in DPAs, and the MA Office of Coastal Zone Management (CZM), which oversees boundary reviews for DPAs.

A 1994 amendment to the DPA regulation addressed the need for public access to the waterfront within DPAs: "… judicious planning of the use mix in the DPA and its environs, together with compatible incorporation of public access facilities into the design of individual projects, can advance the quality-of-life objectives of the surrounding community without significant interference with maritime activities at or near the waterfront."[9]

There are a number of successful examples of waterfront uses that might provide examples for the lower Mystic DPAs.[10] Some of these waterfront revivals have happened after the decline of port activity, however, and would not be good models for the Lower Mystic, where there continues to be active port use. The Everett Waterfront Assessment and the Chelsea Waterfront Vision both represent strong first steps in the process of reclaiming access to the waterfront for lower watershed communities.

Long stretches of parkland along the waterfront are not likely to be compatible with port uses in DPAs. More feasible options are likely to be pocket parks or "point access" to the waterfront (perpendicular access to the waterfront from inland locations).

In addition, there may be limits to the amount of small recreational boat use that can be accommodated in a DPA. For example, the regulations discourage placement of boat launches or marinas that would increase the number of small craft using the DPA waters. However, the DEP and CZM may approve a facility that allows launching of small craft upstream of a DPA, with a channel that requires boats to immediately leave but not to transverse the DPA shore-to-shore.

Requests for changes in DPA boundaries can be made by municipalities, port authorities or state agencies, owners of the affected properties, or any 10 citizens of the Commonwealth. Only certain lands are eligible for boundary review, and CZM and DEP may be more inclined to allow temporary or supporting uses than to make a change in the DPA boundaries.[11]

There are three mechanisms that might allow for increased public waterfront use and access in the watershed's DPAs:

- First, the DPA regulations allow for up to 25 percent of a project to be used for Supporting DPA Uses -- commercial uses such as restaurants or retail

[9] 1994 Designated Port Area (DPA) Regulations, Introduction, p. 3.
[10] For example, in Massachusetts, the planning efforts conducted for Gloucester, Salem, New Bedford/Fairhaven, and Fall River, and outside of Massachusetts, the Fulton Fish market and the South Street Seaport shopping area in New York City, Baltimore, Vancouver, San Francisco's Pier 39, and the Bell Street Pier at Pier 66 in Seattle.
[11] The Tufts University student study cited above provides four examples of recent requests for boundary review in the lower watershed.

businesses.[12] Public access or viewing points along the waterfront could be developed in conjunction with those uses. (DPA Regulations, p. 238.4). Municipal zoning codes determine what qualifies as a Supporting DPA Use. Municipalities can prepare a DPA Master Plan, with a Supporting DPA Use District within the DPA, that would encourage concentrated development of commercial uses with associated public access benefits.

- Second, the regulations allow for "Temporary Uses", which can be in place for up to 10 years. The Fleet Boston Pavilion in South Boston is an example of such a temporary use.

- Third, publicly owned lands within a DPA may be available for redevelopment as a pocket park or waterfront vista point. For example, an observation park and platform was created on Pier 7 in South Boston on land owned by the City of Boston.

Further investigation of public access options in the watershed's DPAs is worthwhile. This effort could support development of municipal "DPA Master Plans" and specific actions to improve public access in the lower watershed, including combining public access with commercial or "temporary use" projects, and/or requesting a DPA boundary review.

There are also significant Homeland Security issues, as well as the DPA regulations, that have to be considered in allowing public access to the waterfront and waterways in the lower watershed. More research is needed to translate security needs into waterfront planning guidelines.

Regional Planning Efforts and Smart Growth Initiatives

There are several programs now underway that will influence the distribution of state resources and will lay out a vision for development in the future. It is important that the needs of the Mystic River watershed communities and resources be considered in these efforts.

The Metropolitan Area Planning Council is conducting the **MetroFuture Project**. This effort builds on the MAPC's earlier MetroPlan for the 101 communities in its region (which includes all of the Mystic River watershed cities and towns.) This multi-year initiative will develop a sustainable growth plan for the region, and includes a large participatory process seeking public "visions" for Metro Boston. The project began with a major public meeting in October 2003, has had visioning meetings throughout the region, and will have a second major public meeting in January 2005.

The state's Department of Conservation and Recreation's **Urban Parks Division** has recently been reorganized, to provide a single point of contact at the agency for parks and reservations in each region. In addition, the agency is conducting an assessment of all of

[12] Office space, housing and hotels do not qualify as Supporting Uses.

its parks and reservations, and establishing priorities for upgrading and maintenance. Many of the Mystic River watershed's parks owned by the DCR are in need of improvements, and preparation of a Master Plan for the Mystic River Reservation has been delayed for a number of years. It will be important for watershed advocates to participate in the DCR's planning and priority-setting process, to ensure that the watershed's parks receive the attention and resources they need.

Finally, the state's Office of Commonwealth Development is promoting a **Smart Growth** agenda that has a variety of components. In general, the goal is to encourage redevelopment over development in new locations; concentrated development, especially around transit centers; and use of existing infrastructure. Strong incentives are being provided to encourage "Smart Growth" projects. These include directing many of the state's capital investments toward projects that comply with Smart Growth principles, and evaluating municipal requests for state funding using specific criteria that reflect the municipality's performance on various Smart Growth measures, under the Commonwealth Capital program. Simplified or expedited environmental review of projects that meet Smart Growth criteria is also being discussed as part of the MEPA review process.

These Smart Growth initiatives have the potential to achieve important environmental benefits throughout the state. It is extremely important, however, that the initiatives do not have the unintended effect of reducing water quality and open space in urbanized areas. For example, it is important that "Smart Growth" projects in densely-developed areas meet stringent standards for providing local open space resources, improving stormwater quality, and reducing flooding problems. Moreover, it is important that low-income urban municipalities not be placed at a disadvantage in their efforts to protect local watershed resources by the provisions of the Commonwealth Capital program. An effective forum should be found for discussing the implications of the state's Smart Growth initiatives for urban communities like those in the Mystic River watershed.

5.4 Priorities for Action

The following priorities for action are suggested by the assessment of land use and open space issues presented above:

- Develop a DCR Master Plan for the Mystic River.

- Identify and implement critical next steps from previous planning efforts:
    - Chelsea Creek Master Plan
    - Blair Pond Master Plan
    - Alewife Reservation Master Plan
    - Everett Waterfront Plan
    - Mill Creek Restoration 2000

- Publicize the results of the UEI Natural Cities and MyRWA Open Space Report priorities for open space protection to local planning officials and Conservation Commissions. Update these studies as required and track the status of sites listed as priorities.

- Investigate options for improving public access in port areas:
  - Research examples of effective mixed use in active port areas that allow public access to the waterfront without hindering valuable maritime uses.
  - Develop a list of types of public access options that are compatible with port uses (e.g., pocket parks, point access, public boating areas and mooring sites, etc.).
  - Develop a list of sites in Mystic River watershed DPAs that are candidates for such public access options.
  - Take as a starting point the 2003 Chelsea Open Space Plan and Waterfront Vision, the 2003 Everett Waterfront Assessment, and the Boston HarborWalk plans.
  - Assess the impact of Homeland Security requirements on planning for public access.
  - Develop recommendations for municipal DPA Master Plans that will promote improved public access in DPAs.

- Initiate regional planning in the Alewife area as a case study of Smart Growth management in urban areas.
- Communicate key watershed priorities and issues to major state and regional planning efforts, including the MAPC MetroFutures project, DCR priority-setting for urban parks management, and local planning efforts (e.g., the Cambridge Concord-Alewife Study.)

- Participate in the development of state Smart Growth policies, to ensure that they promote improved water quality, reduced flooding, and enhanced quality of life in urban areas.

  - Develop principles for promoting Smart Growth in urbanized areas. Focus on (1) correcting infrastructure problems; and (2) preserving adequate open space and habitat in urban areas;
  - Provide input on MEPA criteria for expediting review of Smart Growth projects and other state agency initiatives, the Commonwealth Capital criteria, and other state incentives that promote Smart Growth.

Chapter 6: Recreation

Chapter Contents

6.1 Purpose and Overview

This chapter discusses recreation resources and activities in the Mystic River watershed. The watershed offers attractive areas for boating and swimming, especially at Upper and Lower Mystic Lakes (Sandy Beach). Fishing is popular in a number of locations. There is a network of pedestrian and bike trails, and the extensive urban parks and reservations described in Chapter 5 offer beautiful natural settings for walking, picnicking and playing.

There are limitations, however, that keep the watershed from reaching its potential as the "world class" urban natural resource its residents deserve. There are many missing links in the pedestrian and bike trails that limit their usefulness. Poor water quality and lack of public access discourage local residents from taking advantage of the water's recreational potential. In general, recreational use of the watershed's resources is limited, compared to activity on its sister river the Charles.

Improving opportunities for recreation in the watershed would significantly enhance the quality of life in the Mystic communities, as well as providing important public health benefits. Improving recreational opportunities is also important for building a constituency for the watershed. Residents who actively use the watershed's resources are more likely to support its protection and restoration.

This chapter first describes the recreation resources in the watershed, and then describes current use of these resources and the challenges involved in enhancing recreation in the watershed. Section 6.3 identifies priorities for action.

6.2 Current Recreational Activities and Challenges

Current Recreational Use

The Mystic River Watershed Association (MyRWA) conducted a survey of recreational uses of the Mystic River during the summer of 2003, funded by an anonymous foundation. Surveyors observed activities at various times of the day and days of the week at 21 different locations along the river between High Street (in Arlington) and Little Mystic Inlet (in Charlestown). This "Reconnaissance Survey" provided information on the numbers of people engaged in different activities at each location and at different times. In-person interviews were then conducted at four locations – Sandy Beach (on Upper Mystic Lake), the Blessing of the Bay Boathouse (in Somerville), Draw 7 Park adjacent to the Amelia Earhart Dam in Somerville, and Little Mystic Inlet[1] (in

[1] Also known as Little Mystic Channel.

Charlestown). These in-person interviews obtained information on where people came from, what they liked best and least about the river, what they fish for and what they do with their catch, and their opinions about water quality and the safety of consuming fish caught in the Mystic.

Table 6.1 summarizes the activities observed by location.

Boating

The survey revealed extensive boating on the Mystic River itself. However, no boating was observed from Village Landing Park or Gateway Center Park (both of which face the Malden River). The Tufts University crew rows on the Malden River, but otherwise boat use is apparently limited on the Malden. Boating on the Malden may have been understated, however, because views of the river are obscured by vegetation in much of the Gateway Center Park.

Canoeing and kayaking on the Mystic would benefit from more convenient locations to put boats into the river, but there are a number of locations where public boating access is available. The availability of these access points needs to be better publicized, however. The MA Department of Fish and Wildlife's Public Access Board lists only one state-maintained boat ramp in the watershed – a DCM concrete ramp on Upper Mystic Lake. The Mystic Wellington Boat Club in Medford maintains a ramp for public access, and there is a ramp on Upper Mystic Lake near the Medford Boat Club. There is also a boat ramp at Mary O'Malley Park in Chelsea, which is reported to be in poor repair, and another ramp at the Little Mystic Inlet in Charlestown. Walk-on access and canoe rentals are available at the Blessing of the Bay Boathouse. Medford has a canoe launch and parking at Mystic Riverbend Park. Finally, there is a public boat mooring and parking (but no trailer access) behind the Schrafft's Building in Charlestown.

Unofficial access is available at some other locations, including the former Arthur D. Little parking lot (now Discovery Park) in Cambridge, Mystic River Road in West Medford (below Lower Mystic Lake), and Medford Center near the Condon Band Shell. In general, however, public boating access to the river is more limited than on the urban portions of the Charles River. The Everett Waterfront Plan envisions a public mooring area for boats in the Malden River, for example, and the TeleCom City development (now called River's Edge) is expected to include boating access. Public boat access should also be included in plans for the revitalization of Medford Square.

Table 6.1: Mystic River Use Survey Results – Number of People Observed by Activity and Location

Survey Location	Boating	Swimming/ Wading	Passing Through*	Fishing/ Angling	Playing**	Hanging Out***	All Activities	% by Location
High Street (Arlington/Medford)	8	0	12	3	22	11	56	*3%*
Dugger Park (Medford)	13	0	18	4	97	34	166	*8%*
Boston Ave (Medford)	12	0	6	2	15	1	36	*2%*
Mystic River Bend Park (Medford)	25	0	65	0	13	11	114	*5%*
Mystic Basin Trail (north) (Medford)	55	0	350	18	86	79	588	*28%*
Mystic Basin Trail (south) (Somerville)	36	0	118	5	8	5	172	*8%*
Blessing of the Bay Boathouse (Somerville)	62	0	123	4	26	24	239	*11%*
Draw 7 Park/Amelia Earhart Dam (Somerville)	80	0	28	112	26	81	327	*16%*
Village Landing Park (Everett)	0	0	0	0	0	2	2	*0%*
Gateway Center Park (Everett)	0	0	15	1	5	12	33	*2%*
Route 99 Bridge (Charlestown/Everett)	12	0	19	5	0	1	37	*2%*
Riverfront near Schrafft's Bldg (Charlestown)	51	0	6	1	8	13	79	*4%*
Little Mystic Inlet (Charlestown)	0	29	32	6	55	121	243	*12%*
Total Observations	354	29	792	161	361	395	2,092	*100%*
% by Activity	*17%*	*1%*	*38%*	*8%*	*17%*	*19%*	*100%*	

*Passing through = walking, running, biking, rollerblading, skateboarding.

**Playing = field sports, playing catch, children playing.

***Hanging out = sitting/resting, relaxing, sunbathing, picnicking, gardening, bird watching.

Source: *Mystic River Watershed Association, River Use Survey 2003 (report forthcoming).*

There are eight private boat or yacht clubs in the watershed, as well as the Blessing of the Bay Boathouse, which is leased to the City of Somerville and used by the Boys and Girls Club of Middlesex. The private clubs include:

- Admiral's Hill Yacht Club (Island End River, Chelsea)
- Chelsea Yacht Club (Mystic River)
- East Boston (Jeffries) Yacht Club
- Medford Boat Club (between Upper and Lower Mystic Lakes)*
- Mystic Wellington Yacht Club (Mystic River, Medford)*
- Riverside Yacht Club (Mystic River, Medford)*
- Winter Hill Yacht Club (Mystic River, Somerville)*
- Winchester Boat Club (Upper Mystic Lake, sailing and canoeing).

The clubs noted with * are located on DCR parklands along the Mystic River, as is the Blessing of the Bay Boathouse.

The private yacht clubs located on DCR land are subject to permits. The permits for each club have similar provisions and a five-year life. In return for use of public land at very low cost, each club is required to have a "Public Participation Plan", in which they provide public access and activities to the general public. The clubs must report to the DCR on their Public Participation activities every year. The permits most recently expired on January 1, 2004, and have been renewed by the DCR with some changes, including higher fees.

In the past, MDC (the predecessor to the DCR) did not supervise the Public Participation requirements closely, and there were no standards or guidelines for what constitutes adequate public access. With the renewal of these leases, there has been increased discussion about what requirements should apply to the yacht clubs in the Mystic watershed and in other DCR parklands. The nature of the Public Participation requirements is currently under review for the new permits.

Spokespersons for the clubs have noted that they have to restrict public access in order to protect valuable boats and the club facilities. Within those reasonable constraints, it should be possible to identify ways in which public access to the water can be enhanced as part of the Public Participation requirements. A Tufts University student research project compiled information on the Public Participation activities of the four private clubs on DCR land, under the leases that expired January 1, 2004. They include provisions that provide direct water-related benefits to local residents in some cases, and in other cases are less related to water uses. Increasing the water-related benefits provided by the clubs as a condition of their leases should be a priority, given the goal of creating connections between residents and the water. Examples of such benefits already offered by one or more of the clubs include:

- Space for local groups' and schools' picnics;
- Access for bird watching groups;
- Youth sailing program (open to the public);
- Site for road races;

- Sponsoring river cleanups;
- Access through club to the shoreline;
- Public use of restrooms and phones; and
- Boat trips for residents and other groups.

Park Use

The River Use survey showed an uneven distribution of use by location, with substantially more use of parks that have been in existence for some time (Dugger Park, River Bend Park, Mystic Basin Trail, Blessing of the Bay Boathouse, and Draw 7 Park). Several relatively new parks were not used much, including Village Landing Park and Gateway Center Park in Everett, and the riverfront park behind the Schrafft's Building. All three of these parks are hidden from neighborhoods by highways and commercial buildings, and their existence is not evident to passersby. More publicity about their location might encourage greater use of these resources.

Fishing

The survey also revealed widespread fishing. The Draw 7 Park near the Amelia Earhart Dam was the most popular fishing location, but fishing was observed at least once at most of the other locations surveyed.

In the in-person surveys with fishermen at Draw 7 Park, Little Mystic Inlet, and Sandy Beach, 16 of 27 respondents indicated that they fished "everyday" or "1 to 4 times a week." Eight of the respondents reported their race or ethnicity, including Black/African American (2), Latino/Hispanic (3), Brazilian/Portuguese (2), Asian (1), and "White" (14). Striped bass was the most popular target fish, followed by Bluegill, Bluefish, Herring, Mackerel, and "anything that bites." Eleven reported that they (or their families and friends) ate the fish they caught.

The survey covered only the main stem of the Mystic River. Fishing is also reported to be common elsewhere in the watershed, including in the many lakes and ponds. The extent of fishing in the watershed, and the fact that at least some fishermen and their families are eating their catch, raises concerns about potential public health risks from consuming contaminated fish.

The Mystic watershed is subject to the statewide fish consumption advisory for mercury. In addition, there is an advisory for Clay Pit Pond in Belmont (for chlordane) and, more recently, an advisory for Spy Pond in Arlington (for DDT and chlordane). The small number of Mystic-specific advisories is somewhat surprising, given the widespread historic contamination of the rivers.[2] The limited available fish contamination data does not indicate that additional advisories are needed. However, more testing should be conducted, especially in the saltwater portion of the watershed and in actively fished

[2] Substantial stretches of the Charles River and the Neponset River have advisories for PCBs and, in the case of the Charles, for pesticides and mercury as well.

lakes and ponds. It was a local group's recent request for testing of Spy Pond that revealed the need for an advisory for DDT and chlordane.

The most recent comprehensive fish tissue testing in the Mystic was conducted by the MA Department of Environmental Protection (DEP) in 1999, as part of the Year 2 Basin Cycle assessments. Testing occurred from the middle of the Mystic River upstream to Lower Mystic Lake, and included both predatory and fatty species of fish. Table 6.2 provides the results for various toxics.

Table 6.2: Mystic River Fish Toxics Survey Results (mg/kg wet weight)

Species	Arsenic	Cadmium	Mercury	Lead	Selenium	PCBs	Pesticides
Trigger Level	NA	NA	0.5	NA	NA	1.0	5.0
Carp	0.08	*	0.15	*	0.27	0.46	0.07
Largemouth Bass	0.11	*	0.41	*	0.17	0.14	0.017
White Perch	0.08	*	0.28	*	0.31	*	0.015
Yellow Perch	0.04	*	0.08	*	0.30	*	*

NA limit not established by MA
* = below detection limit
** value for highest specific pesticide

Source: *MA DEP 1999.*

The Massachusetts Department of Public Health and the DEP report that all values are either below detection limits, below state trigger levels, or (where there are no state trigger levels) lower than levels that cause health concerns.

More effort is needed to publicize the existing mercury advisory. There are currently no postings about the advisory at the locations where fishing is occurring, including the Draw 7 Park.

Swimming

The 2003 River Use survey showed that swimming is occurring in the Little Mystic Inlet. There are also anecdotal reports of swimming, especially by kids, at other locations in the lower watershed – including Chelsea Creek, the Blessing of the Bay Boathouse, the Chelsea Mystic River shoreline, and under the Route 99 bridge. Swimming and wading in these areas can present public health hazards due to high bacteria levels (particularly when it rains) and other contaminants. The survey findings and the anecdotal evidence suggest that substantial primary contact occurs in the Mystic. This evidence should encourage regulators to set standards consistent with primary contact when issuing permits and taking enforcement actions. It also suggests that more public outreach and education is needed to promote safe recreational practices.

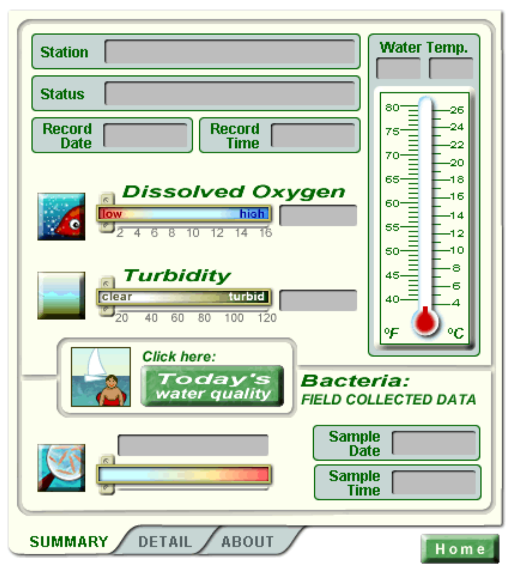
A major hurdle to promoting safer recreation in the lower watershed is the lack of other options for swimming and wading in these Environmental Justice communities. The DCR pool in Chelsea has been closed for some time, and the supervised swimming at Sandy Beach on Upper Mystic Lake can only be reached by car. A young girl drowned when kids were jumping off a dock in Chelsea in the summer of 2004, recalling another drowning of a local boy near the Blessing of the Bay Boathouse some years ago. Promoting safe recreation in the lower watershed will require a combination of public education and outreach and increasing safe opportunities for adults and youth to swim in the adjacent communities.

Sandy Beach at Upper Mystic Lake is the only monitored and supervised public swimming location in the watershed. The beach is monitored by the DEP and by the EMPACT project (see below.) There are potential concerns about toxic metal pollution from the Aberjona affecting the Sandy Beach area, but it appears that pollutants settle out in the upper forebay above the lake before reaching the lake itself. Additional monitoring for toxic metals in the waters at Sandy Beach is worthwhile.

EMPACT Project

The EMPACT project, funded originally by a US EPA grant, is designed to provide timely advice to residents on the safety of swimming and boating. This was a joint effort of the City of Somerville, Tufts University, and the Mystic River Watershed Association. The project collects real-time data on water quality in the Mystic River watershed at five locations during the recreation season (April or May to September or October):

- Sandy Beach (Upper Mystic Lake)
- Mystic River at High Street Bridge
- Alewife Brook
- Blessing of the Bay Boathouse, Somerville (Boys & Girls Club), and
- the Amelia Earhart Dam.

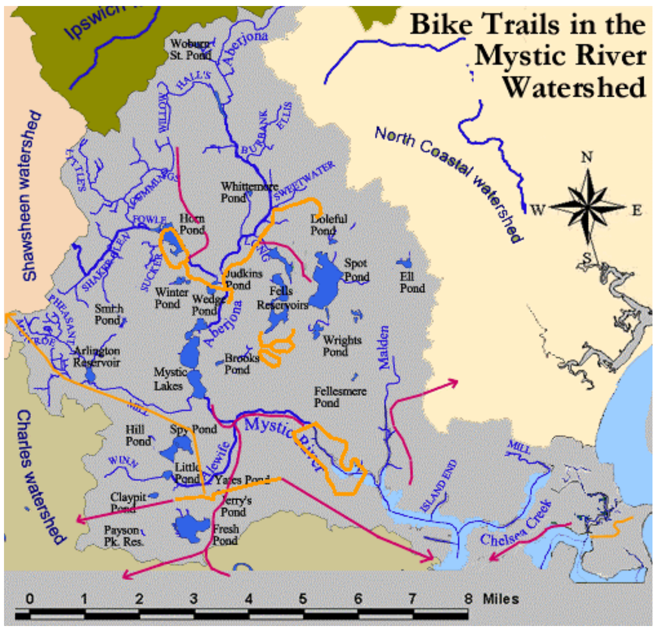


Data on depth, temperature, pH, conductivity, dissolved oxygen, and turbidity are collected by automatic sensors every 15 minutes and radio-transmitted to Tufts University for review and publication on the project website (www.mysticriveronline.org). Bacteria data were collected for two recreation seasons (2002 & 2003) and were analyzed in Tufts University's labs. A predictive model developed by Tufts researchers provides predictions of bacteria levels based on recent rainfall. Comparisons of the predicted bacterial levels with state water quality standards for swimming and boating (primary and secondary contact) indicate when bacteria levels are low enough to allow safe recreation.

The EMPACT project is an important resource for alerting the public about water quality conditions. EPA funding for the project ended after the 2003 recreation season. A grant from the Massachusetts Water Resources Authority (MWRA) supported continued operation in 2004. Funding is needed to continue monitoring and operation of the website in future years. In addition, the project's outreach effort needs to be expanded to include flagging at key locations on the river, similar to the flagging program conducted by the Charles River Watershed Association. Finally, there are plans to expand the monitoring to a new site on the Malden River in Everett, where waterfront development plans anticipate increased boating and where the Tufts University crew rows now.

Walking and Biking

The Mystic River watershed has a number of pedestrian and bike paths, although they are not well connected. The Minuteman Commuter Bikeway is a very popular path that runs from the Alewife T station in Cambridge through Arlington and Lexington to Bedford. There are bike paths on DCR lands along the Mystic River in Medford and Somerville and in the Middlesex Fells. The value of the Mystic River Reservation paths would be greatly enhanced by connecting to the Minuteman via the parkland along Alewife Brook (which is called for in the DCR's Alewife Reservation Master Plan), and to Boston with an extension through Charlestown.



There are a variety of plans for paths that would knit together a rich network throughout the region. For example,

- The Mystic Crossing group is advocating for pedestrian and bike access across the Amelia Earhart Dam.This crossing would connect Draw 7 Park and the Assembly Square area of Somerville with the future Bike to the Sea path (see below.) This crossing would also provide greater access to the Gateway Center Park, which is currently underutilized. An EPA enforcement settlement with Exelon has provided $250,000 to plan this connection.

- The proposed Bike-to-the-Sea path would run from the center of Malden through Everett to Revere Beach, with possible connections to the Mystic Reservation bike paths.

- The Somerville Community Path is a proposed linear park that would link to the Minuteman and the Red Line Linear Park, and run to Lechmere in Cambridge.

- Plans for Assembly Square include a connection along the Mystic River under the Wellington Bridge, which would connect to the DCR Mystic Reservation on the Somerville side and to the paths in Draw 7 Park, linking the entire Somerville waterfront.

- A proposed Tri-Community Bikeway through Woburn, Winchester and Stoneham would connect the Mystic River, the Middlesex Fells and the Bike-to-the-Sea path.

- An EPA enforcement settlement with the MBTA includes a potential path through MBTA property that would improve access at Sullivan Square – currently a very dangerous area for bikers.

The MassBike organization keeps track of these and other proposals for extending the bikeways and trails in Metropolitan Boston (http://www.massbike.org/bikeways/indexm.htm).

6.4 Priorities for Action

The following are priorities for improving recreational opportunities in the Mystic River watershed:

- Expand the survey of recreational uses to additional portions of watershed, to identify locations where swimming and fishing might present public health risks.

- Investigate and promote safe swimming options for residents (especially youth) in the lower watershed.

- Conduct fish tissue sampling for key fishing locations – in particular, lakes and ponds and the saltwater portion of the Mystic River, and issue location-specific advisories as needed.

- Post notices about the statewide mercury advisories at popular fishing spots.

- Provide pedestrian and bike access across Amelia Earhart Dam and through the MBTA property near Sullivan Square.

- Continue efforts to complete key links in the bikeways throughout the watershed, including connecting to the Boston Harbor Walk through Charlestown.

- Enhance Public Participation policies at boat clubs located on DCR lands, with an emphasis on opportunities for the public to use the waterfront.

- Develop a DCR Master Plan for the Mystic Reservation, and implement the provisions of the Blair Pond and Alewife Reservation Master Plans, including the bike path.

- Identify locations for improved public canoe and kayak access.

- Publicize the recreational assets of the watershed with a revised Blueways and Greenways map, including the new Village Landing, Gateway Plaza and Schrafft's area parks.

- Improve upkeep, maintenance and amenities in the DCR urban parks (repairing benches, providing water fountains, etc.).

Chapter 7: Habitat

Chapter Contents

7.1 Overview of Watershed Habitat

There are a limited number of high value habitat areas in the Mystic River Watershed, as measured by various state designations. These include:

Areas of Critical Environmental Concern (ACECs): Belle Isle Reservation in Winthrop is part of the Rumney Marshes ACEC.

Vernal Pools: Certified vernal pools are located in xx of the watershed's municipalities, including Reading (66), Medford (9), Lexington (6), Belmont (5), Woburn (5), and Melrose (3). Some of the pools listed in these towns may lie outside the watershed boundaries.

BioMap Core Habitats and Supporting Natural Landscapes: Areas around Spy Pond, Fresh Pond, and Horn Pond, and the Middlesex Fells have been designated core habitats and their supporting natural landscapes.

Great Ponds of Massachusetts: Spy Pond in Arlington, Little Pond in Belmont, Upper and Lower Mystic Lakes, Ell Pond in Melrose, Mystic, Wedge and Winter Ponds (all in Winchester), and Horn Pond in Woburn are all designated as Great Ponds.

There are no "Living Waters" Core Habitats identified by the Natural Heritage & Endangered Species Program in the Mystic River watershed.

With the exception of Belle Isle Marsh, all of the high value habitats are located in the upper portion of the watershed, as might be expected from the land use information presented in Chapter 5.

While there are only a few large-acreage high value habitats, there are numerous smaller areas that provide valuable urban wilds and should be targeted for protection. For example, studies of Alewife Reservation have found substantial wildlife value, which suggests the need to provide greater protection for some smaller areas in the watershed. Many such sites identified as priorities for protection in the open space inventories described in Chapter 5.

7.2 Aquatic Life

Anadromous Fish

The Mystic River and Alewife Brook have a significant annual herring run, which includes alewife and blueback herring. Variations in the numbers of herring running have been observed, including no observations of herring in Winn Brook (in the Alewife Brook subbasin) in 2004 and a lower-than-normal run in the Mystic River.

The operation of the Amelia Earhart dam has a significant impact on the ability of herring to migrate up the Mystic during spawning season. In past years, the MDC operator of the dam, the state Division of Marine Fisheries and the watershed association developed a protocol to allow for fish passage through the dam, which does not have a fish ladder. The protocol involved operating the gates to let fish into and through the locks during low tides, and continued during the spawning season until the amount of boat traffic was sufficient to allow large numbers of fish through without separate openings specifically for fish passage. This understanding should be reviewed periodically, to assess whether the protocol is being followed and whether it appears to be effective.

Herring are not able to get past the Mystic Lakes dam that divides Upper and Lower Mystic Lakes. This dam is in poor repair, which is of concern for dam safety and flooding reasons as well as for fish passage. Past proposals to install a fish ladder were rejected because the dam could not bear the weight in its current condition. The DCR is now developing a plan for restoring the dam, which is expected to include providing for fish passage into Upper Mystic Lake.

Observers have noted a steady decline of the alewife herring population in the Alewife Brook subbasin, with no alewife observed in the 2004 season. A variety of hypotheses have been suggested for the decline in populations, including low flow and shallow conditions in Alewife Brook, Little River, and Perch Pond; low DO levels; chemical pollution (e.g., from treatment of Spy Pond); operation of the Amelia Earhart Dam; or even region-wide declines in alewife runs. (See discussion on the Friends of Alewife Reservation's website, http://www.friendsofalewifereservation.org/homepage.htm.) More work is needed to determine the extent and causes of reduced alewife populations.

The Massachusetts Division of Marine Fisheries has been conducting surveys of anadromous fish passage in coastal Massachusetts, which will provide insight into the state of the herring run. The report for the Boston Harbor region was not available in time to be considered in this assessment.

Inland Fisheries

The Department of Fish and Wildlife conducts fish population sampling to 1) assess their current status, and 2) determine a process for restoration. Determining strategies for restoration includes identifying target fish communities, habitat mapping, and developing an index of "biotic integrity." The DFW must first define a fish community appropriate for a natural river in southern New England, defined by the mix of 3 categories of fish: fluvial specialists – those that require flowing water – such as brook trout; fluvial dependents – species that require flowing water at some time, as during reproduction – such as white suckers; and generalist/pond fishes – species that do not require flowing water, such as bluegill and crappie. So far, DFW has been examining rivers in a *desirable fishery state*, i.e., quality rivers, and incorporating input from regional biologists other relevant data to verify their determination. From this analysis, the DFW estimates that rivers in a desirable fishery state will exhibit ratios of 50% fluvial specialists, 25% fluvial dependents, and 25% generalists. DFW will also determine the habitat available, through habitat mapping, for the different types of fish communities and use the index of biological integrity to set measurable goals for restoration of specific waterbodies.

The DFW's maps for major ponds in the watershed provide the following (unfortunately dated) information on fish populations:

- Horn Pond is a heavily fished trout pond, and is stocked with thousands of trout each year. The pond also supports good bass fishing. A survey conducted in the summer of 1982 found 13 species, with yellow perch dominating by a wide margin.

- Spy Pond was last surveyed in 1980, when 10 species were recorded. The pond is not heavily fished, and contains numerous largemouth bass and perch. The pond has been regularly stocked with tiger muskie fingerlings for more than a decade.

- Upper Mystic Lake was last surveyed in 1981. Fourteen species were recorded, including largemouth bass and pickerel.

DFW has not yet collected data on freshwater fish in the Mystic River watershed, except for these surveys in the 1980s in Spot and Spy Ponds and Upper Mystic Lakes. The DFW expects to begin sampling at approximately 14 sites in the watershed the near future, however.

7.3 Invasive Plants

Invasive plants are a significant problem throughout the watershed. These plants out-compete native vegetation and provide less attractive habitat for wildlife. While no comprehensive inventory exists, there have been a number of shoreline surveys completed for Mystic waterbodies that have documented extensive intrusion of invasive plants.[1] For example:

- The Alewife Brook/Little River shoreline survey found extensive Japanese Knotweed and Phragmites. The Japanese Knotweed presented a particular problem in some shoreline sections because they blocked access to the shore and hindered native species.

- Phragmites and Knotweed were also widespread in the 1997 survey of the Mystic River and the Malden River. Invasives dominated on the Malden River, also including Purple Loosestrife.

[1] Shoreline surveys were conducted with assistance and training from the Massachusetts Riverways program on the Mystic and Malden Rivers (1997), Alewife Brook (1997 and 2000), the Aberjona River (2001), and Belle Isle Marsh (2002).

- The Aberjona shoreline survey in 2001 found Phragmites, Purple Loosestrife, Japanese Knotweed, and Oriental Bittersweet throughout the study area

Local groups have been working to remove invasive plants in several watershed locations. For example, the Friends of the Mystic River have been removing Japanese Knotweed along the banks of the Mystic River in Medford for several years. Roger Frymire has been removing water chestnuts in the Alewife Subbasin, and has virtually eliminated the plants using hand-pulling methods along Alewife Brook and Little Pond and achieved significant reductions at Blair, Yates and Spy Ponds.

Ideally, invasives control should involve a regional strategy. The success of local efforts can be undone by recolonization from adjacent areas, and careless harvesting – including discarding harvested invasives in the waters – may simply transport the problems downstream.

7.3 Habitat Restoration

There are several efforts underway in the watershed to restore habitat:

- The Department of Conservation and Recreation's Master Plans for Blair Pond (December 1999) and Alewife Reservation (2003) include restored aquatic and wildlife habitat areas, as well as paths, seating, and interpretive elements to support human use of the parklands. Implementing these plans should be a high priority for the watershed. In addition, developing the long-delayed Master Plan for the Mystic River Reservation is also a high priority, to achieve important open space, recreational and habitat goals.

- The Army Corps of Engineers has completed and assessment of the Malden River, and is preparing a habitat restoration plan for the river.

- As redevelopment of industrial and commercial sites occurs in various locations, there are opportunities to restore habitat. For example, a group of local advocates is investigating the potential to restore wetlands on the Discovery Park property in North Cambridge.

7.4 Priorities for Action

Efforts to improve water quality and to preserve open space are directly related to preserving habitat for fish and other wildlife. These priorities were discussed in Chapters 4 and 5, respectively.

The following are additional priorities related to habitat:

- Determine and address the causes of reduced herring runs in the Mystic River and Alewife Brook. The evaluation should consider the results of the DMF's surveys, the operation of the Amelia Earhart dam, and new herring counts conducted by volunteers with guidance from the DMF.

- Conduct inland fish surveys, assess the results, and establish priorities and strategies for restoring degraded habitat.

- Conduct a watershed-wide inventory of invasive plants along Mystic waterbodies, and develop a strategy for regional efforts to reduce or eliminate invasives.

- Implement the DCR's Master Plans for Blair Pond and Alewife Reservation, and develop a Master Plan for the Mystic River.

- Implement restoration of habitat along the Malden River, based on the results of the Army Corps of Engineers investigations.

Chapter 8: Action Plan

8.1 Introduction

Chapter Contents

This chapter presents an Action Plan for the Mystic River watershed, based on the issues and problems identified in the previous assessment chapters. The plan draws on two sources of watershed priority-setting: the Future Search process conducted in 1999, and the work of the Massachusetts Watershed Initiative Basin Team through 2002. This chapter first describes these two efforts and summarizes their findings. Next, the chapter presents the Action Plan, listing priority tasks by major issue.

8.2 Results of Future Search and MWI Basin Team Efforts

1. Future Search 1999

In October 1999, a diverse group of Mystic River watershed stakeholders convened in a two-day Future Search workshop, to develop a vision and a roadmap for the watershed. More than 60 people from nearly 20 communities participated, including representatives from grassroots organizations, academia, business, government, and residents. The group identified a wide range of issues and concerns, and developed a shared vision of what the watershed could be. Five goals or themes were selected for further work at a follow-up:

- Watershed Identity/Awareness
- Habitat Restoration (with subgoals of Environmental and Social Justice)
- New Governance and Partnerships
- Public Access
- Water Quality and Quantity Restoration.

The follow-up "Focus Workshop", held at Tufts University in November 1999, developed specific goals and priority actions for each of these areas, as summarized in Table 8.1.

Table 8.1: Results of 1999 Future Search

Topic	Goal	Priority Actions
1. Awareness & Watershed Identity	Develop Mystic Curriculum	• Get a Toyota Tapestry grant to develop curricula, info kits • Promote their use

Table 8.1: Results of 1999 Future Search

Topic	Goal	Priority Actions
	Visibility	• Website enhancement • Logo (through a competition) • Consistent, regular press releases • Collect press clips • Lecture series/speaker's bureau • "T" bus campaign • Involve libraries • Highway signs • Mystic First Night • Public access cable TV
	Community Connections	• MRW Legislative Caucus Presence at community affairs • Strengthen MRWA (now MyRWA) • Essay contest • Publicize science fair projects in community • Municipal connections • Tufts
2. Habitat Restoration	Mapping and Inventory	• Land use • Exotics • Species • Over time and space • Linkages
	Identify & Clean Sources of Pollution	• Lawn chemicals • Other
	Preserve and Increase Open Space in Emerald Bracelets Where Possible	• Use native plants
	Encourage Use of Native Plants	• Demonstration plots • Increase habitat for certain animals

Table 8.1: Results of 1999 Future Search

Topic	Goal	Priority Actions
3. New Governance & Partnerships	Establish Stormwater Utility Districts	• Use legislative caucus to build support • Identify willing cornmunity(ies) to test a bylaw • Expand district • Seek statewide enabling legislation
	Municipal Buy-in and Community Outreach	• MRWA [MyRWA] develop & distribute presentations to community groups and Chambers Of Commerce to use as a tool • Get Mystic Month on agenda *for* Selectmen, Alderman • Build Compact • Annually revisit Compact draw upon many models/ other success stories • "Carrot objective"
4. Public Access	Inventory and Create Annotated Map of Existing Open Space and Access to River and Other Resource Areas	
	Access & Linkage – where are there gaps?	
	Explore Water Transportation	
5. Water Quality and Quantity	Integrate Water Quality, Water Quality and Land Use Information	
	Better Educate the Public about Water Quality and Quantity Issues	• Use web for dissemination of data and other information • Active public outreach (regular meetings, presentations)

Table 8.1: Results of 1999 Future Search		
Topic	**Goal**	**Priority Actions**
	Collect More Data	• Flow quantity (temporally and spatially) • Pipes (point sources) – number, location, characteristics of discharge • Nonpoint sources • Complete shoreline surveys and inventory throughout watershed
	Promote Active Use of Water Resources	
	Promote Making All the Waters Fishable and Swimmable in 10-20 Years	

Many of the priorities discussed at the 1999 Future Search have received attention. For example, the Mystic River Watershed Association (MyRWA) was reformed and strengthened through a collaboration of a number of local groups. In 2000, MyRWA and Tufts University formed a partnership, the Mystic Watershed Collaborative, with a goal of making the Mystic River "fishable & swimmable" by the year 2010. A Mystic Watershed educational curriculum was developed, although it is not in active use currently. A "Blueways/Greenways" brochure was developed, which now needs updating. Enabling legislation for stormwater utilities was recently adopted, with the active involvement of watershed legislators. Two projects explored open space resources in the watershed, as discussed in Chapter 5. Many other priority actions are still to be done, however. These unmet objectives helped inform the Action Plan presented in this report.

MA Watershed Initiative Basin Team

The Massachusetts Watershed Initiative was described in Chapter 1 and Appendix A. The priorities established by the Basin Team are reflected in its Annual Work Plans. The annual plans were prepared in a collaborative process by the Basin Team – initially by the Boston Harbor Watershed Team and later by the more focused Mystic River Watershed Team. Team members and other stakeholders submitted project ideas, and the team established watershed priorities and selected priority projects for the coming fiscal year. These projects were often supported by state funding distributed through the MWI process. Appendix G lists the priority projects relevant to the Mystic River that were selected each year. The projects funded by the Watershed Initiative provided some of the information presented in this report. As with the Future Search priorities, some of the Watershed Initiative objectives have been met but others are still to be achieved, and are reflected in this Action Plan. Where a specific action was included in one of the Basin Team Annual Work Plans in the following Recommended Actions, the date of that work plan is noted.

8.3 Recommended Priority Actions

This section lists specific recommended tasks for the Action Plan, listed and numbered by issue. In addition to the issues addressed in the previous assessment chapters, priority tasks for Environmental Justice, for Community Capacity Building, and for Funding concerns are recommended.

Water Quantity and Flooding

Regional Planning

1.1 Alewife: Implement the recommendations of the Tricommunity Flooding Work Group Arlington, Belmont, Cambridge) to identify causes and solutions to Alewife area flooding. Develop a joint regional strategy to reduce flooding.

1.2 Aberjona: Revitalize effort to characterize system-wide flooding and contaminant migration and identify solutions (FY04 proposed). Include members of the former Upper Mystic Watershed Board, other municipal representatives (e.g. planners and Conservation Commissions), and community stakeholders.

Data Collection

1.3 Lower Mystic and Malden River: Investigate the extent of damage and floodwater exposures in the Malden River and the saltwater portion of the watershed. Interview municipal officials and conduct a survey of local businesses and residents.

1.4 Implement other data collection activities recommended by CDM 2003 H&H study of the lower Mystic.

Studies

1.5 Conduct a study of the contribution of open space and BMPs to manage flooding and drainage problems, as well as their contribution to management of other basin problems. (Include modeling, pilot studies, and experiences in other similar drainage basins.)

1.6 Conduct study of management options for coastal flooding in Chelsea Creek and the rest of the watershed below Amelia Earhart Dam.

1.7 Assess potential impacts of climate change on future flooding in the watershed.

1.8 Review current assumptions about 3-month, 1-year, 25-year, 100-year rainfall and flooding events, and suggest revisions as needed.

1.9 Complete the MAPC Prehazard Mitigation planning project, review the implications for regional efforts to control flooding, and publicize the results to the watershed communities.

Floodplain Management

1.10 Complete FEMA's revision of floodplain maps for entire watershed;
Conduct outreach on development, development and other implications.

1.11 Develop watershed-wide understanding of flooding interactions:
- Convene workshop to share information about findings of local flooding investigations, hydrologic & hydraulic studies.
- Assess local flood control efforts for upstream and downstream impacts (e.g., the effect of Winchester flood controls in the MEPA review).
- Complete analysis of impacts of the Mystic Lakes dam operation on flooding.

1.12 Develop a comprehensive basin flood management strategy - including identification of institutional obstacles to improved floodplain management, and characterization of major interactions among subbasins that affect flooding.

Water Quality

Water Quality Monitoring

2.1 Fund continuation and expansion of volunteer monitoring (Mystic Monitoring Network) (FY03)
Continue baseline monitoring, and issue a report summarizing findings for the general public.
Expand hot spot monitoring, with source identification and follow-up.

2.2 Conduct additional monitoring in areas not adequately evaluated (add baseline sites, increase hot spot monitoring):
- Mystic 2 subbasin (saltwater portion);
- Horn Pond, Wedge Pond;
- Chelsea Creek.

2.3 Fund continuation of EMPACT monitoring, website and outreach (FY04 proposed).

Water Quality Advisories

2.4 Identify potential public health risks based on results of MyRWA River Use survey and develop public education strategy to address.

2.5 Review and coordinate criteria for public recreation advisories for high-bacteria periods (EMPACT, DCR beach monitoring, CSO advisories).

2.6 Expand EMPACT outreach:
- Flagging at boat houses and Sandy Beach
- Meetings with local community groups (environmental and non-environmental)

2.7 Expand CSO discharge advisories: local papers, CATV, boat houses, and residences in high risk areas (during flooding). Expand to include CSOs in the Lower Watershed.

Water Quality Standards and Classifications

2.8 Complete Triennial Review for Mystic waterbodies: identify gaps (pollutants, unassessed waterbodies) – e.g., metals in the Aberjona, Wellington Brook and Blair Pond are not listed as impaired on the §303(d) list, despite significant problems.

Nutrient Assessment

2.9 Complete nutrient assessment above Mystic Lakes (Tufts University study) and expand to include the Alewife subbasin.

2.10 Use the nutrient management decision tool developed by the Tufts University study to develop regional nutrient management strategies, with the involvement of municipal and community stakeholders.

TMDL Strategy

2.11 Evaluate needs and set priorities for TMDL development.

2.12 Develop TMDLs for priority pollutants and areas:
- Aberjona (bacteria, ammonia)
- Mystic Lakes (bacteria – espec Sandy Beach)
- Alewife Brook (bacteria, nutrients, organic enrichment/low DO)
- Spy Pond (nutrients)
- Ell Pond (bacteria, nutrients)
- Malden River (nutrients)
- Chelsea Creek (bacteria, oil & grease, organics)

Hazardous Waste Site Status

2.13 Remediate contaminated sites identified in the EPA Risk Assessment for Woburn Superfund sites (IndustriPlex and Wells G & H) as requiring action.

2.14 Identify high priority sites with potential to contaminate Mystic waterbodies:
- Update information on current status;

- Evaluate whether adequate consideration was given to surface water quality impacts and potential for human exposure when remedies were selected;
- For sites found to have inadequate review, conduct targeted water quality sampling for the relevant pollutants, and initiate a public involvement process.
- Initiate or revitalize the public river process for high-priority sites where remediation has not been completed and where there is limited public review currently.

2.15 Seek Technical Assistance Grants to support such public review of high priority sites:
- Island End River (coal gasification site)
- Others?

NPDES Permits

2.16 For NPDES permits scheduled for renewal on Chelsea Creek, evaluate the need for water-quality based permits. Conduct monitoring for the relevant pollutants to determine whether ambient levels in surface waters are below levels of concern to support this evaluation.

Sediments

2.17 Map bottom sediment quality throughout the watershed (FY03)
- Complete Lower Mystic USGS monitoring;
- Assess effects on benthic organisms and human health;
- Prepare report on watershed-wide sediment monitoring results (including EPA risk assessment results for NPL sites).

2.18 Assess impact of contaminated sediments on water quality and safety of boating (including personal watercraft, canoeing/kayaking, and power boats).

2.19 Develop overall Sediment Assessment and Remediation/Containment Strategy for the watershed.

Stormwater/CSOs/I&I

2.20 Use MyRWA hot spot monitoring to support location of leaking pipes – report results to municipalities, DEP and EPA.

2.21 Track and report to the public on the results of DEP §308 letters to municipalities.

2.22 Conduct Stormwater Management Demonstration Project(s) (FY04 proposed).

2.23 Evaluate local stormwater management measures and make recommendations to municipalities (FY03 substitute).

2.24 Follow-up on MWRA/municipal Inflow & Infiltration Task Force.

2.25 Investigate the potential for use of stormwater utilities in the watershed.

CSOs

2.26 Continue evaluation of options under the Alewife/Upper Mystic CSO variance.

2.27 Compile public information on all CSOs in the watershed:
- Status and provisions of permit;
- Adequacy of public notification requirements;
- Potential for revisiting current B_{CSO} classifications.

Amelia Earhart Dam Operation

2.28 Integrated study of AE Dam operation (FY03)
- Assess impacts on flooding, fish passage, water and sediment quality;
- Assess potential for reintroducing tidal flow;
- Assess merits of modeling the dam to define operational guidelines.

Land Use and Open Space

Open Space

3.1 Develop a DCR Master Plan for the Mystic River Reservation.

3.2 Identify and implement critical next steps from previous planning efforts:
- Chelsea Creek Master Plan;
- Blair Pond Master Plan;
- Alewife Master Plan;
- Everett Waterfront Plan;
- Mill Creek Restoration 2000.

3.3 Publicize the results of the UEI Natural Cities and MyRWA Open Space Report priorities for open space protection.

3.4 Investigate options for improving public access in Designated Port Areas.

Smart Growth and Land Use

3.5 Initiate regional planning in the Alewife subbasin as a case study of integrated flooding, water quality, and Smart Growth management in urban areas.

3.6 Communicate key watershed priorities and issues to major state and regional planning efforts, including the MAPC *MetroFutures* project, DCR priority-setting for urban parks management, and local planning efforts (e.g., the Cambridge Concord-Alewife Study.)

3.7 Participate in the development of state Smart Growth policies, to ensure that they promote improved water quality, reduced flooding, and enhanced quality of life in urban areas.

3.8.1 Provide input on MEPA criteria for expediting review of Smart Growth projects and other state agency initiatives.

3.9 Support improvement of relevant municipal ordinances:
- Catalog relevant current municipal ordinances in the watershed;
- Compile relevant model ordinances.

3.10 Develop consensus Smart Growth principles for projects in urban areas that consider the need to reclaim open space, repair inadequate sewer infrastructure, control flooding, and address traffic and other community concerns. Consider the need for higher standards in areas that currently affected by CSOs, flooding, SSOs, and inflow & infiltration, and that are otherwise impaired. Incorporate these principles into state Smart Growth incentives and local ordinances, as appropriate.

Recreation

Promote Safe Recreation

4.1 Expand the MyRWA River Use Survey of recreational uses to additional portions of watershed, to identify locations where swimming and fishing might present public health risks.

4.2 Investigate and promote safe swimming options for youth in the lower watershed.

4.3 Conduct fish tissue sampling for key fishing locations – in particular, lakes and ponds and the saltwater portion of the Mystic River, and issue location-specific advisories as needed.

4.4 Post notices about the statewide mercury advisories at popular fishing spots.

Improve Linkages and Access

4.5 Provide pedestrian and bike access across Amelia Earhart Dam and through the MBTA property near Sullivan Square.

4.6 Continue efforts to complete key links in the bikeways throughout the watershed, including connecting to the Boston Harbor Walk through Charlestown.

4.7 Enhance Public Participation policies at boat clubs located on DCR lands, with an emphasis of opportunities for the public to use the waterfront.

4.8 Identify locations for improved public canoe and kayak access.

4.9 Publicize the recreational assets of the watershed with a revised Blueways and Greenways map, including the new Village Landing, Gateway Plaza and Schraffts area parks.

Parkland Improverment, Upkeep and Maintenance

4.10 Develop a DCR Master Plan for the Mystic Reservation, and implement the provisions of the Alewife Reservation and Blair Pond Master Plans, including the bike path.

4.11 Improve upkeep, maintenance and amenities in the DCR urban parks (repairing benches, providing water fountains, etc.).

Habitat

Restoration

5.1 Complete the ACOE Malden River Ecosystem Restoration Feasibility Study and implement the restoration strategy.

5.2 Complete and disseminate Natural Cities Program rapid ecological assessment results (FY03). Identify potential pilot project for restoration of critical ecological resources.

5.3 Investigate causes of low alewife levels in Alewife Brook, and develop plan for addressing the problems.

Invasives Control

5.4 Conduct a comprehensive survey of invasives, and establish watershed priorities for removing and replacing with native species.

5.5 Conduct invasives control pilot project at Yates Pond (FY03), Bellvue Pond.

Fish Passage

5.6 Review the results of Mass. Department of Marine Fisheries Fishway Survey, and identify priorities for improving anadromous fish passage.

5.7 Evaluate current fish passage through Amelia Earhart Dam and identify options for improving.

5.8 Evaluate options for a fish ladder at the Mystic Lakes dam, as part of the planned restoration of the dam.

Environmental Justice

6.1 Review Action Items from EJAM project Summit (report forthcoming) and establish watershed priorities and actions for addressing.

6.2 Advocate for equitable open space in EJ Communities:
- Little Mystic Channel Park;
- Chelsea Creek Action Plan; and
- the Everett Waterfront Plan.

6.3 Conduct outreach and education for youth on safe recreation practices in EJ communities.

Community Capacity and Watershed Awareness

7.1 Support development of new community groups/stream teams (general: FY03).
- Everett (Friends of Everett Waterfront)
- Malden River
- Other

7.2 Disseminate results of past stream team shoreline surveys and assess progress on recommended actions to improve impaired waterways (FY03).

7.3 Develop and disseminate “watershed awareness” publicity:
- Interpretive signs (to be installed in Somerville fall 2004; Aberjona (FY04 proposed);
- Mystic-based educational programs for school children;
- Revise the MyRWA Greenways/Blueways brochure.

7.4 Repeat/expand MassGIS training for watershed groups and municipalities. (Previously organized by MyRWA and MassGIS).

7.5 Improve communication/information-sharing among watershed stakeholders:
- Continue regular stakeholder meetings, similar to the former Basin Team;
- Hold semi-annual or annual informal networking and information- sharing meetings (upper, middle and lower watershed);
- Continue an annual or biennial research conference (December 2003 – Tufts, MyRWA, UEI).
- Maintain and distribute a comprehensive watershed calendar of events.

Funding

8.1 Develop and maintain list of potential projects for Supplemental Environmental Project funding.

8.2 Develop, maintain and disseminate to local groups, municipalities and other watershed stakeholders a coordinated list of potential funding sources (federal and state grants and contracts, foundations and corporate funding)

8.3 Conduct EPA Environmental Finance Network training for local groups and municipalities.

Chapter 9: Implementation

9.1 Introduction

Chapter Contents

The Action Plan presented in Chapter 8 involves a large number of tasks that would need the involvement of many different parties to achieve. It will take a number of steps to turn the Action Plan into action. This chapter discusses issues related to implementing the Action Plan, and recommends an approach for next steps.

9.2 Implementation Issues

This Action Plan has been developed with input from a number of sources. Chapter 8 discussed previous planning and priority-setting efforts that informed the Action Plan. In addition, drafts of the priority activities were discussed with various stakeholders at two events:

- a meeting of the old Basin Team (reconvened after the end of the Mass. Watershed Initiative); and

- a meeting of the Mystic River Watershed Association's Policy Committee, to which the public was invited.

Neither event was long enough to allow a thorough discussion of all the issues and potential actions, however, and some of the relevant players did not attend either meeting.

New efforts will be needed to (1) share the results of the Assessment portion of this report; (2) present the Action Plan for discussion to a wide range of stakeholders; and (3) obtain commitments to specific portions of the Action Plan. With the demise of the Watershed Initiative, there is no regular forum for this discussion currently in place. Funding may be needed to sponsor the required outreach and discussions, as discussed in the next section.

Implementation of the Action Plan is also affected by the widespread shortfalls in funding – in state and municipal budgets, in foundation funding, and in resources available to the relevant nonprofits. The priority tasks related to funding are a high priority, to support implementation of the rest of the plan. In addition, implementation will need to be opportunistic. Some lower-priority projects might be pushed ahead of higher priority but costly or hard-to-fund projects, if funding sources are found for those lower-priority projects or if they can be done without additional funding.

While it may be difficult to move forward systematically on the priority actions recommended in Chapter 8, having the priorities defined may encourage new funding and will help direct activities that do not depend on the availability of new funding.

9.3 Proposed Next Steps

A series of outreach events and workshops should be held to publicize the Assessment and Action Plan, and to engage various stakeholders in making the Action Plan a reality. Information sessions should be held in various locations throughout the watershed, to inform people about the plan and invite their comments and further participation.

Working sessions should then be convened, focusing on each of the major issue areas. These working sessions would include as participants representatives of the community groups, municipal governments, state and federal agencies, academic and other experts, businesses, and any other parties who might be involved in implementing the priority times in each issue area.

These working session could be convened and organized by a variety of parties, including the Metropolitan Area Planning Council, specific municipalities, state agency staff, the Mystic River Watershed Association, other regional groups in the watershed (such as the Lower Mystic Advisory Group (LMAG), the Chelsea Creek Action Group, or the Friends of the Mystic River, etc.), other nonprofits (Mass Audubon, the Massachusetts Association of Conservation Commissioners, New England Wildlife Society, etc.) or university-based groups (e.g., the Mystic Watershed Collaborative or the WSSS program at Tufts University or the Urban Ecology Institute at Boston College.) The Action Plan is most likely to be implemented successfully if there are large number of stakeholders responsible for its success, with the guidance and oversight of an implementation oversight committee.

The following are proposed implementation steps for this Action Plan:

Step 1: Convene an implementation committee to design these next steps

Step 2:

> Hold 3 to 4 evening outreach meetings at various locations in the watershed, to introduce the results of the Assessment and the Action Plan, and to invite participation in future planning and implementation.
>
> Make presentations on the Assessment and Action Plan at various events, such as the MAPC Inner Core meetings and thee state’s Environmental Justice meetings. EPA Region 1 is planning a conference on urban watershed issues, which might be a forum for publicizing and discussing the Action Plan.

Step 3: Convene working groups for the following topics, to develop specific work plans, apply for funding where relevant, and develop success measures for each issue:

- Water quantity flooding
- Water quality
- Open space
- Recreation
- Habitat

- Environmental justice
- Community capacity-building
- Watershed awareness

Step 4: Begin implementation of the specific work plans prepared for each area.

Because of delays in completing this report, this schedule is out of synch with the state's 5-year watershed cycle. According to that schedule, the assessment for the Mystic River watershed should have been completed in 2000, with planning and implementation in 2001, evaluation in 2002, and the beginning of a new watershed cycle in 2003. The proposed next steps represent a combination of outreach (the Year 1 focus), and planning/implementation (the Year 4 focus). Since implementation will certainly continue into 2006, this schedule would put the Mystic River watershed back on the state's Watershed Schedule, with a Year 5 evaluation occurring in 2007.

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Appendix A: The Massachusetts Watershed Initiative[1]

The Massachusetts Watershed Initiative is a broad partnership of state and federal agencies, conservation organizations, businesses, municipal officials and individuals. Begun in 1993 by the Massachusetts Executive Office of Environmental Affairs, the MWI is an innovative, results-oriented program that protects and restores natural resources and ecosystems on a watershed basis by:

- Finding the sources of pollution and taking cooperative action to clean them up;
- Teaching and helping groups and communities to protect and restore their local waters;
- Expanding communication among local, private and public partners so everyone works together to solve water resource problems;
- Improving coordination among government agencies; and,
- Directing resources to critical needs so our limited dollars go further to resolving the most important problems.

Watershed teams, made up of representatives of governmental agencies and community partners (non-profit organizations, municipal boards, and businesses), coordinate the watershed protection efforts in each of the 27 major watersheds of Massachusetts. Since 1998, each team has had a full-time leader employed by EOEA.

The Watershed Teams focus on an innovative five-year management process that is designed to collect and share resources and information, target existing and potential impacts to natural resources, assess impacts to natural resources, and develop and implement activities to protect and improve the Commonwealth's land and water resources. The five-year process is sequenced such that each year builds on the work of the previous year. Annual Work Plans are developed with active team involvement and serve as a guide for coordinating Watershed Team efforts. The Annual Work Plans are the building blocks of the more comprehensive Five Year Watershed Action Plan. Action Plans influence which projects receive state and federal grants and loans, regulatory decision-making, and educational/technical assistance programs to solve the most important environmental problems affecting communities.

The primary goals of the Watershed Initiative are to:

- Improve water quality;
- Restore natural flows to rivers;
- Protect and restore habitats;
- Improve public access and balanced resource use;
- Improve local capacity to protect water resources; and,

[1] This description is taken from EOEA, Massachusetts Watershed Initiative: 5-Year Watershed Action Plan Guidance, October 2002.

- Promote shared responsibility for watershed protection and management.

Each Watershed Team incorporates these broad goals into its own set of watershed-level goals, the "Five Watershed Priorities."

Appendix B: Water Quality Data Methodology

This appendix describes the methods used to compile the database used to assess water quality in the watershed. Historical as well as current water quality data was obtained from several sources and then analyzed according to the methodology shown in Figure B.1.

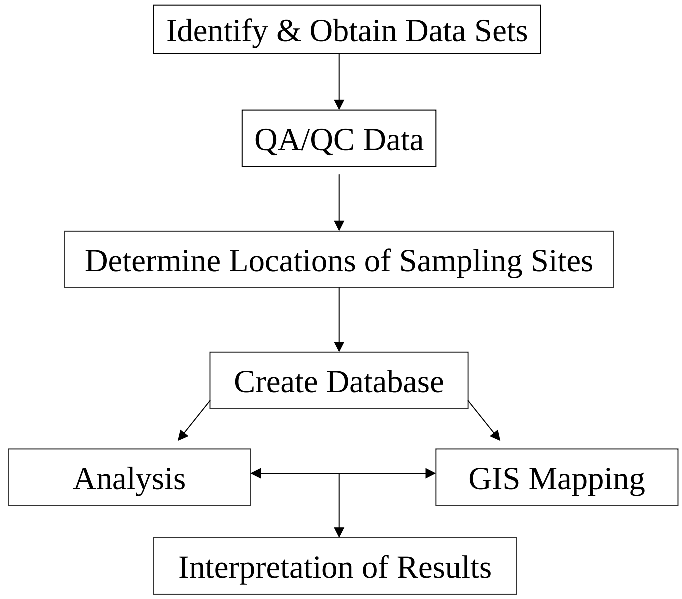

Figure B.1. Water quality data analysis flow chart

Each of the steps in the methodology is described below.

Step 1 – Compile Data

Water quality data collected between 1967 (the earliest year of record) and 2002 were obtained from the written reports and electronic databases (Excel files) are listed in Table B.1

Table B.1. Sources of water quality data (1967-2002)

Written Reports	QA/QA Measures
MWRC, 1970.	*followed Standards Methods for the Examination of Water and Wastewater (12th edition, 1965) *data tabulated and verified by engineers of the Division of Water Pollution Control
MWRC, 1974.	*followed Standards Methods for the Examination of Water and Wastewater (13th edition, 1971) *data tabulated and verified by engineers of the Division of Water Pollution Control
MDC, 1977.	*followed Standards Methods for the Examination of Water and Wastewater (13th edition)
MDC, 1978.	*followed Standards Methods for the Examination of Water and Wastewater (13th edition)

MDC, 1979.	*followed Standards Methods for the Examination of Water and Wastewater (14th edition, 1975, New York)
MDC, 1980.	
MDC, 1981.	
MDC, 1982.	
DEQE, 1982	*followed Standards Methods for the Examination of Water and Wastewater (14th edition, 1975, New York)
MADEP, 1989(1)	*followed Standards Methods for the Examination of Water and Wastewater (16th edition, 1985, New York)
MADEP, 1989(2)	*followed Standard Operating Procedures, Basin Planning Section 1988, Standard Methods for the Examination of Water and Wastewater
.	
Electronic Databases	
MWRA, 1989-2002[1]	MADEP-approved QAPP
MMN, 2000-2002[2]	MADEP-approved QAPP
USGS-NAWQA, 1998-2002[3]	
USGS, 1999-2000[4]	
Tufts, 2000[5]	USEPA-approved QAPP
Tufts, 2002[6]	USEPA-approved QAPP

[1]Datafile received by personal communication from Kelly Coughlin, MWRA, Charlestown, MA, 2002.
[2]Mystic Monitoring Network (MMN), datafile received by personal communication from Libby Larson, MyRWA, Arlington, MA 2003.
[3]Data was downloaded from the USGS NAWQA website (http://waterdata.usgs.gov/nwis/qwdata)
[4]Datafile received by personal communication from Leslie DeSimone, USGS, Marlborough, MA, 2001.
[5]Datafile received by personal communication from Elizabeth Higgins, Tufts University, Medford, MA, 2001.
[6]Datafile received by personal communication from Kim Oriel, Tufts University, Medford, MA, 2003.

Step 2 – QA/QC Data

The QA/QC measures used in each investigation for collecting and analyzing water samples are also listed in Table B.1. Data in the written reports was generated before 1988, and the methods used for QA/QC are not well described. The more recent data from MWRA, USGS, Mystic Monitoring Network, and Tufts University investigators was collected by following MADEP- or USEPA-approved Quality Assurance Project Plans, and therefore, we believe that this data is more reliable than the pre-1988 data.

Step 3 – Determine Locations of Sampling Sites

In the 11 written reports the authors used a river-mile system to identify each location. However, they did not specify the starting point of the river-mile system in the reports, and therefore it was difficult to identify the exact location of the sites. Fortunately, the reports contained written descriptions of the sampling locations (e.g., cross streets or identifying markers and the city in which the site resides), and these were used to create a map in GIS of the sites. Some of the electronic files (e.g., those from MWRA and MMN) contained the latitude and longitude of the sampling sites. The latitude and longitude of the USGS sites were found on the USGS website. The location of the Tufts sampling sites was based on physical descriptions contained in the datasets.

According the data sources listed in Table B.1, a total of 88 sites in the watershed have been monitored at least once between 1967 and 2002. A description of the sampling sites and studies that were included for each site are provided by subbasin in Appendix C.

To facilitate mapping the sites, we gave each one a unique address based on the name of the waterbody and the distance in river-kilometers from a specified zero point. Figures C.1 through C.9 in Appendix C show the sampling locations by subbasin.

Step 4 – Create Database

Because the majority of the sites have been sampled several times over the years and as many as a dozen parameters were measured in each sample, a database was setup to facilitate data analysis. Setting up the database involved several steps. First, each report and dataset was studied to determine which parameters had been analyzed. Next, the common reporting unit for each parameter was identified. In most cases this corresponded to the units of milligrams per liter; however, many of the files reported concentrations in terms of moles per liter, and thus conversion was necessary. The details of the units conversion step are given in Table B.3. [to be provided] For values that were at or near the detection limit that contained qualifiers (< or >), we created a separate column in the database for the qualifiers and used the detection limit as the actual value of the measured parameter. For example, if total phosphorus was reported as "<0.05 mg/L", we assumed that it was present at 0.05 mg/L. The final step in setting up the database was to assign a unique sampling site label to each record (described in Step 3) and then merging all of the datasets into a single flatfile. Using this flatfile and the sampling location information in Table B.2, a database was created in Access®, a database software package.

Steps 5 & 6 – Data analysis/mapping in GIS

Analysis of the data from each subbasin was done by performing queries for violations of the water quality standards and guidelines. Analysis of temporal and spatial trends was performed by querying the data for specific sites and parameters. The results of the queries were then tabulated and in some cases graphed and mapped in ArcMap® thereby allowing more in depth analysis of the data. These results are reported in Chapter 4 and Appendix C.

Appendix C: Detailed Water Quality Results

This appendix provides detailed water quality results supporting Chapter 4. For each subbasin, the appendix provides the following information:

- A table listing the sampling sites and the sources of water quality data for each.
- A map showing the location of sampling sites and the location of hazardous waste sites in the subbasin.
- A table listing the number of samples taken and the number of samples that exceeded water quality standards or guidelines for the entire study period (1967-2002), for each sampling site.
- A table listing the same information for the most recent sampling years only (1998-2002).

Table C.1 Surface water quality sampling sites in the Aberjona River subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investigating Organization	Other Site Names	Sampling Dates	Sampling Frequency
ABJ0.060	0.060	Aberjona River	Inlet to Upper Mystic Lake, Mystic Valley Parkway/Mouth of Aberjona	MWRC, MDC, DEQE		67, 79-81	2-3 times per year
ABJ0.787	0.787	Aberjona River	USGS Permanent Gaging Station (#1102500) d/s of Winchester Center	MWRC, MDC, DEP, DEQE, MMN, USGS, Tufts	ABR006	73, 86 78-81 10/98-2/02 6/02-8/02	few times per yr monthly few times per mo. daily
ABJ2.502	2.502	Aberjona River	Bridge on Swanton St.	MWRC, DEQE, DEP		73, 79-81, 86	2-5 times per yr
ABJ4.091	4.091	Aberjona River	USGS Temporary Gaging Station (#1102474) at Washington St.	USGS	1102474	99-00	4-6 times per yr
ABJ4.140	4.140	Aberjona River	Bridge on Washington St. (southern crossing)	MWRC, DEQE, DEP, MMN	ABR028	73, 79-81, 86 7/00-2/02	2-6 times per yr monthly
ABJ5.549	5.549	Aberjona River	Montvale Ave.	MDC, DEQE		1/78-11/81	Monthly
ABJ6.306	6.306	Aberjona River	Bridge on Washington Cir.	MWRC, DEP		73, 86	4-6 times per yr
ABJ7.236	7.236	Aberjona River	USGS Temporary Gaging Station (#1102460) at Salem St.	MWRC, DEQE, MMN, USGS	ABR049, 1102460	67, 73, 79-81 5/99-6/00	2-4 times per yr monthly
ABJ8.262	8.262	Aberjona River	Olympia St./Ave.	MDC		1/78-11/81	Monthly
ABJ8.784	8.784	Aberjona River	south of Mishawum Road, off parking lot of 99 Restaurant	DEQE		79-81	2-3 times per yr
ABJ8.817	8.817	Aberjona River	Bridge on Mishawum Road	MWRC, DEP		73, 86	4-5 times per yr
ABJ9.490	9.490	Aberjona River	at Industri-Plex Industrial Park off Mishawum Road	MWRC		73	4 times per yr
ABJ10.741	10.741	Aberjona River	(south branch) upstream of its confluence with North Branch, east of Commerce Way	DEQE		79-81	2-3 times per yr
ABJ10.836	10.836	Aberjona River	(north branch) at end of Commerce Way	DEQE		79-81	2-3 times per yr

Site Name	Location by River Kilometer	Water Body	Description	Investigating Organization	Other Site Names	Sampling Dates	Sampling Frequency
ABJ11.113	11.113	Aberjona River	(north branch) downstream of its confluence with an unnamed tributary off gravel road extension of Commerce Way	DEQE		79-81	1-2 times per yr
ABJ12.693	12.693	Aberjona River	West St.	MDC		78, 79	Monthly
ABJ14.180	14.180	Aberjona River	Rte. 129/Lowell St.	MWRC, MDC		67, 73 80, 81	2-3 times per yr monthly
HAL0.089	0.089	Halls Brook	at Boston & Main R.R. bridge, upstream of Halls Brook Holding Area Pond off New Boston Road	MWRC, DEQE		73, 79-81	2-4 times per yr
HAL0.431	0.431	Halls Brook	upstream of New Boston Road	MDC, DEQE		78 - 81	Monthly
SWT0.615	0.615	Sweetwater Brook	at Maple Street Bridge	DEQE		79-81	2-3 times per yr

Table C.2 Summary of water quality data from the Aberjona River subbasin (1967-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	**FC (C)**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
ABJ0.060	60% (5)	40% (5)	33% (3)	0% (3)	0% (3)	13% (8)			75% (8)
ABJ0.787	75% (115)	39% (115)	9% (70)	0% (70)	0% (70)	9% (75)	11% (19)	100% (92)	46% (171)
ABJ2.502	85% (11)	38% (11)	15% (13)	0% (13)	0% (13)	0% (15)			81% (16)
ABJ4.091	100% (10)	40% (10)	30% (10)	0% (10)	0% (10)	0% (10)		100% (10)	10% (10)
ABJ4.140	76% (33)	36% (33)	0% (33)	0% (31)	0% (31)	0% (35)	0% (20)		63% (35)
ABJ5.549	49% (39)	5% (39)	0% (44)	0% (44)	0% (44)	9% (47)			67% (49)
ABJ6.306	50% (6)	0% (6)	50% (6)	0% (6)	0% (6)	0% (8)			44% (9)
ABJ7.236	69% (16)	13% (16)	12% (17)	0% (17)	0% (17)	0% (25)		100% (10)	48% (25)
ABJ8.262	23% (35)	9% (35)	0% (37)	0% (37)	0% (37)	15% (41)			60% (43)
ABJ8.784	43% (7)	14% (7)	0% (7)	0% (7)	0% (7)	0% (7)			71% (7)
ABJ8.817	33% (6)	33% (6)	33% (6)	0% (6)	0% (6)	0% (8)			78% (9)
ABJ9.490						0% (4)			100% (4)
ABJ10.741	43% (7)	0% (7)	0% (7)	14% (7)	14% (7)	0% (7)			86% (7)
ABJ10.836	43% (7)	0% (7)	29% (7)	0% (7)	0% (7)	0% (7)			86% (7)
ABJ11.113	25% (4)	25% (4)	0% (4)	0% (4)	0% (4)	0% (5)			100% (5)
ABJ12.693	47% (15)	7% (15)	25% (16)	0% (15)	0% (15)	10% (21)			95% (21)
ABJ14.180	32% (19)	0% (19)	14% (21)	0% (21)	0% (21)	19% (27)			71% (28)
HAL0.089	57% (7)	14% (7)	0% (7)	0% (7)	0% (7)	0% (11)			91% (11)
HAL0.431	21% (39)	0% (39)	0% (44)	0% (44)	0% (44)	6% (47)			76% (49)
SWT0.615	100% (7)	86% (7)	17% (6)	0% (6)	0% (6)	0% (7)			

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.3 Summary of water quality data from the Aberjona River subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	**FC (C)**	**ENT**	**EC**	**DO**	**DO Sat**	**DO Sat Calc.**	**pH**	**Temp**	**TSS**	**TN**	**TP**
Sites	>200 cfu/100mL	>1,000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
ABJ0.060												
ABJ0.787	90% (70)	47% (70)	100% (56)		0% (19)	21% (19)	16% (32)	0% (19)	0% (19)	11% (19)	100% (92)	36% (112)
ABJ2.502												
ABJ4.091	100% (10)	40% (10)		100% (10)	0% (10)		40% (10)	0% (10)	0% (10)		100% (10)	
ABJ4.140	65% (20)	15% (20)			15% (20)	5% (20)	3% (32)	0% (20)	0% (18)	0% (20)		53% (19)
ABJ5.549												
ABJ6.306												
ABJ7.236	89% (9)	11% (9)		100% (8)	10% (10)		35% (20)	0% (10)	0% (10)		100% (10)	10% (10)
ABJ8.262												
ABJ8.784												
ABJ8.817												
ABJ9.490												
ABJ10.741												
ABJ10.836												
ABJ11.113												
ABJ12.693												
ABJ14.180												
HAL0.089												
HAL0.431												
SWT0.615												

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.4 Surface water quality sampling sites in the Horn Pond subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organi-zations	Sampling Dates	Sampling Frequency
HPBK0.168	0.168	Wedge Pond	Wedge Pond outlet at Main Street bridge	DEQE	79-81	2-3 times per year
HPBK1.990	1.990	Horn Pond Brook	downstream of Horn Pond at Pond St. bridge	DEQE	80, 81	1 time per year
HPBK4.177	4.177	Cummings Brook	at Lexington Street bridge	DEQE	80, 81	1-2 times per year
HPBK4.379	4.379	Shaker Glen Brook	at Lexington Street bridge	DEQE	80, 81	1-2 times per year

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Table C.5 Summary of water quality data from the Horn Pond subbasin (1980-1981).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	**FC (C)**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
HPBK0.168	67% (6)	17% (6)	0% (7)	14% (7)	0% (7)	0% (6)			83% (6)
HPBK1.990	50% (2)	50% (2)	0% (1)		0% (1)	0% (2)			100% (2)
HPBK4.177	100% (3)	0% (3)	0% (3)		0% (3)	0% (3)			100% (3)
HPBK4.379	33% (3)	33% (3)	0% (3)		0% (3)	0% (3)			100% (3)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, “64% (11)” indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.6 Surface water quality sampling sites in the Mystic Lakes subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organi-zations	Other Site Names	Sampling Dates	Sampling Frequency
MLD		Upper Mystic Lake	Mystic Lakes Dam (outlet of Upper Mystic Lake)	MWRC, MDC, DEQE, DEP, MMN	UPL001	67, 73, 86 2/78-10/81, 7/00-2/02	4-6 times per yr. monthly
SAB		Upper Mystic Lake	Sandy Beach	MDC, MMN, Tufts		1/78-12/79 5/02-8/02	monthly daily

Table C.7 Summary of water quality data from the Mystic Lakes subbasin (1967-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	**FC (C)**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
ML Dam	10% (63)	2% (63)	0% (68)		0% (66)	7% (76)	0% (18)		43% (79)
Sandy Beach	25% (63)	6% (63)	0% (16)		0% (16)	5% (19)			74% (19)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, “64% (11)” indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C-8 Summary of water quality data from the Mystic Lakes subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	FC (C)	ENT	EC	DO	DO Sat	DO Sat Calc.	pH	Temp	TSS	TN	TP
Sites	>200 cfu/100mL	>1000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MLD	11% (18)	0% (18)			0% (18)	0% (18)	0% (28)	12% (17)	0% (17)	0% (18)		6% (17)
SAB	31% (52)	8% (52)	23% (61)		0% (2)	0% (2)	0% (2)		0% (2)			

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.9 Surface water quality sampling sites in the Mill Brook subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organi-zations	Other Site Names	Sampling Dates	Sampling Frequency
MIL0.041s	0.041	Mill Brook	Mt. Pleasant Cemetery	MMN	MIB001	7/00-2/02	monthly
MIL0.053	0.053	Mill Brook	Bridge on Mystic Valley Parkway	MWRC, MDC, DEQE		73 1/78-11/81	4 times monthly
MIL0.062	0.062	Mill Brook	USGS Temporary Gaging Station 1103015	USGS	1103015	99-00	Monthly monthly
MIL0.760	0.760	Mill Brook	Mystic St.	MDC		1/80-7/81	monthly
MIL2.385	2.385	Mill Brook	Brattle St.	MDC		1/80-10/81	monthly
MIL4.448	4.448	Mill Brook	Arlington Reservoir Outlet	MDC		1/80-7/81	monthly
MIL5.985	5.985	Mill Brook	Massachusetts Ave.	MDC		1/80-7/81	monthly

Table C.10 Summary of water quality data from the Mill Brook subbasin (1973-2002).

	Percentage of samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	FC (C)	DO	DO Sat	Temp	pH	TSS	TN	TP
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MIL0.041s	95% (20)	55% (20)	0% (20)		0% (19)	0% (20)	35% (20)		84% (19)
MIL0.053	38% (39)	21% (39)	0% (45)		0% (44)	13% (52)			81% (54)
MIL0.062	100% (10)	80% (10)	0% (9)		0% (10)	10% (10)		100% (10)	50% (10)
MIL0.760	100% (1)	0% (1)	0% (16)		0% (16)	19% (16)			75% (16)
MIL2.385	0% (1)	0% (1)	0% (16)		0% (16)	19% (16)			75% (16)
MIL4.448	0% (1)	0% (1)	6% (16)		0% (16)	0% (14)			100% (14)
MIL5.985	0% (1)	0% (1)	19% (16)		0% (16)	19% (16)			94% (16)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, “64% (11)” indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.11 Summary of water quality data from the Mill Brook subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	**FC (C)**	**ENT**	**EC**	**DO**	**DO Sat**	**DO Sat Calc.**	**pH**	**Temp**	**TSS**	**TN**	**TP**
Sites	>200 cfu/100mL	>1000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MIL0.041s	95% (20)	55% (20)			0% (20)	10% (20)	9% (33)	0% (20)	0% (19)	35% (20)		84% (19)
MIL0.053												
MIL0.062	100% (10)	80% (10)		100% (8)	0% (9)		0% (9)	10% (10)	0% (10)		100% (10)	50% (10)
MIL0.760												
MIL2.385												
MIL4.448												
MIL5.985												

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, “64% (11)” indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.12 Surface water quality sampling sites in the Mystic River 1 subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organi-zations	Other Site Names	Sampling Dates	Sampling Frequency	Notes
MYS2.915m	2.915	Mystic River	Amelia Earhart Dam upstream side	MWRA	167	11/96-11/99, 12/99-8/02	several times per mo.	96 -99: surface, middle and bottom samples
MYS3.134m	3.134	Mystic River	Mystic/Malden confluence	MWRA	059	89, 90, 92-95 90 91, 96 97 6/98-12/98 99 - 02	daily (Aug-Sept) daily (August) daily (Jun-July) daily (July-Aug) several times per mo. (Mar-Dec)	
MYS3.160m	3.160	Mystic River	above Amelia Earhart Dam	MWRC, DEQE, DEP		73, 79-81	1-4 times per yr	
MYS3.883m	3.883	Mystic River	at Route 28	DEP, MWRA	067	89, 92, 93 90 (daily) 11/90 to 7/91	daily (Aug-Sept) daily (August) several times per mo.	
MYS3.912	3.912	Mystic River	Wellington Bridge	MDC		1/80-11/81	Monthly	
MYS4.372s	4.372	Mystic River	Blessing of the Bay Boathouse	MMN, Tufts		5/02-8/02	Daily	
MYS4.419	4.419	Mystic River	MDC sailing dock	MWRA	060	8/89-9/89, 8/90, 6/91-7/91	Daily	
MYS5.844m	5.844	Mystic River	Mystic River basin	MWRA	068	8/89-9/89	Daily	
MYS5.912	5.912	Mystic River	Rte. 16 bridge near Meadow Glen Drive-In Theatre	MWRC, DEP, MWRA		67, 73	4 times per yr.	
MYS7.111m	7.111	Mystic River	100 m upstream of Rt. 93	MWRA	056	89, 92-95 90 91, 96 97 98 98-02	daily (Aug-Sept) daily (August) daily (June-July) daily (June-Aug) many x per mo. (June-Dec) many x per mo. (Mar-Dec)	
MYS7.948	7.948	Mystic River	at Route 38/16	DEQE, DEP		79, 80, 81, 86	1-6 times per yr.	
MYS8.054	8.054	Mystic River	Medford Square	MWRA	061	89	daily (Aug-Sept)	
MYS8.326n	8.236	Meetin g-house Brook	outlet into Mystic R/unnamed tributary 20-25 meters d/s of Winthrop St on northern bank	DEQE, MMN	MEB001	81 7/00-2/02	once monthly	
MYS8.422	8.422	Mystic River	Winthrop St.	MDC, DEQE		1/78-11/81	Monthly	
MYS9.195s	9.195	Mystic River	Mystic Valley Parkway	MWRA	058	89 97	daily (Aug-Sept) daily (August)	

MYS9.570m	9.570	Mystic River	Bridge on Boston Ave.	MWRC, DEP, MWRA	066	73, 86 89 3/99-11/99, 12/99-8/02	4-6 times per yr. daily (July-Sept) several times per mo.	99: surface, middle, and bottom samples
MYS9.653s	9.653	Mystic River	creek 200m downstream #57	MWRA	120	92	Once	
MYS9.861s	9.861	Mystic River	upstream Rt. 16 Bridge	MWRA	119	9/92	Daily	
MYS9.911	9.911	Mystic River	Mystic/Alewife confluence	MWRA	057	89, 93-95 90 92 91, 96 97 98-02	daily (Aug-Sept) daily (August) daily (Sept) daily (June-July) daily (July-Aug) several times per mo.	
MYS10.050 m	10.050	Mystic River	upstream of Mystic/Alewife confluence	MWRA	083	90 91, 96 92-95 97 98-02	daily (August) daily (June to July) daily (Aug-Sept) daily (June-Aug) several times per mo.	
MYS11.050s	11.050	Mystic River	USGS Temporary Gaging Station 1103017	USGS	1103017	5/99-6/00	Monthly	
MYS11.077s	11.077	Mystic River	Outlet of Lower Mystic Lake, High St.	MWRC, MDC, DEQE, DEP, MMN, Tufts	MYR071	67, 73, 86 1/78-11/81, 7/00-2/02 5/02-8/02	4-6 times per yr. monthly daily	

Table C.13 Summary of water quality data from the Mystic River 1 subbasin (1967-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	**FC (C)**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MYS2.915m	24% (327)	7% (327)	10% (826)		0% (838)	28% (720)	86% (91)	100% (269)	74% (285)
MYS3.134m	21% (274)	4% (274)	3% (147)		0% (151)		0% (22)	100% (5)	36% (11)
MYS3.160m	60% (5)	40% (5)	0% (5)		0% (5)	11% (9)			100% (9)
MYS3.883m	33% (67)	6% (67)	1% (78)		0% (78)		11% (27)	100% (8)	46% (24)
MYS3.912	29% (17)	0% (17)	10% (20)		0% (20)	22% (18)			100% (8)
MYS4.372s	68% (53)	26% (53)							
MYS4.419	11% (27)	4% (27)	0% (35)		0% (35)		9% (23)	100% (7)	50% (8)
MYS5.844m	33% (6)	17% (6)	0% (7)		0% (7)		0% (2)	100% (1)	100% (1)
MYS5.912						0% (8)			100% (8)
MYS7.111m	69% (259)	14% (259)	1% (145)		0% (148)		8% (24)	100% (8)	75% (8)
MYS7.948	64% (11)	27% (11)	9% (11)		9% (11)	0% (9)			100% (10)
MYS8.054	43% (7)	29% (7)	0% (8)		0% (8)		0% (6)	100% (2)	100% (1)
MYS8.326n	67% (21)	33% (21)	0% (20)		0% (21)	0% (19)	21% (19)		58% (19)
MYS8.422	53% (30)	3% (30)	3% (34)		0% (35)	8% (38)			78% (40)
MYS9.195s	35% (20)	30% (20)	0% (13)		0% (16)		13% (8)	100% (5)	100% (1)
MYS9.570m	52% (221)	16% (221)	10% (146)		0% (146)	6% (141)	40% (47)	100% (168)	63% (178)
MYS9.653s			0% (1)		0% (1)				
MYS9.861s	50% (2)	0% (2)	0% (4)		0% (4)				

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	**FC (C)**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MYS9.911	45% (241)	16% (241)	1% (150)		0% (154)		9% (23)	83% (6)	71% (7)
MYS10.050m	24% (259)	7% (259)	1% (152)		0% (157)		11% (18)	67% (3)	70% (10)
MYS11.050s	30% (10)	0% (10)	11% (9)		0% (10)	0% (10)		100% (10)	10% (10)
MYS11.077s	49% (117)	12% (117)	4% (72)		0% (71)	15% (78)	0% (19)		58% (83)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, “64% (11)” indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.14 Summary of water quality data from the Mystic River 1 subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	**FC (C)**	**ENT**	**EC**	**DO**	**DO Sat**	**DO Sat Calc.**	**pH**	**Temp**	**TSS**	**TN**	**TP**
Sites	>200 cfu/100mL	>1,000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MYS8.326n	65% (20)	30% (20)			0% (19)	0% (19)	0% (32)	0% (18)	0% (20)	21% (19)		61% (18)
MYS2.915m	22% (269)	7% (269)	24% (271)		11% (691)	13% (691)	16% (691)	23% (603)	0% (694)	35% (222)	100% (219)	80% (220)
MYS3.134m	19% (108)	3% (108)	14% (106)		0% (2)	0% (2)	0% (2)		0% (2)			
MYS3.160m												
MYS3.883m												
MYS3.912												
MYS4.372s	68% (53)	26% (53)	25% (53)									
MYS4.419												
MYS5.844m												
MYS5.912												
MYS7.111m	68% (101)	12% (101)	55% (101)		0% (2)	0% (2)	0% (2)		0% (2)			
MYS7.948												
MYS8.054												
MYS8.422												
MYS9.195s												
MYS9.570m	50% (206)	16% (206)	77% (204)		11% (133)	14% (133)	14% (133)	7% (133)	0% (133)	11% (171)	100% (168)	62% (169)
MYS9.653s												
MYS9.861s												
MYS9.911	33% (76)	8% (76)	58% (76)		0% (2)	0% (2)	0% (2)		0% (2)			
MYS10.050m	20% (104)	5% (104)	57% (104)		0% (13)	0% (13)	0% (13)		0% (13)			
MYS11.050s	30% (10)	0% (10)		44% (9)	11% (9)		0% (9)	20% (10)	0% (10)		100% (10)	10% (10)
MYS11.077s	47% (72)	8% (72)	71% (45)		0% (20)	0% (18)	0% (32)	12% (17)	0% (19)	0% (19)		21% (19)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, “64% (11)” indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.15 Surface water quality sampling sites in the Alewife Brook subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investigating Organizations	Other Site Names	Sampling Dates	Sampling Frequency
ALE0.076	0.076	Alewife Brook	Bridge on Mystic Valley Parkway	MWRC, MDC, DEQE, DEP, MWRA, Tufts	070	73, 86, 88, 89 78, 79, 80, 81 90-91, 98-02 96-97	2-8 times per year monthly few times per year daily during summer
ALE0.144	0.144	Alewife Brook	Dilboy Field Parking Lot	MDC, MMN, Tufts		7/02 to 8/02	daily
ALE0.431	0.431	Alewife Brook	off Sunnyside Avenue, above Dilboy Field	DEP		88	twice
ALE0.474	0.474	Alewife Brook	Mid-channel off SOM-002A	MWRA	071	89	few times per year
ALE0.937w	0.937	Alewife Brook	at Broadway St./downstream side of bridge above St. Paul's Cemetery	DEP, MWRA, MMN, Tufts	072, ALB006	8/89-9/99, 5/02-7/02 7/00-9/00 10/00-2/02	daily storm sampling monthly
ALE0.972w	0.972	Alewife Brook	USGS Temporary Gaging Station 1103025	USGS	1103025	5/99-6/00	monthly
ALE1.333w	1.333	Alewife Brook	Cambridge/Somerville line	MWRA	073	8/89-9/89	daily
ALE1.253	1.253	Alewife Brook	Bridge on Cross St	Tufts		7/00-9/00	storm sampling
ALE1.623w	1.623	Alewife Brook	upstream side of Massachusetts Avenue Bridge	DEP, MWRA	172	88 2/99-8/02	3 times several times per mo.
ALE1.656	1.656	Alewife Brook	Bridge on Massachusetts Ave.	MWRC, DEQE, Tufts		73, 81 7/00-9/00	2-4 times per yr storm sampling
ALE2.466w	2.466	Alewife Brook	offramp to Alewife T	MWRA, Tufts	074	8/89-9/89 90, 91, 99-02 7/00 - 9/00	Daily few times per mo. (several mo. in a row) storm sampling
LIT1.358	1.358	Little Pond	outlet of Little Pond	DEP		88	2 times
LIT0.023	0.023	Little River	downstream side of Rindge Avenue Extension Bridge	DEP		88	2 times
LIT0.189n	0.189	Little River	125-m upstream of Rt. 2E - offramp to Alewife T	MWRA	174	8/99-11/99, 4/00-8/02	several times per mo.
LIT0.345	0.345	Little River	below Arthur D. Little Complex	DEP		88	3 times
LIT0.585	0.585	Little River	above Arthur D. Little Complex	DEP		88	2 times
LIT1.189	1.189	Little River	Pond St.	DEP		88	2 times
WIN0.0		Winn Brook	inlet to Little Pond	MMN	WIB001	7/00-2/02	monthly

Table C.16 Summary of water quality data from the Alewife Brook subbasin (1973-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]										
	FC (B)	**FC (C)**	**EC**	**Entero**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	>126 cfu/mL	>33 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
ALE0.076	84% (322)	49% (322)	100% (18)	94% (261)	36% (206)		0% (209)	5% (56)	6% (18)	75% (8)	27% (169)
ALE0.144	100% (19)	100% (19)		100% (40)							
ALE0.431	100% (2)	50% (2)			50% (2)		0% (2)	0% (2)			100% (2)
ALE0.474	14% (7)	0% (7)		14% (7)	78% (9)		0% (9)		25% (4)	100% (2)	100% (1)
ALE0.937w	95% (80)	69% (80)	100% (18)	89% (36)	54% (28)		0% (28)	0% (19)	22% (23)		100% (21)
ALE0.972w	100% (8)	75% (8)	100% (9)		36% (11)		0% (12)	0% (12)		100% (12)	100% (12)
ALE1.333w	20% (5)	0% (5)		0% (5)	100% (7)		0% (7)		0% (3)		
ALE1.253	90% (20)	75% (20)	100% (18)				0% (3)				
ALE1.623w	98% (106)	51% (106)		99% (103)	69% (13)		0% (13)	0% (3)			100% (3)
ALE1.656	100% (19)	95% (19)	94% (18)		100% (2)		0% (3)	0% ()			100% (6)
ALE2.466w	93% (134)	59% (134)	100% (22)	96% (111)	23% (31)		0% (33)		13% (8)	100% (2)	100% (3)
LIT1.358	100% (2)	100% (2)			100% (2)		0% (2)	50% (2)			50% (2)
LIT0.023	100% (2)	100% (2)			100% (2)		0% (2)	50% (2)			100% (2)
LIT0.189n	93% (84)	51% (84)		94% (85)							
LIT0.345	100% (3)	100% (3)			100% (3)		0% (3)	0% (3)			100% (3)
LIT0.585	100% (2)	100% (2)			100% (2)		0% (2)	50% (2)			100% (2)
LIT1.189	50% (2)	50% (2)			100% (2)		0% (2)	0% (2)			100% (2)
WIN0.0	0% (20)	0% (20)			0% (20)		0% (20)	5% (20)	20% (20)		94% (16)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.17 Summary of water quality data from the Alewife Brook subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	**FC (C)**	**ENT**	**EC**	**DO**	**DO Sat**	**DO Sat Calc.**	**pH**	**Temp**	**TSS**	**TN**	**TP**
Site	>200 cfu/100mL	>1,000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
ALE0.076	83% (121)	45% (121)	90% (103)	100% (18)	14% (14)	57% (14)	57% (14)		0% (15)			
ALE0.144	100% (19)	100% (19)	100% (40)									
ALE0.431												
ALE0.474	0% (1)	0% (1)	0% (1)		0% (1)	0% (1)	0% (1)		0% (1)			
ALE0.937w	100% (72)	72% (72)	100% (30)	100% (18)	30% (20)	53% (19)	55% (33)	0% (17)	0% (20)	25% (20)		100% (19)
ALE0.972w	100% (8)	75% (8)		100% (9)	27% (11)		45% (11)	0% (12)	0% (12)		100% (12)	100% (12)
ALE1.333w												
ALE1.253	100% (20)	75% (20)		100% (20)					0% (3)			

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	FC (C)	ENT	EC	DO	DO Sat	DO Sat Calc.	pH	Temp	TSS	TN	TP
Site	>200 cfu/100mL	>1,000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
ALE1.623w	98% (103)	50% (103)	99% (103)		60% (10)	60% (10)	60% (10)		0% (10)			
ALE1.656	100% (17)	94% (17)		94% (18)					0% (1)			
ALE2.466w	93% (111)	60% (111)	97% (88)	100% (22)	44% (9)	44% (9)	44% (9)		0% (11)			
LIT1.358												
LIT0.023												
LIT0.189n	94% (84)	61% (84)	94% (85)									
LIT0.345												
LIT0.585												
LIT1.189												
WIN0.0	80% (20)	50% (20)			0% (20)	0% (20)	0% (33)	5% (20)	0% (20)	20% (20)		94% (16)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.18 Surface water quality sampling sites in the Malden River subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organizations	Other Site Names	Sampling Dates	Sampling Frequency
MAL0.985	0.985	Malden River	Rte. 16 Bridge	MWRC, MDC		67	4 times
MAL2.570w	2.570	Malden River	Medford St.	MDC, DEQE MMN	MAR036	1/78-11/81 7/00-12/02	monthly

Table C.19 Summary of water quality data from the Malden River subbasin (1967-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	FC (C)	DO	DO Sat	Temp	pH	TSS	TN	TP
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MAL0.985						0% (4)			100% (4)
MAL2.570w	57% (53)	28% (53)	2% (60)		3% (61)	5% (60)	5% (19)		83% (63)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.20 Summary of water quality data from the Malden River subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	FC (C)	ENT	EC	DO	DO Sat	DO Sat Calc.	pH	Temp	TSS	TN	TP
Sites	>200 cfu/100mL	>1000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MAL0.985												
MAL2.570w	61% (18)	22% (18)			0% (19)	21% (19)	19% (32)	6% (16)	5% (20)	5% (19)		88% (17)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.21 Surface water quality sampling sites in the Mystic River 2 subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organi-zation	Other Site Names	Sampling Dates	Sampling Frequency	Notes
MYS0.108m	0.108	Mystic River	Confluence between Mystic and Chelsea Rivers	MWRA	015	89 - 98	daily (June-Sept)	surface and bottom samples
MYS1.407m	1.407	Mystic River	1/3-mile upstream of Tobin Bridge	MWRA	137	6/94 to 8/02	several x per mo.	surface and bottom samples
MYS2.344s	2.344	Mystic River	near Schrafft's Building, BOS 017	MWRA	069	89 - 90, 92 - 95 91, 96, 97	daily (Aug-Sept) daily (June-July)	surface and bottom samples
MYS2.787s	2.787	Mystic River	below Amelia Earhart Dam, MRW205	MWRA	052	89-90, 92-95 11/90-3/91, 8/96-4/97 6/91-8/91, 1/92-2/92, 6/96-7/96, 6/97-8/97, 6/98-7/98 8/98-8/02	daily (Aug-Sept) several x per mo. daily daily daily several x per mo.	89-98: surface and bottom samples

Table C.22 Summary of water quality data from the Mystic River 2 subbasin (1989-2002).

	Percentage of samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	FC (C)	DO	DO Sat	Temp	pH	TSS	TN	TP
Site	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MYS0.108m	32% (555)	12% (555)	4% (582)	3% (306)	0% (594)		19% (103)	100% (58)	67% (54)
MYS1.407m	10% (324)	10% (324)	0% (3)	0% (3)			6% (280)		
MYS2.344s	38% (271)	13% (271)	12% (280)	4% (151)	0% (291)		2% (44)	100% (13)	39% (33)
MYS2.787s	49% (676)	20% (676)	28% (374)	14% (145)	0% (381)		8% (115)	97% (61)	60% (25)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.23 Summary of water quality data from the Mystic River 2 subbasin (1998-2002).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	FC (C)	ENT	EC	DO	DO Sat	DO Sat Calc.	pH	Temp	TSS	TN	TP
Sites	>200 cfu/100mL	>1,000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
MYS0.108m	0% (2)	0% (2)	50% (2)		0% (2)	0% (2)	50% (2)		0% (2)			
MYS1.407m	10% (324)	3% (324)	10% (379)		0% (3)	0% (3)	0% (3)		0% (3)	6% (280)		
MYS2.344s	50% (6)	17% (6)	43% (7)									
MYS2.787s	37% (267)	16% (267)	34% (286)		0% (7)	0% (7)	43% (7)		0% (7)			

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C.24 Surface water quality sampling sites in the Chelsea Creek subbasin

Site Name	Location by River Kilometer	Water Body	Description	Investi-gating Organi-zation	Other Site Names	Sampling Dates	Sampling Frequency	Notes
CCK0.143	0.143	Chelsea Creek	Chelsea River	MWRA	NE01			
CCK0.463m	0.463	Chelsea Creek	Chelsea off McCardle Bridge	MWRA	15.1	11/90 to 1/91	several x per mo.	surface and bottom samples
CCK0.613m	0.613	Chelsea Creek	(Mile 0.2) at Meridian St.	MWRA	CR01			
CCK1.497m	1.497	Chelsea Creek	Chelsea River Mid-Channel	MWRA	027	89 – 95 96 - 97	daily (Aug-Sept) daily (June-July)	surface and bottom samples
CCK3.707m	3.707	Chelsea Creek	G"7" - near Merritt Park	MWRA	IH06			
CCK3.845m	3.845	Inner Harbor	Near Head of Chelsea River	MWRA	026	89 - 90 4/99	daily (Aug-Sept) daily	surface and bottom samples in 89

Table C.25 Summary of water quality data from the Chelsea Creek subbasin (1989-1999).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]								
	FC (B)	**FC (C)**	**DO**	**DO Sat**	**Temp**	**pH**	**TSS**	**TN**	**TP**
Sites	>200 cfu/mL	>1000 cfu/mL	<5 mg/L	<60%	>28.3 °C	<6.5 or >8.3	>10 mg/L	>0.3 mg/L	>0.05 mg/L
CCK0.143									
CCK0.463m	0% (9)	0% (9)	0% (12)		0% (12)				71% (7)
CCK0.613m									
CCK1.497m	30% (281)	12% (281)	10% (276)	7% (149)	0% (283)		4% (45)	100% (19)	85% (20)
CCK3.707m									
CCK3.845m	23% (35)	9% (35)	14% (42)	0% (8)	0% (42)		11% (19)	100% (2)	67% (9)

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Table C-26 Summary of water quality data from the Chelsea Creek subbasin (1998-1999).

	Percentage of Samples in Violation of Water Quality Standards/Guidelines[1]											
	FC (B)	**FC (C)**	**ENT**	**EC**	**DO**	**DO Sat**	**DO Sat Calc.**	**pH**	**Temp**	**TSS**	**TN**	**TP**
Sites	>200 cfu/100mL	>1,000 cfu/100mL	>33 cfu/100mL	>126 cfu/100mL	<5 mg/L	<60%	<60%	<6.5 or >8.3	>28.3°C	>10 mg/L	>0.3 mg/L	>0.05 mg/L
CCK0.143												
CCK0.463m												
CCK0.613m												
CCK1.497m	0% (2)	0% (2)	0% (2)		0% (2)	0% (2)	50% (2)		0% (2)			
CCK3.707m												
CCK3.845m	43% (7)	29% (7)	43% (7)		0% (8)	0% (8)	0% (8)		0% (8)			

[1] See Table 4-2 for a description of the standards and guidelines used. Results are expressed as a percentage of the total samples analyzed (shown in parentheses). For example, "64% (11)" indicates that 64% of the 11 samples analyzed did not comply with the water quality standard or guideline.

Appendix D. State-Identified Hazardous Waste (21e) Sites in the Mystic River Watershed

Site #	Site Name	Address	City/Town	Status[2]
Aberjona River Subbasin				
J1	RITTER TRUCKING FMR	856 WOBURN ST	WILMINGTON	TIER 2
J2	AMERICAN SHOE MACHINERY	30 NASHUA ST	WOBURN	TIER 2
J3	GETTY SERVICE STATION	325 WASHINGTON ST	WOBURN	TIER 1C
J4	PARKVIEW RD	163 SALEM ST	WOBURN	TIER 2
J5	OLYMPIA NOMINEE TRUST	60 OLYMPIA AVE	WOBURN	TIER 1B
J6	NO LOCATION AID	263 SALEM ST	WOBURN	DEF TIER 1B
J7	DS SERVICE CENTER	482 WASHINGTON ST	WOBURN	DEF TIER 1B
J8	BLOX BRUSSARD	100 ASHBURTON AVE	WOBURN	DEF TIER 1B
J9	HILLTOP CONSTRUCTION	124 DRAGON COURT	WOBURN	DEF TIER 1B
J10	NE MEMORIAL HOSPITAL	5 WOODLAND RD	STONEHAM	TIER 2
J11	MERIT	163-167 MAIN ST	STONEHAM	TIER 2
J12	MCCALL JR HIGH SCHOOL	458 MAIN ST	WINCHESTER	TIER 2
J13	JO WHITTEN CO FMR	134 CROSS ST	WINCHESTER	TIER 1A
J14	NO LOCATION AID	430 MAIN ST	STONEHAM	TIER 2
J15	CONSOLIDATED FREIGHTWAYS	295 SALEM ST	WOBURN	TIER 1C
J16	INDUSTRI PLEX 128	COMMERCE WAY ATLANTIC AVE	WOBURN	TIER 1A
J17	UNDERCOVERWEAR	LOT 2A 1 PRESIDENTIAL DR	WOBURN	TIER 2
J18	NO LOCATION AID	7 PARKER CHASE RD	STONEHAM	TIER 2
J19	PEACH ORCHARD ST	32 WEBSTER ST	WOBURN	TIER 2
J20	WELLS G&H	ABERJONA RIVER VALLEY	WOBURN	TIER 1A
J21	INTERSECTION RTES 38/128	2 ELM ST	WOBURN	TIER 1C
J22	NO LOCATION AID	331 MONTVALE AVE	WOBURN	TIER 2
J23	VACANT LOT	39 CEDAR ST	WOBURN	TIER 2
J24	RAILROAD BED	101 CENTRAL ST	STONEHAM	TIER 2
J25	NO LOCATION AID	12 SWANTON ST	WINCHESTER	TIER 2
J26	NO LOCATION AID	322 MONTVALE AVE	WOBURN	TIER 2
J27	MOBIL STATION	225 MAIN ST	STONEHAM	TIER 2
J28	ULTIMAR PETROLEUM STATION	135 SWANTON ST	WINCHESTER	TIER 2
J29	WINCHESTER HOSPITAL	41 HIGHLAND AVE	WINCHESTER	TIER 2
J30	CAREY RESIDENCE	121 PINE RIDGE RD	READING	TIER 2
J31	NO LOCATION AID	1R WASHINGTON ST	WOBURN	TIER 2
J32	ADJACENT TO TRAIN TRACKS	888 WOBURN ST	WILMINGTON	TIER 2
Horn Pond Subbasin				
H1	MOBIL SERVICE STATION 01 D2R	183 CAMBRIDGE ST	WOBURN	TIER 1C
H2	WOBURN PLAZA	344-400 CAMBRIDGE ST	WOBURN	TIER 1C
H3	WOBURN DPW CITY BARN	50 NORTH WARREN ST	WOBURN	TIER 2
H4	PROPERTY	75 MAIN ST	WOBURN	TIER 1C
H5	MAIN ST TEXACO STATION	641 MAIN ST	WINCHESTER	DEF TIER 1B
H6	AT MAIN ST	3 GREEN ST	WOBURN	DEF TIER 1B
H7	TANNERY FMR	60 SOUTH BEDFORD ST	WOBURN	DEF TIER 1B
H8	VINCO HEATING SUPPLY CO	50 HIGH ST	WOBURN	TIER 2
H9	NO LOCATION AID	50 HIGH ST	WOBURN	TIER 2

Site #	Site Name	Address	City/Town	Status[2]
H10	OIL DEPOT FMR	50 STURGIS ST	WOBURN	TIER 1A
H11	NO LOCATION AID	586 MAIN ST	WINCHESTER	DEF TIER 1B
H12	NO LOCATION AID	671 MAIN ST	WINCHESTER	DEF TIER 1B
H13	SUNOCO SERVICE STATION	671 MAIN ST	WINCHESTER	TIER 2
H14	BURKES GARAGE	71 MAIN ST	WOBURN	TIER 1C
H15	NO LOCATION AID	57 WINN ST	WOBURN	TIER 2
H16	NO LOCATION AID	57 WINN ST	WOBURN	TIER 2
H17	LUKIES SUNOCO SERVICE	545 MAIN ST CHURCH ST	WOBURN	TIER 2
H18	GASOLINE STATION	117 PLEASANT ST	WOBURN	TIER 2
H19	WINCHESTER DPW	15 LAKE ST	WINCHESTER	TIER 2
H20	EG BARKER LUMBER	36-40 PROSPECT ST	WOBURN	TIER 2
Mill Brook Subbasin				
I1	ROWSELLS WELDING	1 & 9R PARK AVE	ARLINGTON	DEF TIER 1B
I2	MASSACHUSETTS AVE AND FOTTER AVE	301 MASSACHUSETTS AVE	LEXINGTON	TIER 2
I3	MA HWY GARAGE	WATERTOWN ST	LEXINGTON	DEF TIER 1B
I4	PAUL REVERE FUEL CO	1531 MASSACHUSETTS AVE	ARLINGTON	DEF TIER 1B
I5	NO LOCATION AID	81 MYSTIC ST	ARLINGTON	TIER 2
I6	BRIGHAMS INC	30 MILL ST	ARLINGTON	TIER 2
I7	FACILITY #51/DISTRICT 4 HEADQUARTERS	519 APPLETON ST	ARLINGTON	TIER 2
I8	NEAR MT PLEASANT CEMETERY	MEDFORD ST	ARLINGTON	DEF TIER 1B
I9	SYMMES HOSPITAL	HOSPITAL RD	ARLINGTON	TIER 2
I10	COMMERCIAL PROPERTY	20 HOBBS COURT	ARLINGTON	DEF TIER 1B
I11	ROADWAY	14 RYDER ST	ARLINGTON	DEF TIER 1B
I12	NO LOCATION AID	1386 MASSACHUSETTS AVE	ARLINGTON	DEF TIER 1B
I13	MBTA PARKING LOT	1395-1425 MASSACHUSETTS AVE	ARLINGTON	TIER 1C
I14	ARLINGTON DPW	51 GROVE ST	ARLINGTON	TIER 1B
I15	NO LOCATION AID	180 MOUNTAIN AVE	ARLINGTON	TIER 2
I16	DPW YARD	51 GROVE ST	ARLINGTON	TIER 2
I17	DRY CLEANERS	1092 MASSACHUSETTS AVE	ARLINGTON	TIER 2
Mystic River 1 Subbasin				
M1	NO LOCATION AID	120 MAIN ST	MEDFORD	TIER 2
M2	ASHTON FUELS	55 MYSTIC AVE	SOMERVILLE	TIER 2
M3	SOMERVILLE COURTHOUSE	FELLSWAY ST	SOMERVILLE	TIER 2
M4	PARKWAY MOTOR SERVICES	166 BOSTON AVE	SOMERVILLE	DEF TIER 1B
M5	WELLINGTON CIRCLE MOTORS FMR	4080-4100 MYSTIC VALLEY PKW	MEDFORD	DEF TIER 1B
M6	HADDAD SERVICE STATION	205 BROADWAY	SOMERVILLE	TIER 2
M7	PAYLESS CASHWAYS INC	779 MCGRATH HWY	SOMERVILLE	TIER 2
M8	NEAR MYSTIC AVE INTERSECTION	779 MCGRATH HWY	SOMERVILLE	TIER 2
M9	FIRST NATL GASOLINE STA FMR	MYSTIC AVE	SOMERVILLE	DEF TIER 1B
M10	ASSEMBLY SQUARE	100 STURTEVANT	SOMERVILLE	TIER 2
M11	GAS METER STATION	22-24 ALLSTON ST	MEDFORD	DEF TIER 1B
M12	ROUTE 60	9 PLAYSTEAD RD	MEDFORD	TIER 2
M13	MWRA CSO ESMNT BTN ASSMBLY SQ & MYSTIC R	MIDDLESEX AVE	SOMERVILLE	DEF TIER 1B

Site #	Site Name	Address	City/Town	Status[2]
M14	HILLSIDE AUTOMOTIVE	583 BROADWAY	SOMERVILLE	TIER 2
M15	MEDFORD DPW	3097 MYSTIC VALLEY 52 SWAN ST	MEDFORD	TIER 2
M16	INTERSECTION OF RIVERSIDE AVE	1 MAIN ST	MEDFORD	TIER 2
M17	NO LOCATION AID	65 RIVERSIDE AVE	MEDFORD	DEF TIER 1B
M18	C/O MEDFORD	85 GEORGE P HASSETT DR	MEDFORD	TIER 2
M19	LAWRENCE MEMORIAL HOSPITAL	170 GOVERNORS AVE	MEDFORD	TIER 2
M20	NO LOCATION AID	222 MYSTIC AVE	MEDFORD	TIER 2
M21	COMMERCIAL PROPERTY	294 HARVARD ST	MEDFORD	DEF TIER 1B
M22	NO LOCATION AID	LOCUST ST	MEDFORD	DEF TIER 1B
M23	PROPERTY	322 MYSTIC AVE	MEDFORD	TIER 2
M24	KNOX DODGE FMR	643-645 BROADWAY	SOMERVILLE	TIER 2
M25	AMI LEASING	407 MYSTIC AVE	MEDFORD	TIER 2
M26	GENERAL ELECTRIC FACILITY	3960 MYSTIC VALLEY PKWY	MEDFORD	TIER 1C
M27	NO LOCATION AID	60 CROSS ST EAST	SOMERVILLE	TIER 2
M28	NO LOCATION AID	393 MYSTIC AVE	MEDFORD	TIER 2
M29	CORNER REARDON	74 MYSTIC AVE	MEDFORD	TIER 2
M30	NO LOCATION AID	61 CLYDE ST	SOMERVILLE	TIER 2
M31	NO LOCATION AID	259 LOWELL ST	SOMERVILLE	TIER 2
M32	NO LOCATION AID	259 LOWELL ST	SOMERVILLE	TIER 2
M33	RIVERSIDE TRANSMISSION COMPANY	308 MAIN ST	MEDFORD	TIER 2
M34	MOBIL STATION 01 PE8	978 HIGHLAND AVE	MEDFORD	TIER 2
M35	TEXACO SERVICE STATION	525 FELLSWAY	MEDFORD	TIER 2
M36	HUDSON BUS LINES MOBIL EF C32	70 UNION ST	MEDFORD	TIER 2
M37	SHELL STATION	620 BROADWAY	SOMERVILLE	TIER 2
M38	NO LOCATION AID	255 MYSTIC AVE	MEDFORD	TIER 2
M39	INTERSECTION WITH FOURTH ST	470 RIVERSIDE AVE	MEDFORD	TIER 2
M40	HUDSON BUS CO PROPERTY	70 UNION ST	MEDFORD	TIER 2
M41	HORMEL FIELD FOSTER COURT	MYSTIC RIVER RESERVATION	MEDFORD	TIER 2
M42	DRY WELL	393 MYSTIC AVE	MEDFORD	TIER 2
M43	UST NO 1	393 MYSTIC AVE	MEDFORD	TIER 2
M44	NO LOCATION AID	17 MANNING ST	MEDFORD	DEF TIER 1B
M45	PARKWOOD	3163 MYSTIC VALLEY PKWY	MEDFORD	TIER 2
Alewife Brook Subbasin				
A1	MOBIL STATION	82 CONCORD AVE	BELMONT	TIER 2
A2	GULF STATION	50 BRIGHTON ST	BELMONT	DEF TIER 1B
A3	COMMERCIAL PROPERTY	126 JACKSON ST	CAMBRIDGE	DEF TIER 1B
A4	JEFFERSON PARK APTS	RINDGE AVE	CAMBRIDGE	DEF TIER 1B
A5	NO LOCATION AID	131 ORCHARD ST	SOMERVILLE	TIER 2
A6	TEXACO STATION FMR	201-203 ELM ST	SOMERVILLE	TIER 2
A7	GASOLINE STATION FMR	290 HIGHLAND AVE	SOMERVILLE	DEF TIER 1B
A8	RUSSELL FIELD	RINDGE AND WHITTEMORE	CAMBRIDGE	TIER 2
A9	ADLEY EXPRESS SITE FMR	54 SMITH ST	CAMBRIDGE	TIER 2
A10	RTE 60/RTE 2	RTE 60	BELMONT	DEF TIER 1B
A11	NO LOCATION AID	305 BROADWAY	ARLINGTON	DEF TIER 1B

Site #	Site Name	Address	City/Town	Status[2]
A12	NO LOCATION AID	2055 MASS AVE	CAMBRIDGE	TIER 2
A13	RR BRIDGE C-1-20	ALEWIFE BROOK PKWY	CAMBRIDGE	TIER 2
A14	HOUSING AUTHORITY APTS	278 POWDERHOUSE BLVD	SOMERVILLE	TIER 2
A15	MOBIL STATION	1284 BROADWAY	SOMERVILLE	TIER 2
A16	WR GRACE	62 WHITTEMORE AVE	CAMBRIDGE	TIER 1C
A17	MASS AVE FIRESTONE	2472-2484 MASSACHUSETTS AVE	CAMBRIDGE	TIER 2
A18	UNCLE RUSSS CITGO STATION	2485 MASS AVE	CAMBRIDGE	TIER 2
A19	NO LOCATION AID	45 KINGSTON ST	SOMERVILLE	TIER 2
A20	MOBIL STATION FMR 01 193	337 PLEASANT ST	BELMONT	TIER 2
A21	BELMONT VOLKSWAGON	263 270 TRAPELO RD	BELMONT	TIER 2
A22	COMMERCIAL PROPERTY	143 ALEWIFE BROOK PKWY	CAMBRIDGE	DEF TIER 1B
A23	A&E SERVICE CENTER	191 CONCORD AVE	CAMBRIDGE	TIER 2
A24	ADJACENT TO FORMER CITY DUMP	NEW ST	CAMBRIDGE	DEF TIER 1B
A25	PROPERTY	1010 PLEASANT ST	BELMONT	TIER 2
A26	NO LOCATION AID	1010 PLEASANT ST	BELMONT	TIER 2
A27	EVERETT ST	125 BROADWAY	ARLINGTON	TIER 2
A28	CORNER OF CAMERON & MASS AVE	5 CAMERON AVE	CAMBRIDGE	TIER 1C
A29	BP STATION FMR	70 CONCORD AVE	BELMONT	TIER 2
A30	SUNOCO SERVICE STATION	46 BROADWAY	ARLINGTON	TIER 2
A31	EXXON SERVICE STAFMR 3 0966	7 CHANNING RD	BELMONT	TIER 2
A32	NO LOCATION AID	270 TRAPELO RD	BELMONT	TIER 2
A33	NO LOCATION AID	115 MILL ST	BELMONT	TIER 2
A34	MOONEY ST	127 SMITH PLACE	CAMBRIDGE	TIER 2
A35	US PETROLEUM GAS STATION	297 CONCORD AVE	CAMBRIDGE	TIER 2
Malden River Subbasin				
D1	MORTON OIL CO FMR	171 MEDFORD ST	MALDEN	TIER 2
D2	CUMBERLAND	470 LYNNFELLS PKWY	MELROSE	TIER 2
D3	WONDERBREAD THRIFT & DISTRIBUTION FACIL	420 EASTERN AVE	MALDEN	TIER 2
D4	LOMBARD TRUCKING	COMMERCIAL ST	MALDEN	TIER 2
D5	KONTRON FACILITY	9 PLYMOUTH ST	EVERETT	TIER 2
D6	COMMERCIAL PROPERTY	185 MAIN ST	MALDEN	DEF TIER 1B
D7	GAS STATION	245 MAIN ST EASTERN AVE	MALDEN	DEF TIER 1B
D8	FELLSVIEW TERRACE APARTMENTS	400 FELLSVIEW TER	STONEHAM	DEF TIER 1B
D9	MDC DRY WELL	164 POND ST	STONEHAM	TIER 2
D10	SPALDING STREET	66 MAIN ST	EVERETT	TIER 2
D11	PROSPECT AUTO CENTER	504 MEDFORD ST	MALDEN	TIER 2
D12	NYNEX MAINTENANCE GARAGE	373-375 WASHINGTON ST	MALDEN	TIER 2
D13	FRANKS AUTO BODY	189 HIGHLAND AVE	MALDEN	TIER 2
D14	NO LOCATION AID	219 AND 243 MEDFORD ST	MALDEN	TIER 2
D15	ALSO 298 MEDFORD ST	360-392 PEARL ST	MALDEN	TIER 1C
D16	NO LOCATION AID	WATERS AND ELM WAY	EVERETT	DEF TIER 1B
D17	TERMINATION ALONG RAILROAD RIGHT OF WAY	WATERS AVE	EVERETT	TIER 1C
D18	NO LOCATION AID	PRESCOTT AND TREMONT	EVERETT	DEF TIER 1B

Site #	Site Name	Address	City/Town	Status[2]
D19	EVERETT INDUSTRIAL	69 NORMAN ST	EVERETT	DEF TIER 1B
D20	NO LOCATION AID	302 TO 304 MAIN ST	EVERETT	DEF TIER 1B
D21	NO LOCATION AID	120 TREMONT ST	EVERETT	TIER 2
D22	BABE RUTH PLAYGROUND	BELL ROCK ST	EVERETT	TIER 2
D23	CIROS FOREIGN AUTO REPAIR	107 BROADWAY	EVERETT	TIER 2
D24	CABLE SYSTEMS CORPORATION	210 BROADWAY	EVERETT	TIER 2
D25	MANUFACTURING COMPLEX	970 FELLSWAY	MEDFORD	TIER 2
D26	NO LOCATION AID	159 MYRTLE ST	MEDFORD	DEF TIER 1B
D27	AMOCO SERVICE STATION FMR	353 SALEM ST	MEDFORD	TIER 2
D28	NE BOLT	9 CHARLTON ST	EVERETT	TIER 2
D29	LUCEYS SERVICE STATION	889 MAIN ST	MELROSE	TIER 2
D30	GASOLINE STATION	362 MEDFORD ST	MALDEN	DEF TIER 1B
D31	WORLD GASOLINE STATION	875 MAIN ST	MALDEN	DEF TIER 1B
D32	NO LOCATION AID	MAIN & CHARLES ST	MALDEN	DEF TIER 1B
D33	NO LOCATION AID	MAIN AND CHARLES	MALDEN	DEF TIER 1B
D34	NO LOCATION AID	178 EASTERN AVE	MALDEN	TIER 2
D35	NO LOCATION AID	SANTILLI HWY	EVERETT	DEF TIER 1B
D36	NO LOCATION AID	440 RIVERSIDE AVE	MEDFORD	TIER 2
D37	NO LOCATION AID	22 FRANKLIN ST	MALDEN	DEF TIER 1B
D38	NO LOCATION AID	348-350 SALEM ST	MEDFORD	TIER 2
D39	MEDFORD AUTO CLINIC	348-350 SALEM ST	MEDFORD	TIER 2
D40	MWRA SPOT POND PUMP STATION	2 WOODLAND RD	STONEHAM	TIER 1B
D41	MALDEN CAR WASH & MOBIL STA	330-445 EASTERN AVE	MALDEN	TIER 2
D42	ROHM TECH INC	195 CANAL ST	MALDEN	TIER 1B
D43	HARVARD STREET GARAGE	271 SALEM ST	MEDFORD	TIER 2
D44	TILLOTSON RUBBER CO INC	59 WATERS AVE	EVERETT	TIER 2
D45	CORNER OF REVERE PL	235 SALEM ST	MEDFORD	TIER 2
D46	STEVENS STREET INTERSECTION	128 FRANKLIN ST	STONEHAM	TIER 2
D47	BOSTON GAS COMPANY MALDEN PLANT	100 COMMERCIAL ST	MALDEN	TIER 1B
D48	NO LOCATION AID	80 BROADWAY	EVERETT	TIER 2
D49	MBTA EVERETT SHOPS	80 BROADWAY	EVERETT	TIER 2
D50	WELLINGTON REALTY	COMMERCIAL ST	MALDEN	TIER 2
D51	UPPER MALDEN RIVER SEDIMENTS	COMMERCIAL ST	MALDEN	DEF TIER 1B
D52	FLEET OPERATIONS CENTER	200 EXCHANGE ST	MALDEN	TIER 2
D53	NO LOCATION AID	12 BELTRAN ST	MALDEN	TIER 2
D54	CORNER	CHARLES AND PEARL ST	MALDEN	TIER 1B
D55	CALLAHAN PARK	PEARL ST @ CHARLES ST	MALDEN	TIER 1B
D56	NEW ENGLAND SHRIMP CO	129 COMMERCIAL ST	MALDEN	TIER 2
D57	VACANT LOT	22 FRANKLIN ST	MALDEN	TIER 2
D58	NO LOCATION AID	66 CHARLES ST	MALDEN	TIER 2
Mystic River 2 Subbasin				
Y1	EXXON TERMINAL	52 BEACHAM ST	EVERETT	TIER 1B
Y2	AUTO DEALERSHIP FMR	101 PARK ST	CHELSEA	TIER 2
Y3	NO LOCATION AID	MORAN TERMINAL	BOSTON	DEF TIER 1B
Y4	NAVAL SHIPYARD PRCLS 567	CHELSEA ST	BOSTON	DEF TIER 1B
Y5	BOSTON FIRE STATION	525 MAIN ST	BOSTON	DEF TIER 1B
Y6	P&S AUTO	29 BOW ST	EVERETT	DEF TIER 1B
Y7	COMMERCIAL PROPERTY	1994-1998 REVERE BEACH PKWY	EVERETT	DEF TIER 1B

Site #	Site Name	Address	City/Town	Status[2]
Y8	FMR WINTER ST	111 CHELSEA ST	EVERETT	DEF TIER 1B
Y9	9TH ST CHARLESTOWN NAVY YARD BLDG 105	FIRST AVE	BOSTON	TIER 2
Y10	CHARLESTOWN NAVY YARD-BLDG 105	100 FIRST ST	BOSTON	TIER 2
Y11	BLDG #23 BOSTON HOUSING AUTHORITY	90 MEDFORD ST	BOSTON	TIER 2
Y12	NORTH OF INTERSECTION	VALE AND CARTER STS	CHELSEA	TIER 2
Y13	MARKET ST	285 SECOND ST	EVERETT	DEF TIER 1B
Y14	NO LOCATION AID	ALFORD ST	EVERETT	TIER 2
Y15	SAMUEL GORDON & SONS INC	333 THIRD ST	CHELSEA	TIER 2
Y16	LOCAL 25	544 MAIN ST	BOSTON	TIER 2
Y17	RYAN FIELD	ALFORD ST	BOSTON	TIER 2
Y18	COMMERCIAL PROPERTY	1683 REVERE BEACH PKWY	EVERETT	DEF TIER 1B
Y19	SERVICE STATION FMR	325 CHELSEA ST	EVERETT	DEF TIER 1B
Y20	COAL GAS FACILITY FMR	MARKET ST BEHEN ST	EVERETT	TIER 1A
Y21	DPW YARD	380 BEACHAM ST	CHELSEA	TIER 2
Y22	PROPERTY	140-180 SPRUCE ST	CHELSEA	DEF TIER 1B
Y23	C&C OIL	148 HAWTHORNE ST	CHELSEA	DEF TIER 1B
Y24	LEDKOTE GALVANIZING FMR	128-132 SPRING ST	EVERETT	TIER 2
Y25	POWER PLANT TANKS #4 & #5 AREA	FMR CHARLESTOWN NAVY YARD	BOSTON	DEF TIER 1B
Y26	NAVY YARD-POWERPLANT	NINTH ST	BOSTON	DEF TIER 1B
Y27	NO LOCATION AID	1716 REVERE BEACH PWY	EVERETT	TIER 2
Y28	TOURAINE PAINTS INC	1760 REVERE BEACH PKWY	EVERETT	TIER 2
Y29	BROADWAY BRAKE	45 BROADWAY	SOMERVILLE	TIER 2
Y30	NO LOCATION AID	354 THIRD ST	EVERETT	TIER 2
Y31	INDUSTRIAL PROPERTY	200 CHELSEA ST	EVERETT	DEF TIER 1B
Y32	BOSTON GAS PLANT FMR	ROVER ST	EVERETT	TIER 2
Y33	NO LOCATION AID	ROVER ST	EVERETT	TIER 2
Y34	NO LOCATION AID	52 BEACON ST	EVERETT	DEF TIER 1B
Y35	NO LOCATION AID	RAILROAD RIGHT OF WAY	EVERETT	DEF TIER 1B
Y36	BOSTON MARKET TERMINAL PROPERTY	MARKET ST	EVERETT	TIER 2
Y37	INTERSECTION WITH CARTER ST	144 THRU 155 BEECH ST	CHELSEA	TIER 2
Y38	NO LOCATION AID	31 SECOND ST	CHELSEA	TIER 2
Y39	BEHEN ST	8 COMMERCIAL ST	EVERETT	TIER 2
Y40	NO LOCATION AID	38 TO 48 BROADWAY	EVERETT	TIER 2
Y41	INTERSECTION WITH MAPLE ST	203 EVERETT AVE	CHELSEA	TIER 2
Y42	MAPLE ST	211 EVERETT ST	CHELSEA	TIER 2
Y43	NO LOCATION AID	18 & 69 ROVER ST	EVERETT	DEF TIER 1B
Y44	CHARLESTOWN BUS GARAGE	21 ARLINGTON AVE	BOSTON	TIER 2
Y45	US GYPSUM CO INC	200 TERMINAL AVE	BOSTON	TIER 2
Y46	FEDERAL METAL FINISHING	18 DORRANCE ST	BOSTON	TIER 2
Y47	FEDERAL METAL FINISHING INC	18 DORRANCE ST	BOSTON	TIER 2
Y48	DAMPNEY CO INC	85 PARIS ST	EVERETT	TIER 2
Y49	EVERETT DPW YARD	48 EAST ELM ST	EVERETT	TIER 2
Y50	NO LOCATION AID	38 BROADWAY	EVERETT	DEF TIER 1B
Y51	PARKING LOT	1000 JUSTIN DR	CHELSEA	DEF TIER 1B
Y52	MARINA	1000 JUSTIN DR	CHELSEA	DEF TIER 1B
Y53	HAMILTON SCHOOL	28 NICHOLS ST	EVERETT	TIER 2

Site #	Site Name	Address	City/Town	Status[2]
Y54	330 EVERETT AVE	1690 REVERE BEACH PRKWY	EVERETT	TIER 2
Y55	NORTH OF INTERSECTION	VALE AND CARTER STS	CHELSEA	TIER 2
Y56	CHELSEA FMR ISLAND END RIVER OXBOW	BEACHAM ST	EVERETT	TIER 2
Y57	FORMER GAS STA	141-145 WASHINGTON AVE	CHELSEA	TIER 2
Y58	WAREHOUSE	156 ROVER ST	EVERETT	TIER 2
Y59	B&M YARD 21	FOLEY ST TENNEY CT	SOMERVILLE	TIER 2
Y60	CHARLESTOWN HS COMMUNITY CENTER	240 MEDFORD ST	BOSTON	TIER 2
Y61	115 KV SWITCHYARD	173 ALFORD ST	EVERETT	TIER 2
Y62	NO LOCATION AID	MARKET ST	EVERETT	DEF TIER 1B
Y63	NO LOCATION AID	211 EVERETT AVE	CHELSEA	TIER 2
Y64	NO LOCATION AID	101 SECOND ST	CHELSEA	TIER 2
Chelsea Creek Subbasin				
C1	NO LOCATION AID	60 CLARENCE	EVERETT	DEF TIER 1B
C2	NO LOCATION AID	505 WASHINGTON AVE	CHELSEA	TIER 2
C3	ADAMSONS AUTO REPAIR	404 REVERE BEACH PKWY	REVERE	DEF TIER 1B
C4	GLOBAL PETRO	140 LEE BURBANK HWY	REVERE	TIER 2
C5	WEBSTER ST	1100 REVERE BEACH PKWY	CHELSEA	TIER 2
C6	MOBIL GAS STATION AT GLENDALE SQUARE	725 BROADWAY	EVERETT	TIER 2
C7	FMR MOBIL OIL CORP BULK STORAGE	467 AND 580 CHELSEA ST	BOSTON	TIER 1C
C8	AMERADA HESS CORP	148 CONDOR ST	BOSTON	TIER 1C
C9	NO LOCATION AID	CONDOR ST	BOSTON	TIER 2
C10	GULF OIL TERMINAL	281 EASTERN AVE	CHELSEA	DEF TIER 1B
C11	NO LOCATION AID	412 EASTERN AVE	CHELSEA	DEF TIER 1B
C12	SAMUEL CABOT INC	229 MARGINAL ST	CHELSEA	TIER 1A
C13	NO LOCATION AID	28 GERRISH AVE	CHELSEA	TIER 2
C14	NO LOCATION AID	553A WASHINGTON AVE	CHELSEA	TIER 2
C15	GASOLINE STATION	419 BREMEN ST	BOSTON	DEF TIER 1B
C16	COMMERCIAL PROPERTY	144 ADDISON ST	BOSTON	DEF TIER 1B
C17	NO LOCATION AID	180 VINAL ST	REVERE	DEF TIER 1B
C18	SUNOCO SERVICE STA	251 LEE BURBANK HWY	REVERE	TIER 2
C19	INTERSECTION ROUTE 1A	20 RAILROAD ST	REVERE	TIER 2
C20	NO LOCATION AID	644 WASHINGTON ST	CHELSEA	DEF TIER 1B
C21	NO LOCATION AID	201 MARGINAL ST	CHELSEA	TIER 2
C22	ACROSS FROM HOLIDAY INN	225 MCCLELLAN HWY	BOSTON	TIER 2
C23	FMR EAST BOSTON NAVAL FUEL ANNEX	225 & 345-365 MCCLELLAN HWY	BOSTON	TIER 2
C24	NO LOCATION AID	225 & 345-365 MCCLELLAN HWY	BOSTON	TIER 2
C25	ACROSS FROM MANSON CORP	155 CRESENT ST	CHELSEA	DEF TIER 1B
C26	NO LOCATION AID	2 GRIFFIN WAY	CHELSEA	TIER 2
C27	NO LOCATION AID	2 GRIFFIN WAY	CHELSEA	TIER 2
C28	CHELSEA TRUNK SEWER RELIEF PROJECT	BROADWAY	CHELSEA	DEF TIER 1B
C29	NO LOCATION AID	EASTERN AVE & CABOT ST	CHELSEA	DEF TIER 1B
C30	MONITORING WELL VRU 11	140 LEE BURBANK HWY	REVERE	TIER 2
C31	AMOCO STATION FMR 2106	470 MERIDIAN ST	BOSTON	TIER 2

Site #	Site Name	Address	City/Town	Status[2]
C32	CUMBERLAND FARMS OIL TERMINAL	123 EASTERN AVE	CHELSEA	TIER 2
C33	FORBES LITHOGRAPHIC CO FMR	1 FORBES ST MARGINAL ST	CHELSEA	TIER 2
C34	PETROLEUM TERMINAL	11 BROADWAY	CHELSEA	TIER 2
C35	AMERICAN FINISH & CHEM CO	1012 BROADWAY	CHELSEA	TIER 2
C36	ADJACENT TO FORMER MFG GAS DIST FACILITY	RAILROAD ST	REVERE	TIER 2

[1]All sites are on the list of "21E" sites in Massachusetts requiring regulatory oversight and in some cases cleanup as stipulated in the Massachusetts Contingency Plan (310 CMR 40.0000).

[2]Tier I sites require a DEP permit before proceeding with cleanup. Tier I sites are classified as Tier IA, IB, or IC depending on the severity of contamination and complexity of the site. Tier IA are the worst and are subject to direct DEP oversight. Tier II sites are generally less contaminated than Tier I sites. Tier II sites may be remediated without a permit or direct DEP oversight.

Source of data: http://www.state.ma.us/dep/bwsc/sitelist.htm (accessed June 2003).

Appendix E. NPDES-permitted Wastewater Dischargers in the Mystic River Watershed

Receiving Waters	Segment #	Company/ Organization	Address	City	NPDES ID #	Permit Type2	Major/ Minor	Status	Discharge Type
Aberjona River	MA 71-01	Acme Printing Company	30 Industrial Way	Wilmington	MAR05B836	SW MSGP	Minor	Active	
Aberjona River	MA 71-01	AFMC INC	135 Swanton St.	Winchester	MA0036421	Individual Permit	Minor	Active?	
Aberjona River	MA 71-01	C N Wood Company Inc.	62 Cambridge St.	Burlington	MAU251691	Unpermitted	Minor	Active?	
Aberjona River	MA 71-01	Consolidated Freightways	295 Salem St.	Woburn	MAR05B720	SW MSGP	Minor	Active	
Aberjona River	MA 71-01	Heffron Materials	Draper St.	Woburn	MAR05B908	SW MSGP	Minor	Active	
Detention Pond	MA 71-019	High Voltage Engineering	85 South Bedford St.	Burlington	MA0034827	Individual Permit	Minor	Active	
Aberjona River	MA 71-01	Kraft Foods	7 Hill St.	Woburn	MAR05B760	SW MSGP	Minor	Active	
Aberjona River	MA 71-01	Lowe's Home Improvement Center	15 Commerce Way	Woburn	MAU000023	Unpermitted	Minor	Active	
Aberjona River	MA 71-01	Madico, Inc.	45 Industrial Pkwy.	Woburn	MAR05C054	SW MSGP	Minor	Active	
Aberjona River	MA 71-01	Olin Corporation	51 Eames St.	Wilmington	MA0005304	Individual Permit	Major	Active	
Aberjona River	MA 71-01	Parkview Condominiums	200 Swanton St.	Winchester	MAG250009	NCCW	Minor	Active	
Aberjona River	MA 71-01	Sanmina Corp Multilayer	1 Jewel Drive	Wilmington	MAR05B855	SW MSGP	Minor	Active	
Aberjona River	MA 71-01	Sanmina Corporation International	8 Presidential Wy.	Woburn	MAR05B854	SW MSGP	Minor	Active	
Aberjona River Trib.	MA 71-01	Waste Management of MA	204 Merrimac St.	Woburn	MAR05C034	SW MSGP	Minor	Active	
Aberjona River	MA 71-01	Winchester, Town of	Unknown	Winchester	MAU000008	Unpermitted	Minor	Active	CSO
Aberjona River	MA 71-01	Woburn Truck Parts	1095R Main St.	Woburn	MAR05B758	SW MSGP	Minor	Active	
[redacted]									
Mystic Lakes	MA 71-027	Brigham's Inc.	30-42 Mill St.	Arlington	MA0032999	Individual Permit	Minor	Active	
Mystic Lakes	MA 71-027	Brigham's Inc.	30-42 Mill St.	Arlington	MAR05B745	SW MSGP	Minor	Active	
Mystic Lakes	MA 71-027	Winchester, Town of	71 Mt. Vernon St.	Winchester	MA0102792	Individual Permit	Minor	Active	CSO

Receiving Waters	Segment #	Company/ Organization	Address	City	NPDES ID #	Permit Type2	Major/ Minor	Status	Discharge Type
[redacted]									
Mystic River 1	MA 71-02	Boston Ave. Autobody/Cavanagh Brothers	527 Boston Ave.	Somerville	MAU251461	Unpermitted	Minor	Active?	
Mystic River 1	MA 71-02	Boston Metal Products	400 Riverside Ave.	Medford	MA0035220	Individual Permit	Minor	Active	
Mystic River 1	MA 71-02	Federal Express-CEF	25 Sycamore Ave.	Medford	MAR05C070	SW MSGP	Minor	Active	
Mystic River 1	MA 71-02	MBTA - Fellsway Bus Garage	447 Salem St.	Medford	MA0034967	Individual Permit	Minor	Active	
Mystic River 1	MA 71-02	MBTA - Fellsway Bus Garage	447 Salem St.	Medford	MAR05C024	SW MSGP	Minor	Active	
Mystic River 1	MA 71-02	MBTA - Wellington Carhouse	37 Revere Beach Pkwy	Medford	MAR05C019	SW MSGP	Minor	Active	
Mystic River 1	MA 71-02	MWRA - Watermain Section 16W	Mystic Valley Parkway	Medford	MAG070033	Construction Dewatering	Minor	Active	
Mystic River 1	MA 71-02	Riverside Place	65 Riverside Ave.	Medford	MA0036811	Individual Permit	Minor	Active	
Mystic River 1	MA 71-02	Somerville, City Of	Franey Rd.	Somerville	MA01101982	Individual Permit	Major	Active	CSO
Mystic River 1	MA 71-02	Terry's Auto Salvage Inc.	170 Mystic Ave.	Medford	MAR05A858	SW MSGP	Minor	Active?	
Mystic River 1/ Alewife Brook	MA 71-04, MA 71-02	Arlington, Town of	Unknown	Arlington	MAU000011	Unpermitted	Minor	Active	CSO
Mystic River 1/ Alewife Brook	MA 71-04, MA 71-02	Medford, City of	Unknown	Medford	MAU000010	Unpermitted	Minor	Active	CSO
[redacted]									
Mill Brook	MA 71-01	Fairlawn Nursing Home	265 Lowell St.	Lexington	MA0035858	Individual Permit	Minor	Active	
[redacted]									
Alewife Brook	MA 71-04		165 Cambridge Park Dr.	Cambridge	MAR05B649	SW MSGP	Minor	Active	
Alewife Brook	MA 71-04	Alewife Brook Pump Station (MWRA)	392 Alewife Brook Pkwy	Somerville	MAR05B638	SW MSGP	Minor	Active	
Alewife Brook	MA 71-04	Amtrak - West Cambridge Factory	86 Cambridge Park Dr.	Cambridge	MAU000002	Unpermitted	Minor	Active	
Alewife Brook	MA 71-04	Belmont, Town of	Unknown	Belmont	MAU000009	Unpermitted	Minor	Active	CSO
Alewife Brook	MA 71-04	Cambridge, City Of		Cambridge	MA0101974	Individual Permit	Major	Active	CSO
Alewife Brook	MA 71-04	Former Sunoco Service Station	880 Mass Ave.	Arlington	MA0036633	Individual Permit	Minor	Active	

Receiving Waters	Segment #	Company/ Organization	Address	City	NPDES ID #	Permit Type2	Major/ Minor	Status	Discharge Type
Alewife Brook	MA 71-04	MWRA - Northern Rehab	Waltham St.- Lexington Mass. Ave. Summer Street	Woburn/Lexington	MAG070034	Construction dewatering	Minor	Active	
Alewife Brook	MA 71-04	Somerville, City Of	Franey Rd.	Somerville	MA01101982	Individual Permit	Major	Active	CSO
Alewife Brook	MA 71-04	The Dodge Company	165 Cambridge Park Dr.	Cambridge	MAR05B649	SW MSGP	Minor	Active	
Malden River	MA 71-05	Exxon (52 Beacham Street)	52 Beacham St.	Everett Charlestown	MA0032760	Individual Permit	Minor	Active	
Malden River	MA 71-05	Gateway Condominiums	20 Summer St.	Malden	MA0030759	Individual Permit	Minor	Active	
Malden River	MA 71-05	Imported Stone, Inc.	1 Air Force Rd.	Everett	MA0034622	Individual Permit	Minor	Inactive	
Malden River	MA 71-05	Malden Middlesex Motor Sales	35 Canal Street	Malden	MAU251453	Unpermitted	Minor	Active	
Malden River	MA 71-05	Rohm Technology Inc.	195 Canal St.	Malden	MA0030759	Individual Permit	Major (disc)	Active?	
Malden River	MA 71-05	Spadafora Funeral Home	865 Main Street	Malden	MAU251470	Unpermitted	Minor	Active	
Mystic River 2	MA 71-03	Allied Industries, Inc.	201 Rover St.	Everett	MA0002038	Individual Permit	Minor	Active	
Mystic River 2	MA 71-03	Baystate Galvanizing	128-132 Spring St.	Everett	MAR05C052	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	Boston Water & Sewer Commission	Unknown	Charlestown	MAS010001	Individual, SW	Minor	Active	CSO
Mystic River 2	MA 71-03	Chelsea Yacht Club	1 Broadway St.	Chelsea	MAU251011	Unpermitted	Minor	Active	Unauthorized
Mystic River 2	MA 71-03	Chelsea, City Of (CSO)		Chelsea	MA0101877	Individual Permit	Major	Active	
Mystic River 2	MA 71-03	Distrigas of Massachusetts River	18 Rover St.	Everett	MA0020010	Individual Permit	Minor	Active	
Mystic River 2	MA 71-03	Exxon Co. USA Everett Terminal	52 Beacham St.	Everett	MA0000833	Individual Permit	Major	Active	
Mystic River 2	MA 71-03	Island End Cogeneration Project	156 Rover Street	Everett	MA0040126 .	Individual Permit	Minor	Active	
Mystic River 2	MA 71-03	Market Forge Ind., Inc.	35 Garvey St.	Everett	MAR05B795	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	MBTA Bus Overhaul Garage	80 Broadway Ave.	Everett	MAR05C025	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	MBTA Charlestown Facility	21 Arlington Ave.	Charlestown	MAR05C026	SW MSGP	Minor	Active	

Receiving Waters	Segment #	Company/ Organization	Address	City	NPDES ID #	Permit Type2	Major/ Minor	Status	Discharge Type
Mystic River 2	MA 71-03	MBTA Charlestown Facility	21 Arlington Ave.	Charlestown	MAR05B504	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	MWRA Delauri Pump Station	172 Alford St.	Charlestown	MAR05B641	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	Mystic Station Redevelopment	39 Rover St.	Everett	MAR05C030	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	Ossipee Aggregates	201 Rover St.	Everett	MAR05B565	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	Prolerized of New England	69 Rover St.	Everett	MAR05C065	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	Sithe Mystic	147 Alsford St.	Charlestown	MA0004740	Individual Permit	Major	Active	
Mystic River 2	MA 71-03	Sithe Mystic Development	Unknown	Charlestown	MAR10A803	Unknown	Minor	Active	
Mystic River 2	MA 71-03	United States Gypsum Company	200 Terminal Street	Charlestown	MAR05C196	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	USPS Vehicle Maint. Facility	307 Beacham St.	Chelsea	MAR05B789	SW MSGP	Minor	Active	
Mystic River 2	MA 71-03	W A Wood Co	108 Spring St.	Everett	MA0036463	Individual Permit	Minor	Active	
[redacted]									
Chelsea River	MA 71-06	Chelsea, City Of (CSO)	340 Marginal Street	Chelsea	MA0101877	Individual Permit	Major	Active	CSO
Chelsea River	MA 71-06	Mobil Oil - TOSCO	467 Chelsea St.	E. Boston	MA0004006	Individual Permit	Major	Active	
[redacted]									
Norwell Creek	MA 71-05	MBTA Bus Overhaul Garage	447 Salem St.	Medford	MA0034479	Individual Permit	Minor	Active	

[1]The information in this appendix is taken from a combination of DEP's Facility Master File database (FMF), EPA's Permit Control System (PCS, which applies to NPDES permits), and DEP's Division of Watershed Management (DWM) records). The information was provided by John Reinhardt at the MA-DEP, Division of Business Compliance, Bureau of Waste Prevention, 1 Winter St. Boston, MA.

[2]SW MSGP = Surface Water Municipal Stormwater General Permit; NCCW = noncontact cooling water

Appendix F. Pipes in the Mystic River Watershed Addressed by DEP §308 Letters

Subbasin	Receiving Waters	Town	Pipes Listed
Mill Brook	Mill Brook	Arlington	106000 - 150' West of Grove St.
Mill Brook	Mill Brook	Arlington	139000 - Lowell Street at Brook
Mystic Lakes	Upper Mystic Lake	Winchester	S007 Cambridge Street (next to boat club)
Mystic River 1	Mystic River	Arlington	048000 - West Side, Mystic Street Bridge
Mystic River 1	Mystic River	Medford	M-44
Mystic River 1	Mystic River	Medford	M-40
Mystic River 1	Mystic River	Medford	MED-2 Willis Street/Two Penny Brook
Mystic River 1	Mystic River	Somerville	006: Mystic River Opposite Moreland
Mystic River 1	Mystic River	Somerville	006A: Mystic River opposite Mt. Vernon
Mystic River 1	Mystic River	Somerville	007B
Mystic River 1	Mystic River	Somerville	007D
Alewife Brook	Alewife Brook	Arlington	013000 - 60' East of Henderson St.
Alewife Brook	Alewife Brook	Arlington	014000 - 40' North of Cross St.
Alewife Brook	Wellington Brook	Belmont	#1 Oxford Circle #2 Huron Ave.at Grove St. #7 Birds Pond Outlet
Alewife Brook	Little Pond	Belmont	#10 Winn's Brook Discharge to Little Pond (WIB001)
Alewife Brook	Little Pond	Belmont	#11A Oliver Road (between Staunton and Lodge)
Alewife Brook	Little Pond	Belmont	#12 Oliver Road at Gilmore Road
Alewife Brook	Little Pond or Spy Pond	Belmont	#15 Pleasant Street at Lake Street
Alewife Brook	Wellington Brook	Cambridge	#1 48" St. Saveur Court #2 39" Belmont - Huron Ave. #3 86" Wellington Brook
Alewife Brook	Wellington Brook	Cambridge	#5 24" Normandy Terrace
Alewife Brook	Alewife Brook	Cambridge	#6 Fawcett Street MH at GTE Gate
Alewife Brook	Alewife Brook	Cambridge	#7 Concord Ave. - Wheeler Outfall

Subbasin	Receiving Waters	Town	Pipes Listed
Alewife Brook	Alewife Brook	Cambridge	#8 Cambridge Park Outfall
Alewife Brook	Alewife Brook	Cambridge	#14 24" Acorn Park - ADL
Alewife Brook	Alewife Brook	Somerville	001C 001D
Alewife Brook	Alewife Brook	Somerville	002A
Alewife Brook	Alewife Brook	Somerville	004

Source: MA Department of Environmental Protection, summarized by Libby Larson, Mystic River Watershed Association, Arlington, MA, June 2003.

Appendix G: Massachusetts Watershed Initiative Annual Work Plans for the Mystic River Watershed

The following table provides a brief summary of the Annual Work Plans developed by the Massachusetts Watershed Initiative's Boston Harbor Team and later the Mystic River Watershed Team, for Fiscal Years 1999 through 2004. The FY 2004 plan was not implemented because the Watershed Initiative was discontinued. Many of the projects listed in the work plans are nonetheless proceeding, with continuation funding or with funding from alternative sources.

Table G.1: Mass. Watershed Initiative Priority Projects for the Mystic River Watershed

Project*	Partners	Location	Estimated Cost
FY 1999 (Boston Harbor Watershed)			
Sample/assess major WQ parameters, develop appropriate QAPPs	MWRA, EPA, watershed associations	Basinwide (freshwater portion)	$90,000
Restore fish (herring) passage between Upper and Lower Mystic Lakes – interim fish ladder	USFWS, DFWELE, MyRWA, Mystic River Coalition	Arlington, Medford, Winchester	$10,000
FY 2000 (Boston Harbor Watershed)			
Development and installation of streamflow staff gages			
Aberjona-Mystic River H&H study			
Water quality monitoring project (continuation – source bracketing and toxics sampling)	MWRA, EPA, watershed associations, USGS		
FY 2001 (Boston Harbor Watershed)			
Development of basinwide water quality strategy	EOEA, towns, MAPC, CZM, DEP UMass	Basinwide	$65,000
Assessment & analytical services in support of volunteer monitoring efforts	MyRWA, in-kind lab support from EPA, MWRA, Charles River Watershed Assoc.	Basinwide	$20,000
Upper Mystic Lake dam assessment (H&H study), repair and fish ladder installation	MDC, DEM, Tufts, towns	Upper Mystic Lake	$20,000
Assessment of instream flow dynamics and pollutant loading in a dam-controlled basin (Lower Mystic/Alewife Brook)	MAPC, Tufts, Mystic River Coalition, towns	Lower Mystic, Alewife Brook	$50,000
Watershed boundary and stream crossing signage	EOEA, MDC, towns, local businesses	Basinwide	
FY 2002 (Boston Harbor Watershed)			
Basinwide water quality monitoring	MWRA, EPA,	Basinwide (fresh	$40,000 (Mystic

Table G.1: Mass. Watershed Initiative Priority Projects for the Mystic River Watershed

Project*	Partners	Location	Estimated Cost
and sampling (includes continuation of Mystic monitoring started in FY 99).	watershed associations, USGS	water portion)	$10,000)
Chelsea Creek Master Plan	CCAG	Chelsea, East Boston	$12,000
Alewife Brook/Mystic River Assessment and Action Plan	MyRWA	Basinwide	$19,000
FY 2003 (Mystic Watershed Team)			
Water quality monitoring (continue baseline, expand hotspot monitoring, add saltwater sampling)	USGS, EPA, Tufts, MyRWA, MWRA, towns	Basinwide	$25,000
Stream team development and implementation (formation of new stream teams)	MyRWA, towns, Riverways	Boston Harbor basinwide	$2,000
Mapping of bottom-sediment quality in the Lower Mystic	USGS, EOEA	Lower Mystic, Chelsea Creek	$25,000
Study of the Amelia Earhart Dam (review of impacts and operations)	MDC, ACOE, EPA, Mystic Valley Development Commission, Malden River Park Task Force	Amelia Earhart Dam	$10,000
Restoring critical ecosystem: (1) rapid ecological assessment (2) model restoration project	The Watershed Institute, DEM, MAPC, Boston College, Tufts, USDA, MyRWA, CCAG, Eagle Eye	Basinwide	$20,000
Invasive control pilot project – Yates Pond	MDC, MBTA, City of Cambridge	Yates Pond	$18,000
Evaluation of local stormwater management measures and recommendations for communities (substitute project)	DEP, EOEA, DEM, MAPC, AVDC, USGS, towns, MyRWA	Basinwide	$12,000
Chapter 91 sites and coastal access project map at Chelsea Creek (substitute project)	CZM, DEP, EOEA, MAPC, MassBays, BHA	Chelsea Creek	$3,000

* Includes only projects with a basinwide or Mystic watershed-specific scope.
Source: *Massachusetts Watershed Initiative Annual Work Plans (Boston Harbor and Mystic River)*