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Boston Harbor South Watersheds 2004 Assessment Report

Neponset River Watershed Association

Urban Harbors Institute, University of Massachusetts Boston

Boston Harbor Association

Fore River Watershed Association

Weir River Watershed Association

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Boston Harbor South Watersheds 2004 Assessment Report

June 30, 2004

**Prepared for:
Massachusetts Executive Office of Environmental Affairs**

**Prepared by:
Neponset River Watershed Association
University of Massachusetts, Urban Harbors Institute
Boston Harbor Association
Fore River Watershed Association
Weir River Watershed Association**

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Introduction

The 2004 Boston Harbor South Watersheds Assessment and Action Plan was produced under a contract between the Massachusetts Executive Office of Environmental Affairs and the Neponset River Watershed Association (NepRWA). NepRWA collaborated in its work with the Urban Harbors Institute of the University of Massachusetts Boston, the Boston Harbor Association, the Fore River Watershed Association, the Weir River Watershed Association and the Back River Watershed Association. In addition, a volunteer Advisory Committee provided invaluable assistance in the design, development and review of the Plan. Advisory Committee members included David Colton, Director of the Milton Department of Public Works; Wes Dripps of the University of Massachusetts, Boston; Margo Clerkin, Conservation Agent of Hull; and Nan Crossland, Executive Director of the Dedham-Westwood Water District. Finally, there was considerable public participation in the preparation of this report, including interviews with at least three stakeholders in each of the four watershed and Boston, and open public meetings to take input on the Assessments.

This report includes assessments covering the four individual watersheds that discharge into Boston Harbor from south of the City of Boston — the Neponset, Weir, Fore and Back River Watersheds — plus an assessment for those portions of the City of Boston which border the Harbor itself south of the Charles River, hereinafter referred to as “Boston Inner Harbor Watershed.” The companion to this report is the “Boston Harbor South Watersheds 2004 -2009 Action Plan,” which spells out a comprehensive set of responses needed to remedy problems identified here.

This document does not cover the two major watersheds that discharge to the Harbor to the north of Boston — the Charles and Mystic River

Watersheds -- nor those sections of Boston that border or discharge into these watersheds. Therefore, it is not the purpose of the Assessment to analyze the health of the Boston Harbor itself, but rather to look at the environmental health of the individual watersheds from their headwaters to their discharge points into the Harbor, plus direct discharges into the Harbor from Boston.

Since MWRA began pumping sewage from Deer Island to its outfall pipe in Massachusetts Bay, most of the pollution in the Harbor itself comes from the contributions of the various rivers discharging into the Harbor and Combined Sewage Overflows (CSOs) from the City of Boston. MWRA data indicate that it is the Charles and Mystic Rivers, and not the rivers covered in this report, which are the largest contributors to the Harbor’s pollution. In any case, extensive research by MWRA has been unable to pinpoint the exact pollutant contributions coming from each individual watershed.

This report is based on a review of existing data and studies relevant to each of the watersheds, including water quality data reports, shoreline survey reports, EOE’s Basin-wide Water Quality Strategy, relevant municipal plans, DEP reports, regional buildout analyses, Massachusetts Geographic Information Systems (MassGIS) data, and other relevant materials from non-governmental, academic, local, regional, state and federal sources.

The priority issues identified in the assessment are (in no particular order):

- Water Quality;
- Watershed Hydrology;

- Physical Habitat;
- Land Use; and
- Open Space

Each of the covered watersheds (including the Boston Inner Harbor) addresses in its Assessment a series of questions involving these five issues. It should be noted that the maps contained in the Assessments were almost entirely obtained from MassGIS data. There may be some inaccuracies in the maps, due to the wide variety of original source data used in developing MassGIS' digital data, the age of some of the data, the variable scales of the maps used by GIS, and the subjectivity involved in interpretation of the aerial photographs that were used to generate land use and open space maps. For more specific descriptions of the data represented by the various GIS data layers used for this document, see Table 2 at the end of the "Common Assessment for all Watersheds".

Common Assessment for All Watersheds

Introduction

This Common Assessment relates to watershed problems shared by the Neponset, Fore, Back and Weir Watersheds and the City of Boston south of the Charles River. It is followed by assessments specific to these individual watersheds and Boston.

The various Assessments make regular reference to water quality information contained in “The Boston Harbor 1999 Water Quality Assessment Report” (hereinafter referred to as the “DEP Report”), which was published by the Massachusetts Department of Environmental Protection (DEP) in October 2002 and includes data through 2001. While the Neponset River Watershed Association and MWRA have additional water quality data beyond 2001 that are included in some of these Assessments, for the most part the DEP Report provides a good overview of the health of the Harbor and its contributing watersheds. The DEP Report, however, does not directly address the same issues that the Assessments do (in addition to water quality, the Assessments address watershed hydrology, physical habitat, land use, and open space), but rather uses water quality data to assess which stream segments, ponds, and estuaries meet their “designated uses” as defined in the federal Clean Water Act. The individual watershed Assessments, especially the Neponset River Watershed Assessment, at times rely on data obtained after the DEP Report was completed.

Does bacterial pollution limit fishing or recreation?

Yes. Bacterial pollution limits all three. Bacterial pollution indicative of water-borne pathogens is one of the most common water quality problems in at least a portion of all of the watersheds covered in these Assessments. Human and animal wastes enter waterways through

various mechanisms, including stormwater runoff, sanitary sewer overflows (SSOs), leaking sewer pipes and illicit sewer and storm drain connections. The DEP Report used bacterial levels mainly to assess primary contact recreational uses (e.g., swimming) and secondary contact recreational uses (e.g., boating and fishing) in accordance with Massachusetts Water Quality Standards (314 CMR 4.00). DEP rated each assessed stream segment and pond as “supportive”, “partially supportive”, or “nonsupportive” of primary and secondary contact recreation. None of the watersheds covered in this report were found to be fully supportive of primary or secondary recreational uses (see individual watershed Assessments).

Does nutrient pollution pose a threat to aquatic life?

Yes. Excessive nutrients from fertilizers, animal waste and other nutrient-rich materials enter waterways through sewage pollution and stormwater runoff, posing a problem for aquatic life and recreational activities in at least a portion of all of the watersheds covered in this Report. Excessive plant and algae growth in aquatic systems can make waterways malodorous and unsuitable for aquatic life as waterways become organically enriched and dissolved oxygen levels are reduced. Elevated nutrient levels are also a major factor in lost recreational value due to excessive weed and algal growth, especially in ponds.

Assessing nutrient problems, as well as finding solutions to them, is particularly difficult in aquatic environments that include ponds, freshwater rivers/streams, and saltwater estuaries. Each type of water body is threatened by different levels of different types of nutrients (e.g., phosphorous vs. nitrogen) and may be more or less sensitive to those nutrients. Thus, phosphorous levels that may not be high enough to cause

Figure 1: Watershed Locations

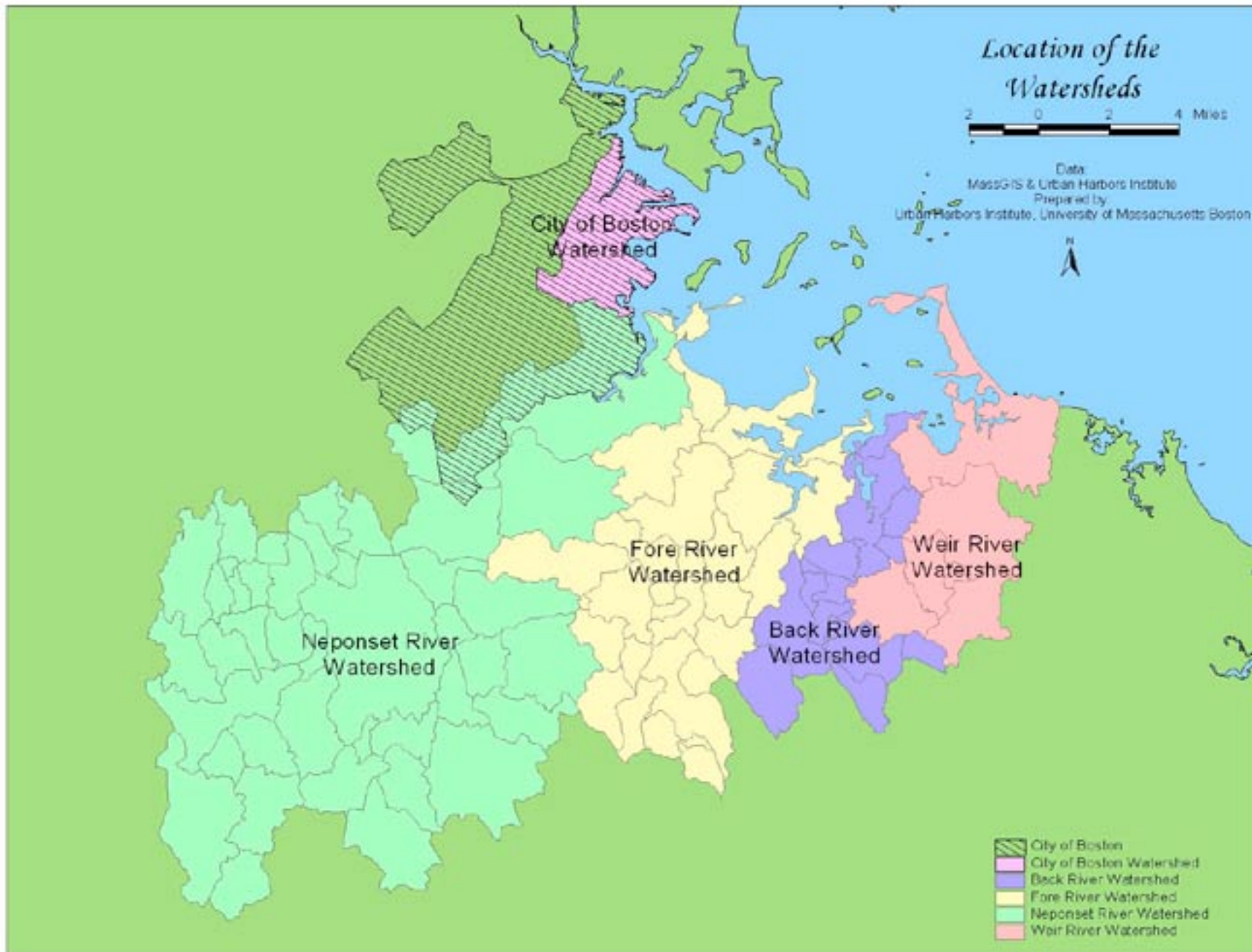
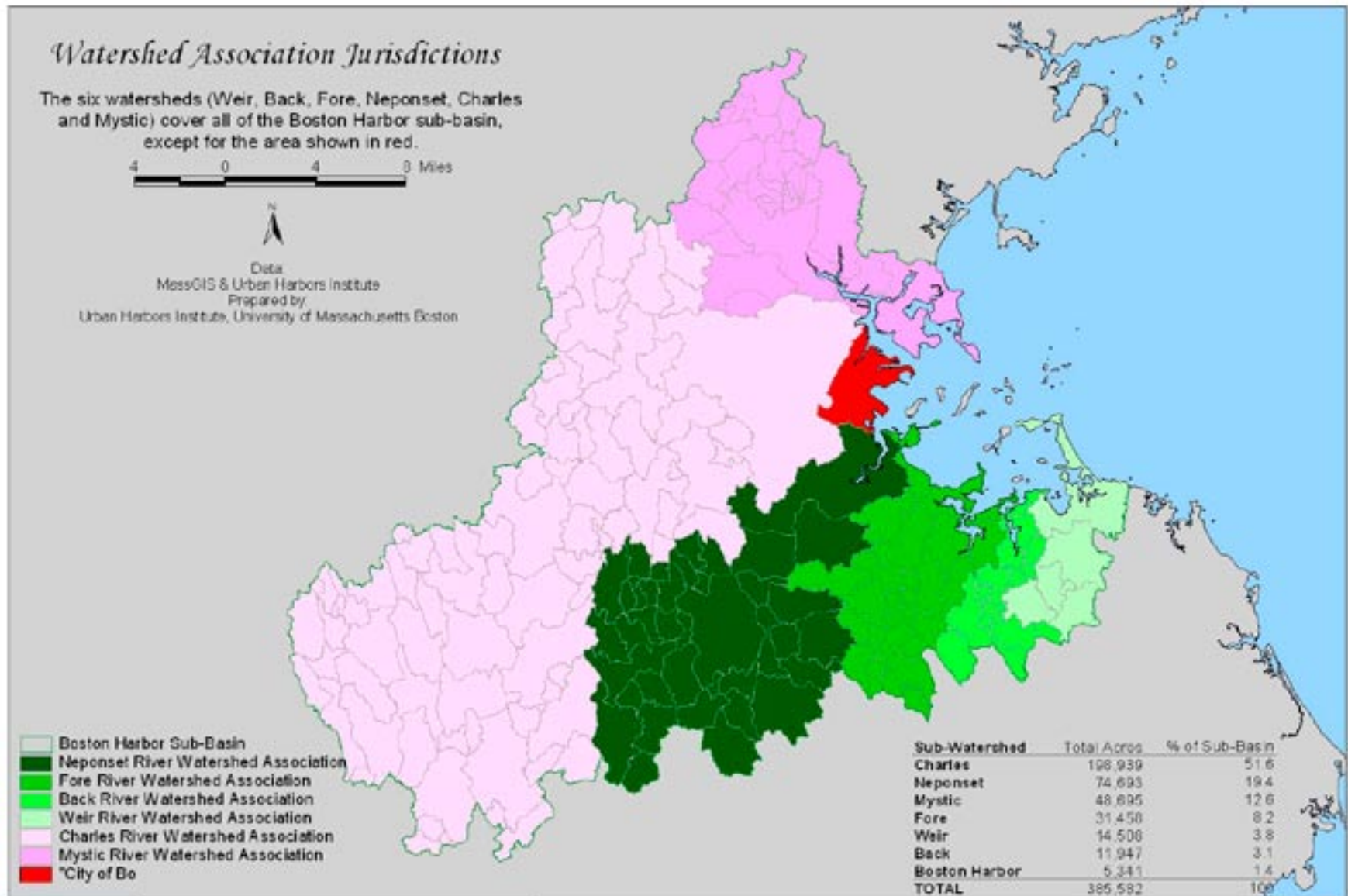


Figure 2: Watershed Association Jurisdictions:



problems in streams become problems when stream water enters more phosphorus-sensitive ponds. Similarly, nitrogen levels in a river may not pose a problem until they reach a more nitrogen sensitive estuary. As a result, “acceptable” nutrient levels for a stream may be a function of more sensitive systems located downstream. In the watersheds covered in these Assessments, freshwater ponds are generally the limiting criteria for phosphorous. Estuaries are generally the limiting criteria for nitrogen levels in the river.

The complexity of determining acceptable nutrient levels is further complicated by the fact that the Massachusetts Surface Water Quality

Standards (314 CMR 4.05(5)) do not include specific numeric thresholds for nutrient levels, but rather contain requirements such as the following:

“All surface waters should be free from pollutants in concentrations or combinations that ... produce undesirable or nuisance species of vegetation ... interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms... (or) exceed the site-specific limits necessary to control accelerated or cultural eutrophication.”

Figure 3:

Inner Boston Harbor: 1999 DEP Assessment

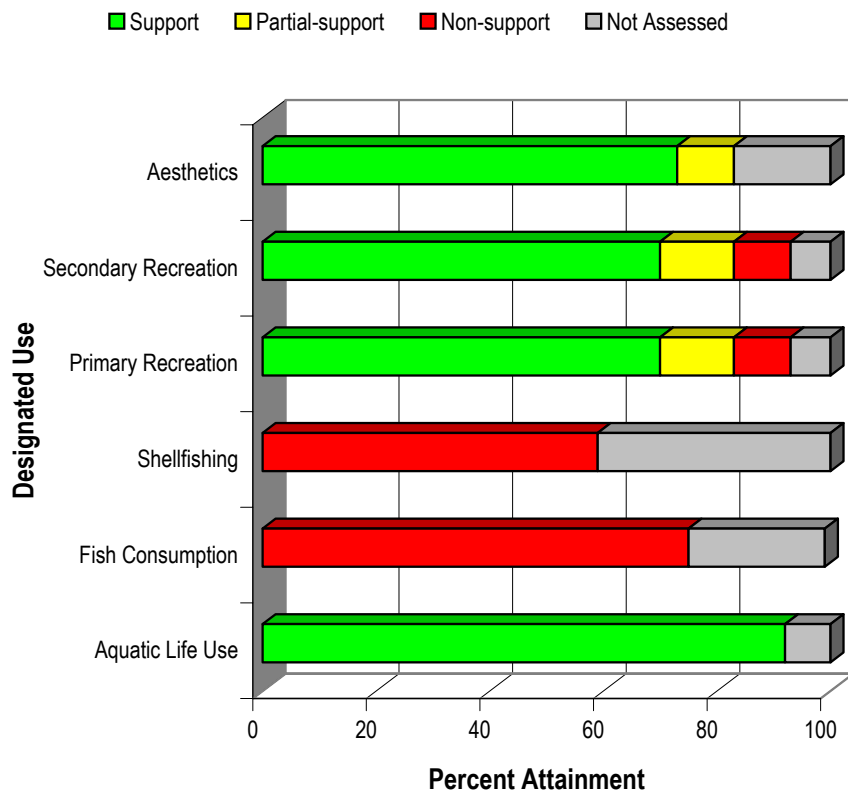
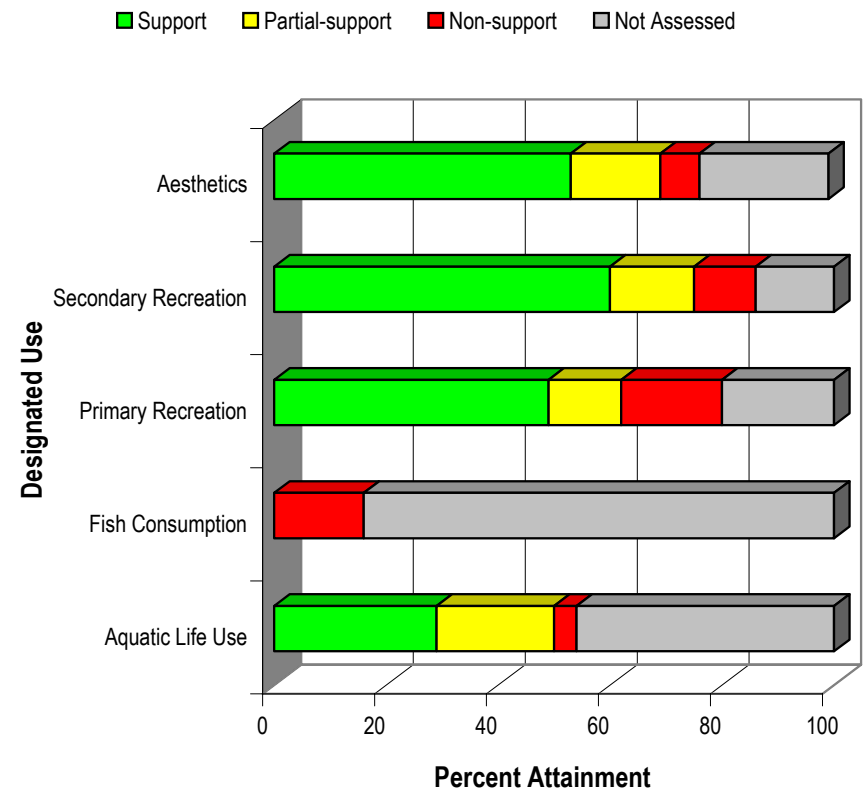


Figure 4:

Neponset Watershed: 1999 DEP Assessment of Rivers and Streams



DEP is in the process of developing a system of numeric nutrient thresholds that will be incorporated into future editions of the Surface Water Quality Standards.

Do dissolved oxygen levels support aquatic life?

No. Low DO levels are a problem in each of the watersheds covered in this Report, to greater or lesser degree. Dissolved oxygen, the amount of

oxygen available in the water, is critical for the survival of aquatic life. Under the Massachusetts Surface Water Quality Standards, a minimum DO level of 6.0mg/l is required for drinking water sources and for cold water fisheries. A minimum DO of 5.0 mg/l is required for warm water fisheries and for the tidal waters in the Boston Harbor Watershed. Inadequate DO levels, even for very short periods of time, cause aquatic life to suffocate, and can result in dramatic events such as fish kills. Even when oxygen levels are not low enough to cause acute fish kills, moderate reductions in oxygen levels can lead to the elimination of certain sensitive, native species such as trout, and an overall shift in

Figure 5:

Neponset Watershed: 1999 DEP Assessment of Lakes and Ponds

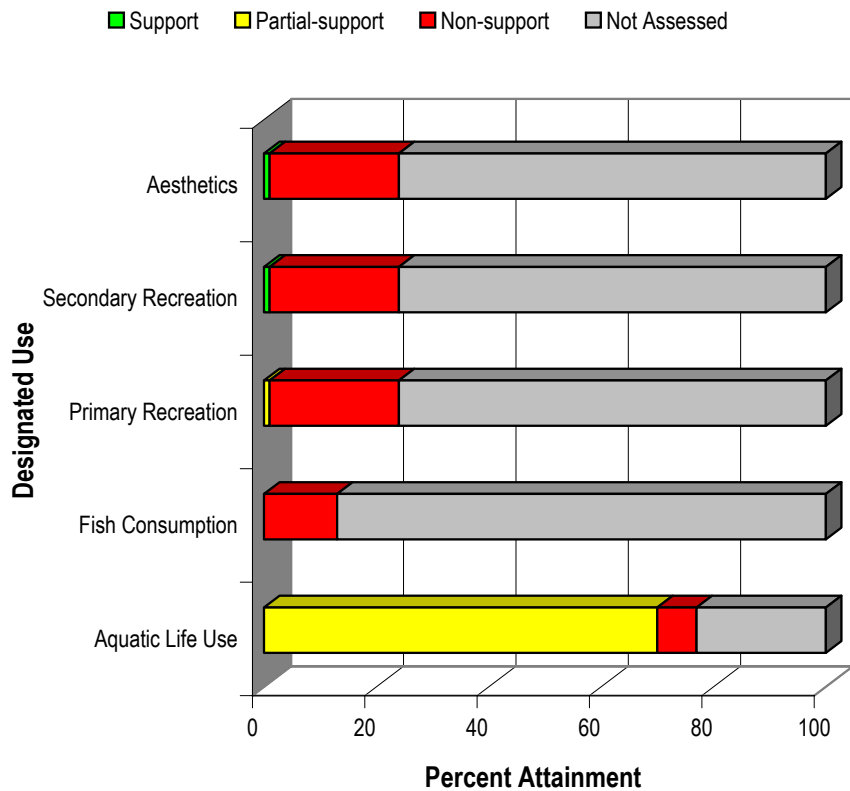
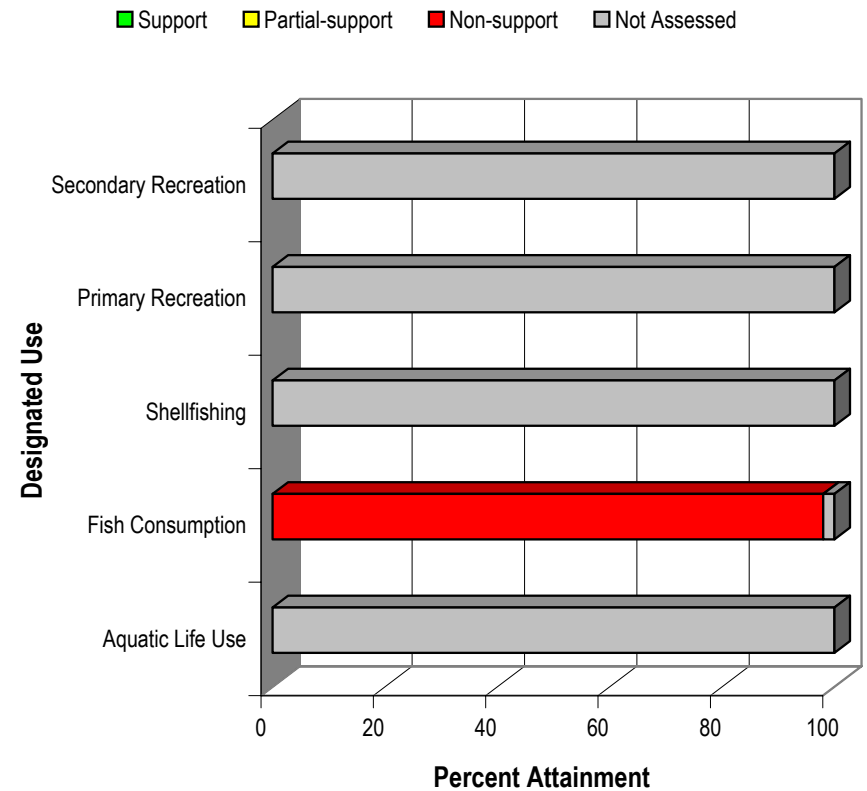


Figure 6:

Neponset Watershed: 1999 DEP Assessment of Estuary



aquatic life populations toward less sensitive species such as “pond” fish.

Low DO levels can be caused by nutrient enrichment (see discussion above), which leads to excessive algae growth and decay that consumes oxygen in the water. DO levels are also closely tied to water temperatures and instream flow levels. DO levels drop when temperatures rise, and streams and ponds become stagnant due to low flow or excessive numbers of artificial impoundments (see further discussion of these issues below.)

Are there other water quality problems?

Yes. The Massachusetts Department of Public Health has issued a statewide health advisory limiting consumption of fish for children and childbearing-age women due to possible contaminants such as mercury and PCBs in edible fish tissue. All waters covered by this Report are either non-supportive of fish consumption or are unassessed. The same is true for state “Open Shellfish Areas” in Boston Harbor, except for a tiny fraction (well under 1%) of shellfish beds. In addition, each of the watersheds discussed has problems with aesthetically objectionable

Figure 7:
Fore, Back & Weir Watersheds: 1999 DEP Assessment of Rivers and Streams

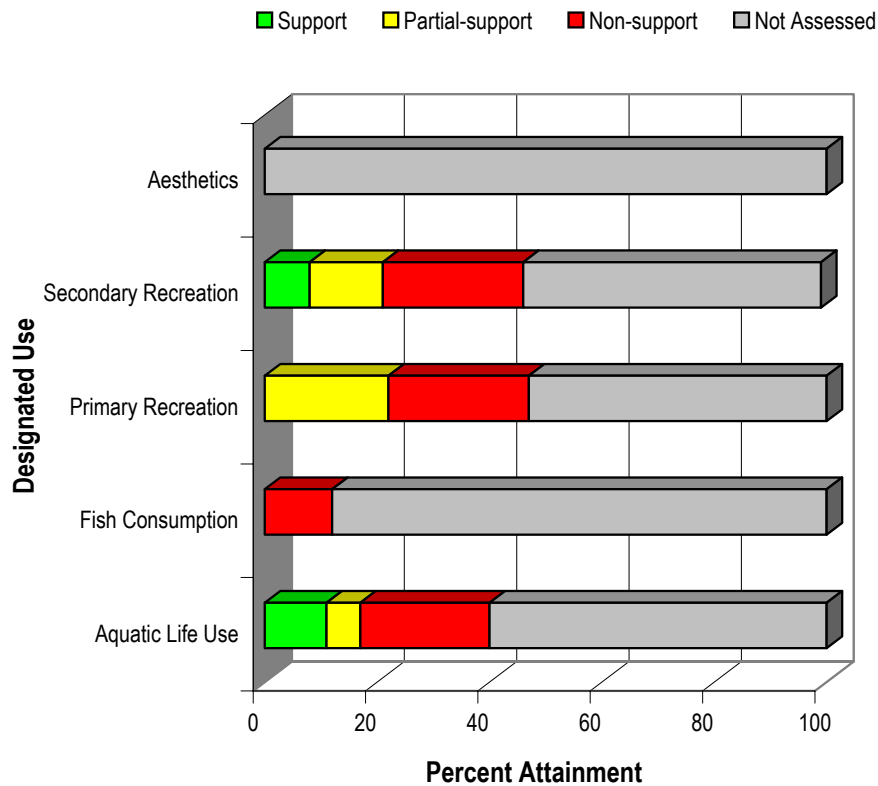
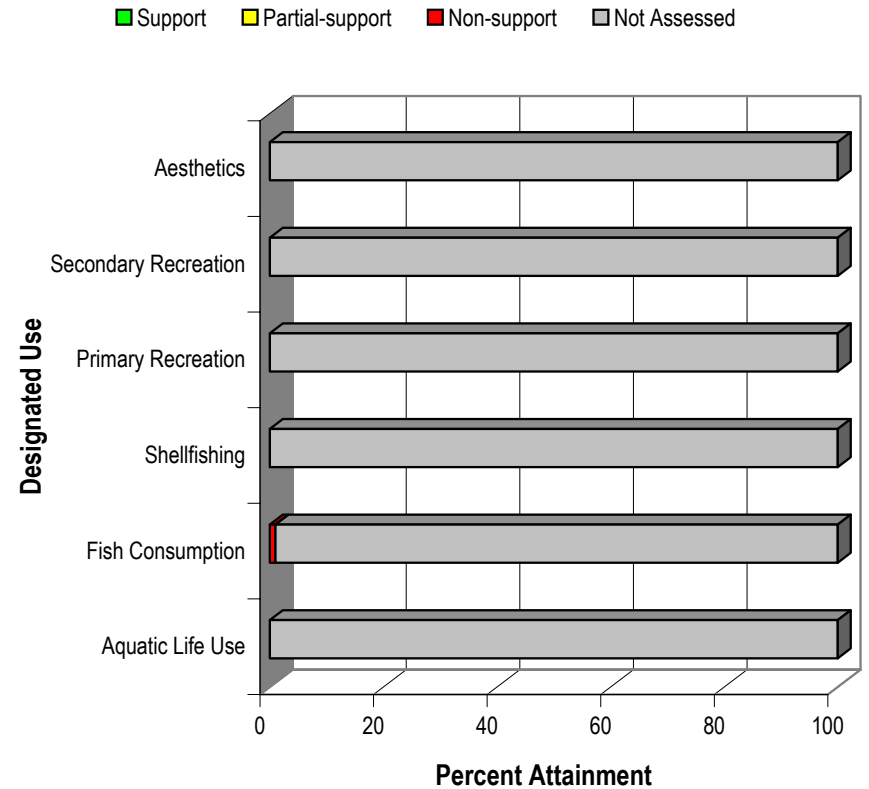


Figure 8:
Fore, Back & Weir Watersheds: 1999 DEP Assessment of Lakes and Ponds



pollution such as debris, scum, odor, color, taste, turbidity, and nuisance species of aquatic life.

Do water supply or wastewater management impact instream flows?

Yes. The negative impacts of reduced instream flow include curtailment of recreational activities, increased temperature and decreased oxygen, increased concentration of bacterial and nutrient pollutants, increased risk of human exposure to contaminated river-bottom sediments, and a

substantial reduction in the area and quality of aquatic habitats, including resident and anadromous fisheries. All of the watersheds covered in this Report are affected, to a greater or lesser degree, by instream flow reduction.

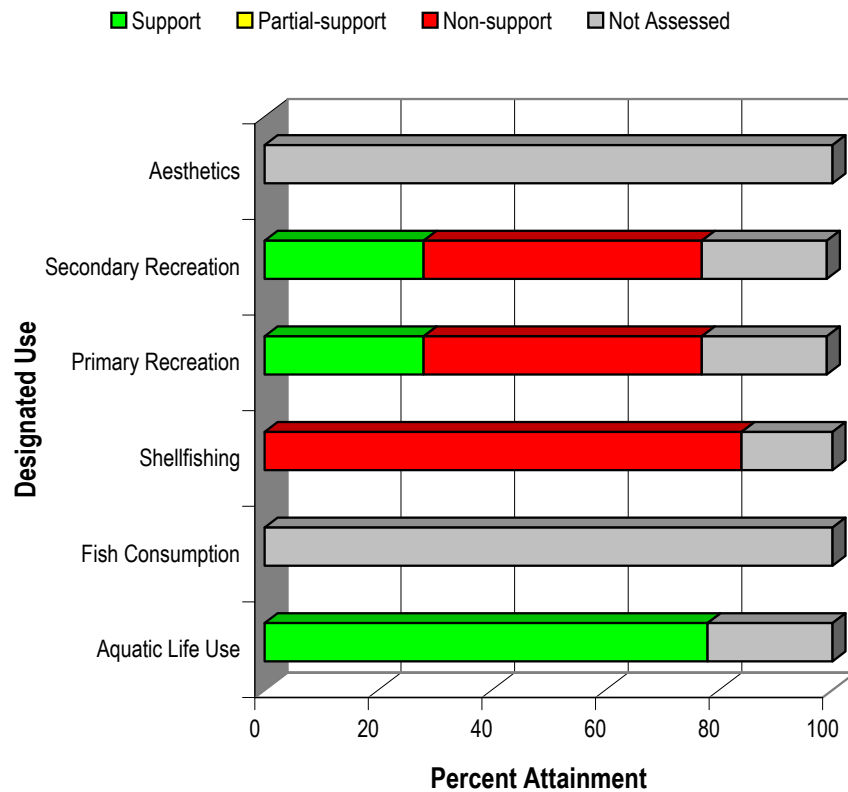
Each watershed gets at least a portion of its water supply from groundwater taken from the watershed. Only a small portion of the water pumped is returned to the watershed as septic system effluent. The majority is transferred out of basin (so-called interbasin transfer) by water supply and wastewater infrastructure. Mechanisms through which water is lost include: water supplied to homes and businesses located across watershed boundaries; wastewater transferred out of the watershed by regional sewer systems (e.g., the MWRA); water transferred to the atmosphere after being used to irrigate landscapes. Water losses are further exacerbated by aging sewer infrastructure, which allows groundwater to leak into deteriorated sewer lines (so called infiltration and inflow) where it is transferred outside of the watershed. For example, only 21% of the wastewater discharged by households in the Neponset watershed is returned to the Neponset watershed via recharge; only 27% is returned to the Weir River Watershed (see individual watershed assessments).

This recharge of treated wastewater has been decreasing for the past several decades as sewer lines are extended to service both new development and existing development formerly serviced by septic systems; as municipalities seek to develop new water supply sources within their watersheds to meet the demands of a growing population and, in some cases where population is not growing, to meet increased per-capita demands for seasonal landscape irrigation water; and as some municipalities develop watershed supply sources as a substitute for imported MWRA water, whose cost is rising as the MWRA implements capital improvements to come into compliance with the Federal Safe Drinking Water Act.

Another important factor is that water withdrawals for public water supply are considerably greater in summer (May to September) than in winter (October to April). Almost all of the increased summer water use is due to watering of lawns, gardens, golf courses, etc. Combined with higher ambient evaporation in the summer months, these additional seasonal water withdrawals greatly exacerbate seasonal low

Figure 9:

Fore, Back & Weir Watersheds: 1999 DEP Assessment of Estuaries



streamflows. This problem is being exacerbated as affluent homeowners install private irrigation wells in an effort to avoid compliance with the increasingly frequent application of outdoor water use restrictions on publicly supplied water.

A significantly smaller, but still notable influence on instream flows is the existence and operation of dams and impoundments in the watersheds. Most of these impoundments were created by historic industries as a means to harness waterpower, and have relatively little storage capacity. However, through the 1950's and 1960's the larger impoundments were actively managed by the larger industries to ensure adequate flows for mill operations throughout the summer. Most of these water dependent industries are now gone, as is their former, well-coordinated regulation of water releases, and with it, one means of moderating the impact of seasonal low flows. In the absence of good coordination, impoundments now adversely affect water levels more often than ameliorating them.

Roughly what percentage of the watersheds is impervious?

Though varying greatly from town to town (and even within town borders), impervious surfaces cover 23.5% of the total acreage in the Neponset River Watershed; 19.9% in the Weir River Watershed; 28.9% in the Fore River Watershed; 22.5% in the Back River Watershed, and 47.7% in Boston (see individual watershed assessments).

Impervious surfaces include streets, parking lots, and buildings. Rainwater flows over such surfaces, collects pollutants and debris, and deposits them directly, or via storm sewers, into local waterways. Impervious surfaces are associated with a host of hydrologic and pollution related impacts, such as streambank erosion, poor water quality, decreased recharge, and decreased biodiversity within aquatic ecosystems. By inhibiting the natural process of groundwater recharge and exacerbating flooding problems, impervious surfaces have an even greater impact on watershed hydrology than water supply and wastewater management activities. The impact varies directly with the percentage of impervious surfaces found in the watershed.

In Massachusetts as a whole, "urban runoff and storm water are responsible for 46% of assessed river segments not supporting their

designated uses and 48% of assessed marine waters not supporting theirs" (MA DEP, "Stormwater Management Volume 1: Stormwater Policy Handbook", 1997).

Are there current or expected water supply shortages?

Yes, if current water use and development practices continue. Every watershed covered by this report has experienced water supply shortages. (See discussion under "Do water supply or wastewater management impact instream flows?", above.) Based on MA EOE's "Buildout" analysis, water supply demand will increase significantly in many municipalities if and when buildout levels of development occur (see individual watershed assessments).

Are the watersheds considered hydrologically stressed based on the WRC definition?

The Massachusetts Water Resources Commission (WRC) has recently classified the state's waterways in terms of their degree of hydrologic stress. The Weir, Fore and Back River Watersheds are unassessed, as is a majority of the Neponset River Watershed. The "upper" Neponset mainstem (essentially from Hawes Brook and upstream) is rated by the WRC as being "moderately stressed," while the East Branch of the Neponset is listed as "low stress." The DEP has recently announced a new set of performance standards for water suppliers regulated under the Water Management Act, which imposes increasingly stringent water conservation measures on water suppliers drawing from highly stressed watersheds.

The WRC classification is based on a simple analysis of historic stream gauge data and classifies streams as "low stress" if their flow level is higher than that of 75% of the streams in the state, as "high stress" if their flow level is lower than 75% of the streams in the state, and as "moderately stressed" if they fall in between. While the WRC classification is an invaluable screening tool, it is not a substitute for on the ground assessments of actual conditions and biota. Other assessments conducted in the Neponset Watershed suggest that the entire Neponset Watershed should be classified as "highly stressed." More

data are needed to assess the other watersheds.

What habitats are present in the watersheds?

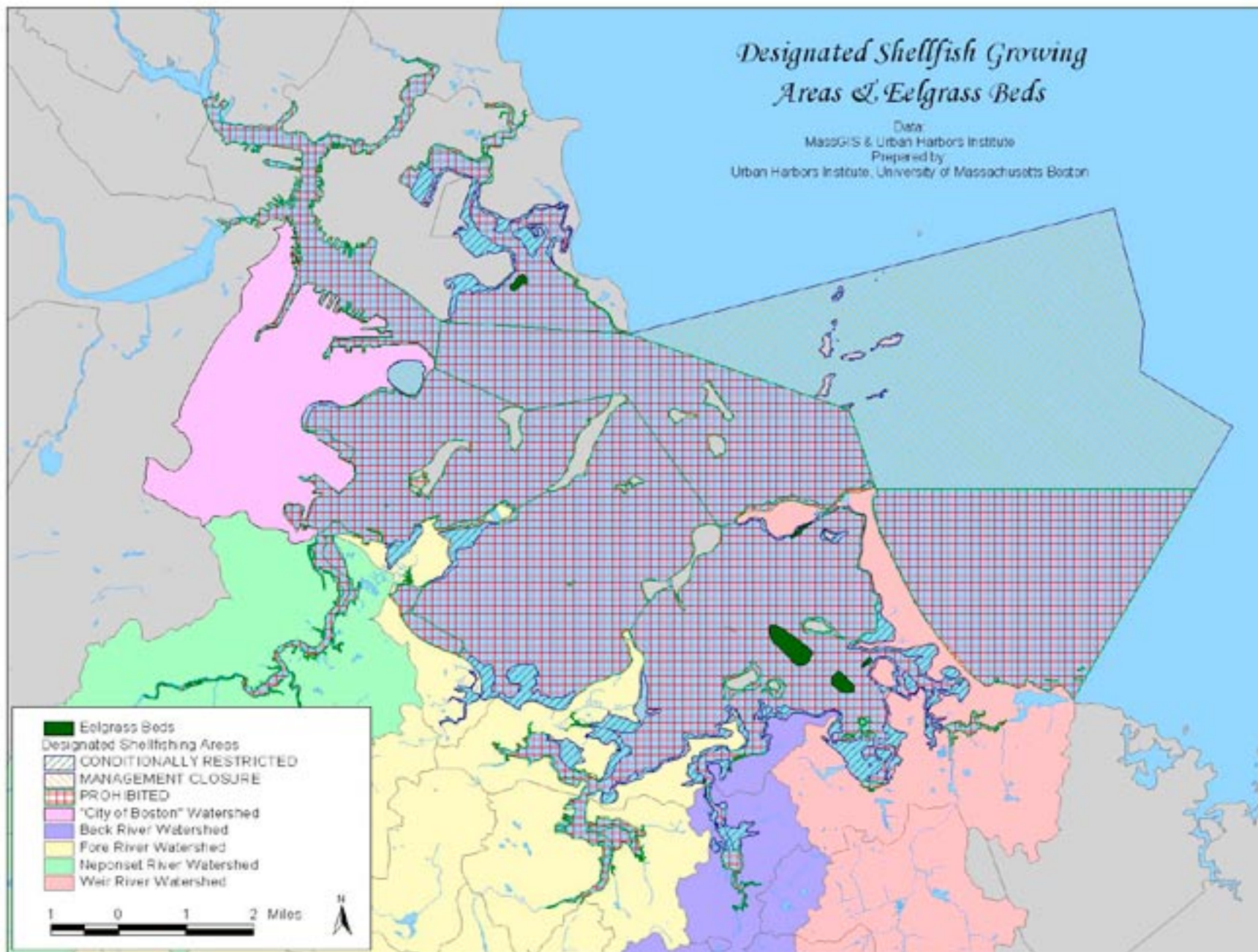
Each individual watershed's assessment contains the following maps :

- The Massachusetts Natural Heritage and Endangered Species Program (hereinafter, "NHESP") Biomap Core Habitats & Supporting Natural Landscapes. The maps show areas that, if protected, would provide suitable habitat over the long term for the maximum number of Massachusetts' terrestrial and wetland plant and animal species and natural communities. The BioMap focuses primarily on state-listed rare species and exemplary natural communities, but also includes the full breadth of the state's biological diversity.
- NHESP Living Waters Core Habitats & Critical Supporting Watersheds. These Core Habitats identify the most critical sites for freshwater biodiversity in the Commonwealth where the state government believes we should focus proactive conservation activities. NHESP based these sites on 58 species of rare fish, aquatic vascular plants, freshwater mussels, crayfish, snails, and other aquatic invertebrates. Changes in water flow and degradations in water quality threaten these and other freshwater species.
- Estimated Wetland Habitats of Rare Wildlife. The maps cover estimated habitats of state protected rare animal (but not plant) species that are given extra protection if they fall within the jurisdiction of the MA Wetlands Protection Act (generally, all open waters, marshes, bogs, and their 100 year floodplains plus a 50 to 200 foot corridor along perennial streams).
- Priority Habitats for State-Protected Species. These maps cover all priority habitats for state protected rare plant and animal species, not just those subject to the protection of the MA Wetlands Protection Act.
- NHESP Certified and Potential Vernal Pools. Vernal pools are unique wildlife habitats best known for the amphibians that use them to breed. Vernal pools typically fill with water in

the autumn or winter due to rising ground water and rainfall, then dry out completely by the middle or end of summer each year, or at least every few years. Occasional drying prevents fish from establishing permanent populations. Many amphibian and invertebrate species rely on breeding habitat that is free of fish predators. Some vernal pools (limited mostly to those within the 100-year floodplain of perennial rivers and streams) are protected in Massachusetts under the state Wetlands Protection Act. The NHESP serves the important role of officially "certifying" vernal pools that are documented by citizens. The maps show both "certified" and "potential" vernal pool locations (not necessary in protected wetland resource areas).

- Areas of Critical Environmental Concern. ACECs are places in Massachusetts that receive special recognition because of their quality and uniqueness as well as the significance of their natural and cultural resources. These areas are identified and nominated at the community level and are reviewed and designated by the state's Secretary of Environmental Affairs. ACEC designation creates a framework for local and regional stewardship of critical resources and ecosystems.
- Physical Extent of Wetland Resource Areas. The map includes coastal and vegetated wetland resource areas plus the 100-year floodplain (land subject to flooding) and riparian corridors (which roughly correspond to the riverfront resource area), as estimated from aerial photos.
- Coastal and Vegetated Wetlands. These resource areas are given the highest level of protection under the Massachusetts Wetlands Protection Act Regulations.
- Outstanding Resource Waters. These areas are given extra protection in the state Water Quality Certification process (required whenever a federal wetlands permit is mandated).
- Anadromous Fish Runs. The maps indicate historic locations where saltwater fish spawned in fresh waters.

Figure 10: Shellfish Areas and Eelgrass Beds



Are invasive species a threat to habitats?

Yes. Invasive species are common in these watersheds and have significant adverse impacts on fish and wildlife habitat and recreational activities. Throughout the watersheds, the greatest concern is purple loosestrife (*Lithrum salicaria*). Of greatest concern in salt marshes is *Phragmites australis*.

What are current land use trends?

Commercial/industrial and residential land uses cover the following percentages of total land area in each watershed: Maps on land uses and types of development are included in the Assessments of each watershed. The primary land use trend in the study area is the conversion of open space into residential uses.

Table 1: Summary of Developed Land Uses by Watershed

Watershed	Commercial/ Industrial	Residential All	Residential > ½ acre lots
Neponset	6.9%	39.4%	30%
Fore	10.3%	41.7%	3%
Back	7.7%	36.3%	6%
Weir	3.2%	37.9%	37%
Boston	29.8%	34.1%	0

Are existing open spaces sufficient?

As indicated in the individual watershed assessments, the answer is clearly no. Maps included in the Assessments of each watershed show contiguous natural lands, natural land riparian corridors, and other (presumably not natural land) riparian corridors. Other maps show “protected and recreational open space”; these maps, however, show both privately and publicly owned open space and the extent to which these areas can be said to be “protected” open space is unknown.

Table 2: MassGIS Datalayer Descriptions

**Description of Datalayers used for Maps in the 2004 Boston Harbor Watershed Assessment and Action Plan
Derived from MA Geographic Information System (GIS) unless otherwise noted]**

THEME	YEAR	DESCRIPTION
Anadromous Fish	1997	Should not be considered definitive in determining the presence or absence of fish runs, spawning habitat, barriers or fishways; appropriate use is for education and regional planning. Biologists from Department of Fisheries, Wildlife & Environmental Law Enforcement (DFWELE), MA Division of Marine Fisheries & MA Division of Fisheries and Wildlife compiled point coverage of anadromous fish data. These data include fish runs, spawning habitat, barriers or fishways.
Areas of Critical Environmental Concern	Various updated 2002	Areas of Critical Environmental Concern (ACECs) are places in Massachusetts that receive special recognition because of the quality, uniqueness and significance of their natural and cultural resources. These areas are identified and nominated at the community level and are reviewed and designated by the state's Secretary of Environmental Affairs. ACEC designation creates a framework for local and regional stewardship of these critical resource areas and ecosystems. ACEC designation also requires greater environmental review of certain kinds of proposed development under state jurisdiction within the ACEC boundaries.
DEP Tier Classified Oil or Hazardous Materials Sites (M.G.L. c. 21E)	2004	Statewide point dataset containing the approximate location of oil or hazardous material disposal sites that have been (1) reported and (2) Tier Classified under M.G.L. Chapter 21E and the Massachusetts Contingency Plan (MCP). TIER IA: Tier IA sites require a permit and any person undertaking response actions must do so under direct Departmental supervision TIER IB: These sites also require a permit but any person undertaking response actions may do so without the Department's approval after a Tier I Permit is issued. TIER IC: In addition, any release/site receiving a total NRS score of less than 350 and that meets any of the Tier I Inclusionary TIER II: Permits are not required at Tier 2 sites and response action may be performed under the supervision of a Licensed Site Professional, without prior Departmental approval. TIER ID: (Previously Default Tier 1B) A site where the responsible party fails to provide a required submittal to DEP by a specified deadline.
Coastal and Vegetative Wetlands	2004	Shows resource areas given the highest degree of protection under the MA Wetlands Protection Act Regulations, including swamps, beaches, dunes etc. The wetlands are interpreted from 1:12,000 scale, stereo color-infrared photography (CIR) by staff at UMASS Amherst. The interpretation is field checked by Department of Environmental Protection (DEP) Wetlands Conservancy Program (WCP).
Approximate Extent of DEP Wetland Resource Areas		Derived from the MRIP Riparian Corridors theme (see below) and the FEMA 100-year Flood Zone (see below), showing the approximate extent of the areas covered by the MA Wetlands Protection Act. Riparian Corridors on the map approximately coincide with the Riverfront Area; virtually all other wetland resource areas lie within the FEMA 100-year Flood Zone.

Table 2: MassGIS Datalayer Descriptions, Continued

THEME	YEAR	DESCRIPTION	
Designated Shellfish Growing Areas	2000	<p>APPROVED - open for harvest of shellfish for direct human consumption</p> <p>CONDITIONALLY APPROVED - While approved, open for harvest of shellfish for direct human consumption</p> <p>CONDITIONALLY RESTRICTED - While restricted, only open for the harvest of shellfish with depuration</p> <p>RESTRICTED - Open for harvest of shellfish with depuration</p> <p>MANAGEMENT CLOSURE - Closed. Not enough testing has been done in the area to determine whether it is fit for shellfish harvestor not</p> <p>PROHIBITED - Closed for harvest of shellfish</p> <p>Compiled by the MA Division of Marine Fisheries (DMF).</p>	
Development	1990	See LAND USE. From the MA C3GIS Land Use data layer, only those classification considered as "Development" were selected.	
Eelgrass Beds		The Mass. Department of Environmental Protection (DEP) Wetlands Conservancy Program (WCP) has developed and completed a project to map the SRV resources of the entire Massachusetts' coastline.	
FEMA 100-year Flood Zones		These data represent a subset of the data available on the paper Flood Insurance Rate Maps (FIRM) as provided by the Federal Emergency Management Agency (FEMA).	
Hydrological Features	2003	Datalayer represents hydrographic (water-related) features, including surface water (lakes, ponds, reservoirs), wetlands, bogs, flats, rivers, streams, and others.	
Officially Impaired Waters	Developed 2004 using data from 1999	<p>UHI used the Boston Harbor 1999 Water Quality Assessment Report to reclassify the MassGIS Hydrological features as:</p> <ol style="list-style-type: none"> 1) Unimpaired for all designated uses; 2) Unimpaired for some uses and not assessed for others; 3) Insufficient information to make assessments for any uses; 4) Impaired for one or more uses but not needing a TMDL; and 5) Impaired for one or more uses and requiring a TMDL. 	
Land Use	1990	37 classes - based on Umass Amherst photointerpretation.	
MRIP Contiguous Natural Lands	1999	Natural lands with area of 250 acres or greater.	Massachusetts Resource Identification Project
MRIP Riparian Corridors	1999	Riparian Corridors are defined as 100 meter corridors encompassing perennial stream and river features. 100 meters corresponds to conservation restrictions.	
MRIP Natural Land Riparian Corridors	1999	Areas within the riparian corridor that remain in a "natural state".	
NHESP BioMap Core Habitats	Updated 2002	The most viable habitat for rare species and natural communities in Massachusetts.	Natural Heritage and Endangered Species Program, part of MA Division of Fish & Wildlife
NHESP BioMap Supporting Natural Landscapes	Updated 2002	Represents buffers and connections between Core Habitat.	
NHESP Living Waters Core Habitats	2003	Lakes, ponds, rivers, and streams that are important for the protection of freshwater biodiversity in Massachusetts.	
NHESP Living Waters Supporting Natural Landscapes	2003	Areas with the highest potential to sustain Core Habitats.	

Table 2: MassGIS Datalayer Descriptions, Continued

THEME	YEAR	DESCRIPTION
NHESP Priority Habitats for Rare Species	2003	Represent estimations of important state-listed rare species habitats in Massachusetts.
NHESP Estimated Habitats for Rare Wildlife	2003	Estimations of the habitats of state-protected rare wildlife populations that occur in Resource Areas (as defined in the Wetlands Protection Act Regulations).
NHESP Vernal Pools - Certified	2002	All vernal pools that have been certified by NHESP. Vernal pools are small, shallow ponds characterized by lack of fish and by periods of dryness. Vernal pool habitat is extremely important to a variety of wildlife species including some amphibians that breed exclusively in vernal pools, and other organisms such as fairy shrimp, which spend their entire life cycles confined to vernal pool habitat. Many additional wildlife species utilize vernal pools for breeding, feeding and other important functions. Certified vernal pools are protected if they fall under the jurisdiction of the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00). Certified vernal pools are also afforded protection under the state Water Quality Certification regulations (401 Program), the state Title 5 regulations, and the Forest Cutting Practices Act regulations.
NHESP Vernal Pools - Potential	1993 & 2000	Unverified, potential vernal pools.
1:5,000 Color Ortho Images	2001	Medium resolution true color images.
Outstanding Resource Waters	Various	Delineates those watershed areas in which some resources may be afforded Outstanding Resource Waters classification under the Massachusetts Surface Water Quality Standards of 1995. These waters constitute an outstanding resource as determined by their outstanding socioeconomic, recreational, ecological and/or aesthetic values. The quality of these waters shall be protected and maintained.
Percent Impervious Surface	1990	% impervious was calculated for each land use type using the mean percentages derived from work by the Massachusetts Office of Coastal Zone Management.
Protected & Recreational Open Space	Original 1988 Updated but changes occur frequently.	Contains the boundaries of conservation lands <i>and</i> outdoor recreational facilities in Massachusetts. Although the initial data collection effort for this data layer has been completed, open space changes continually and this data layer is therefore considered to be under development. Additionally, due to the collaborative nature of this data collection effort, the accuracy and completeness of open space data varies across the state's municipalities.
USGS Topographic Quadrangle Images	Various 1977-1985	MassGIS scanned the USGS 7.5 minute series topographic quadrangles to create a digital database that can provide images of the paper maps.

Figure 11: Boston Watershed Orthophoto



Boston Inner Harbor Watershed

Introduction

The portion of the City of Boston covered in this Assessment is located at the center of the Boston Harbor Watershed and includes those portions of the city south of the Charles River Dam that border or discharge their wastewater directly to the Harbor. This 5,267-acre area includes Boston’s downtown waterfront, the Inner Harbor, Fort Point Channel, South Boston waterfront, Reserved Channel, Pleasure Bay and Dorchester Bay.

Historical damming and filling have shaped the City of Boston’s waterfront, essentially transforming the Inner Harbor from an estuarine, salt marsh environment into an artificial embayment. This portion of Boston includes a mix of commercial, residential, maritime, industrial, transportation and other uses. There are also several swimming beaches along the South Boston and Dorchester waterfront owned and operated by the Department of Conservation and Recreation and the City of Boston.

The environmental health of the Inner Harbor is affected not only by those portions of the City of Boston covered in this Assessment, as discussed below, but also by pollutant loadings from the Charles River, the Mystic River, Chelsea Creek, East Boston waterfront and the Neponset, Weir, North and Fore Rivers.

Does pollution limit the use and enjoyment of water resources?

Yes. Pollutants such as bacteria, nutrients, floating debris, and industrial byproducts limit the use and enjoyment of water resources within the Inner Harbor. Because of limited flushing and significant pollutant loadings, the Inner Harbor is often the most heavily impacted area

within the Boston Harbor Watershed. The relatively narrow and deep Inner Harbor is more poorly flushed than the outer harbor, with 90% of water remaining after seven tidal cycles or three and a half days. At the same time, the Inner Harbor drains the most highly urbanized and industrialized portion of the Watershed.

Does bacterial pollution limit fishing or recreation?

Yes. Pollution from bacteria has limited shellfishing and recreational uses within Boston’s Inner Harbor. According to the Massachusetts Surface Water Quality Standards, the Boston Inner Harbor is classified

Figure 12: Historic MWRA Discharges to Inner Harbor

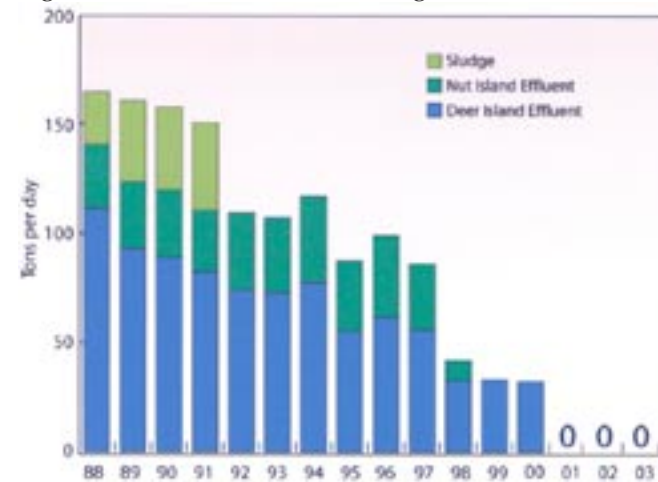
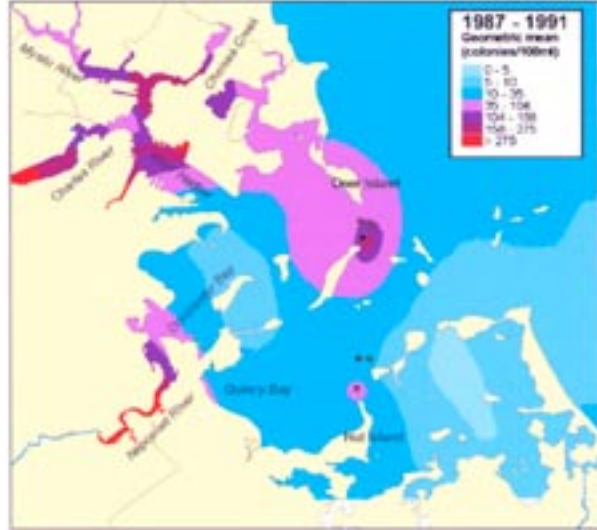


Figure 13: Boston Watershed Topographic Map



Figure 14: Boston Harbor Enterococcus, During Wet Weather (MWRA) <35 meets EPA swimming standards.



as an SBCSO water body. This classification reflects the fact that Combined Sewer Overflows (CSOs) operated by the Massachusetts Water Resources Authority and the Boston Water and Sewer Commission are authorized to discharge into the Harbor.

Water quality in Boston Harbor has significantly improved as a result of the Massachusetts Water Resources Authority’s (MWRA) Boston Harbor Project and the Boston Water and Sewer Commission’s (BWSC) ongoing efforts to address stormwater pollution. In 1988, the MWRA discharged approximately 160 tons of sludge and effluent to Boston Harbor each day. With completion of the upgraded wastewater treatment plant at Deer Island and construction of a 9 1/2-mile long outfall pipe, the MWRA’s discharges of solids to the Inner Harbor were eliminated in 2001, as illustrated in Figure 14.

As shown in Figure 14, water quality in Boston Harbor was degraded before the Boston Harbor Project and CSO improvement projects began, and prior to the 1991 end of sludge discharges to Boston Harbor. In comparison, the figure shows that average bacterial counts for Enterococcus in Boston Harbor between 1999 and 2003 met the state water quality standards for swimming in most locations. Enterococcus is the sewage indicator bacteria recommended by the U.S. Environmental Protection Agency for monitoring marine waters. Water quality improvements in recent years are due to completion of the Deer Island treatment facility, cessation of sludge dumping into the Harbor, removal of effluent discharges from the Harbor (redirected into Massachusetts Bay via the new outfall), closure of 22 combined sewer overflows, minimization of CSO discharges at remaining outfalls and improved treatment at CSO facilities, and local efforts to abate stormwater pollution.

Combined Sewer Overflows

Combined Sewer Overflows continue to contribute bacteria to Boston Harbor following major rainstorms. Between 1987 and 1997, CSOs to Boston Harbor decreased from 3.3 billion gallons annually to one billion gallons annually. As detailed in the remainder of this section, implementation of the MWRA’s Final CSO Plan includes several projects that will further reduce bacterial pollution from CSOs currently discharging to the Inner Harbor.

Union Park/Detention/Treatment Facility

The Union Park Detention/Treatment Facility will improve water quality in the Fort Point Channel by providing treatment of CSO flows that are discharged through BWSC's Union Park Pumping Station. The existing pumping station, constructed in 1976, provides flood control for the South End neighborhood of Boston. The new facility will treat 88% of the CSO flow that is discharged to the Fort Point Channel in a typical year.

The approved plan calls for adding finer screens, chlorination with sodium hypochlorite, dechlorination with sodium bisulfite and underground storage tanks with a capacity of 2.2 million gallons. The storage tanks are designed to reduce the average annual number of pumping station CSO discharges to the Fort Point Channel (from 25 to 17 per year), to detain flows that exceed the storage capacity in larger storms, and to allow a level of solids removal. Construction is expected to be complete by January 2006. Sewer system improvements planned by the Boston Water and Sewer Commission in the South End neighborhood will further reduce overflows to the pump station and Fort Point Channel. Sewer separation in other areas tributary to Fort Point Channel will also reduce CSO discharges to this receiving water.

North Dorchester Bay and Reserved Channel

In April 2004, the MWRA Board of Directors voted to approve a recommended plan for CSO control for North Dorchester Bay and the Reserved Channel. The recommended plan includes the following components:

- 17-foot diameter, 2.1 mile storage tunnel mined beneath Day Boulevard with a pump station at Conley Terminal and odor control facility behind the State Police building near outfall BOS087.
- Gates at outfalls BOS081 through BOS086 to allow the tunnel to collect separate stormwater in most storms.
- A 12x12-foot storm drain along Morrissey Boulevard to divert stormwater in large storms from BOS087 to Patten's Cove in South Dorchester Bay. During most rainstorms, stormwater will be diverted to the Deer Island treatment plant to reduce pollution at swimming beaches.
- Relocation of separate stormwater from Pleasure Bay to the

Reserved Channel through outfall BOS080.

- Sewer separation of a 355-acre area north of East Fourth Street that is tributary to the four Reserved Channel CSO outfalls.

The recommended plan will provide a 25-year level of CSO control and 5-year level of separate stormwater control for North Dorchester Bay, eliminate stormwater discharges to Pleasure Bay, and reduce CSO discharges to the Reserved Channel from 37 to 3 times in a typical year. The redirection of some separate stormwater flows to South Dorchester Bay will add about 15% additional stormwater flow to the Bay in a typical year compared to the volumes entering South Dorchester Bay through existing stormwater outfalls and through outfalls BOS088, BOS089 and BOS090, which are being converted to storm drains with the sewer separation work underway by MWRA and BWSC in South Dorchester Bay.

South Dorchester Bay Sewer Separation Project

The Boston Water and Sewer Commission is implementing this project to eliminate CSO discharges to South Dorchester Bay by separating combined sewer systems in Dorchester. The separation work primarily involves construction of new storm drains, relocation of storm runoff connections from the existing combined sewer to the new storm drains, and rehabilitation of the existing combined sewers for use as sanitary sewers. The plan calls for approximately 140,000 linear feet of new storm drains. This project is jointly funded by MWRA and BWSC. Construction is expected to be complete by November 2008.

As of March 2004, construction is about 54% complete and all remaining construction contracts have been awarded. In 2003, BWSC installed approximately 16,800 linear feet of new storm drain, 12% of the total length to be installed by this project. BWSC plans to install a similar amount of storm drain in 2004. Once the sewer separation and related work is complete and the CSO regulators are then closed, MWRA plans to decommission its Commercial Point and Fox Point CSO treatment facilities.

Limits to Fishing, Shellfishing and Recreation

Bacteria levels have caused closures of shellfish beds at and public health postings for South Boston and Dorchester Beaches. Advisories regarding fish consumption are related to non-bacterial sources of pollution and are discussed elsewhere in this report.

Shellfish Beds

The Massachusetts Division of Marine Fisheries (DMF) conducts regular sanitary surveys to assess the health of shellfish beds along the coast of Massachusetts. While harvesting of some shellfish located in Boston Harbor has been prohibited due to bacterial pollution, many clams are harvested from specially designated, conditionally restricted areas of Dorchester Bay and transported by DMF licensed and bonded master diggers under strict enforcement to the Shellfish Purification Plant located on Plum Island in Newburyport. Once at the Shellfish Purification Plant, the clams are treated in a controlled aquatic environment and purified.

The Shellfish Purification Plant is a state of the art facility containing nine depuration units. Pure seawater is obtained from two deep salt-water wells and is continuously disinfected using ultra-violet light. Depuration is a complex biological process requiring constant validation, during and upon completion of the treatment, through testing of shellfish and tank water. This is accomplished by daily testing in an on-site certified laboratory. The depuration process occurs for a minimum of three days and upon completion, the clams are returned to the harvesters, who pay a depuration fee. The purified clams are then sold in commerce.

Swimming and Boating

The City of Boston has several swimming beaches owned and managed by the Department of Conservation and Recreation (DCR) and the City of Boston. These include Pleasure Bay Beach, City Point Beach, L Street Beach and Carson Beach in South Boston; and Tenean Beach, Savin Hill Beach and Malibu Beach in Dorchester. Water quality conditions at Boston Harbor beaches have dramatically improved over the past decade as a result of the ongoing efforts of the MWRA and the Boston Water and Sewer Commission to implement the Boston Harbor Project, reduce combined sewer overflows, and reduce stormwater pollution. Today, most beaches in Boston Harbor meet acceptable swimming conditions at least 90% of the time.

Water quality is evaluated at most Boston Harbor Beaches on a daily basis throughout the summer months. As recommended by the U.S. Environmental Protection Agency, samples are tested for Enterococcus bacteria levels. As shown in Table 5, the average geometric mean for

Enterococcus at South Boston and Dorchester Bay beaches was within the EPA recommended swimming level of <35 Enterococcus/100ml. Despite overall improvements in water quality at Boston Harbor Beaches, bacteria levels were often elevated for 24 to 48 hours following heavy rainstorms. Remaining water quality problems associated with bacterial pollution at Inner Harbor beaches are expected to improve following implementation of the MWRA's Final CSO Plan.

Based on water quality testing, public information about water quality conditions is provided at Boston Harbor Beaches through a daily flagging program. Blue flags indicate acceptable water quality conditions while red flags indicate potential public health risks associated with elevated bacteria.

Studies conducted by the MWRA and other agencies indicate that bacteria levels found in Boston Harbor are low enough to meet the State Water Quality Standards for secondary contact or boating. As discussed above, bacteria levels in Boston Harbor also meet the swimming standard during dry weather conditions.

Does nutrient pollution pose a threat to aquatic life?

Yes. While the Department of Environmental Protection's 1999 Water Quality Assessment Report for Boston Harbor indicates that the Inner Harbor and Dorchester Bay support aquatic life, this designation is on "alert status" due to potential nutrient, sediment and other pollutant loadings following rainstorms.

The Inner Harbor has exhibited signs of eutrophication in the form of nuisance algal blooms. While these blooms have to date only caused a nuisance in the Harbor, a toxic algal bloom could occur in the future. High levels of nutrients in Boston Harbor have also contributed to the elimination of sea grass beds in Dorchester Bay over the past century. While nutrients are still elevated in the Inner Harbor, they have decreased since the ocean outfall began discharging treated effluent into Massachusetts Bay instead of the Inner Harbor.

Are dissolved oxygen levels high enough to support aquatic life?

Yes, in most areas. Dissolved oxygen levels are generally high enough to support aquatic life throughout the Inner Harbor and Dorchester Bay. As part of their ongoing CSO monitoring program, the Massachusetts Water Resources Authority collected monthly water quality samples throughout the Inner Harbor and Dorchester Bay between 1996 and 2000. All samples collected in Dorchester Bay were above the 5.0 mg/l required by Massachusetts Water Quality Standards to support cold water fisheries. On 33 occasions, dissolved oxygen levels were below 5.0 mg/l at the Inner Harbor sites. Additional research is needed to assess dissolved oxygen levels in Pleasure Bay.

According to the MWRA, lower levels of dissolved oxygen levels were often found in the Fort Point Channel, downstream of the Mystic River, downstream of the Charles River dam, and in the Reserved Channel. In general, the deeper, more enclosed portions of the Inner Harbor exhibit higher levels of nutrients and lower levels of dissolved oxygen.

Are there other indicators that limit use of the watershed?

Yes. Contaminated sediments, polluted runoff and floatable marine debris have also limited the use of water resources within the Inner Harbor. Boston Harbor's industrial history has left a legacy of sediments contaminated with heavy metals, PCBs, PAHs and other pollutants in the Inner Harbor. The figure at right shows that concentrations of zinc are most significant in the Inner Harbor sediments of Boston Harbor. Other heavy metals have a similar distribution pattern.

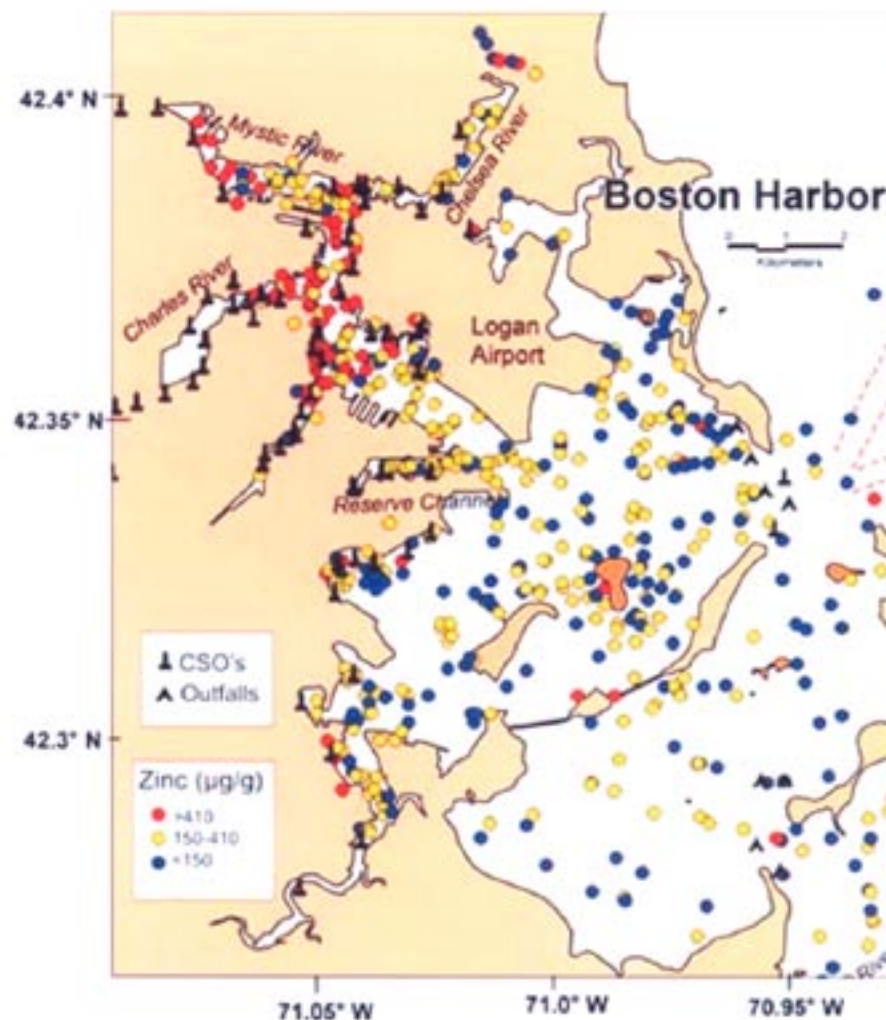
Contaminated Sediments

Understanding the physical and chemical composition of bottom sediments is essential for environmental management, including dredging and disposing of sediment to deepen shipping channels and regulating fisheries. The U.S. Geological Survey (USGS) has assembled a database, compiled from all available sources of information, describing chemicals in sediments from Boston Harbor.

As depicted in Figure 16, lead concentrations in surface sediments

decrease with distance from Boston, focusing the highest levels of lead (shown with red and orange dots) in the innermost harbor. Similar patterns arise for a variety of metals, which are documented in the USGS

Figure 15: Sediment Zinc Levels in Boston Harbor (USGS)



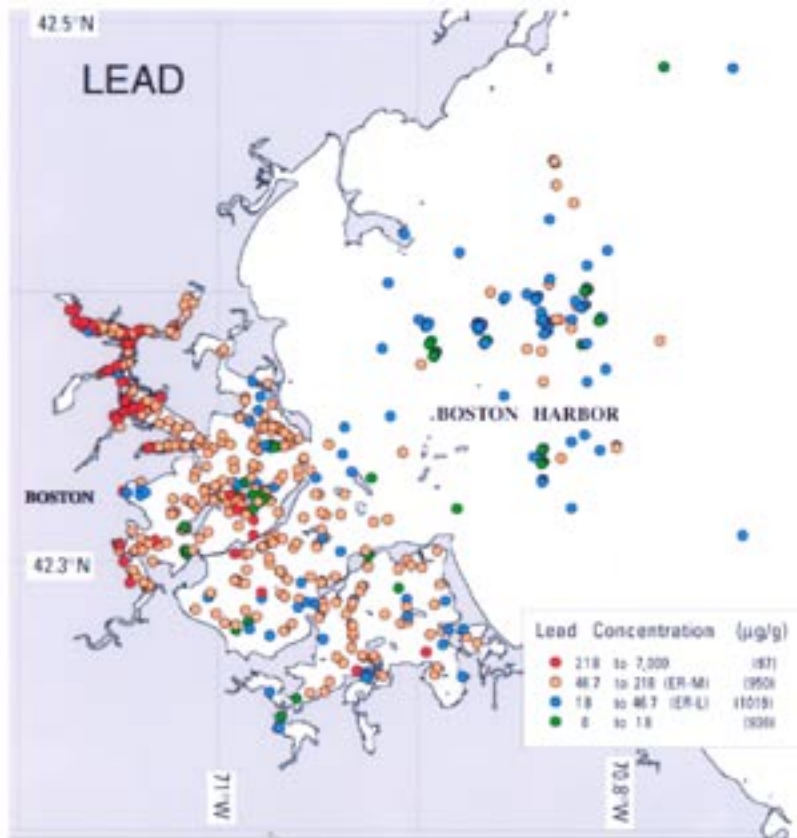
Coastal and Marine Geology database.

Beginning in 1988, the Massachusetts Department of Public Health issued the following advisory regarding consumption of seafood from Boston Harbor:

“Lobster tomalley: all persons should eliminate consumption of the lobster tomalley (liver). This recommendation applies to tomalley from lobsters from any source due to the finding of abnormally high chemical contaminant levels.....

Boston Harbor Fishery Products: Pregnant and breast-feeding women, women who intend to become pregnant, children under the age of 12, and individuals with lowered immunity should avoid consuming certain fishery products from Boston Harbor. This applies to lobster, flounder, soft-shell clams and other bivalves...”

Figure 16: Lead Concentrations in Sediments of Boston Harbor (USGS)



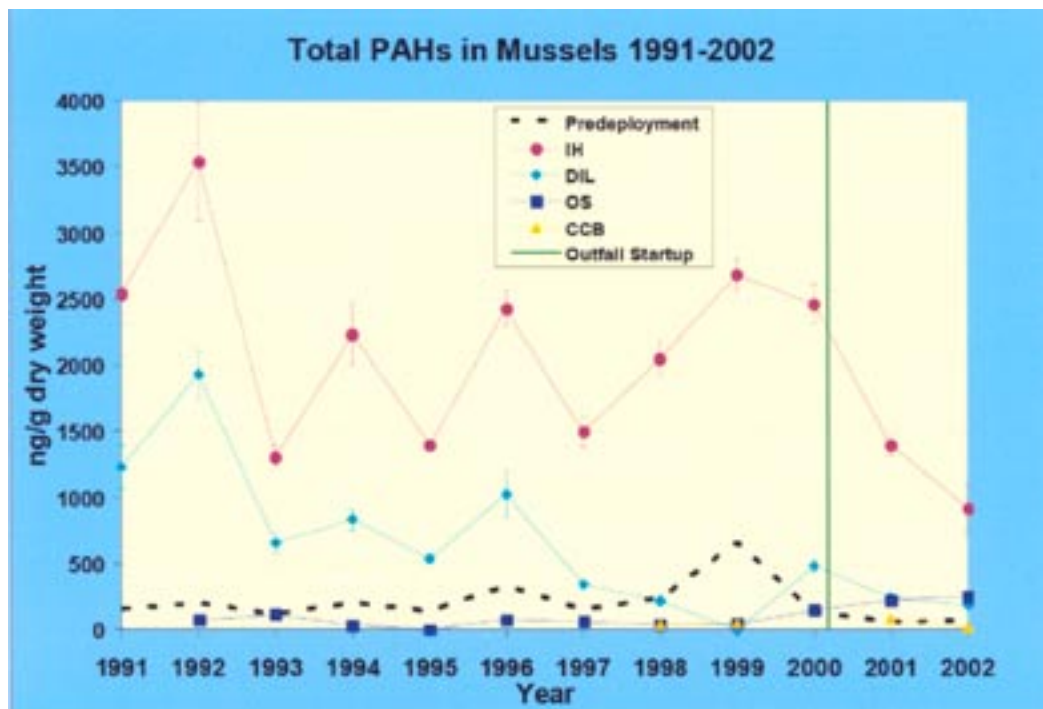
As part of the MWRA’s ongoing fish and shellfish monitoring program, caged blue mussels from Rockport were deployed in several locations around Boston Harbor to evaluate bioaccumulation potential. The mussels were suspended in cages for 60 days at sites near the New England Aquarium, the former Deer Island outfalls, the offshore outfall site, and Cape Cod Bay. Once retrieved, the mussels were analyzed for toxic contamination. As shown in Figure 7, results indicated that PAHs found in mussels left in the Inner Harbor (IH) were higher than other locations such as Deer Island Light (DIL), the Outfall Site (OS) and Cape Cod Bay (CCB).

According to DEP’s Boston Harbor Watershed 1999 Water Quality Assessment Report, water chemistry data collected at multiple stations over several years was generally within the State Water Quality Standards for a Class SB waterbody. The report does note, however, that because of the highly industrialized/developed nature and multiple active CSO discharges, the Inner Harbor segment of Boston Harbor is on “alert status” for its ability to support aquatic life.

While environmental regulations have significantly reduced new sources of industrial pollution, Boston’s Inner Harbor is still affected by road runoff, atmospheric deposition, and numerous industrial uses within the watershed. Figure 23 on page 33 shows the relatively high number of DEP Oil or Hazardous Material Sites concentrated within the City of Boston watershed.

Stormwater runoff from the City of Boston area covered by this Assessment enters the Inner Harbor through 21 outfalls operated by the Boston Water and Sewer Commission for the City of Boston. Other storm drains in the watershed are owned by the Massachusetts Turnpike Authority, the Massachusetts Highway Department, the Department of Conservation and Recreation, and private property owners.

Figure 17: PAHs in Boston Harbor Mussels (MWRA)



Floatables and Marine Debris

Floatable debris can harm marine life, limit recreational uses and degrade aesthetics. Floatable debris in Boston Harbor has been greatly reduced since the Boston Harbor Marine Debris Cleanup Project was launched during 2001 to remove floatable debris from the Inner Harbor during the summer months.

The Marine Debris Cleanup Project is coordinated by The Boston Harbor Association in partnership with several agencies such as the Massachusetts Water Resources Authority, City of Boston Environmental Department, the Office of Coastal Zone Management, Massport, the U.S. Environmental Protection Agency and others. Each year, on-water vessels patrol the Inner Harbor to remove debris such

as plastic bottles, fishing gear, large pieces of wood and other small trash. Since 2001, the program has removed over 130 tons of floatable debris from the Inner Harbor. On-water efforts are supplemented by outreach and prevention strategies aimed at reducing debris from landside sources such as high traffic areas and construction sites.

The Department of Environmental Protection’s 1999 Water Quality Assessment Report determined that the Inner Harbor supports Aesthetics as a designated use because of the ongoing Marine Debris Cleanup Project. According to DEP, the Aesthetic Use is only partially supported in Dorchester Bay due to water quality problems, intermittent areas of trash, and the negative impacts of multiple CSO discharges.

Are streamflow and groundwater levels sufficient?

There are no freshwater streams located within the portion of the City of Boston covered in this Assessment. The City of Boston does not include any water supply sources.

The City of Boston is faced with unique environmental problems associated with depleted groundwater levels in filled tidelands. According to the Boston Groundwater Trust, over 2,000 acres of metropolitan Boston are vulnerable to foundation damage from deteriorated groundwater levels. Most buildings constructed before 1920 in Back Bay, Beacon Hill, Chinatown and along Boston’s waterfront were built in filled areas and are supported by wooden pilings. While these wooden pilings resist rot as long as they are submerged, decreases in groundwater levels have caused them to rot in several locations throughout Boston. The Boston Groundwater Trust is a collaboration of community residents, public officials and scientists working together to monitor and maintain adequate groundwater levels in Boston.

What percentage of the watershed is impervious?

Approximately 47.7% of this portion of the City of Boston sub-watershed

is impervious. See Table 3 and Figure 18 for a detailed breakdown of impervious land uses.

The very high percentage of impervious surface reflects this region’s character as a very developed urban inner city. Impervious surface is an

Table 3: Boston Watershed Land Use and Imperviousness

Land Use Category	Total Acres	Total Impervious
Cropland	0.0	0.0
Pasture	0.0	0.0
Forest	0.0	0.0
Wetland	0.0	0.0
Mining	0.0	0.0
Open Land	72.8	2.1
Participation Recreation	249.1	14.9
Spectator Recreation	13.1	0.7
Water Based Recreation	56.9	19.5
Residential (Multi-family)	1242.5	564.1
Residential (Smaller than 1/4 acre lots)	553.7	300.7
Residential (1/4 - 1/2 acre lots)	2.3	0.7
Residential (Larger than 1/2 acre lots)	0.0	0.0
Salt Wetland	1.8	0.0
Commercial	1256.1	803.9
Industrial	315.7	172.7
Urban Open	640.1	199.1
Transportation	854.1	433.9
Waste Disposal	6.3	1.4
Water	2.4	0.1
Orchard, Nursery or Cranberry Bog	0.0	0.0
TOTAL	5267.1	2513.8
% Impervious	47.7%	

important factor in determining the quality and quantity of stormwater flowing within a watershed. As more land area within a watershed is covered by surfaces that shed water rather than absorb it, the volume and velocity of stormwater runoff carrying pollutants into nearby water bodies increases.

Are there current or expected water supply shortages?

No. The City of Boston receives its drinking water from the Massachusetts Water Resources Authority, which pumps water to the region from the Quabbin Reservoir. Average annual water use for the Boston region is lower than the water withdrawals allowed by the state Water Management Act permits. Boston does not regularly experience

Table 4: Generalized Effects of Unmitigated Imperviousness (based on Center for Watershed Protection, 1998)

Percent Impervious	Expected Watershed Impacts
26% or more	Streambank erosion, channel instability
	Poor to fair water quality (often with high nutrient levels)
	Low biodiversity (limited to heartier insects and fish that are tolerant of pollution)
	Human water contact often not possible due to high bacteria levels
11 to 25%	Some signs of degradation
	Some channel erosion and widening
	Fair to good water quality (some elevated nutrients and pathogens)
	Fair to good biodiversity (more sensitive, intolerant aquatic species)
0% to 10%	Channels stable
	Good to excellent water quality
	Excellent biodiversity

Figure 18: Boston Watershed Development

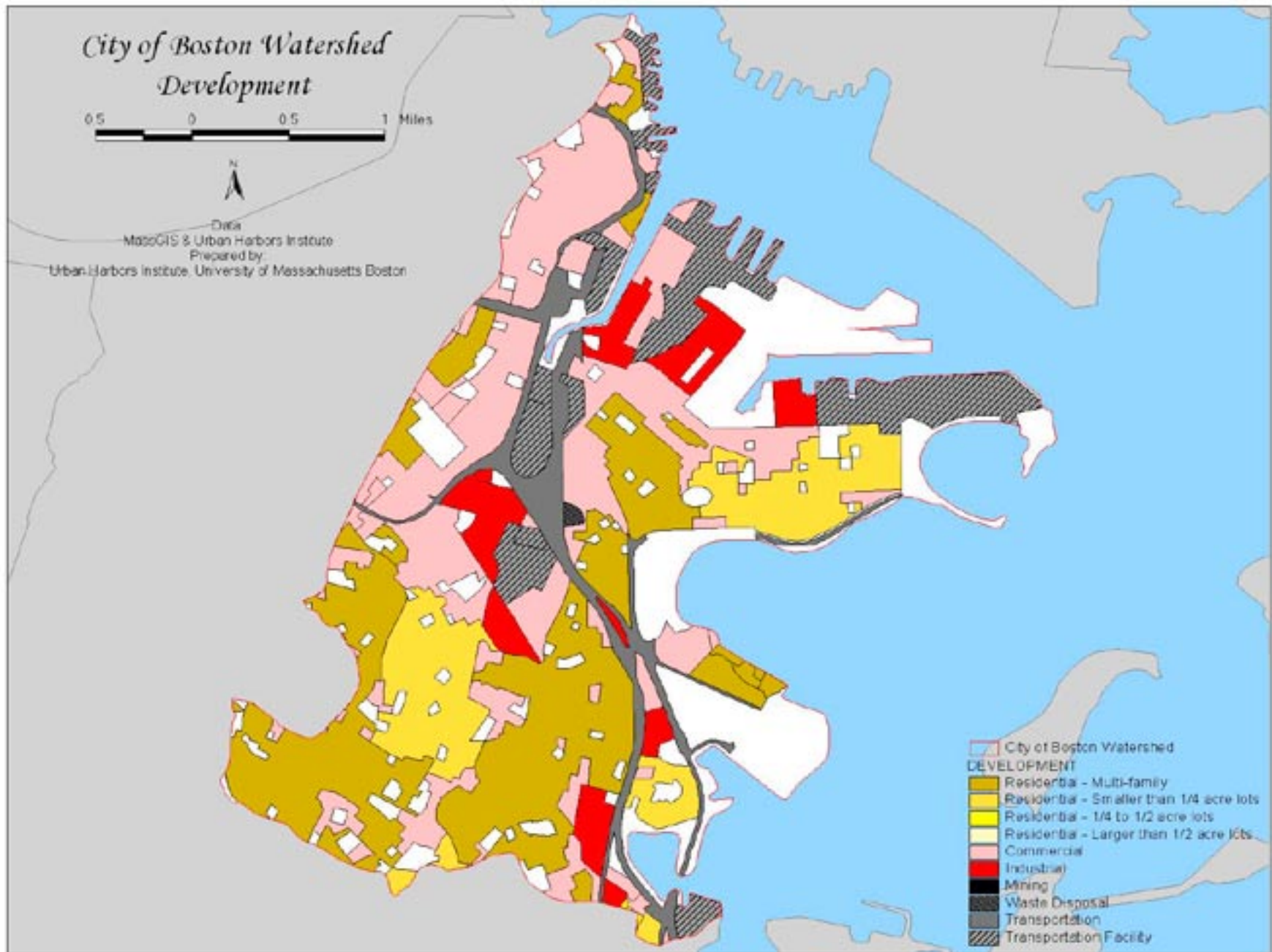
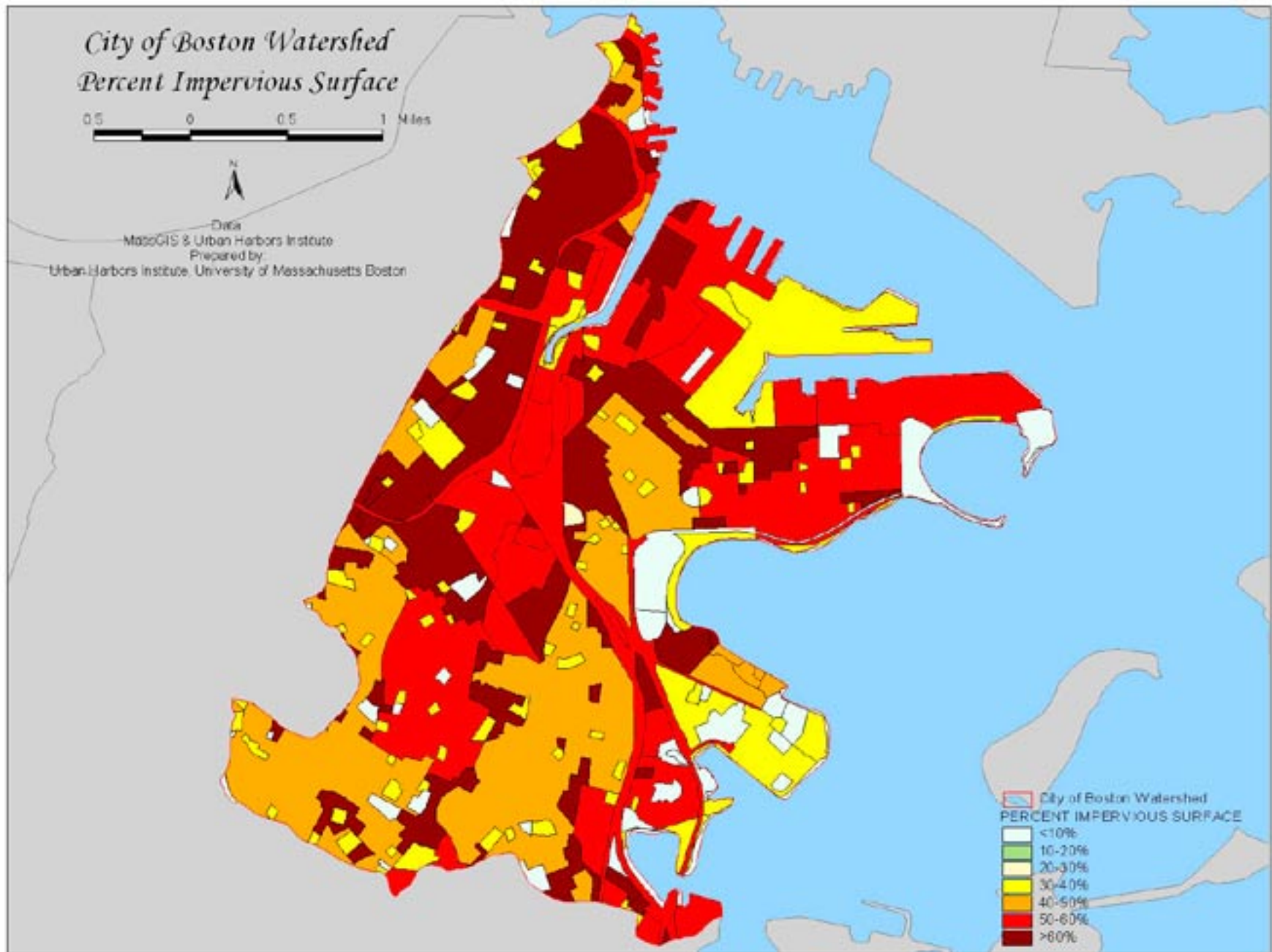


Figure 19: Boston Watershed Impervious Surface:



water supply shortages.

Do flooding or high flows cause problems for structures or aquatic life?

Flooding or heavy rainstorms lead to activation of combined sewer overflows and an increase in stormwater runoff to the Inner Harbor. Pollution from bacteria and other contaminants is higher following rainstorms. Flooding problems have also been documented in the South End. Construction of the Union Park Pump station is needed to alleviate this problem.

Are NHESP listed habitats or Biomap habitats present in the watershed?

The City of Boston includes one NHESP priority habitat for state protected rare species. According to the Massachusetts Natural Heritage and Endangered Species Program, several protected, endangered or species of concern have been observed within the watershed in recent years. These include blue spotted salamander, threespine stickleback, spotted turtle, peregrine falcon, common tern and least tern.

Are there other special habitat types?

The City of Boston provides important habitat for birds, fish, shellfish and marine mammals. Boston's Inner Harbor provides a "gateway" for a wide variety of anadromous and other fish that travel from offshore locations to feed in the Boston Harbor estuary and spawn in the ponds, rivers and streams of upstream habitats such as the Charles River and Neponset River watersheds. In recent years, striped bass, blue fish and cod have all been making a comeback throughout Boston Harbor. As schools of herring make their way through Boston Harbor in search of upstream spawning habitat, they are often followed by flocks of birds in search of easy prey.

Boston Harbor is also home to marine mammals such as harbor porpoise and seals that travel throughout the region from the Inner Harbor, out to the Boston Harbor Islands and beyond. Recent sightings of a Beluga whale in Boston Harbor illustrate the varied and extensive habitat utilized by marine mammals in New England.

The extent and diversity of marine life in Boston Harbor has greatly improved as a result of ongoing Harbor cleanup projects. In addition to a return of waterfowl, marine mammals and fish populations -- mussels, kelp, sea urchins and anemones -- have begun to re-colonize the areas near former sludge outfalls in Boston's Inner Harbor.

Are wetland and vernal pool habitats healthy or degraded?

The City of Boston's waterfront was created via historic filling of tidal wetlands. Thus wetlands in this heavily developed area of Boston have either been eliminated or are severely degraded. While not part of the geographic area covered in this assessment, there are significant salt marshes located in other areas of the Inner Harbor such as East Boston and the Boston Harbor Islands. There are no registered vernal pools in the portion of Boston covered in this assessment.

Are invasive species a significant threat to upland, wetland or aquatic habitats?

Invasive aquatic species known as marine bioinvaders have been identified throughout Boston Harbor and New England. The MIT Sea Grant Center for Coastal Resources has been tracking marine bioinvaders throughout the region. These invading species (also known as aquatic nuisance, non-indigenous, exotic, or alien species) can cause complex changes within the structure and function of their new ecosystem. Impacts include restructuring established food webs, importing new diseases to the new surroundings, and competition with indigenous organisms for space and food. Invading organisms can also reproduce with native species, leading to hybridization and homogeneity, which reduces biodiversity.

Surveys conducted by the MIT Sea Grant Program have identified at least 13 introduced species in Boston's Inner Harbor. The most common species of invaders found in the Inner Harbor were sea squirts, periwinkles, skeleton shrimp, red alga, green fleece and green crab. Most species entered the Harbor through ballast water or on hulls of ships.

Massachusetts and several other states have been working together to develop a management plan to minimize introduction of invasive species

Figure 20: Boston Watershed Floodplains and Vegetated Wetlands

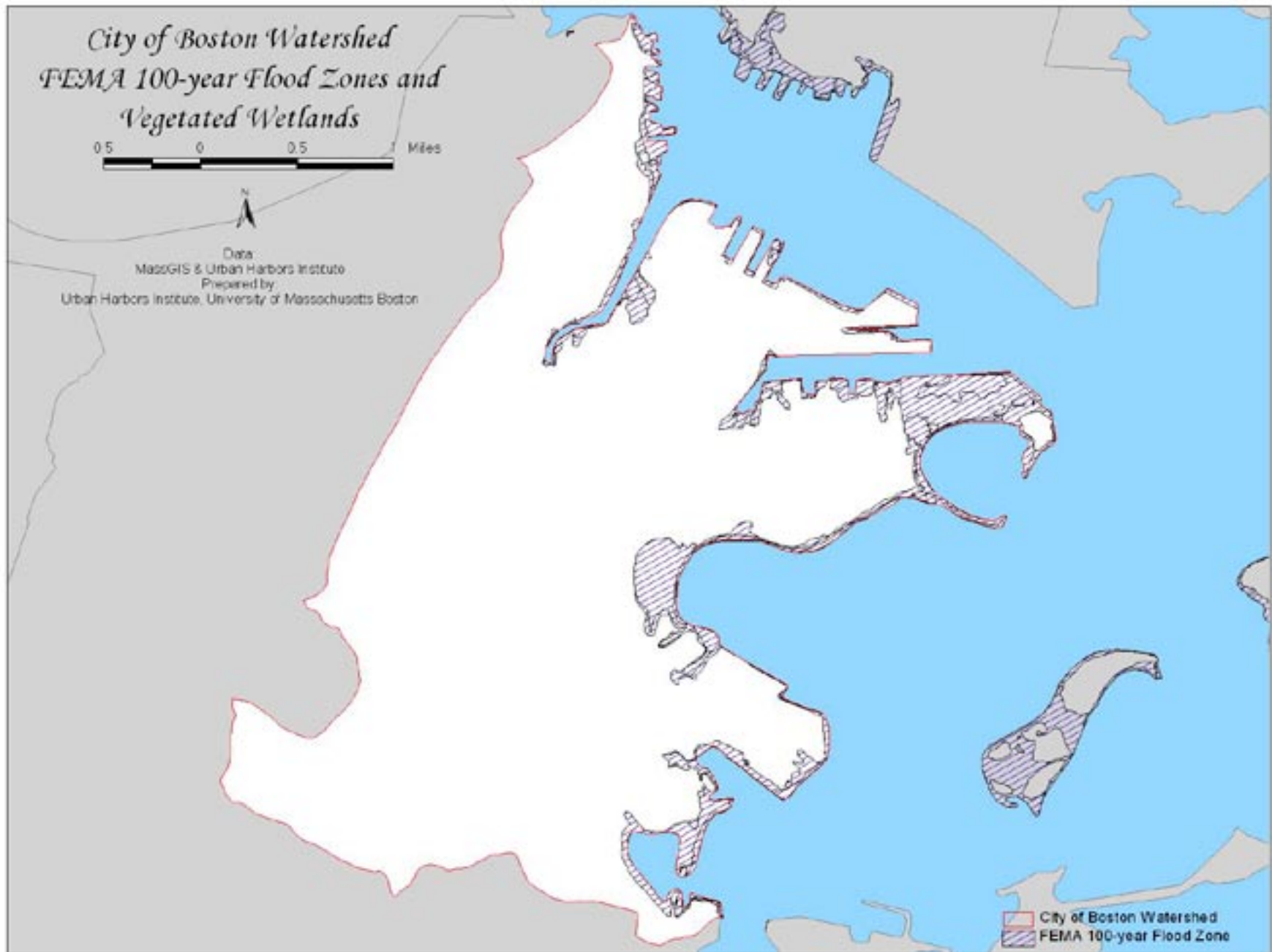
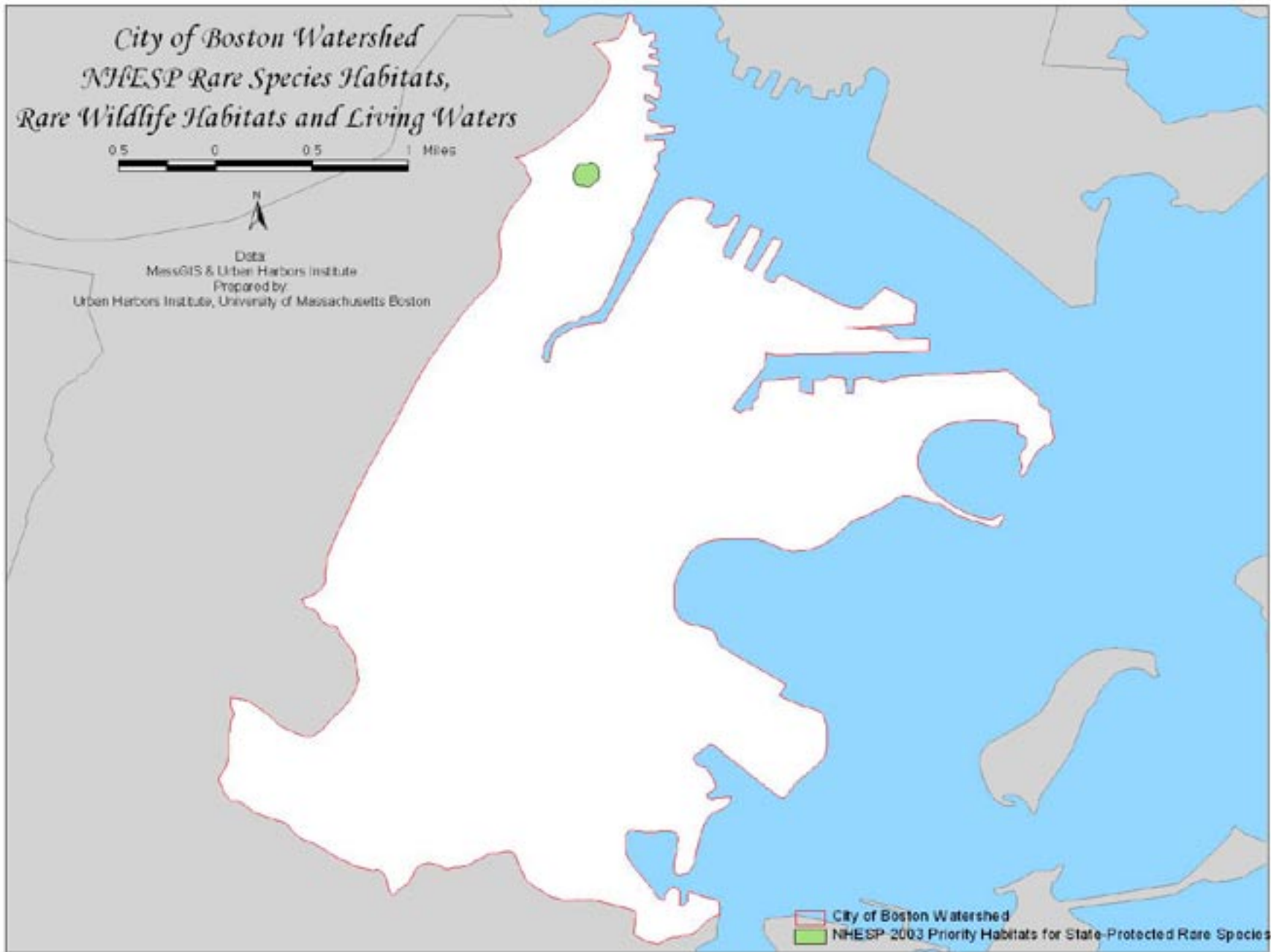


Figure 21: Boston Watershed Rare Habitats and Living Waters



in the Gulf of Maine and beyond. The Massachusetts Sea Grant Program at MIT, the Massachusetts Office of Coastal Zone Management, and Massachusetts Port Authority are working together to limit introduction of invasive species into Boston Harbor. The Massachusetts Office of Coastal Zone Management recently published a Massachusetts Aquatic Invasive Species Management Plan, which highlights outreach, education and other strategies for addressing invasive aquatics.

At the same time, the Northeast Aquatic Nuisance Species Task Force has formed a ballast water committee to develop recommendations to prevent the spread of marine bioinvasers. National legislation is needed to give the U.S. Coast Guard the ability to enforce measures to limit the introduction of invasive species from ballast water. Additional education is also needed to prevent problems associated with the bait industry, live seafood, and dumping of personal aquarium contents.

What are current land use trends?

As indicated in the Table 6 and Figure 22, the two most significant land uses within the City of Boston sub-watershed are commercial and residential. Roadways, rail service and other transportation are also significant land uses within the watershed.

Table 5: Mean Enterococcus at Boston Watershed Beaches (MWRA and DCR)

Beach	2003 Enterococcus/100ml Geometric Mean
Carson Beach (I St. and Bathhouse locations)	10
M St. Beach	10
City Point Beach	8
Pleasure Bay Beach	5
Tenean Beach	29

What percentage of the watershed is “built-out”?

As of production of this report, a build-out analysis for the City of Boston has not been completed.

Are there significant brownfields or opportunities for redevelopment in the watershed?

Yes. The City of Boston includes numerous brownfields and other opportunities for redevelopment. The City of Boston has more than 3,000 state-listed disposal sites, many of which are considered brownfields. Several brownfield remediation projects are complete, underway or planned within the region. One of the largest examples of brownfield remediation in the City is construction of the new Convention Center in South Boston, which encompasses several former brownfield sites. Another unique success story is the ongoing transformation of Spectacle Island from a dumping ground into a vital component of the Boston Harbor Islands National Park area.

With support from the U.S. Environmental Protection Agency, the City of Boston created a Brownfields Cleanup Revolving Loan Fund to redevelop a parcel in the South End. In addition, the City of Boston was recently selected to receive a brownfields assessment grant from the U.S. Environmental Protection Agency to conduct site assessment and remedial plans for several other sites in Boston. MassDevelopment also provides financing for brownfields redevelopment projects throughout Massachusetts, including several in the City of Boston.

In addition to brownfield remediation projects, many properties within the City of Boston watershed are expected to be redeveloped over the next decade. For example, the ongoing Central Artery/Third Harbor Tunnel Project will lead to the creation of the Rose Kennedy Greenway, a combination of new open spaces, civic areas and other uses. At the same time, plans to redevelop the South Boston waterfront with a mix of commercial, residential and other uses have been ongoing for several years. These and other redevelopment projects provide an opportunity to expand public access to Boston Harbor, increase public open space, and improve stormwater management.

Figure 22: Boston Watershed Land Use

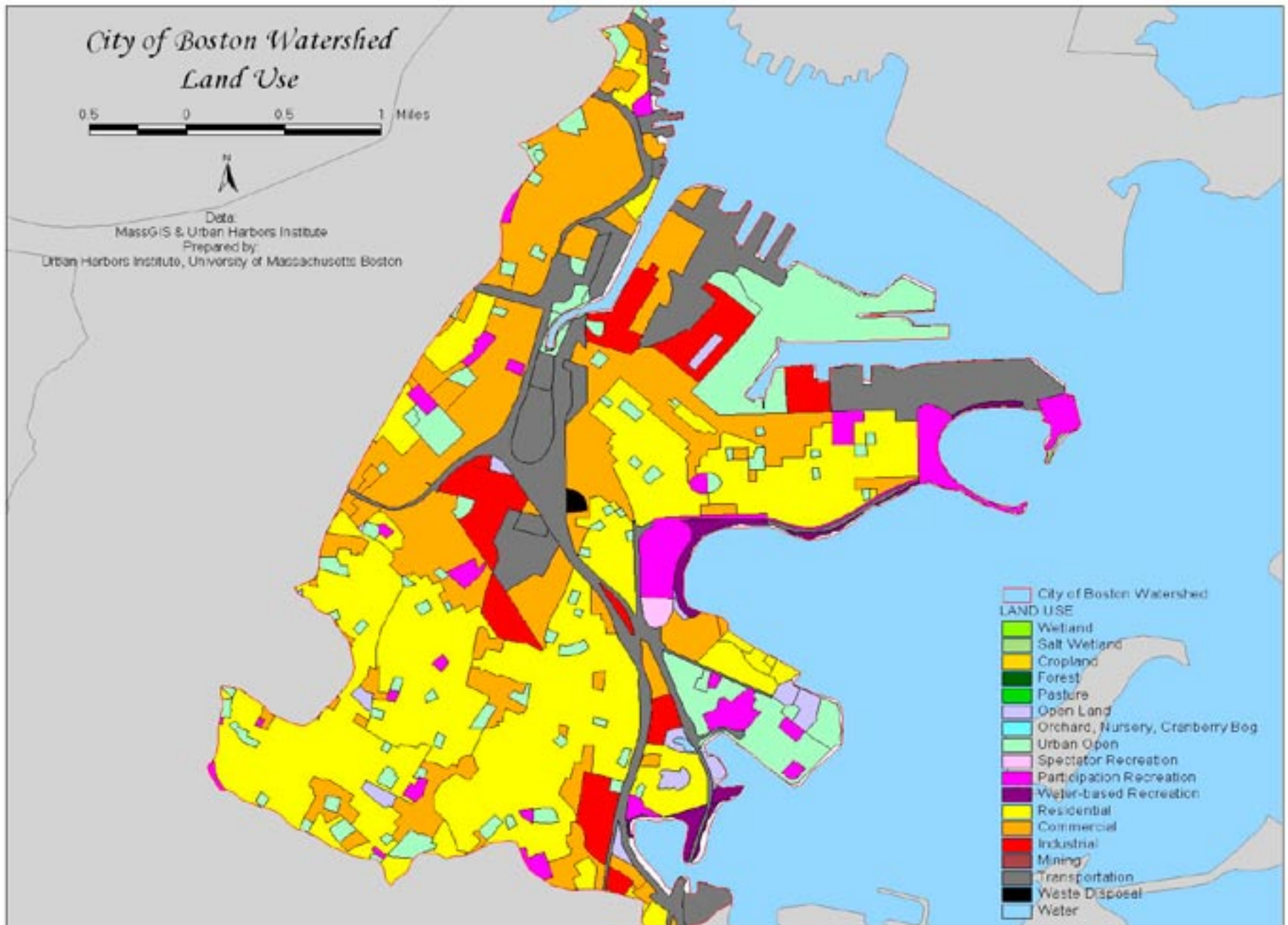
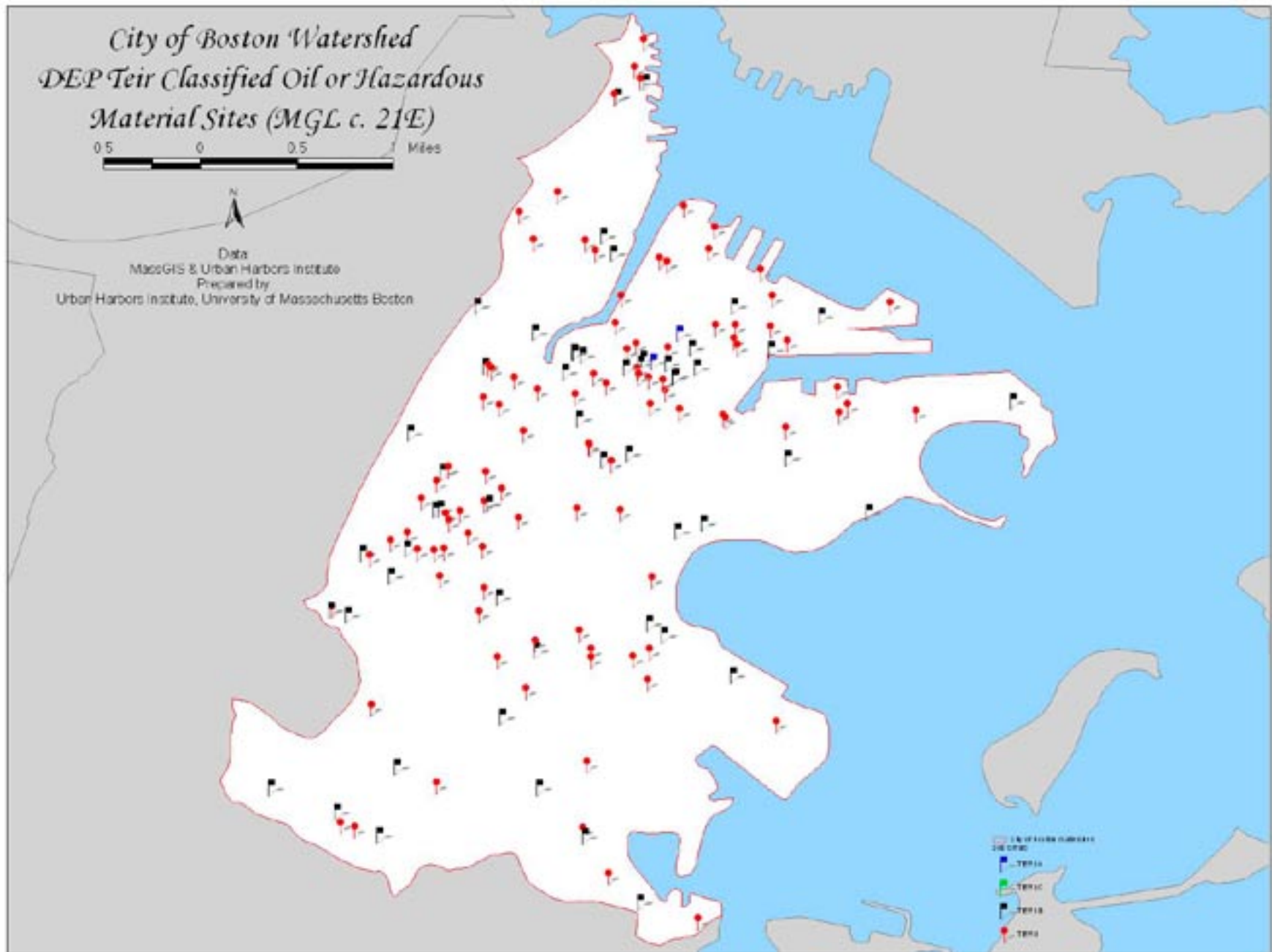


Figure 23: Boston Watershed Contaminated Sites



What are the major trends in population, land use, transportation and water needs?

Between 1990 and 2000, population grew in the Inner Core Region (including all of the City of Boston) of the Metropolitan Area Planning Council Region by 3.1%. This growth rate was slower than that experienced in the surrounding regions, which ranged from 5.5% growth on the South Shore to 8.5% growth in the MetroWest subregion and 16.2% growth in the SouthWest region. From 1990 to 2000, the City of Boston experienced a 2.6% population growth rate with 14,858 new residents.

The City of Boston has been undergoing tremendous changes in transportation and land use. The restoration of water quality in Boston Harbor and the Central Artery/Tunnel Project (CA/T) have been the two most significant driving forces of change in the City of Boston.

The Central Artery/Tunnel Project operated by the Massachusetts Turnpike Authority has been transforming the City's transportation infrastructure at an unparalleled scale. The project's two major components are:

- Replacing the six-lane elevated highway with an eight-to-ten-lane underground expressway directly beneath the existing road, culminating at its northern limit in a 14-lane, two-bridge crossing of the Charles River. Now that the underground highway is open to traffic, the crumbling elevated road is being demolished and replaced by open space and modest development.
- The extension of I-90 (the Massachusetts Turnpike) from its former terminus south of downtown Boston through a tunnel beneath South Boston and Boston Harbor to Logan Airport. The first link in this new connection – the four-lane Ted Williams Tunnel under the harbor – was finished in December 1995.

Along with improving mobility in notoriously congested downtown Boston, the Central Artery project will reconnect neighborhoods

severed by the old elevated highway, and improve the quality of life in the city beyond the limited confines of the new expressway. Apart from a 12 percent reduction in citywide carbon monoxide levels, major project benefits include creation of more than 260 acres of open land, including 27 acres where the existing Central Artery now stands, more than 100 acres at Spectacle Island in Boston Harbor (where project dirt

Table 6: Boston Watershed Land Uses

Land Use Category	Total Acreage	% acreage
Cropland	0.0	0.0
Pasture	0.0	0.0
Forest	0.0	0.0
Wetland	0.0	0.0
Mining	0.0	0.0
Open Land	72.8	1.4
Participation Recreation	249.1	4.7
Spectator Recreation	13.1	0.2
Water Based Recreation	56.9	1.1
Residential (Multi-family)	1242.5	23.6
Residential (Smaller than 1/4 acre lots)	553.7	10.5
Residential (1/4 - 1/2 acre lots)	2.3	0.0
Residential (Larger than 1/2 acre lots)	0.0	0.0
Salt Wetland	1.8	0.0
Commercial	1256.1	23.8
Industrial	315.7	6.0
Urban Open	640.1	12.2
Transportation	854.1	16.2
Waste Disposal	6.3	0.1
Water	2.4	0.0
Orchard, Nursery or Cranberry Bog	0.0	0.0
TOTAL	5267.1	100

has capped an abandoned dump), and 40 more acres of new parks in and around downtown Boston. As of June 2004, construction is more than 90 percent complete. The entire project is expected to be finished in mid-2005, including demolition of the elevated highway and restoration of the surface.

At the same time, the restoration of water quality in Boston Harbor has been the driving force toward development that capitalizes on a cleaner waterfront and Harbor. Over the past decade, the desire to locate new housing and commercial development on the waterfront has increased significantly. Formerly blighted or underutilized waterfront properties are being transformed into high-end housing and other mixed development uses throughout the Inner Harbor. Waterfront properties are now among the most expensive in the greater Boston area. Major new development projects are expected to continue dramatically altering land uses along the City of Boston’s waterfront in the future.

What percentage of the watershed area is protected open space?

Approximately 457 acres or 8.7% of the 5,267-acre portion of the City of Boston covered in this Assessment consists of protected or recreational open space. Though just outside of the geographic area covered by this assessment, the 34 islands that make up the Boston Harbor Islands National Recreation Area also provide significant open space for public access and recreational opportunities, as well as habitat for a variety of wildlife.

How rapidly is open space being lost?

The City of Boston is comprised of an already developed urban inner city. While open space continues to be lost to development at a rapid pace, several ongoing and planned development projects will ultimately result in the creation of new publicly accessible open spaces in the City and along the Boston waterfront.

Unfortunately, it is often difficult to accurately track open space associated with new waterfront development because developers’ claims that they are providing 50% open space can be misleading. Any non-buildable area, such as roads and sidewalks, can be used to satisfy the 50% open space requirement for waterfront development projects

to meet Chapter 91 permitting requirements. To resolve this problem, regulatory revisions to Chapter 91 are needed to differentiate between requirements for green open spaces and those with pervious surfaces.

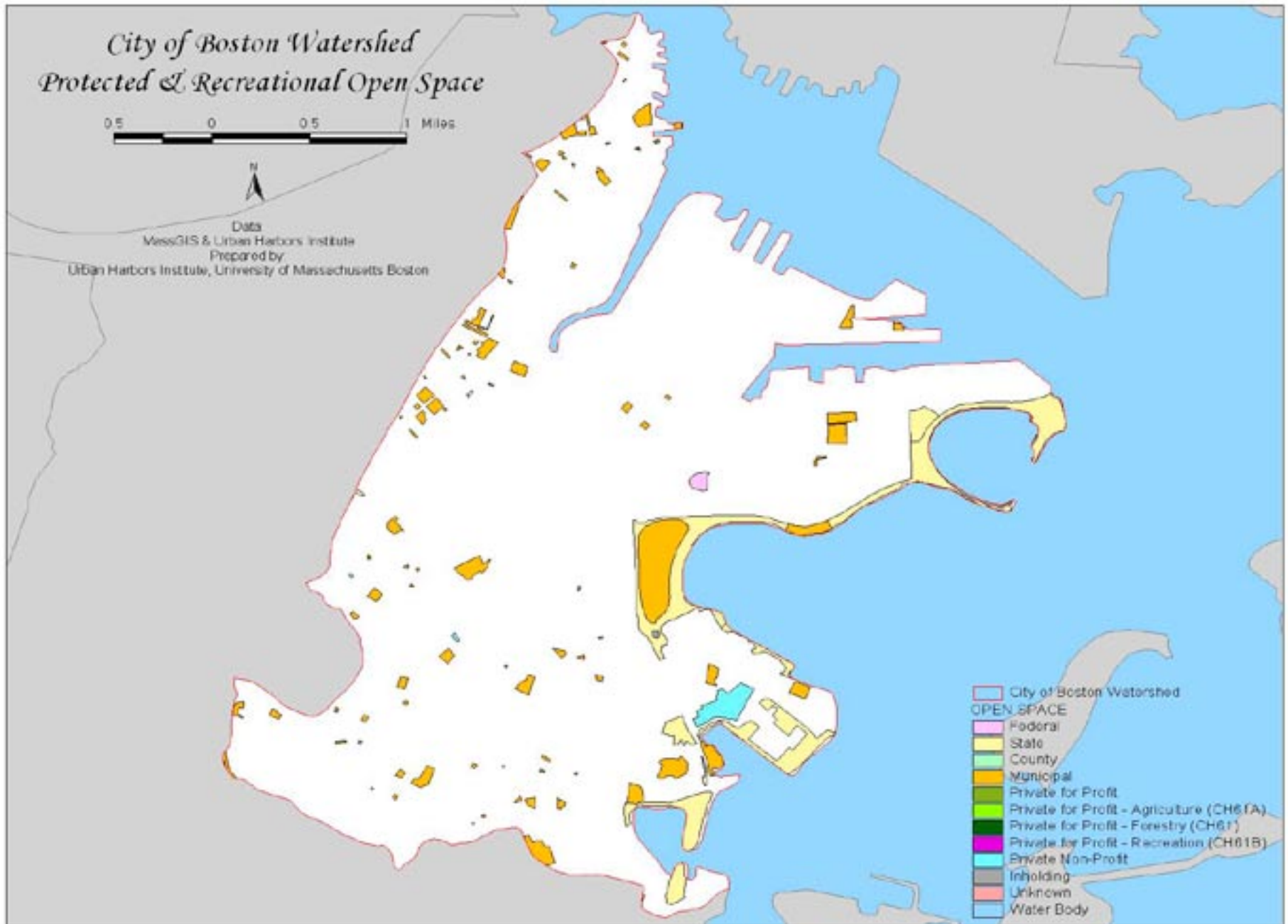
What % of the shoreline, both coastal and riparian, is publicly accessible?

Approximately 70% of the shoreline within this portion of the City of Boston is publicly accessible. Thanks to the proactive efforts of the City of Boston, the Department of Environmental Protection, the Massachusetts Office of Coastal Zone Management, and The Boston Harbor Association, a continuous publicly accessible Harborwalk along Boston’s waterfront is becoming a reality. While most of the waterfront in this part of the City of Boston is publicly accessible, access is currently limited at several locations including sites within the Boston Marine Industrial Park, the Reserved Channel, and along portions of the Fort Point Channel.

Table 7: Boston Watershed Protected & Recreational Open Space

Parkland Type	Acres	Percentage
County	0.0	0.0
Federal	4.8	1.0
Inholding	6.4	1.4
Municipal	192.1	42.0
Private for Profit	0.5	0.1
Private for Profit - Agriculture (CH61A)	0.0	0.0
Private for Profit - Forestry (CH61)	0.0	0.0
Private for Profit - Recreation (CH61B)	0.0	0.0
Private Non-Profit	22.5	4.9
State	230.8	50.5
Unknown	0.0	0.0
Water Body	0.0	0.0
TOTAL	457.1	100

Figure 24: Boston Watershed Open Space:



Substantial public investments by the Central Artery Project, the Massachusetts Turnpike Authority, the Massachusetts Water Resources Authority, the Massachusetts Bay Transportation Authority and the Massachusetts Highway Department will ultimately result in new public access opportunities in and along the Fort Point Channel. As part of its mitigation commitments, the CA/T will create a 2,500-foot long pedestrian walkway on the east side of Fort Point Channel and along the waterfront portions of the Gillette property.

In 2002, the Boston Redevelopment Authority, along with community partners and property owners, published a Fort Point Channel Watersheet Activation Plan. The plan establishes both an overall vision for the Fort Point Channel watersheet as well as a series of infrastructure improvements and programming that will fulfill Chapter 91 and Municipal Harbor Plan requirements. The plan envisions expanded public access through new Harborwalk segments and creation of special destinations, improved connections to other greenways and parks in the City, and a lively watersheet with expanded water transportation and recreational boating.

The 2000 South Boston Municipal Harbor Plan and the 1999 Seaport Public Realm Plan provide a framework for developing the South Boston waterfront. Plans call for a vibrant mix of neighborhood uses (commercial, residential, retail, civic, open space) along with an active waterfront with piers, docks and landings that would ensure public access and use of the Harbor.

In addition to shoreline access, efforts to connect inner city neighborhoods with the Inner Harbor are also underway. For example, Save the Harbor/Save the Bay, the South Harbor Trail Coalition, and the City of Boston are working together to plan and develop a 3.5 mile long pedestrian friendly bike trail connecting Lower Roxbury, the South End, Chinatown, the Fort Point Channel and South Boston to Boston Harbor at the Fan Pier.

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www.greenspacealliance.org

The Boston Groundwater Trust
www.bostongroundwater.org

The Boston Harbor Association
www.tbha.org

Boston Harbor Islands National Park Area
www.nps.gov/boha/

Boston Natural Areas Network
www.bostonnatural.org

Boston Water and Sewer Commission
www.bwsc.org

Central Artery/Third Harbor Tunnel Project
www.bigdig.com

Charles River Watershed Association
www.crwa.org

Children's Museum
www.bostonkids.org

U.S. Environmental Protection Agency
www.epa.gov/region01

Executive Office of Environmental Affairs
www.state.ma.us/envir/eoea.htm

Friends of Boston Harbor Islands
www.fbhi.org

Island Alliance
www.bostonislands.com

Massachusetts Aquatic Invasive Species Management Plan
www.state.ma.us/czm/invasivemanagementplan.htm

Massachusetts Department of Conservation and Recreation
www.mass.gov/dcr/

Massachusetts Office of Coastal Zone Management
www.mass.gov/czm

Massachusetts Port Authority
www.massport.com

Massachusetts Water Resources Authority
www.mwra.com

MIT Sea Grant - Center for Coastal Resources
<http://massbay.mit.edu/>

National Park Service
www.nps.gov/bost

Neponset River Watershed Association
www.neponset.org

Save the Harbor/Save the Bay
www.savetheharbor.org

U.S. Geological Survey - Contaminated Sediments Database for Boston Harbor
www.geology.wr.usgs.gov/wgmt/bostonharbor/boston5.html

Figure 25: Neponset Towns



Neponset River Watershed

Introduction

The following Assessment looks at the current status of the Neponset River Watershed in terms of water quality, hydrology, physical habitat, land use and open space. Due to a lack of reliable, comprehensive historic data for the entire Watershed (especially regarding water quality), however, this Assessment does not attempt to analyze the extent to which things are getting better or worse since the last Neponset River Watershed Action Plan was issued in 1997.

Nevertheless, it is clear that some progress is being made. In June, 2000 USEPA approved MADEP's "Total Maximum Daily Loads of Bacteria for the Neponset River Basin," which establishes bacterial limits and outlines corrective actions that should be applied throughout the watershed. A Neponset River Watershed Implementation Project grant was issued by MADEP and funded by USEPA for \$283,005. The grant will allow NepRWA and the towns of Milton and Walpole (which together will contribute a \$189,000 match) to identify specific nonpoint sources of bacteria, reduce residential stormwater runoff (Milton), ensure proper maintenance of septic systems (Walpole), conduct relevant community outreach, and research appropriate technological solutions.

USEPA in March 2003 also issued "Phase II" stormwater rules that are applicable to municipalities with populations below 100,000 that operate municipal separate storm sewer systems (MS4) (larger cities have been covered by "Phase I" rules since 1990). It also regulates stormwater management for construction activities that disturb between 1 and 5 acres.

Finally the Massachusetts Drinking Water and Clean Water State Revolving Funds are financing a number of improvement projects in the Neponset River Basin. These include:

- Walpole: Upgrade of Willis Water Treatment Facility, as well as rehabilitatoin and reactivation of wells needed to comply with drinking water regulations;
- Stoughton: Construction of water main connection between the MWRA system in Canton and Stoughton water mains.
- Walpole: Development of a Stormwater Management Master Plan, including a storm drain system inventory and identification of illicit discharges.
- Milton: Assessment of stormwater in Pine Tree and Unquity Brooks, identifying sources of contamination and methods of remediation.

While progress in implementing both the bacteria TMDL and the Phase II stormwater rules has been slow in most municipalities in the watershed, some progress has been made. For example, the city of Boston has eliminated its last Combined Sewer Overflow in the Neponset River Watershed. Water quality improvements are also underway or completed in Norwood (exfiltration of sewage in underdrains and illicit sewage discharges from Norwood Commerce Center) and Milton (remediation of sewage exfiltration at Lower Mills and illicit connections on Unquity Brook). In addition, the 2002 completion of Gillette Stadium in Foxborough produced significant environmental and ecological improvements including: "daylighting" a 3,300 foot-long stretch of the Neponset River that had previously run through culverts; a new 8.4 acre riparian corridor that allows much freer river flow and wildlife movement; and a new innovative 0.25 million gallons per day (MGD) wastewater treatment that incorporates a water reuse system, returning about 60% back to the stadium for toilet flushing. The state Department of Conservation and Recreation has continued to develop the Neponset River Greenway in Boston and Milton, and the first segment of

Figure 26: Neponset Topography

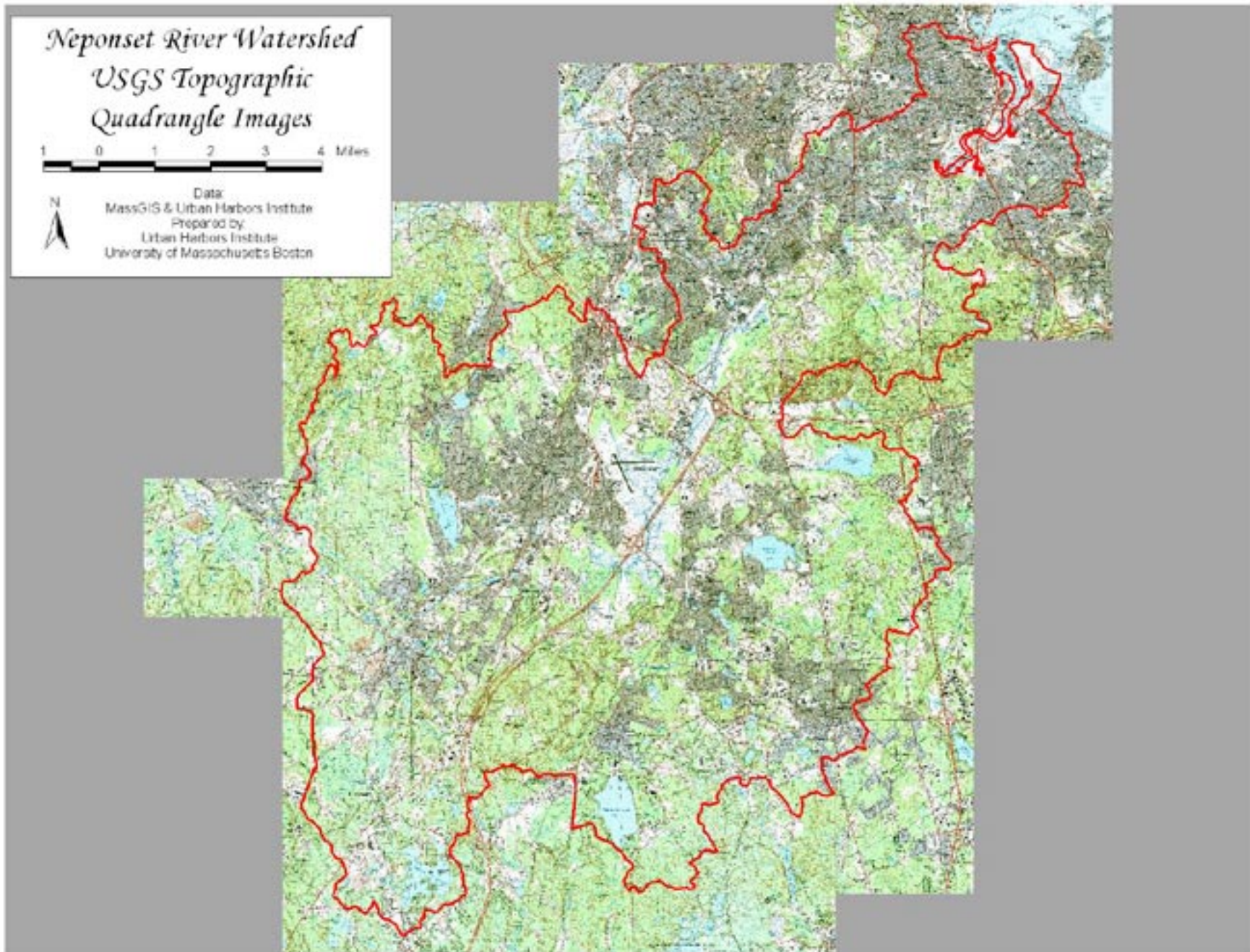


Figure 27: Neponset Orthophoto

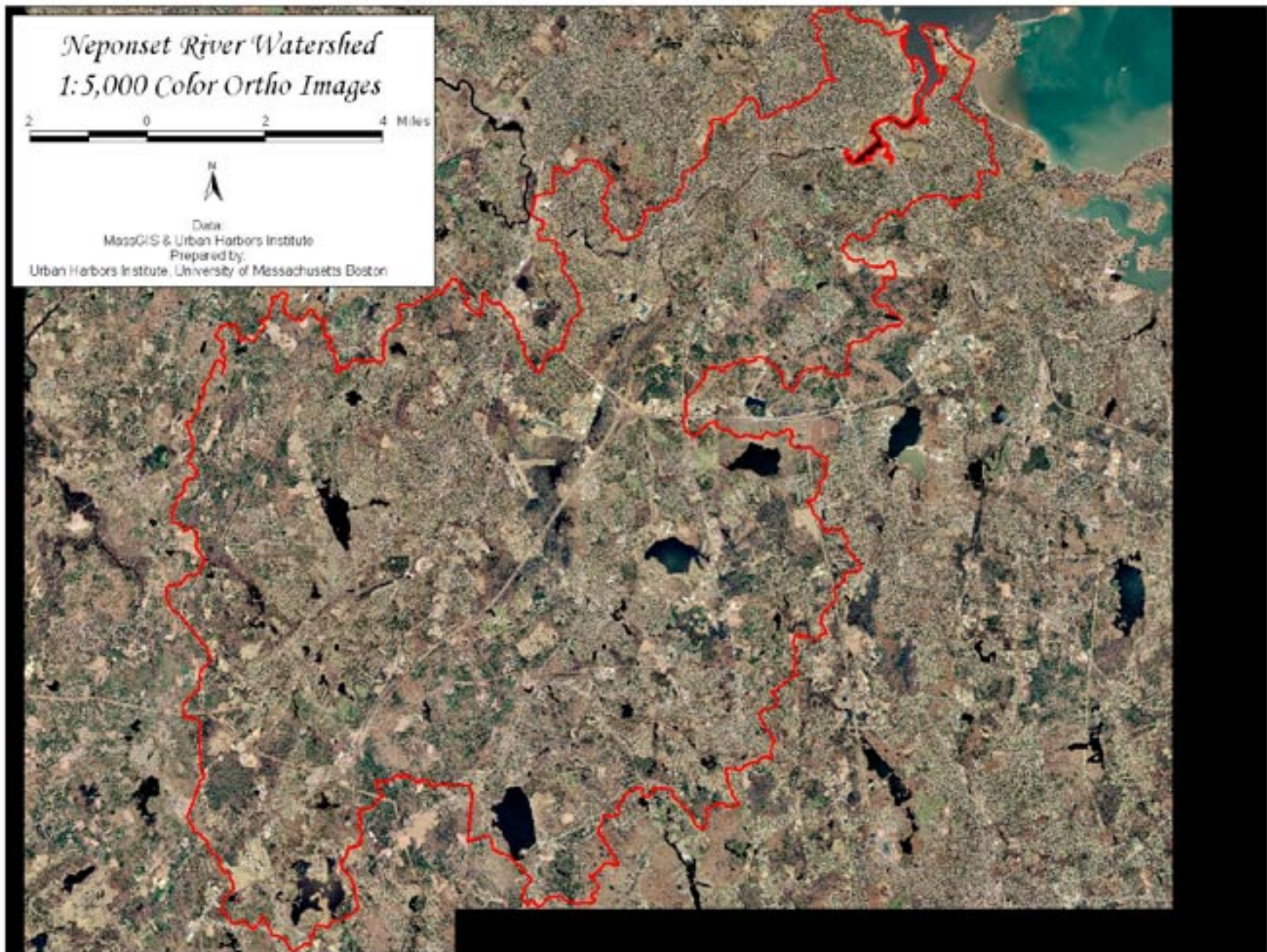


Table 8: Neponset Stream Segments

Stream Segment	Applicable Towns
Beaver Brook	Sharon
Beaver Meadow Brook	Canton & Stoughton
East Branch	Canton
Germany Brook	Norwood and Westwood
Gulliver Creek	Quincy and Milton
Hawes Brook	Norwood
Massapoag Brook	Sharon & Canton
Meadow Brook	Norwood
Mill Brook (off Germany Brook)	Dover & Westwood
Mill Brook (off Mine Brook)	Medfield & Dover
Mine Brook	Medfield & Walpole
Mother Brook	Boston, Dedham
Upper Neponset River mainstem (Nep Reservoir to East Branch)	Canton, Foxborough, Walpole, Norwood
Middle Neponset River mainstem (East Branch to Mother Br)	Boston, Canton, Dedham, Milton, Norwood, Westwood
Lower Neponset River mainstem (Mother Brook to Lower Falls)	Boston, Milton
Estuary Neponset River mainstem (Lower Falls to Dorchester Bay)	Boston, Milton, Quincy
Pecunit Brook	Canton
Pequit Brook	Canton, Randolph
Pine Tree Brook	Milton
Plantingfield Brook	Norwood, Westwood
Ponkapoag Brook	Canton & Randolph
Purgatory Brook	Norwood, Westwood
School Meadow Brook	Walpole, Sharon & Foxborough
Spring Brook	Walpole
Steep Hill Brook	Stoughton & Sharon
Traphole Brook	Norwood, Walpole & Sharon
Unquity Brook	Milton

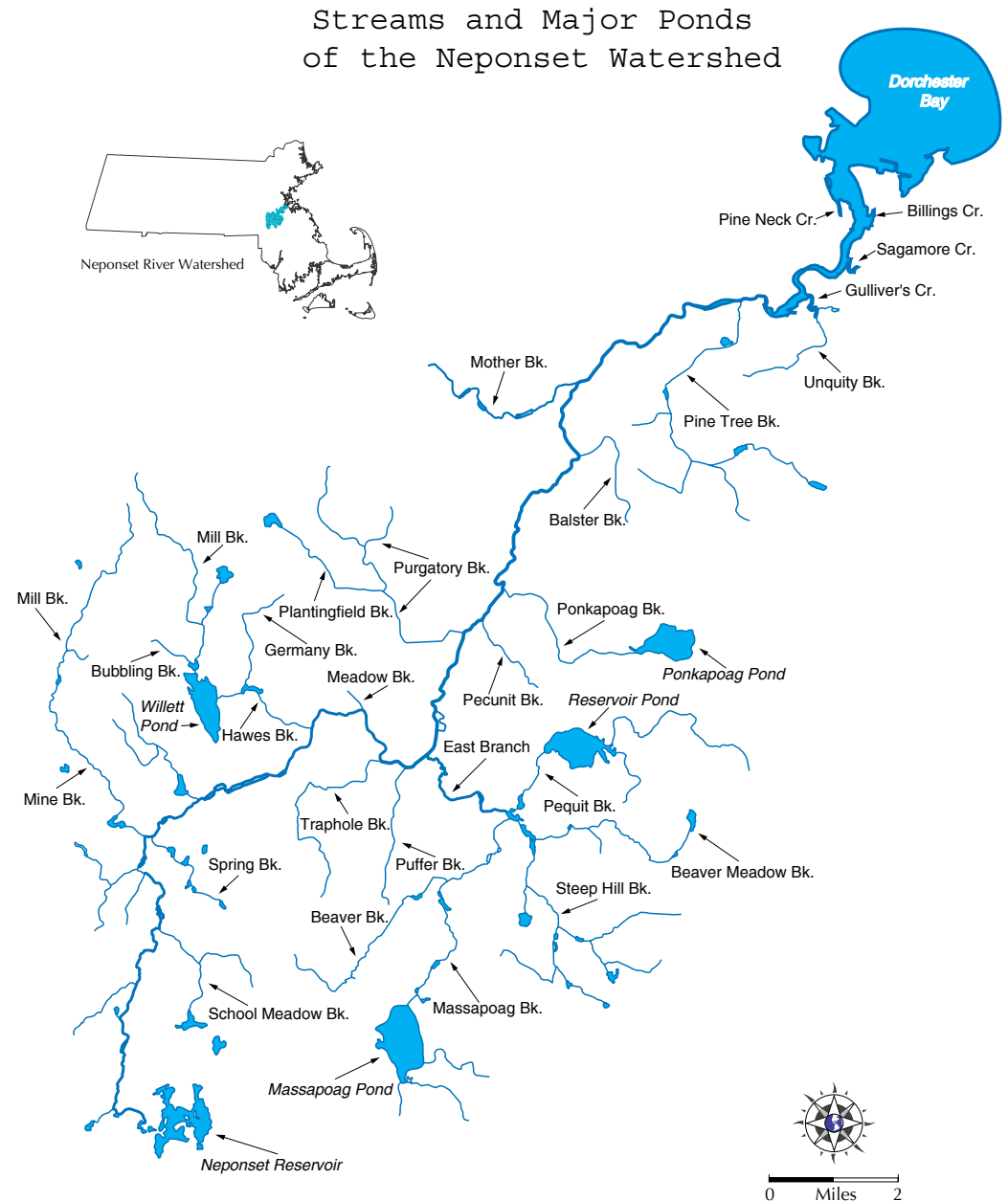
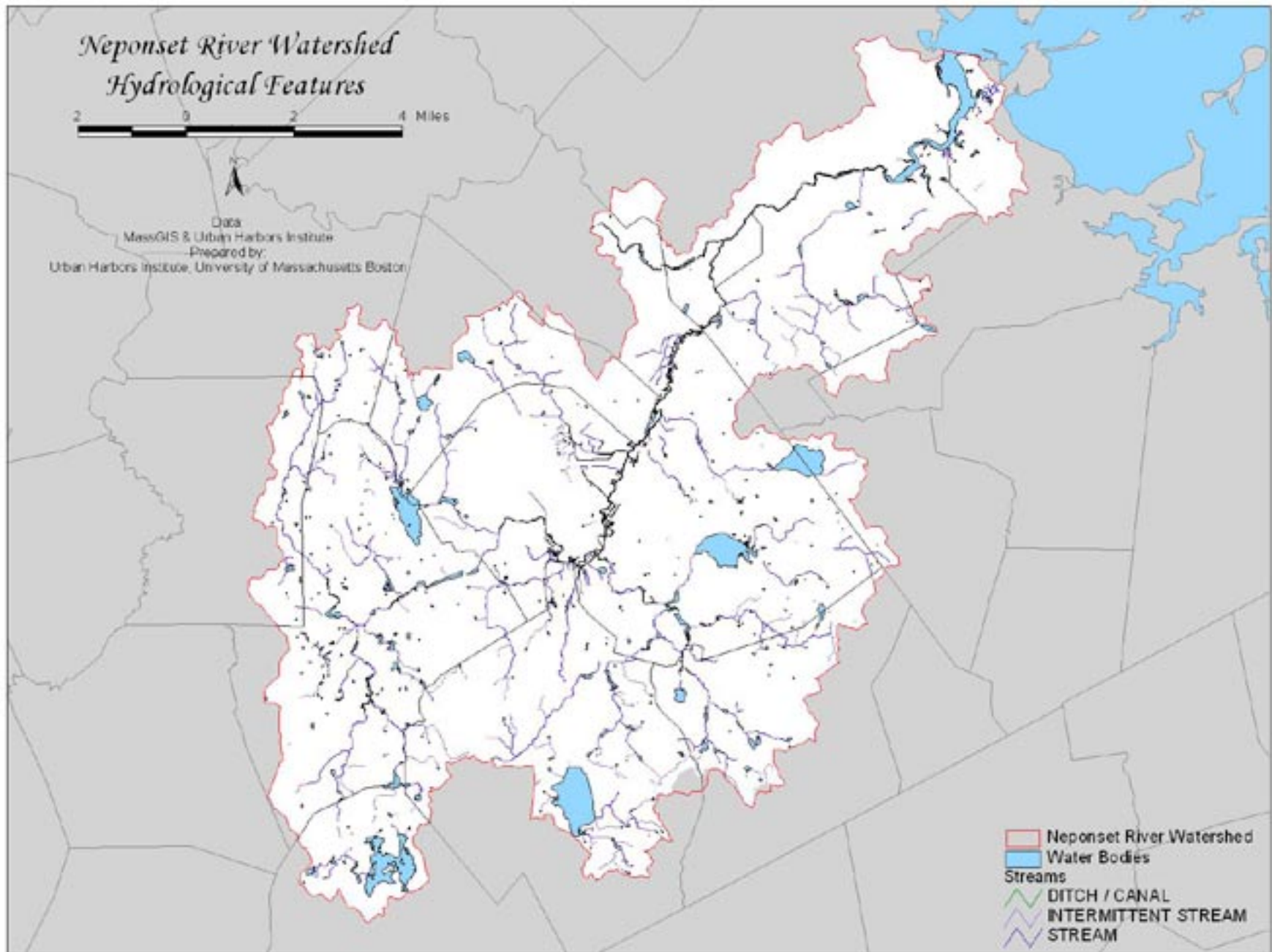


Figure 28: Neponset Hydrological Features



the Quincy Riverwalk was created. Finally, a significant amount of open space has been protected in towns such as Canton, Walpole, Milton, Westwood and Sharon, including such regionally significant properties

Table 9: Neponset Stream Segments by Town

Town	Applicable Streams
Boston	Mother Brook; Neponset River middle and lower mainstems & estuary
Canton	Beaver Meadow Brook; East Branch mainstem (aka Canton River), Massapoag Brook; Neponset River middle mainstem; Pecunit Brook; Pequit Brook; Ponkapoag Brook
Dedham	Mother Brook, Neponset River middle mainstem
Dover	Mill Brook (off Germany Brook) and Mill Brook (off Mine Brook)
Foxboro	Neponset River upper mainstem, School Meadow Brook
Medfield	Mine & Mill Brooks
Milton	Gulliver Creek; Neponset River middle & lower mainstem and estuary; Pine Tree Brook; Unquity Brook
Norwood	Germany Brook; Hawes Brook; Meadow Brook; Neponset River upper & Middle mainstem; Plantingfield Brook; Purgatory Brook; Traphole Brook
Quincy	Neponset River estuary, Gulliver Creek
Randolph	Pequit Brook, Ponkapoag Brook
Sharon	Massapoag & Beaver Brooks; Steep Hill Brook; School Meadow Brook, Traphole Brook
Stoughton	Beaver Meadow Brook; Steep Hill Brook
Walpole	Mine Brook, Neponset River upper mainstem; School Meadow Brook; Spring Brook; Traphole Brook
Westwood	Germany Brook, Mill Brook (off Germany Brook); Neponset middle mainstem; Plantingfield Brook; Purgatory Brook

as Forbes Woods, Signal Hill and Adams Farm, among others.

Note that the Neponset Watershed includes a large number of tributaries and several distinct mainstem segments. For the reader’s convenience a list of stream segments and the towns they flow through is included on Tables 8 and 9.

Does bacterial pollution limit fishing or recreational use?

Yes, it limits all three. Bacterial pollution, caused by human and animal wastes entering waterways through various mechanisms, is one of the most serious pollution problems in the Neponset Valley. While much of the watershed now meets state “fishable and swimmable” water quality standards during dry weather, there remain a number of serious dry-weather, point-sources of sewage pollution. During wet weather, bacterial pollution is much more widespread, with much of the watershed failing to meet fishable and/or swimmable standards.

The Neponset River mainstem and its tributaries, many of which in 1998 were included as “impaired waters” on the Massachusetts Department of Environmental Protection (DEP) “303(d) list” for pathogens, are now subject to a 2002 Neponset River Watershed Total Maximum Daily Load (TMDL) for bacteria (<http://www.mass.gov/dep/brp/wm/tmdls.htm>). The TMDL defines acceptable levels of bacteria indicator organisms to be allowed in discharges, and is in essence a plan for restoring primary and secondary contact recreation uses throughout the watershed.

DEPs “Boston Harbor 1999 Water Quality Assessment” (published in 2002 and including data as late as 2001; <http://www.mass.gov/dep/brp/wm/wqassess.htm>) used pathogen levels mainly to assess primary contact recreational uses (e.g., swimming) and secondary contact recreational uses (e.g., boating and fishing), in accordance with Massachusetts Water Quality Standards (314 CMR 4.00). The Fecal Coliform Bacteria Standard for Class B Waters (not designated as bathing beaches is: a geometric mean of < 200 cfu/100 ml in any representative set of samples and <10% of the samples > 400 cfu/100 ml.

DEP rated each assessed Neponset watershed segment as “supporting”, “partially supporting”, or “nonsupporting” of primary (swimming) and secondary (fishing and boating) contact recreation. (It also rated

Table 10: Neponset Bacterial Pollution Problem Areas (NepRWA 1/1/01 - 3/31/03)

Stream Reach	DRY WEATHER	WET WEATHER
Upper mainstem	ok	2
School Meadow	ok	2
Mine Brook	ok	2
Spring Brook	ok	2
Hawes Brook	3	3
Germany Brook	3	4
Mill	ok	2
Meadow Brook	4	4
Traphole Brook	ok	3
East Branch	NS	3
Pequit Brook	3	4
Steep Hill Br.	ok	3
Beaver Meadow	ok	4
Beaver Brook	2	ok
Massapoag trib.	ok	NS
Purgatory Brook	2	3
Pecunit Brook	2	3
Ponkapoag	ok	3
Middle Mainstem	2	3
Mother Brook	3	3
Pine Tree Brook	NS	2
Lower Mainstem	2	4
Unquity	3	4
Estuary	3	4

Scale	Description
ok	Fully supports swimming
1	Minor problems, swimmable 90% of the time or more
2	Significant problems, swimmable only 75 to 89% of the time
3	Serious problems, swimmable 50 to 74% of the time
4	Very serious problems, swimmable less than 50% of the time.
NS	Nonsupportive of swimming, according to DEP

Gulliver Creek in the lower Neponset as not supporting shellfishing due to pathogens.)

Operating under a DEP/EPA-approved Quality Assurance Project Plan (QAPP), the Neponset River Watershed Association (NepRWA) continued to monitor water quality in the Neponset Watershed from 2001 to March 2003, after the completion of DEPs Water Quality Assessment. Because the entire Neponset River Watershed has swimming as a designated use under the Clean Water Act, NepRWA feels that a problem exists any time and anywhere that sampling identifies nonswimmable conditions.

DEP and NepRWA found that serious pathogen problems continue, especially in Hawes Brook and nearly all of the Neponset Watershed downstream of it, despite issuance of the bacteria TMDL in 2002. The problems on some segments (e.g., Beaver Meadow, Traphole, Steep Hill, and Ponkapoag Brooks) seem to be largely confined to wet weather situations, but many segments are affected in wet and dry weather alike.

As part of the continuing volunteer water quality monitoring conducted from 2001 - 2003, NepRWA identified some additional stream segments with bacteria problems that were not identified in DEP's 1999 Boston Harbor Assessment Report (published in 2002). These segments included the upper Neponset River mainstem, School Meadow Brook, Mine Brook, Traphole Brook, Pequit Brook, Beaver Brook and Pecunit Brook.

As part of the proposed Massachusetts (Draft) DEP Year 2004 Integrated List of Waters public review/comment process, NepRWA on May 24, 2004 recommended that five stream segments be added to the Category 4a list of waters subject to the Neponset River Watershed TMDL for bacteria: Pecunit Brook, Steep Hill Brook, Spring Brook, Beaver Brook and an unnamed tributary to Massapoag Brook. NepRWA's recommendations were based on citizen monitoring data from 2001 to 2003. DEP will review this data for consistency with Massachusetts Surface Water Quality Standards (MA DEP 1996). Upon completion of DEP's review, any additional assessment updates or changes in stream segments will be placed in the appropriate categories of a (Final) Massachusetts Year 2004 Integrated List of Waters.

Sources of bacterial pollution include:

- Sewer infrastructure problems (including Sanitary Sewer Overflow [SSOs], illicit connections, inflow, and exfiltration). Hawes Brook, Pine Tree Brook and Unquity Brook are known to have experienced SSOs. Meadow Brook has experienced exfiltration through underdrains, but the town of Norwood is actively addressing the problem. Because of the high bacterial counts in all the stream segments listed in the table on the next page, it is strongly suspected that sewer problems are a contributing factor in every Neponset River Watershed community except Sharon, which is entirely on septic.
- Dams/impoundments, water withdrawals, infiltration of ground and rain water into deteriorating sewer pipes, and other causes of low flow. See discussion of dissolved oxygen and low streamflows below. Low flow contributes to bacterial pollution by reducing the amount of water in streams that would otherwise dilute bacterial levels.
- Runoff from impervious surfaces – e.g., animal wastes -- particularly in the middle and lower Neponset mainstem and estuary, the East Branch mainstem, Mother Brook, Unquity Brook, Germany Brook, Pine Tree Brook. This is also presumed to be a problem in all other stream segments near major transportation corridors and shopping centers.
- Failing and inadequately maintained septic systems. 35% of the watershed is on septic systems outside Boston and Quincy. The scientific literature has clearly established that septic systems are a cause of fecal coliform bacteria in surface waters, especially when those systems are malfunctioning. Studies from around the country have demonstrated that a certain percentage of septic systems in any given locale are failing or underperforming. The average failure rate is around 20% (Schueler 2002.) Failed septic systems are specifically suspected near the headwaters of Unquity Brook.

Does nutrient pollution pose a threat to aquatic life or other uses?

Yes. Nutrients are the most widespread problem in the Neponset River Watershed. Elevated nutrient levels are a primary problem for the success of aquatic flora and fauna and a major factor in lost recreational value due to excessive weed growth, especially in ponds. Nutrients enter waterways through sewage pollution and through stormwater runoff that carries fertilizers, animal wastes, and other nutrients. Nutrient pollution contributes to excessive plant and algae growth in aquatic systems that in turn can make waterways malodorous and unsuitable for recreation and for aquatic life, as waterways become organically enriched and dissolved oxygen (DO) is reduced.

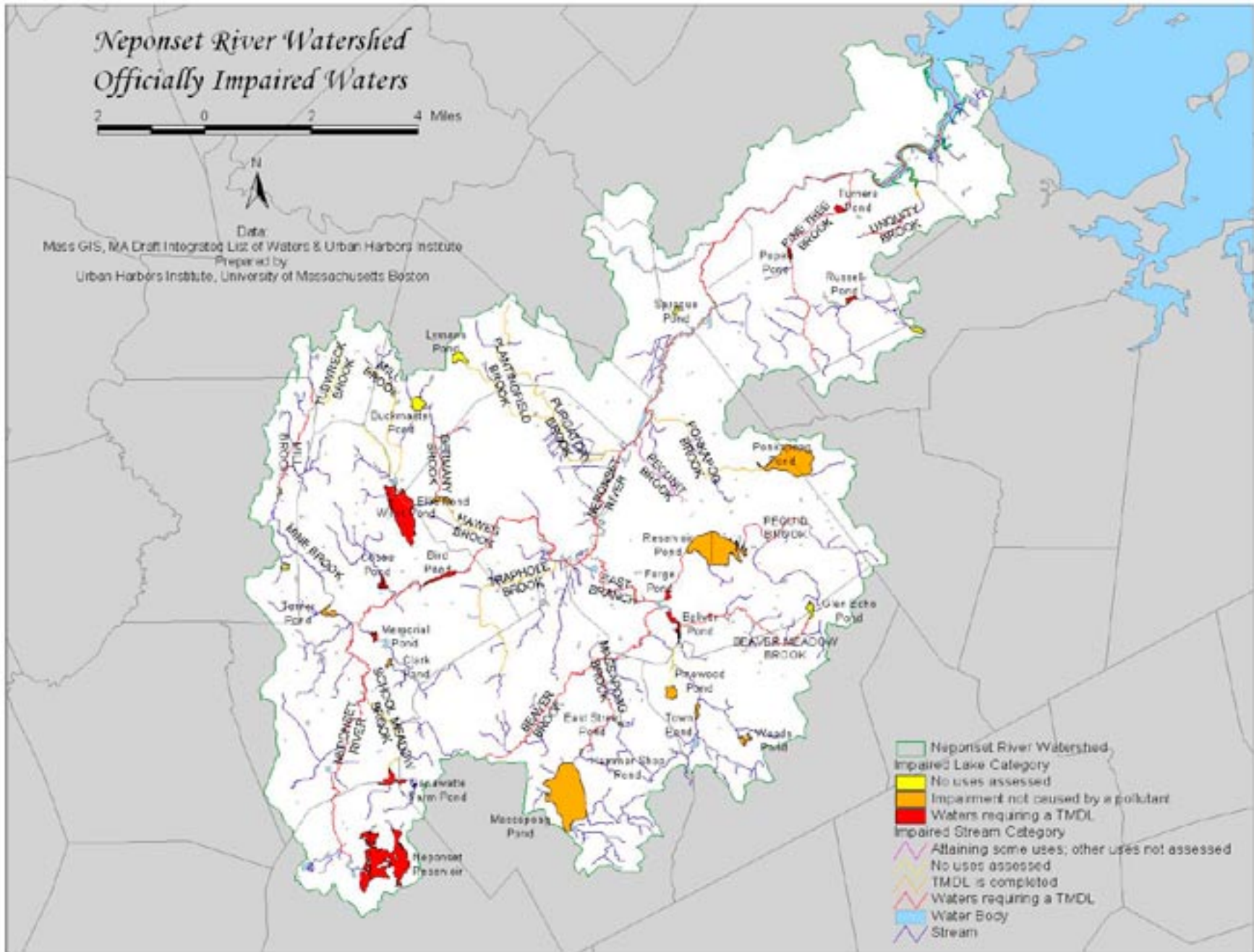
Assessing nutrient problems, as well as finding solutions to these problems, is particularly difficult in an aquatic environment like the Neponset River basin that includes ponds, freshwater rivers/streams, and a saltwater estuary. Each type of water body is threatened by different levels of different types of nutrients (e.g., phosphorous vs. nitrogen) and may be more or less sensitive to those nutrients.

Thus phosphorous levels, which may not be high enough to cause problems in streams, become a problem when stream water enters more phosphorous-sensitive ponds. Similarly, nitrogen in the freshwater Neponset mainstem may not pose a problem until it reaches the more

Table 11: Neponset Stream Segments on DEPs 2002 Integrated List of Waters impaired due to nutrients

Segment Name	Status per DEP 1999
Upper mainstem	Support/Alert Status
Germany Brook	Partial Support
Meadow Brook	Partial Support
Trib. to Steep Hill	Partial Support
Massapoag Brook	Partial Support
Mother Brook	Partial Support
Unquity Brook	Partial Support

Figure 29: Neponset Officially Impaired Waters



nitrogen sensitive estuary. As a result, “acceptable” nutrient levels in a stream may be a function of more sensitive systems located downstream. In the Neponset Watershed, freshwater ponds are generally the limiting criteria for phosphorous. The estuary is generally the limiting resource for nitrogen levels in the river. However, the rainbow smelt run along the mainstem Neponset at Lower Mills is also very sensitive to nutrient levels that promote the growth of algae that kill smelt eggs.

The difficulty of determining acceptable nutrient levels is further complicated by the fact that the Massachusetts Surface Water Quality Standards do not include specific numeric thresholds for nutrient levels, but rather general narrative criteria under various “uses” including aquatic life use, and aesthetics. DEP, however, is currently working on developing specific nutrient numeric criteria for the three main types of waterbodies; lakes, rivers and coastal embayments.

The DEP 1999 Boston Harbor Assessment Report looked at nutrient levels mainly to assess the aquatic life designated use. Seven stream segments in the Neponset Watershed as well as Cobbs and Turners Ponds are on DEP’s “303(d) list” of waters impaired by nutrients (more precisely, they are listed in the proposed “Massachusetts Year 2004 Integrated List of Waters,” as Category 5 “Waters requiring a TMDL” for nutrients). The DEP Assessment rated six of the seven 303(d) stream segments as “partially supporting” aquatic life due to nutrients, with one segment “supporting” aquatic life but with “Alert Status” given for possible nutrient problems. The DEP assessment put eight additional stream segments, which are not on the 303(d) list, on “Alert Status” for nutrients.

NepRWA’s 2001 – 2003 citizen monitoring found significant problems virtually everywhere it sampled. Found most frequently were excessive levels of Total Nitrogen and Orthophosphates, but also found at some sites were excessive Nitrate + Nitrite, Total Phosphorous and Ammonia levels. Only one stream segment of the twenty-five sampled, Pequit Brook, was found to have no significant nutrient problems. Based on these findings, NepRWA recommended that DEP add 18 Neponset watershed stream segments to the 303(d) list. It should be noted, however, that the criteria NepRWA used to reach this conclusion were drawn from the scientific literature and were not based on the current Massachusetts Water Quality standards.

In addition to listing stream segments as impaired because of excessive nutrients, DEP has listed a number of waterways as impaired because of eutrophic conditions and/or noxious aquatic plants. Excessive nutrients are a cause of eutrophic conditions and noxious aquatic plants, especially in ponds, which can destroy fish habitat and severely restrict swimming and boating. The DEP Assessment found eutrophic conditions near the headwaters on the mainstem (Neponset Reservoir), in Crack Rock Pond and in Spring Brook. Very large historic, industrial phosphorous discharges from Foxborough Company on the Neponset Reservoir (1972 – 1988) are still creating eutrophic conditions there. Crack Rock Pond in Foxborough is also eutrophic even though Foxborough State Hospital

Table 12: Neponset Stream Segments Recommended by NepRWA to be added to Category 5 on DEP’s 2004 Integrated List of Waters due to impairment by nutrients

Segment Name	Status per DEP 1999
Hawes Brook	Support/Alert
Traphole Brook	Support/Alert
Beaver Meadow Brook	Support
Purgatory Brook	Support/Alert
Pecunit Brook	Support/Alert
Ponkapoag Brook	Support/Alert
Middle mainstem	Support/Alert
Pine Tree Brook	Support/Alert
Lower mainstem	Support/Alert
School Meadow	Not Assessed
Mill Brook (Mine Br. trib)	Not Assessed
Mine Brook	Not Assessed
Spring Brook	Not Assessed
Mill Brook (Hawes Br. trib)	Not Assessed
East Branch	Not Assessed
Steep Hill Brook	Not Assessed
Beaver Brook	Not Assessed
Neponset Estuary	Not Assessed

has ceased discharging effluent into it. In Spring Brook, the Town of Walpole has been addressing the problem of nuisance aquatic vegetation caused by eutrophic conditions.

The upper and middle portions of the mainstem of the Neponset River are on DEPs list of impaired waters due to noxious aquatic plants, although neither DEP nor NepRWA found recent evidence of the problem in these segments. NepRWA also noted an historic problem in the Spring Brook tributary, although the Town of Walpole has now initiated vegetation control projects to deal with it. Of far greater concern is the fact that nearly every pond in the watershed that was assessed by DEP was found by them to be suffering from noxious aquatic plants and exotic species.

Sources of nutrient pollution:

- Runoff of fertilizers and animal wastes, direct dumping of grass clippings from lawns and golf courses, and lack of riparian buffer strips particularly along Germany Brook, Ponkapoag Brook, Steep Hill Brook, and Unquity Brook. Furthermore, these are suspected contributing causes in virtually every community in the watershed.
- Failing and inadequately maintained septic systems. See also bacterial pollution above.
- Sewer infrastructure problems, including sanitary sewer overflows (SSOs), illicit connections, and exfiltration. See also bacterial pollution above.
- Dams/impoundments, water withdrawals, infiltration of ground and rain water into deteriorating sewer pipes, and other causes of low flow. See also discussion of dissolved oxygen and low streamflows below.
- Historic industrial discharges are a known source for the upper mainstem, Neponset Reservoir and Crack Rock Pond, while being suspected on other segments.
- Runoff from impervious surfaces; e.g., animal wastes. See also bacterial pollution above.

Do dissolved oxygen (DO) levels support aquatic life?

Generally, yes, though there are limited data upon which to reach definitive conclusions. Most often the problems associated with low DO were identified by visual observation of low streamflows, rather than extensive monitoring data showing low DO.

Dissolved oxygen, the amount of oxygen available in the water, is a critical consideration for the survival of aquatic life. Inadequate DO levels, even for very short periods of time, cause aquatic life to suffocate, and can result in dramatic events such as fish kills. Even when oxygen levels are not low enough to cause acute fish kills, moderate reductions in oxygen levels can lead to the elimination of certain sensitive, native species such as trout, and an overall shift in aquatic life populations toward less sensitive species such as “pond” fish (e.g., sunfish, carp and small mouth bass). Low DO levels can be caused by nutrient enrichment (see discussion above), which leads to excessive algae growth and subsequent decay and results in a shortage of DO in the water.

DO levels are also closely tied to water temperatures and instream flow levels. DO levels drop when water temperatures rise. Streams and ponds are vulnerable to high water temperatures when they experience low flows or are impounded by dams (see lengthy discussion of these issues below).

DEPs 303(d) list identifies most of the watershed as being impaired by organic enrichment/low DO and/or low flow (proposed Massachusetts Year 2004 Integrated List of Waters, Category 5). DEP and NepRWA found problems on most, but not all, of these segments. NepRWA identified four stream segments not in Category 4C of the current MA DEP (Draft) 2004 Integrated List of Waters (impairments not caused by a pollutant) that suffer from low flow problems – the Massapoag, School Meadow, Spring and Steep Hill Brooks -- and has recommended to DEP that they be added.

Causes of Organic Enrichment, low DO and low flow:

- Dams and impoundments, channelization and diversion of water into culverts. Impoundments greatly increase water

temperatures while channelization and culverting increase the rate at which stormflows are transported into the ocean, thus reducing water levels in the streams themselves. These kinds of stream modifications are common throughout the Neponset Watershed and are particularly known to be problematic on the East Branch, Massapoag Brook, and Pequit Brook. Diversion and culverting are suspected as contributing factors on Unquity Brook.

- Depletion of groundwater levels through infiltration into broken sewer pipes. See discussion of bacterial pollution above.
- Water withdrawals and subsequent failure to recharge (recycle) wastewater within the watershed from which it was withdrawn. This is a problem through much of the watershed and particularly in Beaver Brook, Beaver Meadow Brook, East Branch mainstem, Pequit Brook. It is suspected as a problem on School Meadow Brook, Mill/Mine Brook, and Steep Hill Brook.
- Dumping of grass clippings/lack of riparian buffer. These are widespread problems that are known to be particularly intense along Germany, Steep Hill and Unquity Brooks.
- See also causes of nutrient pollution cited above, as nutrients are major cause of eutrophication and excessive plant growth, which in turn deprives water of dissolved oxygen
- See also watershed hydrology below.

Table 13: Neponset Stream Segments Affected by Organic Enrichment, Low Dissolved Oxygen (DO), and Low Streamflows (NepRWA)

Stream Segment	303(d) list?	Aquatic Life Status per DEP 1999	NepRWA Results/Remarks
East Branch	Yes	Nonsupport	Flow alterations/organic enrichment
Mill Brook (Mine Br)	Yes	Part. Support	Severe low flows at times
Beaver Brook	Yes	Part. Support	Low flows
Mother Brook	Yes	Part. Support	No temp, few DO or flow prob's
Unquity Brook	Yes	Part. Support	Low flows
Pequit Brook	Yes	Support/Alert	Low flows, serious DO prob's
Lower Mainstem	Yes	NA/Alert	No temp, DO or flow prob's
Beaver Meadow Br.	Yes	Supports	Low base flows
Upper mainstem	Yes	No problems	No temp or DO prob's found
Mine Brook	Yes	N/A	Severe low flow, some DO prob's
Middle mainstem	Yes	N/A	No temp or DO prob's found
Pine Tree Brook	Yes	N/A	No temp or DO prob's found
Neponset Estuary	Yes	N/A	N/A
Massapoag Brook	No	Part. Support	Low flows; Category 4C listing recommended
School Meadow Br.	No	N/A	Low flows, occasional DO prob's; Category 4C listing recommended
Spring Brook	No	N/A	Low flows; Category 4c listing recommended
Steep Hill Brook	No	N/A	Low base flows; Category 4c listing recommended
Ponkapoag Brook	No	N/A	Occasional DO problem
Cobbs Pond	Yes	Nonsupport	N/A
Ganawatte Pond	Yes	Nonsupport	N/A
Turner Pond	Yes	Nonsupport	N/A

Are there other indicators that limit use of the watershed?

Yes, there are three other categories of relevant indicators:

- Metals & other Toxics
- Total Suspended Solids (TSS), Turbidity & Siltation; and
- Aesthetic Impairments.

Metals and Other Toxics

Pollution of sediments or the water column with toxics such as heavy metals and PCBs poses obvious threats to public health, recreational uses and the success of aquatic life. The Massachusetts Department of Public Health has issued a statewide health advisory limiting consumption of fish for children and childbearing-age women due to possible contaminants in edible fish tissue. Thus all waters covered by the DEP Assessment are either “non-supportive” of fish consumption or are “unassessed.” The same is true for “Open Shellfish Areas” in the Neponset Estuary.

The DEP Assessment looked at metals primarily to assess the aquatic life designated use. The Neponset River mainstem, as well as the East Branch of the Neponset River, are on the 303(d) list of waters impaired due to metals, as is Bird Pond. The major concern is historically contaminated sediments. Contamination is also a concern in the Neponset Reservoir at the headwaters of the Neponset due to historic cadmium discharges.

Table 14: Neponset 303d Listings for Metals and Other Toxics (DEP)

Metals & Toxics	303(d) Listed?	Problem Identified
Neponset River	Yes	PCBs in sediments
East Branch	Yes	Various metals in sediments
Bird Pond	Yes	PCBs in sediments
Willett Pond	Yes	Mercury
Massapoag Lake	No	Mercury fish advisory

PCBs

4.7 miles of the mainstem in the upper and middle portions of the watershed, as well as 0.9 miles in the lower portion, are designated in the DEP Assessment as “nonsupportive” of the fish consumption designated use due to PCBs found in fish tissue (the remaining segments in the Basin are “unassessed”). Bird Pond was also rated as “nonsupportive” of fish consumption because of PCBs, and Neponset Estuary was rated as “nonsupportive” of both fish consumption and shellfishing. Work by the USGS (as yet unpublished) shows high levels of PCBs in mainstem sediments from Hyde Park to Lower Mills. The PCB fish consumption advisory for the upper mainstem may also be indicative of PCB sediment contamination in that reach. Finally, the U.S. Army Corps of Engineers in 2002 took bottom-sediment core samples behind the two most downstream dams on the Neponset mainstem, the Walter Baker and the Tileston and Hollingsworth impoundments, and found they contain many contaminants, most notably PCBs (publication pending).

Mercury

The DEP Assessment lists Willett Pond as nonsupportive of fish consumption due to mercury. A fish advisory has also been issued for Massapoag Lake because of mercury, and on that basis NepRWA has asked DEP to include the lake on its 303(d) list (proposed Massachusetts Year 2004 Integrated List of Waters, Category 5). None of the other ponds in the subwatershed were assessed, although mercury contamination of water bodies is widespread throughout the state.

Sources of metals/toxic contamination:

- Historic industrial discharges that have resulted in contaminant accumulation in river bottom sediments are known to be problems in the Neponset Reservoir, Neponset River middle mainstem, and East Branch mainstem, and are suspected elsewhere.
- Urban runoff, especially along transportation systems is suspected as an ongoing source.
- Ongoing discharges from contaminated sites via erosion, groundwater flow or surface runoff (see Figure 43 on “21E” hazardous waste sites), particularly suspected at Lewis Chemical in Hyde Park.
- Resuspension and transport of river bottom and drainage

system sediments contaminated by historic discharges is known to be a problem at Invensys Corporation in Foxboro and is suspected elsewhere.

- Airborne deposition of mercury is the suspected source in Willett Pond and Massapoag Lake both of which otherwise have good water quality and no historic upstream industrial uses.

Total Suspended Solids (TSS), Turbidity and Siltation.

TSS, turbidity and siltation pose a threat to the aquatic life designated use of the watershed, as well as to primary and secondary contact recreation. The upper portion of the mainstem of the Neponset River is on the Category 5 list of waters impaired by TSS, turbidity and siltation, while the middle portion of the mainstem and the estuary are listed for turbidity alone. Unquity Brook is listed for siltation.

In recent monitoring neither DEP nor NepRWA found identifiable problems on the upper or middle mainstem. Neither assessed the Neponset Estuary regarding this problem. However, it is important

to note that TSS and siltation pollution occurs primarily during short, infrequent, high-intensity rain “events”, and thus is unlikely to be fully reflected in the data. NepRWA and DEP previously noted a severe sedimentation problem near the headwaters, but expect that environmental improvements that accompanied the redevelopment of Gillette Stadium will alleviate this problem.

Listed in the DEP Assessment as being “nonsupportive” or only “partially supportive” of recreational uses due to turbidity are three ponds (Neponset Reservoir, Gannawatte Pond and Turners Pond).

Problems were identified by both DEP and NepRWA on some stream segments which are not on the Category 5 list of impaired waters. DEP rated Traphole Brook as “supporting” aquatic uses, but with Alert Status for instream sedimentation. NepRWA noted severe sedimentation on the lower portion of Traphole Brook that is degrading otherwise high quality fish habitat. NepRWA also noted sedimentation problems on Pequit Brook, the upper reaches of Beaver Meadow Brook, and Pine Tree Brook. NepRWA has recommended to DEP that these four steam segments be added to the Category 5 list of impaired waters.

Regarding the aesthetics designated use of the Neponset River Watershed, DEP rated Unquity Brook as “nonsupportive” of aesthetic uses due to siltation. It rated the East Branch as “supportive” of aesthetic uses, but with an Alert Status for high instream turbidity.

Causes of TSS, siltation and turbidity:

- Urban runoff/storm sewers throughout the watershed are the primary suspected source. Stormwater is particularly known to be a problem on Unquity Brook, East Branch at Forge Pond, the Neponset mainstem near Route 1, Pine Tree Brook and Traphole Brook.
- Erosion from construction sites throughout the watershed, including at Pine Tree Brook, the Neponset mainstem at River Ridge Office Park and development adjacent to Bird Pond.
- Exposed soils and areas where the riparian buffer has been eliminated are found throughout the watershed, including at the City of Boston Salt shed in Hyde Park.
- Illegal disposal of sand-laden snow into wetlands and

Table 15: Neponset Stream Segments Impacted by TSS, Turbidity & Siltation

Stream Segment	Category 5 Impaired?	1999 DEP Assessment	NepRWA sampling/ recommendations
Upper mainstem	Yes	No problems	Stadium improvements should solve sedimentation
Neponset Estuary	Yes	N/A	N/A
Unquity Brook	Yes	Non-Support	No problems identified
East Branch	No	Support/Alert	No problems identified
Hawes Brook	No	Support/Alert	No problems identified
Traphole Brook	No	Support/Alert	Severe sediments lower reach, 303(d) Listing Recommended
Pequit Brook	No	No problems	Sedimentation, 303(d) Listing Recommended
Pine Tree Brook	No	N/A	Sedimentation, 303(d)Listing Recommended
Beaver Meadow	No	Support	Sedimentation in upper reaches, 303(d) Listing Recommended

waterways is extensive, including particularly at Stop and Shop in Hyde Park

Aesthetic Indicators.

The DEP Assessment rates a number of segments as “nonsupportive” or “partially supportive” of aesthetic uses due to trash & debris; color, odor and/or taste; and oil and grease. See also the previous discussion on TSS, Turbidity and Sedimentation.

Trash and Debris

DEP rates only two stream segments as being “nonsupportive” of aesthetic uses for this reason – the lower mainstem and Unquity Brook. Four more segments are rated as only “partially supportive” – Hawes Brook, Germany Brook, the middle mainstem and the Estuary. Finally, another four are rated as “supporting” aesthetic uses, but on Alert Status for trash & debris – the upper mainstem, Traphole Brook, Beaver Meadow Brook and Mother Brook.

Color, Odor and Taste.

Three stream segments are on the 303(d) list for taste, odor and color: Germany Brook, Mother Brook and Meadow Brook. Meadow Brook is the only segment rated by DEP in its 1999 Assessment as “nonsupportive” of aesthetic uses due to color, odor and taste (the authors are curious as to who at DEP made the determination of “nonsupport” for taste!). Germany Brook is rated as “partially supports” due to a red color, possibly related to leakage from the now closed Norwood Landfill. The problems in Mother Brook were not noted in the DEP Assessment

NepRWA has recommended to DEP that Hawes Brook and the upper mainstem of the Neponset River be added to the 303(d) list of waters impaired by taste, odor and color. Hawes Brook, which is downstream of Germany Brook, is listed by DEP in the 1999 Assessment as only “partially supporting” aesthetic uses due to odors. Past inspections at the surface water discharge point for Certaineed Roofing on the upper mainstem in Norwood have also indicated color and turbidity problems.

Oil and Grease

The middle and lower (nontidal) mainstem of the Neponset are on the 303(d) list for waters impaired by oil and grease.

Causes of Aesthetic Impairments

- Urban runoff and storm sewers throughout the watershed, especially known to be a problem along middle mainstem, Hawes Brook, Unquity Brook and Mother Brook.
- Illegal dumping throughout the watershed, especially lower Neponset mainstem and Mother Brook.
- Various sewer system problems.

Do water supply, interbasin transfer or inflow and infiltration have a significant impact on instream flow levels?

Yes, these activities have a very substantial impact on instream flows. The negative impacts of reduced instream flow include curtailment of recreational activities, increased temperature and decreased oxygen, increased concentration of bacterial and nutrient pollutants, increased risk of human exposure to contaminated river-bottom sediments, and a substantial reduction in the area and quality of aquatic habitats, with resulting depletion of resident and anadromous fisheries. Anadromous fish are those that live in the ocean but lay their eggs in freshwater rivers and streams.

The key limiting uses which would define “adequate” instream flow levels for the Neponset River include flows necessary to preserve recreation (canoeing) on the freshwater mainstem through Boston during the summer, flows needed to ensure adequate inundation of existing anadromous fishery spawning grounds at Lower Mills from April through July, and flows needed to sustain viable resident freshwater fisheries throughout the watershed during the dry summer months.

See discussion of dissolved oxygen and low streamflows, above, for a stream segment by stream segment analysis of the extent of low instream flow levels.

Water Supply and Interbasin Transfer

Some 220,000 people are served by water supply systems that depend in whole or in part on groundwater pumped from the Neponset Valley. Twenty-one percent of the water pumped is returned to the Neponset River Watershed as septic system effluent, while sixty-five percent of

wastewater is transferred out of basin by sewers. (NepRWA, “Neponset Basin Water Use Efficiency Report,” 1998) Mechanisms through which water is lost include: water supplied to homes and businesses located across watershed and/or subwatershed boundaries; wastewater transferred out of the Neponset River Watershed by regional sewer systems; and water transferred to the atmosphere after being used to irrigate ornamental landscapes (including golf courses). Water losses are further exacerbated by aging sewer infrastructure, which allows an even greater amount of groundwater to leak into deteriorated sewer lines where it is transferred outside the watershed.

Even when one considers the substantial amount of water imported to the Neponset Valley via the MWRA water supply system, the Neponset incurs a net loss of more than 9 billion gallons of water per year which is equivalent to almost 25% of the Neponset River’s annual discharge.

This net loss has been increasing for the past several decades because: sewer lines have been extended to service both new development and

existing development formerly serviced by septic systems (from 1989 to 1997 the percentage of the basin’s population serviced by sewers increased by 14%); municipalities are developing new water supply sources in the Neponset Watershed to meet the demands of a growing population and, in some cases where population is not growing, to meet increased per capita demands for seasonal landscape irrigation water; municipalities are developing new Neponset water supply sources as a substitute for imported MWRA water whose cost is rising as the MWRA implements capital improvements to come into compliance with the Federal Safe Drinking Water Act; and finally, affluent homeowners are installing private irrigation wells to avoid compliance with the increasingly frequent application of outdoor water use restrictions on publicly supplied water.

Water Supply Seasonality

Water withdrawals for public water supply are considerably greater in summer (May to September) than in winter (October to April). Almost all of the increased summer water use is due to watering of lawns, gardens, golf courses, etc. DEP currently sets as a goal for moderately or highly stressed watersheds a summer/winter water use of 1.2 to 1, allowing towns to pump 20% more water in summer months than in the winter. In three towns studied in the Neponset River Watershed, the ratio was 1.8 to 1 in Canton, 1.4 to 1 in Sharon, and 1.1 to 1 in Stoughton.

This sample is a good representation of the rest of the basin. Canton is a community that relies heavily on MWRA water supply, as well as its own local sources, while Stoughton and Sharon have relied mostly on their own local water supply, in addition to buying water from surrounding communities. Towns that rely on their own local water supply rather than importing it from far away usually implement more rigorous water conservation standards in order to lessen substantial drawdown of local aquifers.

Table 16: Neponset Municipal Water Supply Sources and Wastewater Infrastructure

Town	Water Supply Sources			Wastewater Infrastructure		
	Neponset	MWRA	Other	Septic	MWRA	Other
Boston	None	100%	None	None	100%	None
Canton	44%	56%	None	30%	70%	None
Dedham	71%	None	29%	8%	92%	None
Dover	66%	None	34%	100%	None	None
Foxboro	58%	None	42%	95%	None	5%
Medfield	79%	None	33%	67%	None	33%
Milton	None	100%	None	10%	90%	None
Norwood	None	100%	None	2%	98%	None
Quincy	None	100%	None	None	100%	None
Sharon	47%	None	53%	98%	None	2%
Stoughton	45%	None	55%	36%	61%	None
Walpole	100%	None	None	36%	64%	None
Westwood	71%	None	29%	13%	87%	None
TOTAL	47%	34%	19%	21%	56%	23%

Figure 30: Neponset Development

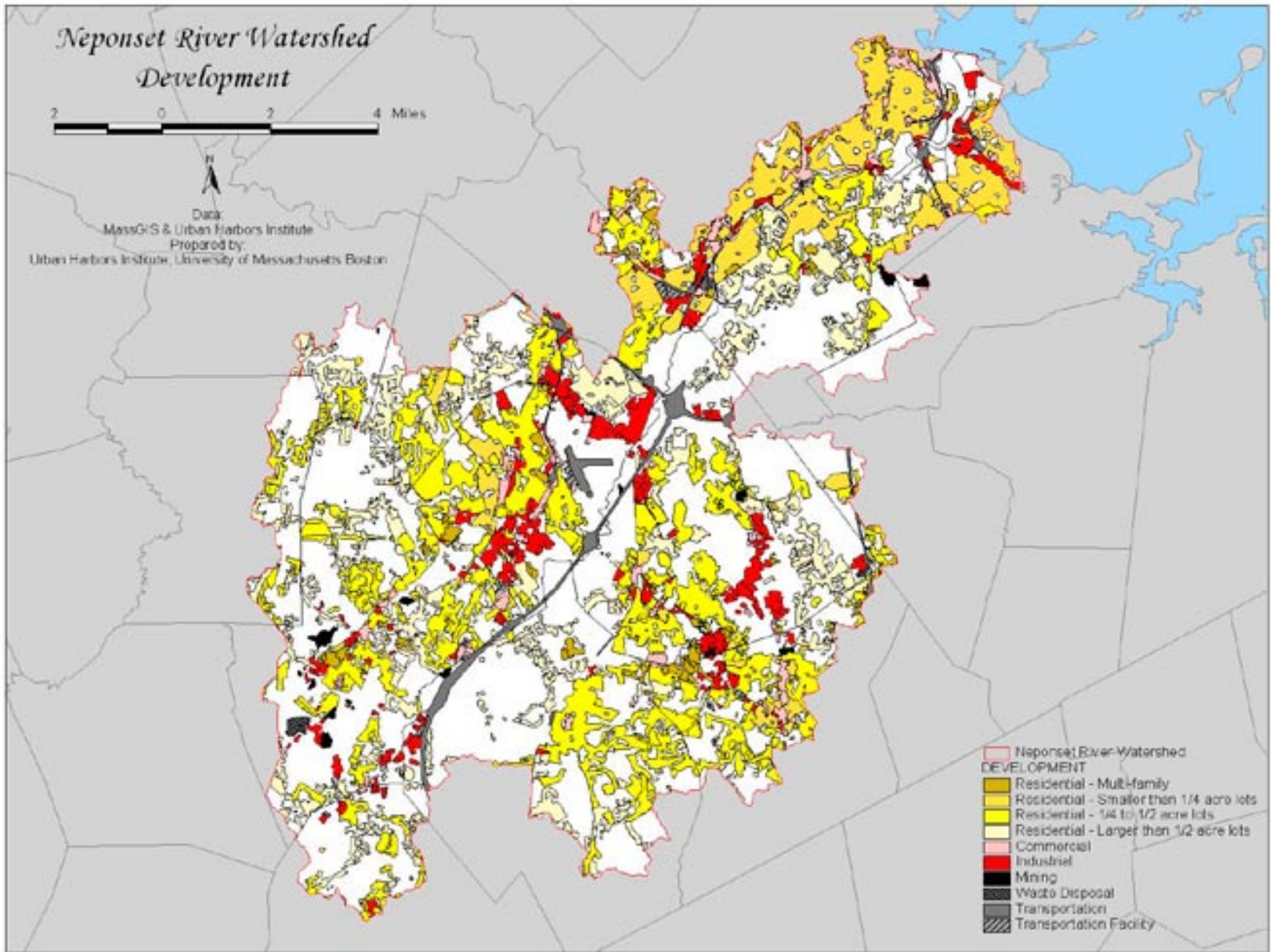


Figure 31: Neponset Imperviousness

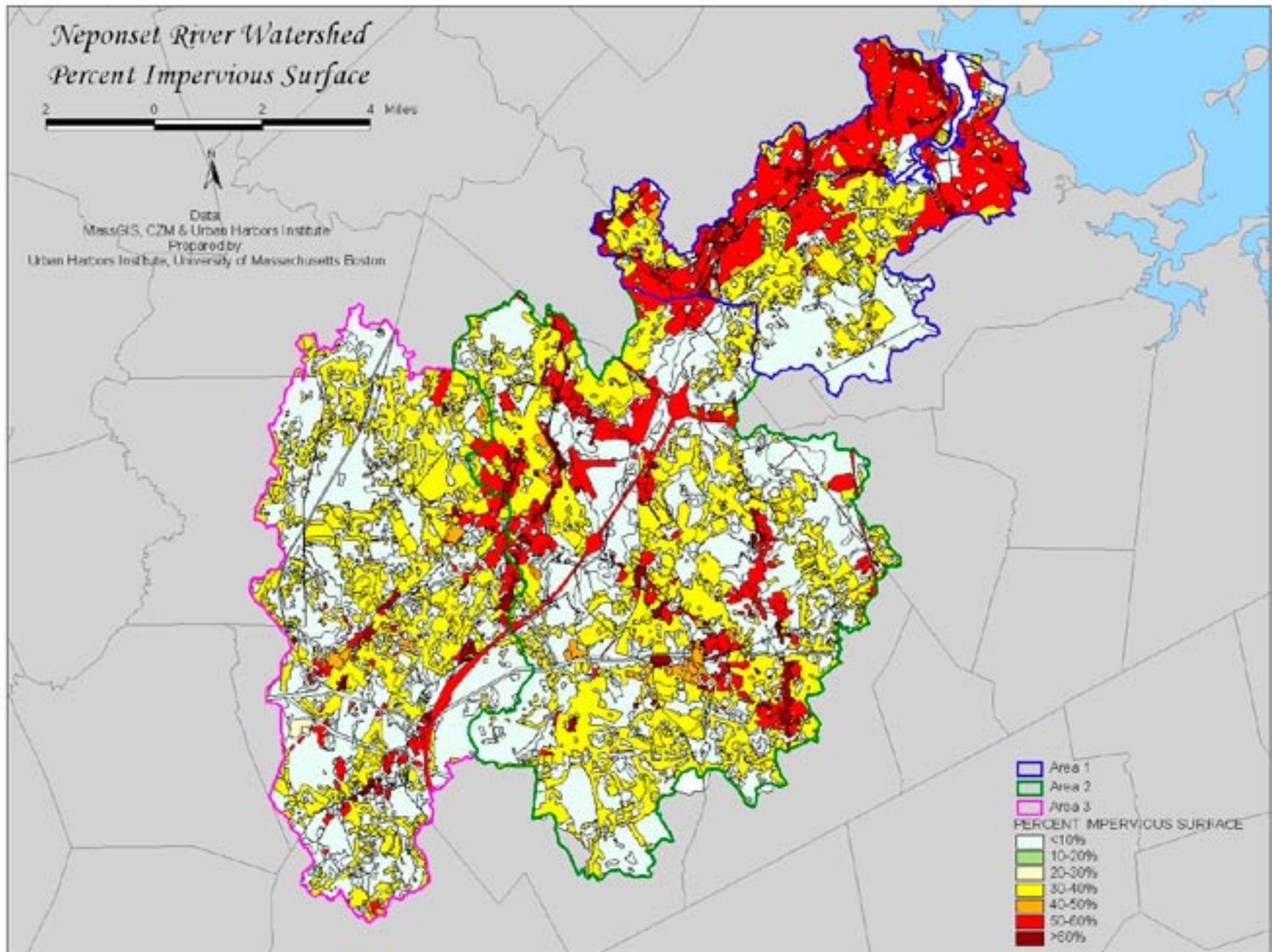


Figure 32: Neponset Imperiousness, Lower Watershed Detail

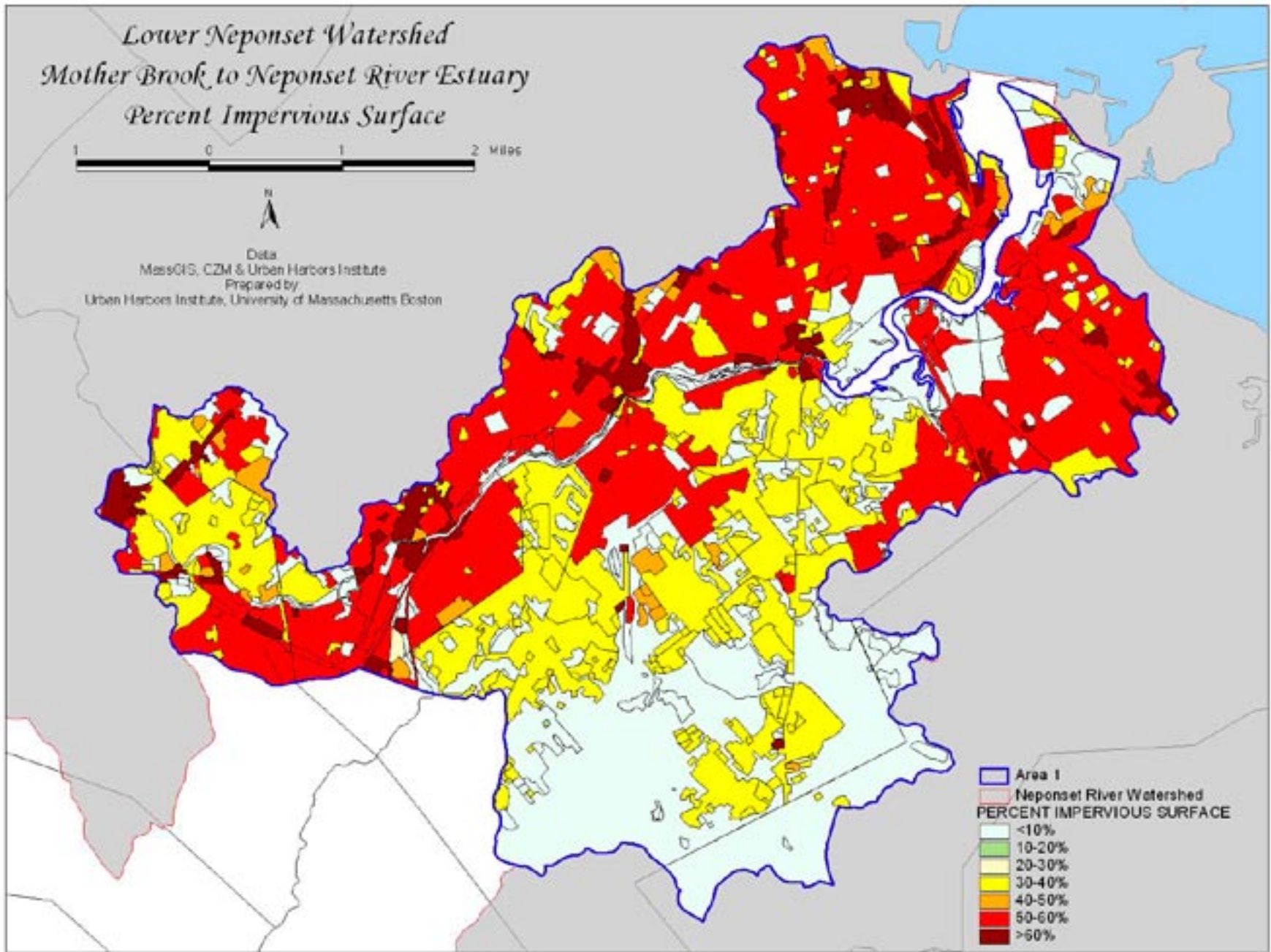


Figure 33: Neponset Imperviousness, Middle and East Branch Detail

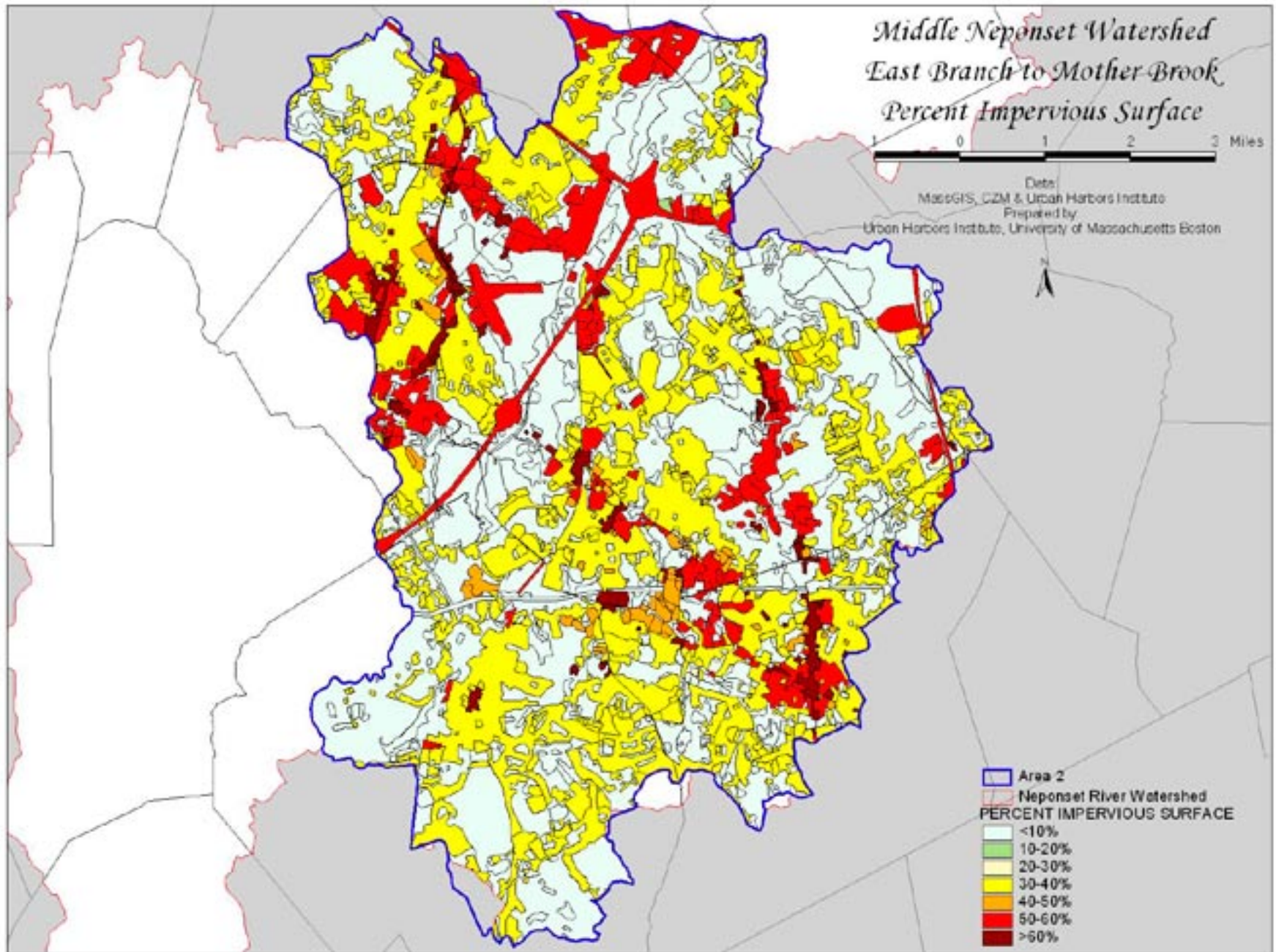
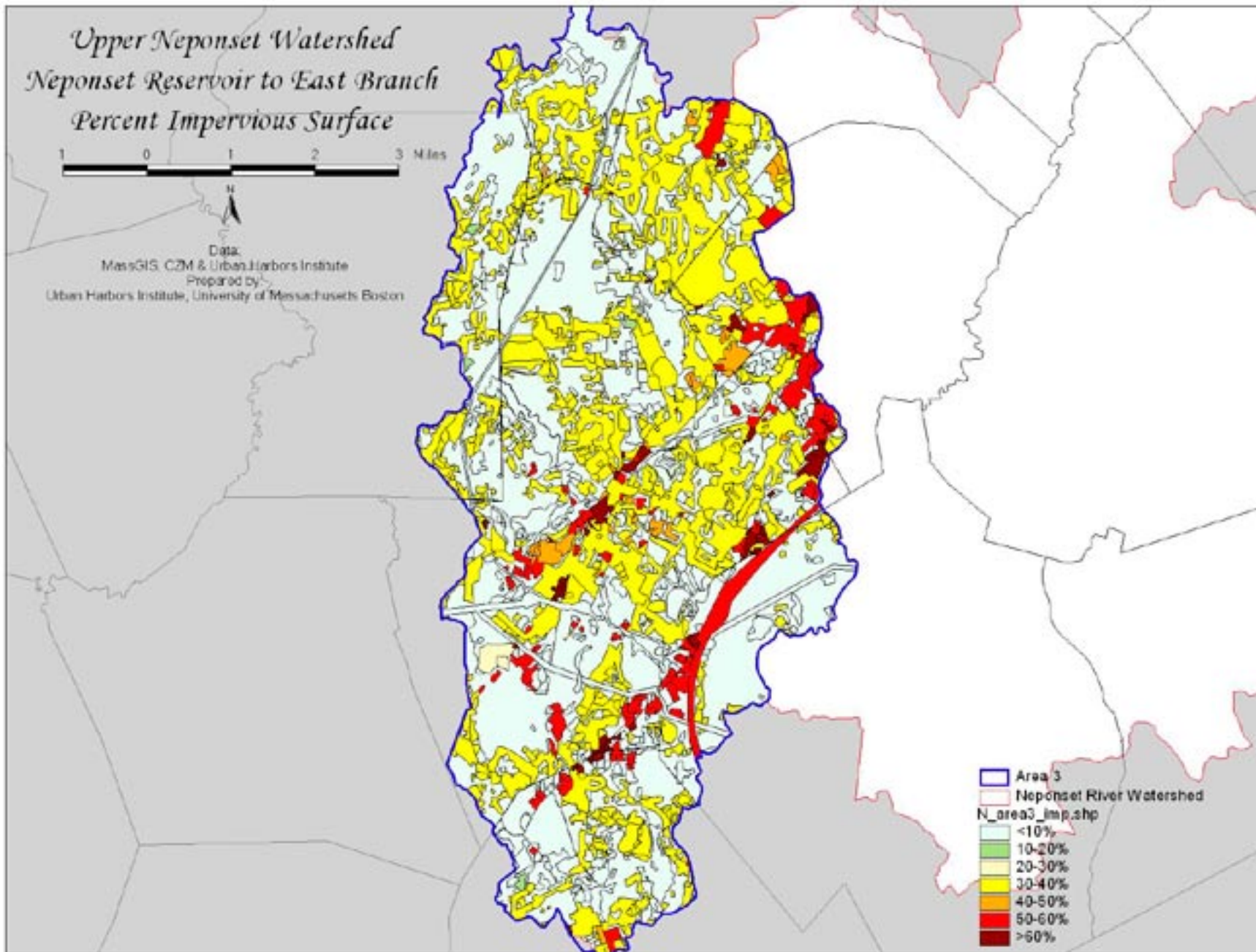


Figure 34: Neponset Imperviousness, Upper Mainstem Detail



Impervious Surfaces

In addition to, and even greater in impact on instream flows than water supply and wastewater management activities, is the impact of the Watershed’s impervious surfaces, which inhibits the natural process of groundwater recharge and exacerbates flooding problems (see discussion of imperviousness below).

Impoundments

A significantly smaller but still notable influence on instream flows is the existence and operation of more than 100 impoundments in the Neponset River Watershed. Most of these impoundments were created by historic industries as a means to harness water-power, and have relatively little storage capacity. However, through the 1950’s and 1960s the larger impoundments were actively managed by the larger industries to ensure adequate river flows throughout the summer for mill operations. Most of these water-dependent industries are now gone, as is their well-coordinated regulation of water releases. Now there is no means to moderate seasonal low flows. Thus, impoundments now adversely affect water levels more often than ameliorating them. This has been the case with some recent inopportune timed, rapid drawdown and refill of impoundments that cut off river flow for periods of a few hours to several days. Most problematic in this regard is the Department of Conservation & Recreation’s ongoing operation of the malfunctioning Tileston and Hollingsworth Dam in Hyde Park which stops river flow several times every week, year-round.

Approximately what percentage of the watershed is impervious?

Twenty-four percent of the total acreage in the Neponset River Watershed consists of impervious surfaces, although the amount of development – and hence imperviousness – varies greatly from town to town and even within most towns and cities. See Figures 31 - 34 below.

Impervious surfaces include streets, parking lots, and buildings. Rainwater flows over such surfaces, collects pollutants and debris, and deposits them directly, or via storm sewers, into local waterways. Impervious surfaces are associated with a host of hydrologic and pollution related impacts, such as streambank erosion, poor water

quality, decreased recharge, and decreased biodiversity within aquatic ecosystems. By inhibiting the natural process of groundwater recharge and exacerbating flooding problems, impervious surfaces have an even

Table 17: Neponset Imperviousness by Land Use (based on MCZM)

Land Use Category	Imperviousness
Residential Overall	36%
Residential Less than ¼ acre	54%
Residential Multi-family (total)	45%
Residential Multi-family (¼ to ½ acre)	30%
Residential Multi-family (over ½ acre)	30%
Commercial/Industrial	58%
Transportation	51%

Table 4: Generalized Effects of Unmitigated Imperviousness (based on Center for Watershed Protection, 1998)

Percent Impervious	Expected Watershed Impacts
26% or more	Streambank erosion, channel instability
	Poor to fair water quality (often with high nutrient levels)
	Low biodiversity (limited to heartier insects and fish that are tolerant of pollution)
	Human water contact often not possible due to high bacteria levels
11 to 25%	Some signs of degradation
	Some channel erosion and widening
	Fair to good water quality (some elevated nutrients and pathogens)
	Fair to good biodiversity (more sensitive, intolerant aquatic species)
0% to 10%	Channels stable
	Good to excellent water quality
	Excellent biodiversity

greater impact on watershed hydrology than water supply and wastewater management activities. The impact varies directly with the percentage of impervious surfaces found in the subwatershed.

In Massachusetts as a whole, “urban runoff and storm water are responsible for 46% of assessed river segments not supporting their designated uses and 48% of assessed marine waters not supporting theirs” (MA DEP, “Stormwater Management Volume 1: Stormwater Policy Handbook”, 1997).

The tables below describe the general severity of impacts associated with varying degrees of imperviousness and the typical degree of imperviousness associated with various categories of land use in our area. Multi-family residences and those on less than ¼ acre of land are most frequently found in the downstream portions of the basins, particularly in Boston, Milton and Quincy. Commercial/Industrial development is more widely dispersed, with heaviest concentrations in Boston, Quincy, Dedham, Westwood, Norwood, Canton and Walpole.

Are there current or expected water supply shortages?

Yes. Supplies are generally adequate now, but are expected to be inadequate in the future. Based on the Massachusetts Executive Office of Environmental Affairs’ 2000 analysis, the seven towns which lie

Table 19: Neponset Additional Water Demand At Buildout (EOEA)

Town	Increase at Buildout (MGD)	Percentage Increase
Canton	1.4	+55%
Milton	0.2	+6%
Norwood	0.6	+18%
Sharon	0.5	+38%
Stoughton	1.0	+50%
Walpole	0.9	+32%
Westwood	0.25	+24%
TOTAL	4.85	+31%

Table 20: Neponset Estimated Water Withdrawal Increase by 2010 vs. 1995 (CDM 1997)

River/Stream	Percentage Increase
Central Neponset River (Canton)	28%
Mill Brook (Dover)	99%
Purgatory Brook (Dedham & Westwood)	25%
Beaver Brook (Sharon)	22%
Neponset Reservoir (Foxborough)	69%
School Meadow Brook (Walpole)	24%

predominantly within the Neponset River Watershed would see a 30% increase in water use demand (4.65 mgd) if and when they are fully built out. “Buildout” is defined as the maximum potential growth under existing zoning. Canton and Stoughton could expect to see water demand increase by 50% or more. Of the seven towns, only Milton could expect to see demand rise by less than 18%. Most of the others would see increases of 25% – 33%. See Table 19.

Not all of this growth would be in the Neponset River Watershed, since only Norwood lies entirely within the Watershed, but the great majority of it would be. In addition, water demand will grow in the seven additional municipalities that lie at least partially within the Watershed (Boston, Quincy, Randolph, Foxborough, Medfield, Dover and Dedham).

Do biological or other monitoring data indicate significant impacts to the aquatic community due to hydrologic stress?

Yes. The Massachusetts Water Resources Commission (MWRC) has recently classified the state’s waterways by their degree of hydrologic stress. This classification has been made on the basis of analyzing streamflow gauge data. The Neponset mainstem upstream from the USGS Norwood Gauge (essentially from Hawes Brook and upstream) is rated by the MWRC as being “moderately stressed.” The East Branch

of the Neponset and its tributaries upstream of the USGS Canton Gauge are listed as “low stress”. The bulk of the mainstem Neponset which is located downstream of these gauges is listed as unassessed because the period of record at the USGS Lower Mills Gauge is too short to draw conclusions.

The WRC classification is based on a simple analysis of historic stream gauge data and classifies streams as “low stress” if their flow level is higher than that of 75% of the streams in the state, as “high stress” if their flow level is lower than 75% of the streams in the state, and as “moderately stressed” if they fall in between. While the WRC classification system is an invaluable screening tool, it is not a substitute for on-the-ground assessments of actual conditions and biota. The DEP has recently announced a new set of performance standards for water suppliers regulated under the Water Management Act, which imposes increasingly stringent water conservation measures on water suppliers drawing from stressed watersheds.

Other assessments conducted in the Neponset Watershed suggest that not only the upper mainstem, but the entire Neponset Watershed should be classified as “highly stressed”.

The DEPs 1999 field inventory of the fish community and aquatic macroinvertebrates in the Neponset Watershed (Fiorentino, “Boston Harbor Watershed 1999 Biological Assessment,” 2000) indicated that “habitat constraints related to reduced baseflow” in the Mill Brook tributary to Mine Brook “appear to compromise biological integrity.” The study noted other impaired benthic communities on a number of other streams that could be indicative of low flows. For example, an over abundance of benthic organisms that are “known to survive dry conditions or periods of reduced baseflow” were found at Pequit Brook (recent NepRWA monitoring confirms low flow conditions). And an overabundance of “fine particulate organic matter” (FPOM) in streams downstream of eutrophic impoundments were found on Massapoag Brook, Beaver Meadow Brook, East Branch, and Steep Hill Brook (all of which suffer from low flow, according to recent NepRWA monitoring). Fine particulates seldom settle in streams with adequate flows. Rather, they are often the result of shallow, slow flowing water.

In 2001, NepRWA developed a target fish community list based on

historic fisheries data for the Neponset Watershed and on comparisons with undeveloped watersheds with features similar to the Neponset. This list is, in essence, an estimate of the historic fish community on the Neponset River. Comparison of this target fish community with the actual composition of fish species observed by DEP in 1994 and 1999 provides further evidence of the apparent impact of reduced seasonal streamflows on aquatic life in the Neponset River. In short, it shows that the fish community in the Neponset River and its tributary streams has shifted from a population dominated by “river fish” to one dominated by “pond fish” (e.g., sunfish, carp and small mouth bass) who are less sensitive to the higher temperatures and lower DO associated with declining streamflows. This shift in species composition is similar to the shift that has occurred in the Ipswich River, a river that regularly runs dry.

Low flows are also having a demonstrable impact on anadromous fish runs in the lower Neponset River (below Milton Lower Falls). A report by the Massachusetts Department of Fish & Game (then the Dept. of Fisheries, Wildlife and Environmental Law Enforcement) concluded that anadromous rainbow smelt are harmed by low flows during the latter part of their spawning period (mid-to-late May). Egg mortality increases as rocks in shallow areas become exposed. Blueback herring are also expected to be impacted by inadequate flows now that their populations are being restored to the river. (Chase, Pelto & Ide, “Final Report on Neponset River Volunteer Flow Monitoring at Lower Mills, Milton,” 1997)

The “Use Attainability Study of the East Branch Neponset River” was prepared by the US Army Corps of Engineers (USACOE) in 1997 response to extremely high (87.8 degrees Fahrenheit) water temperatures documented in the East Branch in 1994. This temperature exceeded the upper temperature limit for warm water fisheries by several degrees. The USACOE study concluded that “the basic problem causing high water temperatures in the watershed is low flows through large open areas during warm weather.”

In 1997 DEP retained Camp, Dresser and McKee (CDM) to demonstrate the application of a new watershed modeling toolkit on the Neponset Watershed. As part of that effort, CDM developed a simple water budget model for the Neponset that identified several tributaries where

substantial streamflow impacts are expected due to projected water withdrawals. Based on the model, CDM estimated the degree to which water withdrawals will increase relative to 1991 – 1995 levels for certain streams. (CDM, “Neponset River Watershed Modeling Project, Prototype Application Report,” 1997.)

In 2001 – 2002, the ESS Group did an in depth assessment of 16 locations along the East Branch mainstem of the Neponset River and some of its tributaries. The assessment examined the adequacy of flow levels for protection and long-term maintenance of key aquatic life forms, including fish (“Trio of Experts Instream Habitat Assessment, East Branch Neponset Watershed”, 12/12/03). The tributaries included Beaver Brook, Beaver Meadow Brook, Massapoag Brook, Pequit Brook, and Steephill Brook. The assessment concluded:

“The flows documented were found to be below the summer aquatic base flows policy target levels set by the U.S. Fish & Wildlife Service flow policy and the more generous site-specific U.S. Geological Survey Streamstats Program computed values for the majority of stream segments assessed.... During the period with highest observed flows (June) all of the 12 stream segments assessed were found to be below the USFW ABF (aquatic base flow) value recommended for spring flow, suggesting that more flow may be beneficial during the spring spawning season. The lack of high flows during the spring may also explain why large amounts of sediment accumulation were documented at many of the stream sites.... The macroinvertebrate communities within most of the stream segments assessed would benefit from increased flow, particularly during the summer low flow period, in order to reduce temperature peaks, improve dissolved oxygen, and to dilute pollutants...The fish community of many of the assessed segments does not fully meet the NepRWA targeted fish community (native stream species). Although the reasons for this vary from stream segment to stream segment, it can generally be stated that flow was a significant factor in the poorer quality habitat available.”

Please see also the stream-by-stream analysis of organic enrichment/low dissolved oxygen above.

Do flooding or high flows cause problems for structures or aquatic life?

Generally not, except for a few locations. Flooding is generally not a widespread threat to homes and businesses except during very major storm events. There have been incidences of flooding along Germany Brook, Pine Tree Brook and Meadow Brook. There has been little assessment of how increased peak flows resulting from impervious surfaces affect aquatic life, though it can be assumed that stream channel morphology and aquatic habitat quality are influenced by increased peak flows.

Are there NHESP listed habitats or Biomap habitats in the watershed?

Yes. They are listed on the following maps:

Biomap Core Habitats

Figure 35 shows areas that, if protected, would provide suitable habitat over the long-term for the maximum number of Massachusetts’ terrestrial and wetland plant and animal species and natural communities. The BioMap focuses primarily on state-listed rare species and exemplary natural communities, but also includes the full breadth of the State’s biological diversity.

Estimated Habitats for Rare Wildlife

Figure 41 covers, among other things, estimated habitats of state-protected rare animal (but not plant) species that are given extra protection if they fall within the jurisdiction of the MA Wetlands Protection Act (generally, all open waters, marshes, bogs, and their 100 year floodplains plus a 50 to 100 foot corridor around perennial rivers and streams).

Priority Habitats for State Protected Rare Species

Figure 41 covers, among other things, all priority habitats for state protected rare plant and animal species, not just those subject to the protection of the MA Wetlands Protection Act.

Living Water Core Habitats

Figure 41 includes Living Water Core Habitats, which identify

Figure 35: Neponset Floodplains and Vegetated Wetlands

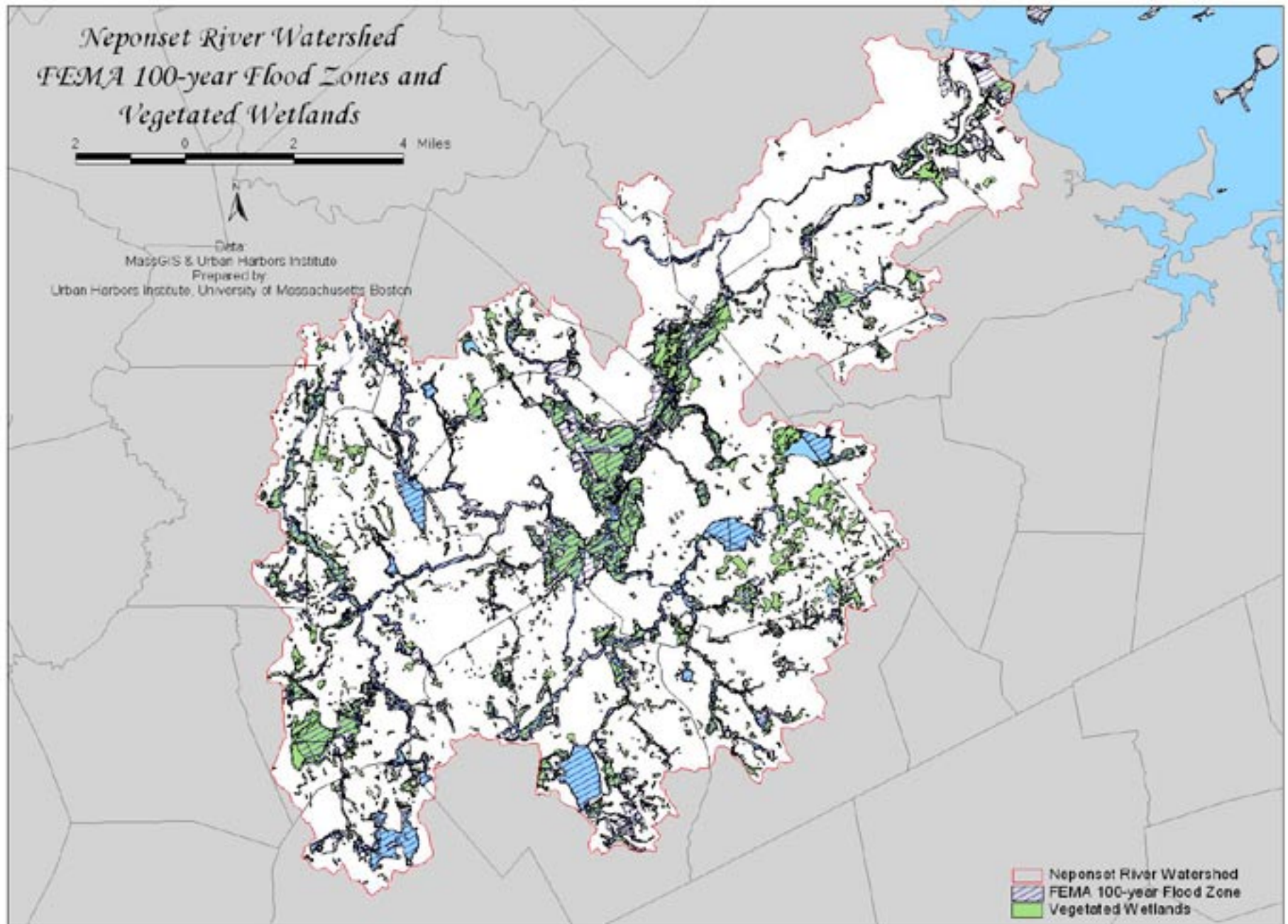


Figure 36: Neponset Biomap Habitats

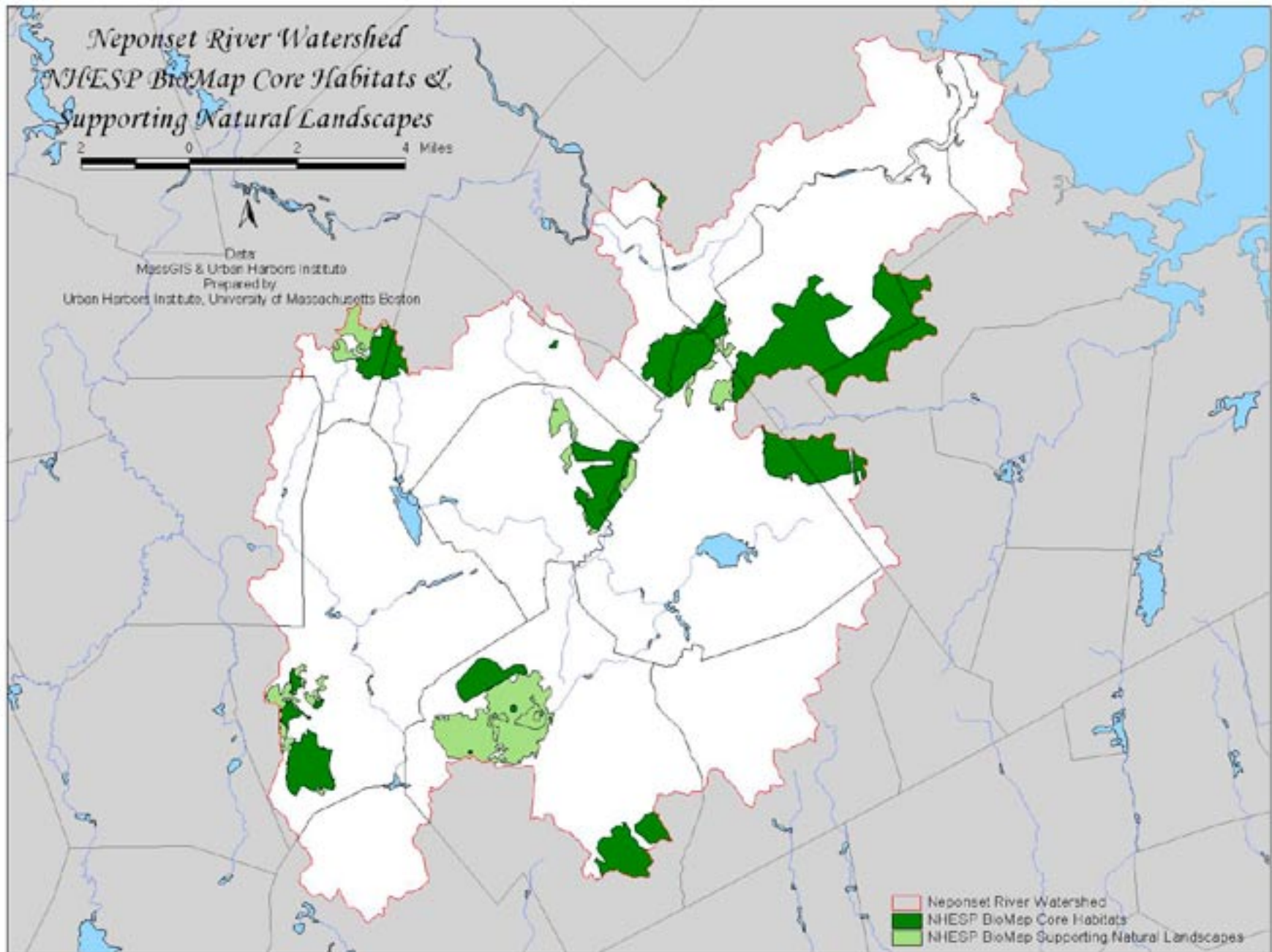


Figure 37: Neponset Riparian Corridors and Contiguous Open Lands

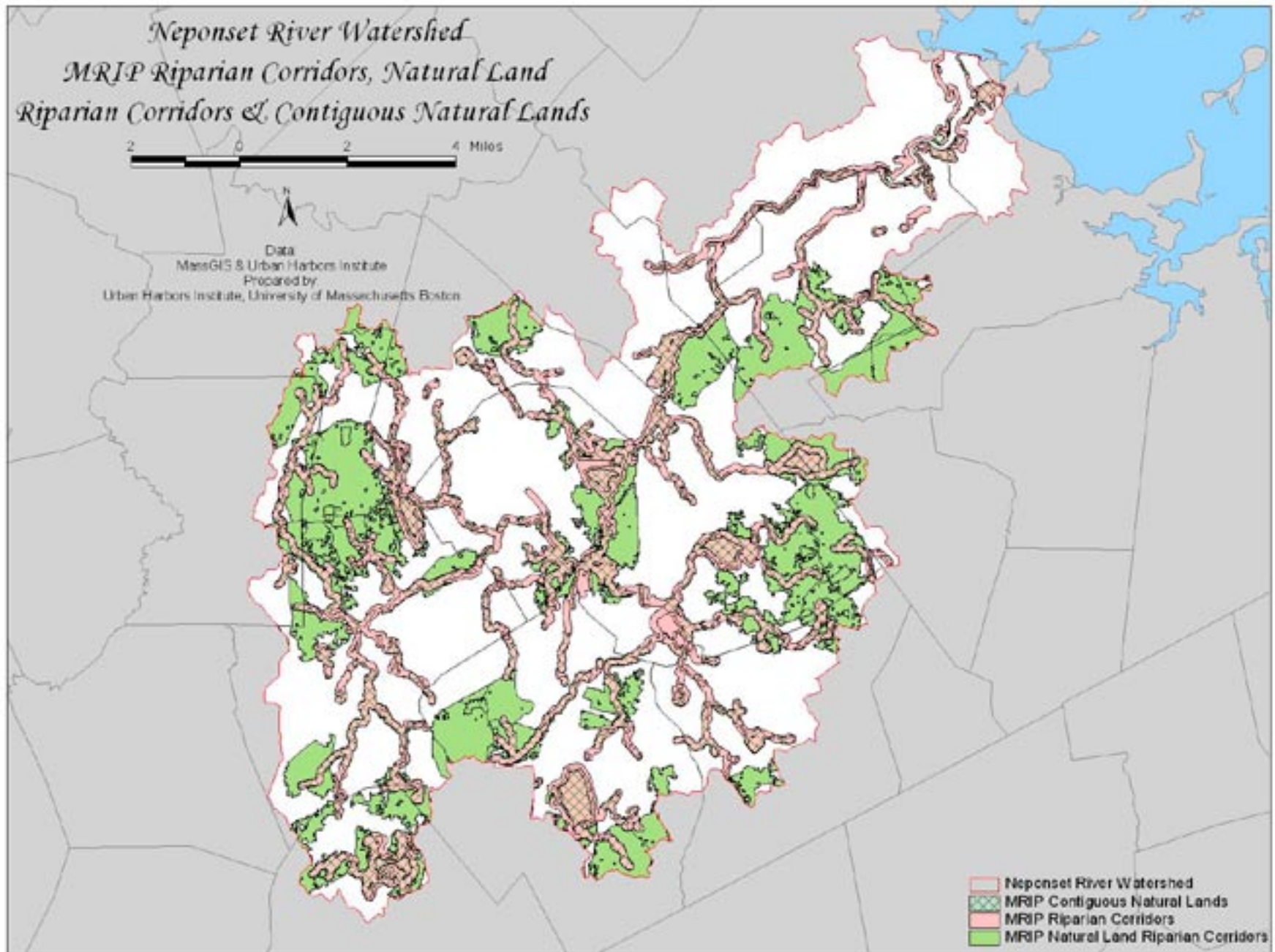


Figure 38: Neponset Coastal and Vegetated Wetland Resource Areas

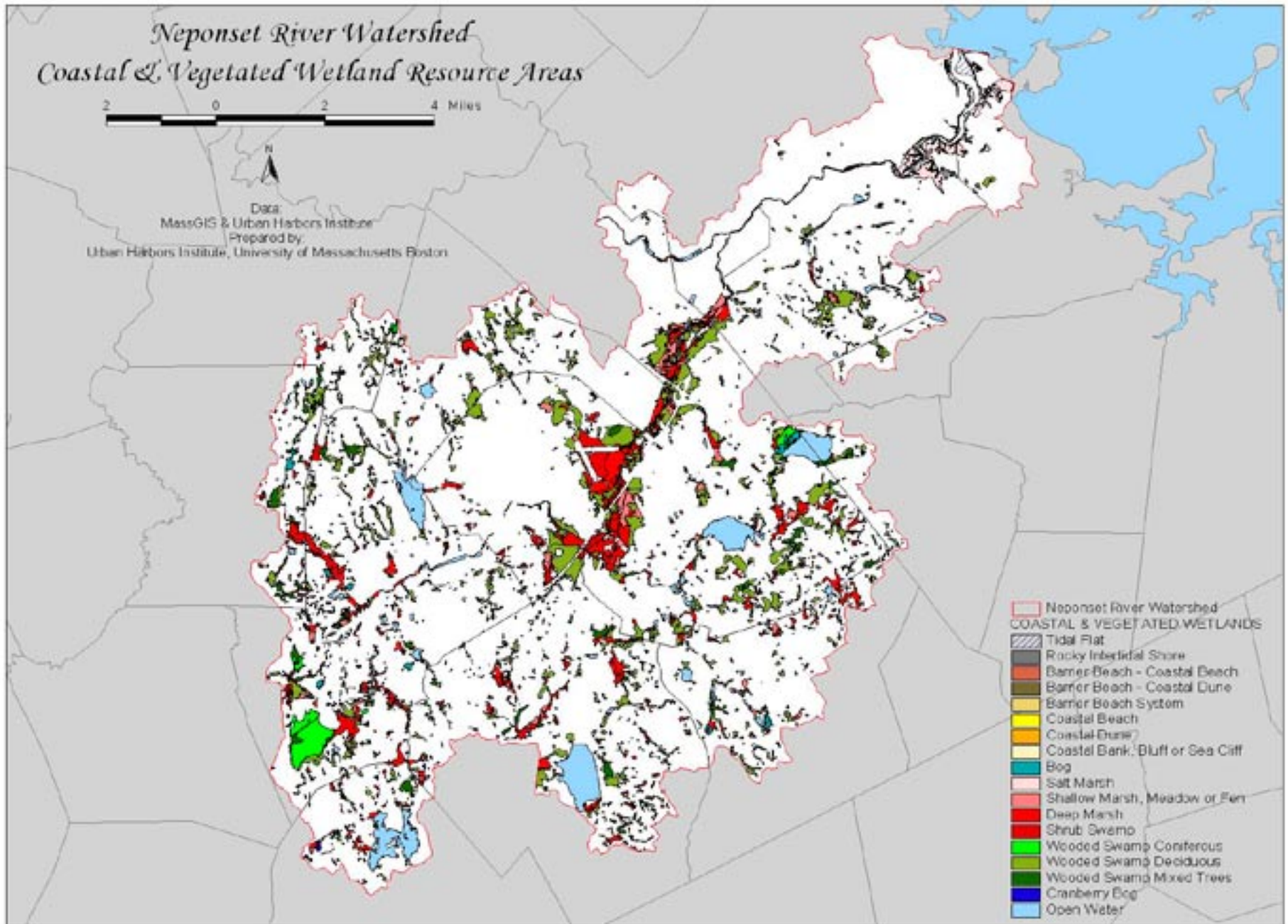


Figure 39: Neponset Vernal Pools, ACECs, ORWs and Zone II

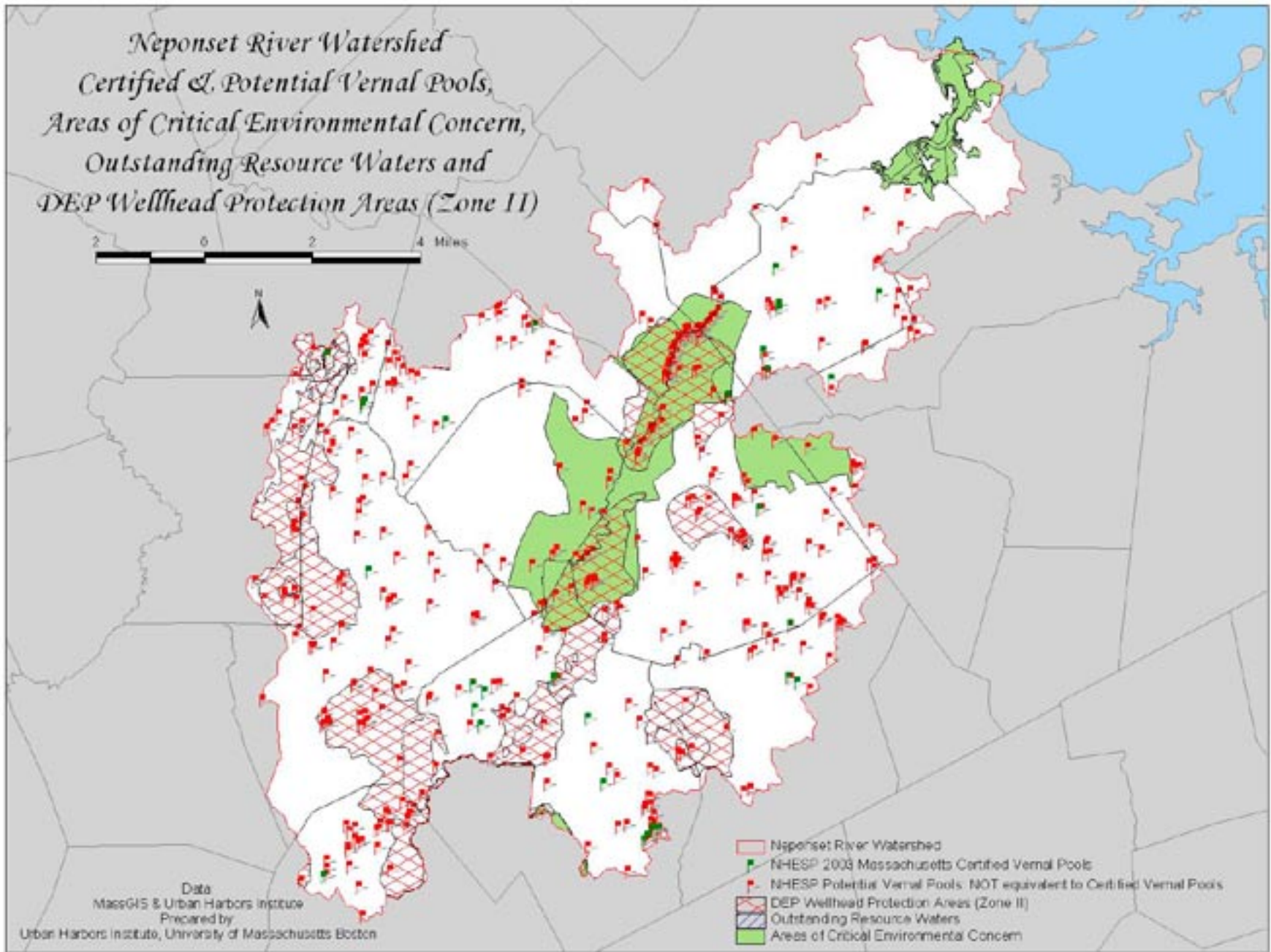


Figure 40: Neponset Approximate DEP Regulated Wetlands

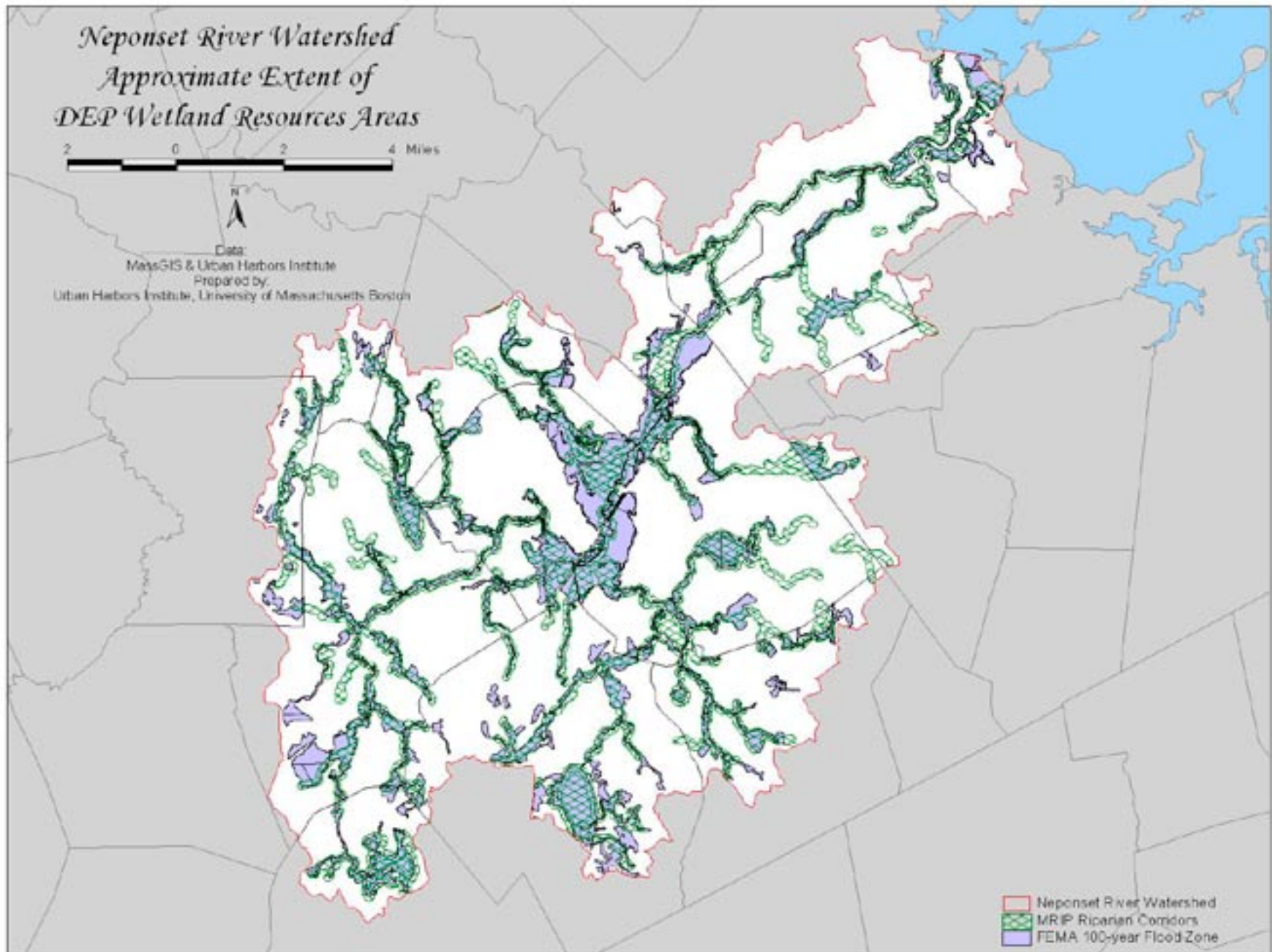
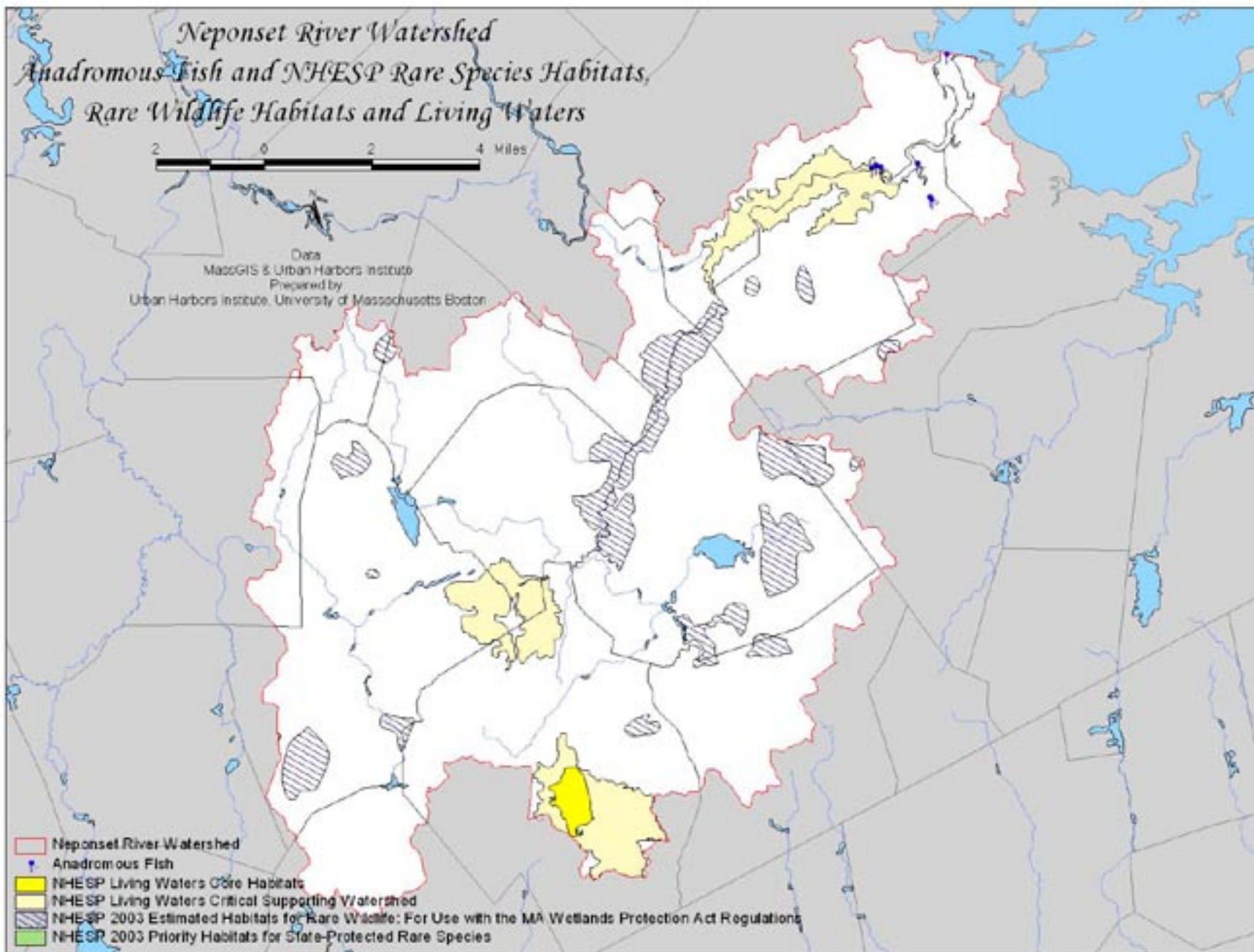


Figure 41: Neponset Anadromous Fish and Rare Species Habitats



Massachusetts' most critical sites for freshwater biodiversity, where the state government believes we should focus proactive conservation activities. The MA Natural Heritage & Endangered Species Program based these sites on the presence of 58 species of rare fish, aquatic vascular plants, freshwater mussels, crayfish, snails, and other aquatic invertebrates. Changes in water flow and degradation in water quality threaten these and other freshwater species. (See map below.)

Are there other special habitat types in the watershed?

Yes. There are a variety of other significant habitats in the Neponset Watershed.

Anadromous Fisheries

See Figure 41. Historically a number of anadromous fish runs existed on the Neponset River, but today only 1000 feet or so (upriver of the Milton Town Landing) are used as a fish run by Rainbow Smelt. The much more extensive historic Herring and American Shad runs might be fully restored if the fish could get around the two most downstream dams on the river. This would open up the river a full seventeen miles. (See map below.)

Vernal Pools

See Figure 39. Vernal pools are unique wildlife habitats best known for the amphibians that use them to breed. Vernal pools typically fill with water in the autumn or winter due to rising ground water and rainfall, then dry out completely by the middle or end of summer each year, or at least every few years. Occasional drying prevents fish from establishing permanent populations. Many amphibian and invertebrate species rely on breeding habitat that is free of fish predators. Some vernal pools (limited mostly to those within the 100 year floodplain of perennial rivers and streams) are protected in Massachusetts under the state Wetlands Protection Act. The state Natural Heritage and Endangered Species Program serves the important role of officially "certifying" vernal pools that are documented by citizens. Within the Neponset River Watershed there are approximately 23 certified vernal pools. There are approximately 350 potential vernal pools. (Figure 39 shows both "certified" and "potential" vernal pool locations [not necessary in protected wetland resource areas].)

Areas of Critical Environmental Concern (ACECs)

See Figure 39. The Neponset River Watershed contains two ACECs, the Fowl River/Ponkapoag Bog ACEC and the Neponset River Estuary ACEC. ACECs are places in Massachusetts that receive special recognition because of the quality, uniqueness and significance of their natural and cultural resources. These areas are identified and nominated at the community level and are reviewed and designated by the state's Secretary of Environmental Affairs. ACEC designation creates a framework for local and regional stewardship of critical resources and ecosystems.

Outstanding Resource Waters

See Figure 39. These areas are given extra protection in the state Water Quality Certification process, required whenever a federal wetlands permit is mandated. (See map below.)

Cold and Warm Water Fisheries

The entire freshwater Neponset River Watershed is designated as a Class B warm water fishery (that is, suitable for native fish species that live in warm water riverine habitats). However, Tubwreck Brook has been identified by the MA Division of Fisheries as a cold water fishery which has proposed that it be reclassified as such in the revised state Water Quality Standards. DEP will also recommend that Traphole Brook be reclassified as a cold water fishery. Productive coldwater fisheries have also been identified on Mill Brook tributary of Hawes Brook, Mill Brook tributary of Mine Brook, and the headwaters of Pine Tree Brook. These nonetheless remain designated as warm water fisheries, although DEP says in its Assessment that it will consider changing the status of the Mill Brook tributary to Hawes Brook.

Wetlands

Figure 40, entitled "Approximate Extent of Wetland Resource Areas," covers all wetland "resource areas" protected by the MA Wetlands Protection Act, including the 100 year floodplains. "Riparian corridors" on Figure 40 correspond generally to the riverfront resource area. Figure 38 (Coastal & Vegetated Wetland Resource Areas) shows open water, and specific types of coastal wetlands and inland bordering vegetated wetlands. These wetland resource areas make up 15.8% of the acreage in the watershed, and are subject to particularly strong protection in

Massachusetts.

Are wetland and vernal pool habitats healthy or degraded?

The Neponset Watershed includes wetlands in a variety of states of health, from excellent to degraded to extinct. In November 1999, the Massachusetts Executive Office of Environmental Affairs (EOEA) Wetlands Restoration & Banking Program published “Restoring Wetlands of the Neponset River Watershed: A Watershed Restoration Plan.” The Plan found the following forms of wetland degradation and identified key sites where the problems could be best addressed.

- Salt marshes. Plan found that all the “remaining salt marshes within the Neponset River estuary have been severely degraded” and identified 16 sites in the Neponset Estuary containing 900 acres of “potentially restorable salt marshes.”
- Wetland Wildlife Habitat. Plan identifies 76 sites for improvement, especially within the Mine/Mill Brook complex, the White Cedar Swamp in Walpole complex, and the Neponset River mainstem.
- Flood Storage. 84 sites for improvement are identified.
- Invasive Species. 39 sites are identified, but “this does not represent a comprehensive survey”.
- Cold Water Fisheries. The Plan addresses 5 sites in Traphole Brook and the Tubwreck/Mine/Mill Brook subwatershed.
- Groundwater Recharge and Stream Baseflow. The Plan identifies 69 potential restoration sites contributing to both.

Land Under Water and Stream Bank Wetland Resource Areas. As discussed above, a large number of water quality and hydrologic problems have degraded much of the Neponset River Watershed aquatic habitat. Aquatic habitats have been harmed by:

- Channelization, particularly in Germany Brook, Steep Hill Brook, lower Massapoag Brook, Pine Tree Brook, Unquity Brook, East Branch Neponset River, the lower freshwater Neponset River, Mother Brook and Plantingfield/Purgatory

Brook

- Lack of riparian buffer zone along the bank, particularly in Germany Brook and Steep Hill Brook
- Thermal modifications caused by large shallow impoundments, particularly in the East Branch mainstem
- Dumping by land owners and others, particularly in Steep Hill Brook, Unquity Brook, and Mother Brook
- Creation of artificial impoundments throughout the watershed
- Other habitat alterations; Pine Tree Brook is on the 303(d) list for this impairment.

Are invasive species a significant threat to upland, wetland or aquatic habitats?

Yes. Throughout the watershed, the greatest invasive species concern is purple loosestrife (*Lithrum salicaria*). Of greatest concern in salt marshes is *Phragmites australis*.

The upper and middle portions of the mainstem of the Neponset River are on the 303(d) list of waters impaired due to noxious aquatic plants, although neither DEP nor NepRWA found recent evidence of the problem in these segments. NepRWA noted an historic invasive species problem in the Spring Brook tributary, although the Town of Walpole has now initiated vegetation control projects to deal with it. Of far greater concern is the fact that nearly every pond in the Neponset Watershed that was assessed by DEP was found to be suffering from noxious aquatic plants and exotic species. There are small and potentially still controllable infestations of water chestnut in Walpole’s Clark’s pond and Norwood’s Ellis Pond.

What percentage of the watershed is “built-out?”

Currently, about half of the acreage in the watershed (including wetlands and open water) has been developed. About 80% of that development is residential and about 15% is commercial/industrial. Based on the seven towns which lie wholly or predominantly in the Neponset River Watershed, population can theoretically grow by 16.5% according to MA EOEA’s buildout analysis, with over 25% total growth possible

Figure 42: Neponset Land Use

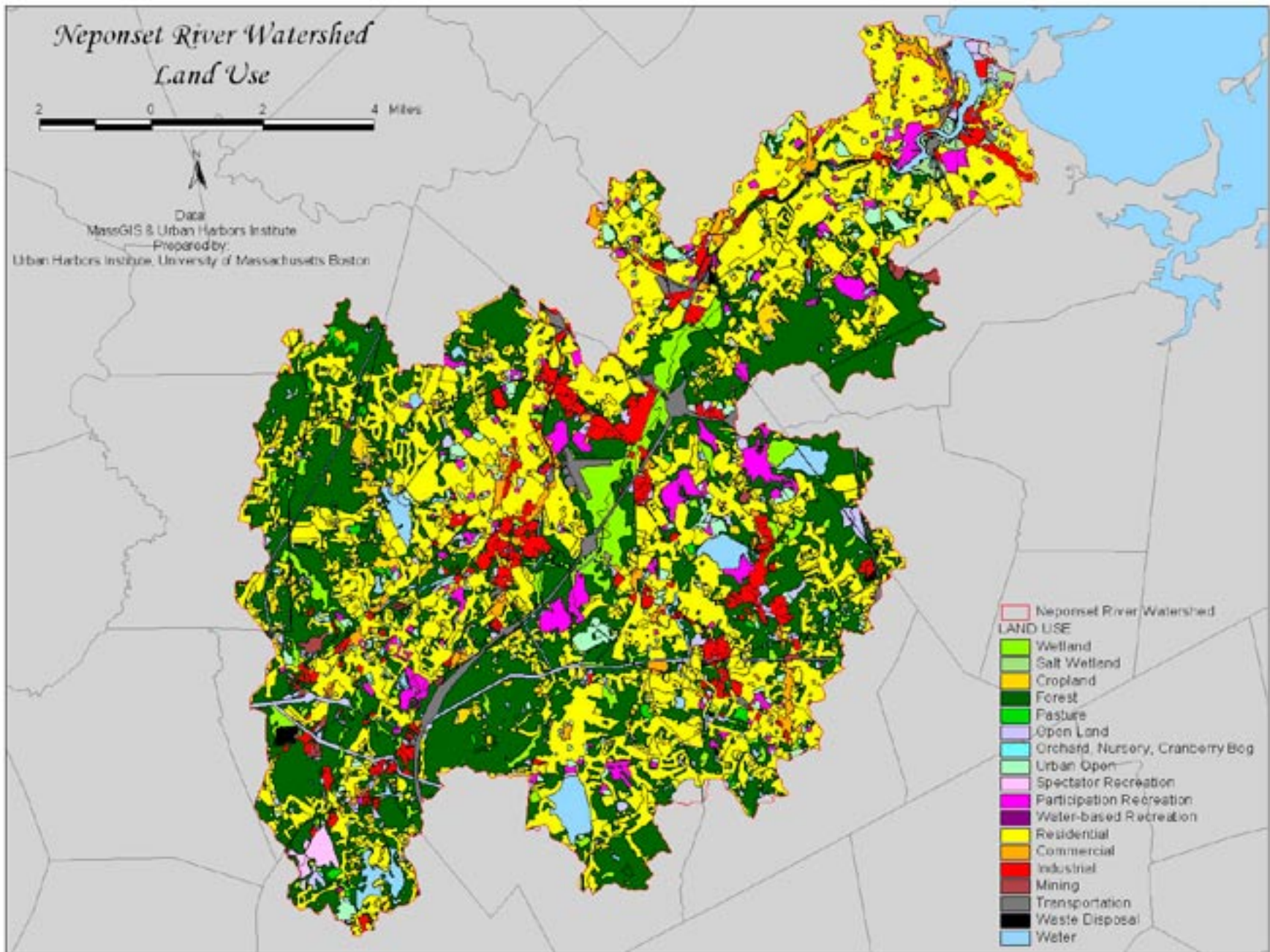


Figure 43: Neponset Contaminated Sites

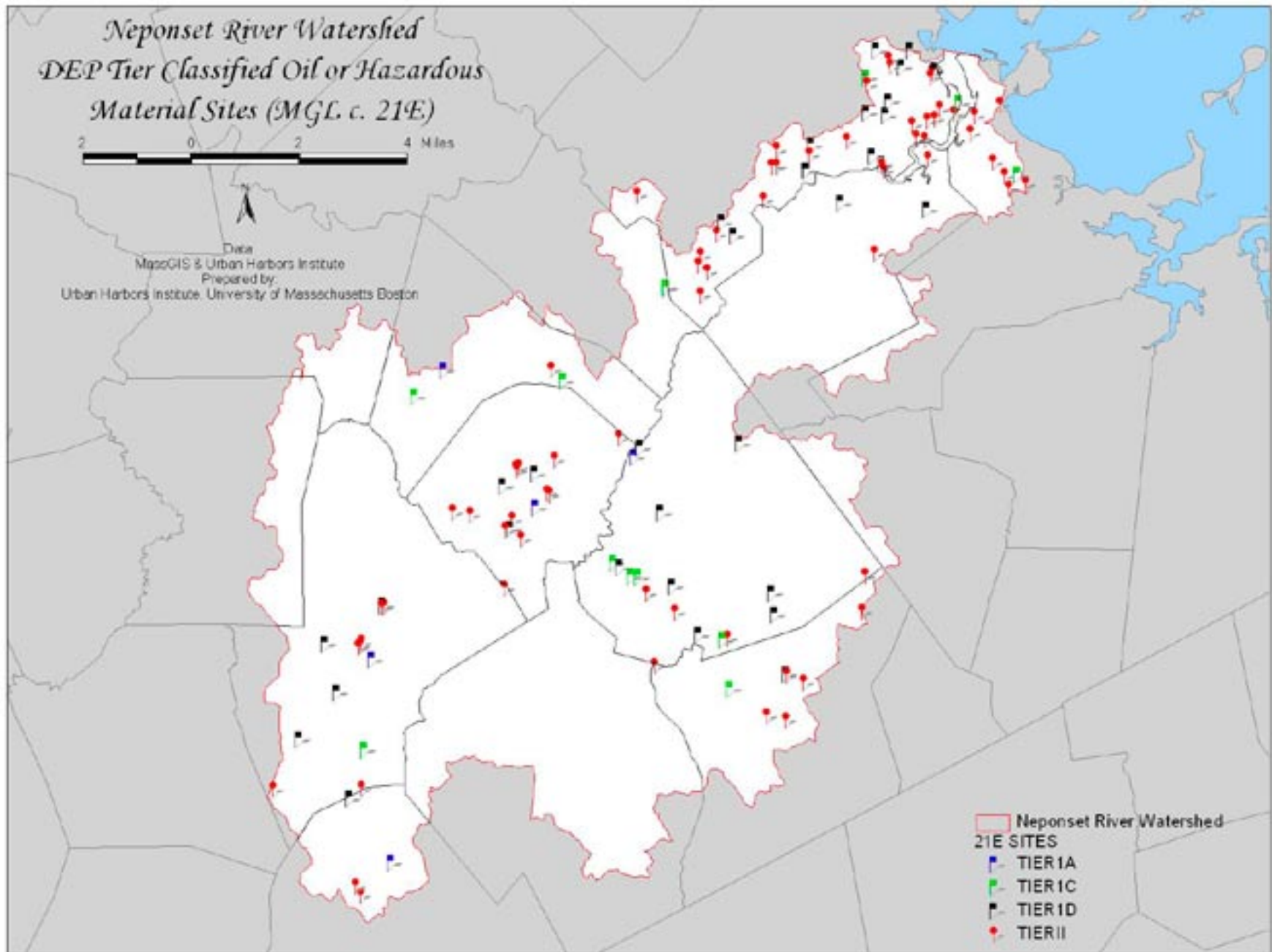
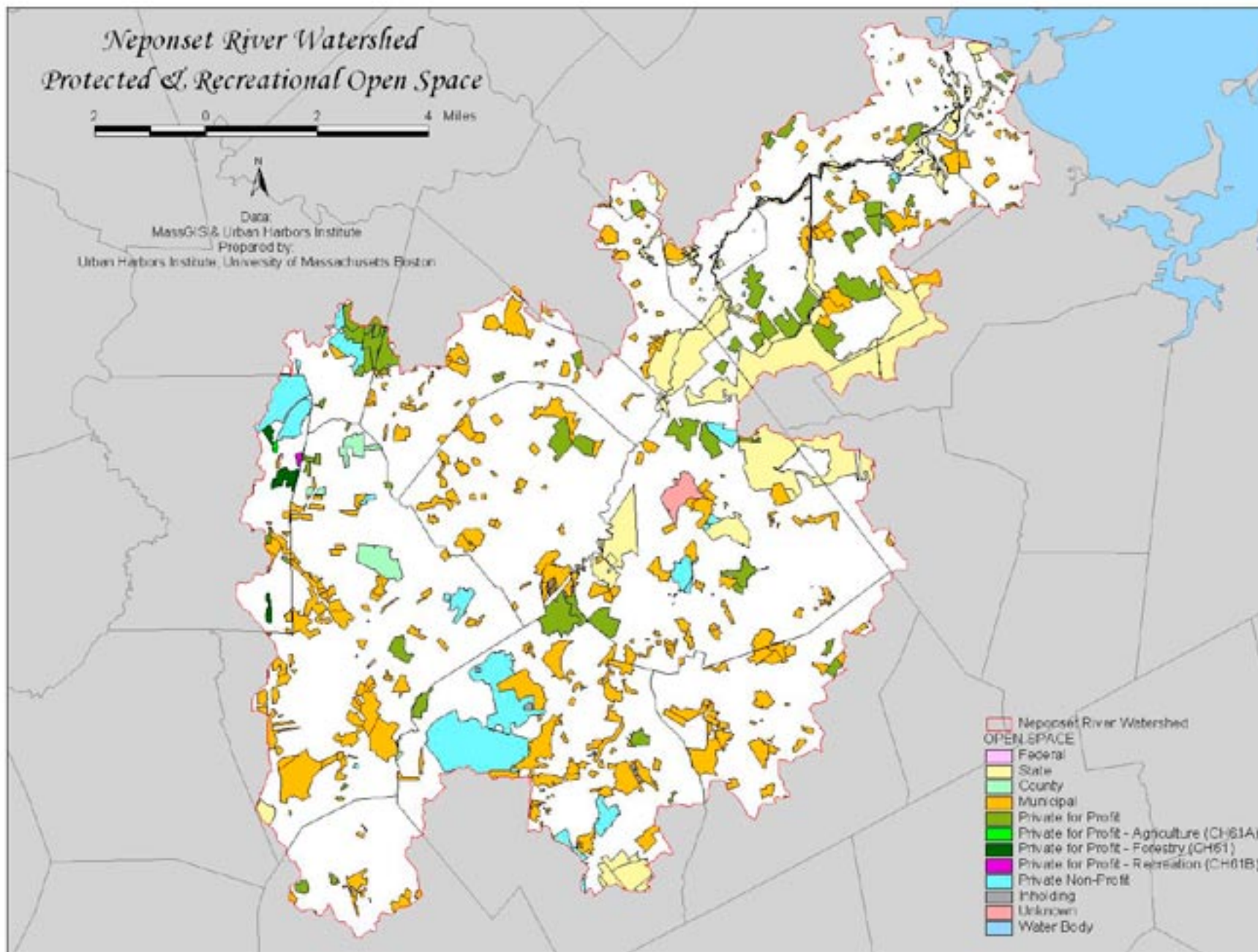


Figure 44: Neponset Open Space



in Canton, Sharon, Walpole and Westwood (which each grew around 12% from 1990 to 2000) and less than 10% in Milton, Norwood and Stoughton (which grew only marginally from 1990 to 2000). Buildout is defined as the theoretical limit of building in a community consistent with local zoning.

Table 21: Neponset Additional Population at Buildout for Selected Towns Relative to Year 2000 (EOEA)

Town	Buildout Population	Percent Increase
Canton	7,158	34%
Milton	2,432	9%
Norwood	1,604	6%
Sharon	4,115	24%
Stoughton	2,045	7.5%
Walpole	6,253	27%
Westwood	2,428	17%
TOTAL	26,035	16.5%

Are there significant brownfields or opportunities for redevelopment in the watershed?

Yes. See Figure 43 regarding “21E” hazardous waste sites

What are the major trends in population, land use, transportation and water?

Based on the seven towns that lie wholly or predominantly in the Neponset River Watershed, population grew by 6% from the 1990 to the 2000 censuses. Canton, Sharon, Walpole and Westwood each grew around 12%, while there was virtually no growth in Milton, Norwood and Stoughton. Most of the growth was and continues to be comprised of additional suburban growth. See Figure 42, as well as previous analysis of Neponset River Watershed “buildout” affects on population, land use and water supply demand.

What percentage of the watershed is permanently protected open space?

20.7% of the Watershed’s total acreage is “protected” or recreational open space owned by some level of government or by nonprofit organizations. An additional 4.3% is owned by private for-profits. It is uncertain, however, how much of this land could be considered “permanently protected open space.” (See Figure 44 .)

How much open space is still available and thus, in need of protection?

Unknown.

How rapidly is open space being lost?

As noted above, population grew by 6% from the 1990 to the 2000 in the seven towns that lie wholly or predominantly in the Neponset River Watershed. EOEA’s buildout analysis indicates there is potential for 16.5% population growth in the future. Most of the growth was and continues to be comprised of additional suburban growth, generally through development of open space.

What percentage of the shoreline is publicly accessible?

Unknown.

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Fore River Watershed

Introduction

The Fore River watershed is illustrated in Figure 45. It is a small watershed contained within the larger Weymouth and Weir watershed, which in turn is a component of the larger Boston Harbor watershed. The Fore River watershed covers an area of approximately 49.2 square miles and encompasses portions of the towns of Quincy (27%), Weymouth (8%), Braintree (28%), Randolph (18%), Holbrook (10%), Milton (3%), Canton (1%), Stoughton (2%), and Avon (2%).

There are several significant features of the Fore River watershed. The

Table 22: Acreage and Percent of Each Town in Fore River Watershed

Town	Acreage of town	Acreage in watershed	Percent of town in watershed	Percent of the watershed
Abington	6,508.8	81.2	1.3	.3
Avon	2,903.0	656.1	22.6	2.1
Braintree	9,193.1	8,817.6	95.9	28.0
Brockton	13,794.0	105.1	0.8	0.3
Canton	12,487.4	268.6	2.2	0.9
Holbrook	4,739.1	3,039.9	64.2	9.7
Milton	8447.0	1,063.9	12.6	3.4
Quincy	10,707.3	8,554.5	79.9	27.2
Randolph	6690.2	5,746.7	85.9	18.3
Stoughton	10530.4	479.2	4.6	1.5
Weymouth	11250.4	2,645.5	23.5	8.4
Totals	97,250.7	31,458.3		100.0

Fore River is a twisting tidal estuary. Its tides are semidiurnal with a mean tide range of 9.5 feet above mean low water (MLW). The major sources of the Fore River are the Monatiquot River, which enters as the non-tidal upstream continuation of the Fore River in Braintree; Smelt Brook, which enters the Fore River just downstream from the entrance to the Monatiquot; and Town River, which feeds Town River Bay in Quincy. The Farm River and Cochato River (upstream from the Monatiquot) and Cranberry Pond in Weymouth also drain into the Fore River.

Historic filling and development have heavily influenced the Fore River embayment. Bulkheads, revetment, and retaining walls control wave action and flooding. Extensive shoaling and silt deposition within the river have caused a reduction in the natural flushing action. This has affected water quality through stagnation and inadequate dilution of freshwater, with subsequent impacts to the aquatic ecosystem. These deposits have also affected drainage outfalls and the cooling water intakes of Braintree Electric Light Department’s Potter Station.

The water quality classification of the river and its upstream tributaries is SB, meaning the Fore River is designated for protection and propagation of fish, other aquatic life and wildlife, primary and secondary contact recreation, and shellfish harvesting. Because of shoaling conditions coupled with historic filling and development, the U.S. Army Corps of Engineers has determined that the future use of the Fore River for boating and recreation is contingent upon channel dredging.

In early 1992 the communities of Braintree, Quincy and Weymouth, in conjunction with the Tellus Institute, received multi-year funding from the Massachusetts Bay Program (MBP) to study environmental conditions in and around the Fore River. As one of three projects

Figure 45: Fore Towns



Figure 46: Fore Orthophoto

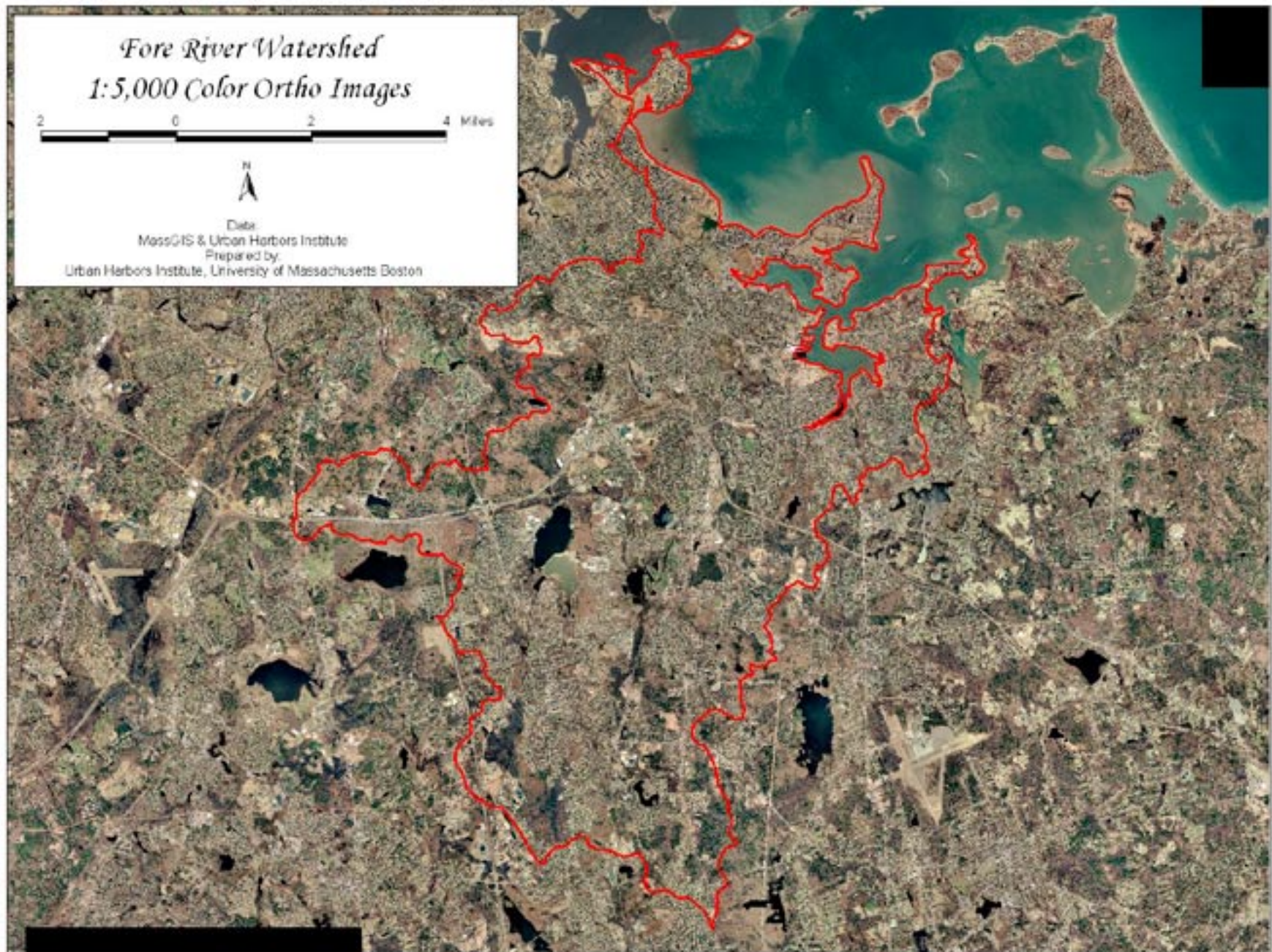
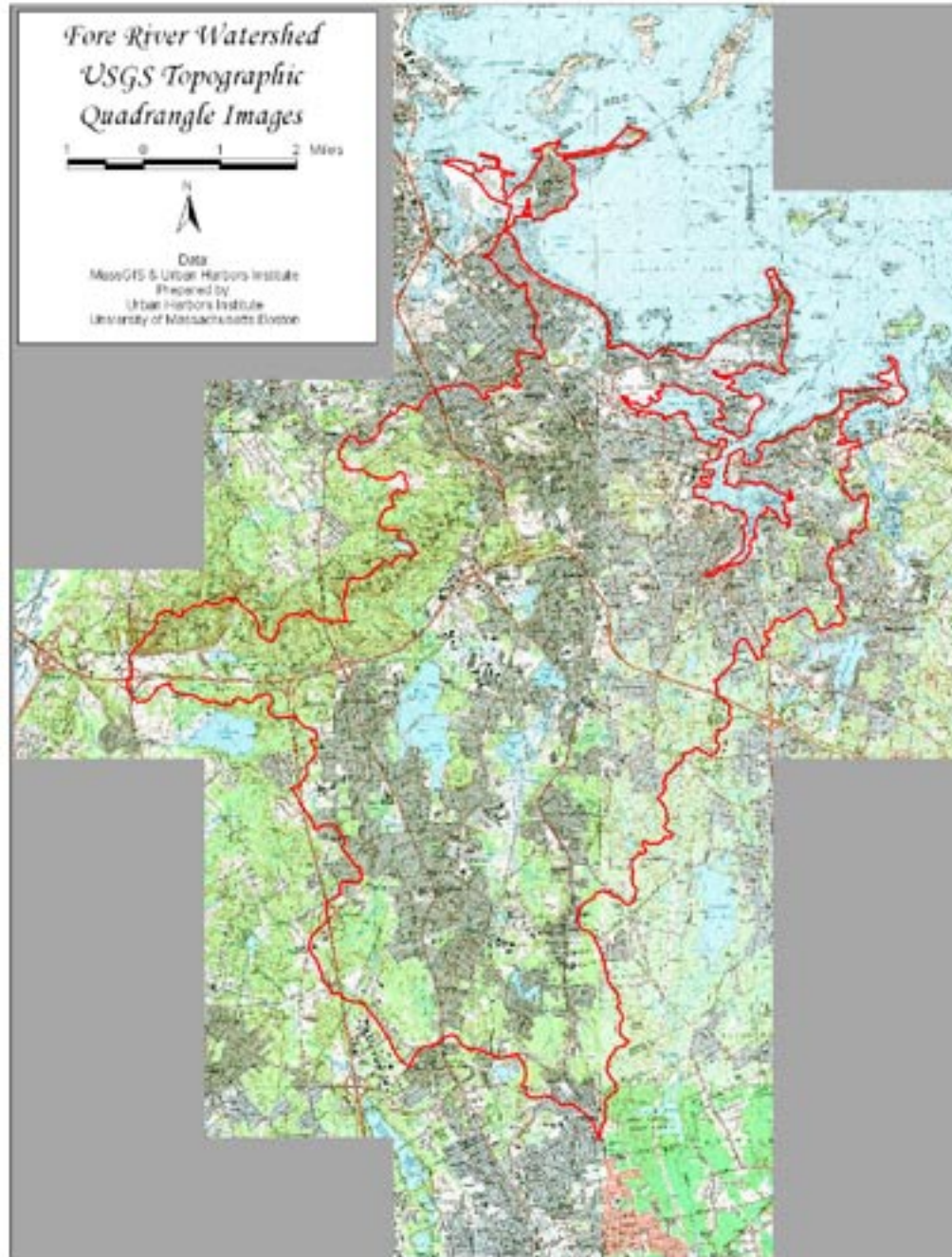


Figure 47: Fore Topography



selected in the MiniBays program, the ultimate aim of the Fore River MiniBays Project was to initiate a tri-community effort to measurably improve water and/or sediment quality in the river and restore certain uses that had been impaired due to contamination. The project's report (Tellus Institute 1996) summarizes the activities conducted by the researchers, presents the project's interim findings and outlines a set of management activities, many of which have been initiated, for improving the long-term environmental conditions of the Fore River. Much of the information presented in this assessment was drawn from this report.

Does pollution limit use of water resources within the watershed?

Yes. The Fore River estuary has a long history of pollution problems (FRWA 2004) that stem from bacteria, pesticides, and heavy metals from former industrial activities. Pollution is also evident further up in the watershed in many of the river's tributaries. Problems with high bacterial loads to the watershed are attributed to frequent, high volume sanitary sewer overflows caused by antiquated sewer infrastructure and disproportionate development that has placed undue strain on the sewer systems. Impacts from bacterial pollution are most severe across the tidal portion of the watershed and in areas near sewerage overflow pipes and storm drains. Shellfish beds throughout the estuary are closed periodically or permanently due to bacterial pollution.

Extensive efforts have been carried out over the past decade to bring awareness of the problems associated with sanitary sewer overflows (SSOs) in Braintree and Weymouth, where major sewer infrastructure improvements are now underway as a result of Department of Environmental Protection consent orders (Thayer 2004). Much of these improvements can be attributed to the efforts and dedication of the Fore River Watershed Association (FRWA). According to FRWA, it is too early to tell whether the work underway is sufficient to curtail the SSOs enough to allow shellfish beds to reopen.

Does bacterial pollution limit use of the watershed?

Yes. The Fore River estuary and a number of tributaries within the Fore

River watershed are on the Massachusetts List of Impaired Waters for bacteria. Provisions of the federal Clean Water Act (CWA) require states to establish a program to monitor and assess the quality of its surface and ground waters and report on its findings. Section 305 (b) of CWA requires each state to submit a Summary of Water Quality Report to the US Environmental Protection Agency every two years (in Massachusetts this is a function of the Department of Environmental Protection (DEP)). In addition, DEP is required under Section 303 (d) of CWA to prepare a List of Impaired Waters every two years, containing surface waters not expected to meet state water quality standards.

Most of the shellfish beds in the watershed are closed completely to shellfishing. Approximately 88 acres are "conditionally restricted" due to high bacterial counts, meaning they must be harvested under the supervision of a master digger and depurated prior to sale. There are 18 marine beaches and 2 fresh water beaches in the watershed. In 2002, there were a total of 23 beach closure days in the Fore River watershed due to high bacterial counts as illustrated in Table 23. Beach water quality is monitored by the Massachusetts Department of Public Health (MDPH) or an authorized representative.

Sources of Bacterial Pollution

Without more recent testing, both spatially and temporally, it is difficult to pinpoint the dominant sources of bacteria in the Fore River watershed. In the past, suspected sources have included:

- Sewer overflows (DEP 1999)
- Improperly operating municipal sewers (such as failing pipelines and interceptors) (Tellus Institute 1996) and residential septic systems
- Illegal hookups to stormwater pipes (Tellus Institute 1996)
- Storm drains that deliver urban runoff
- NPDES permit violations

Bacterial Pollution in the Fore River Estuary

The Fore River is on the proposed 2004 List of Impaired Waters (MADEP 2004) for pathogens. The river is considered by DEP to be in support of the Aquatic Life Use, based on multiple years of water chemistry with

Figure 48: Fore Hydrological Features

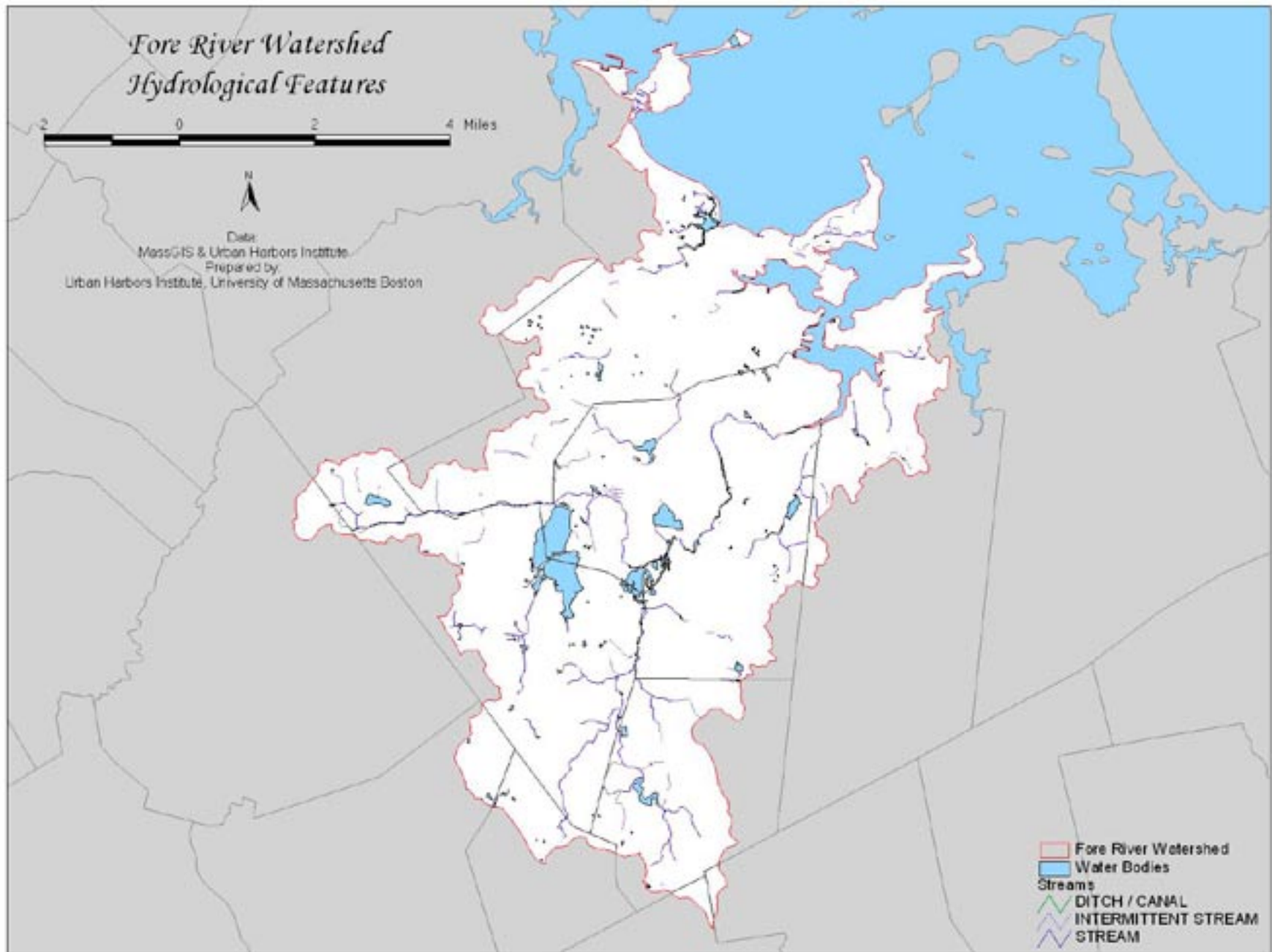
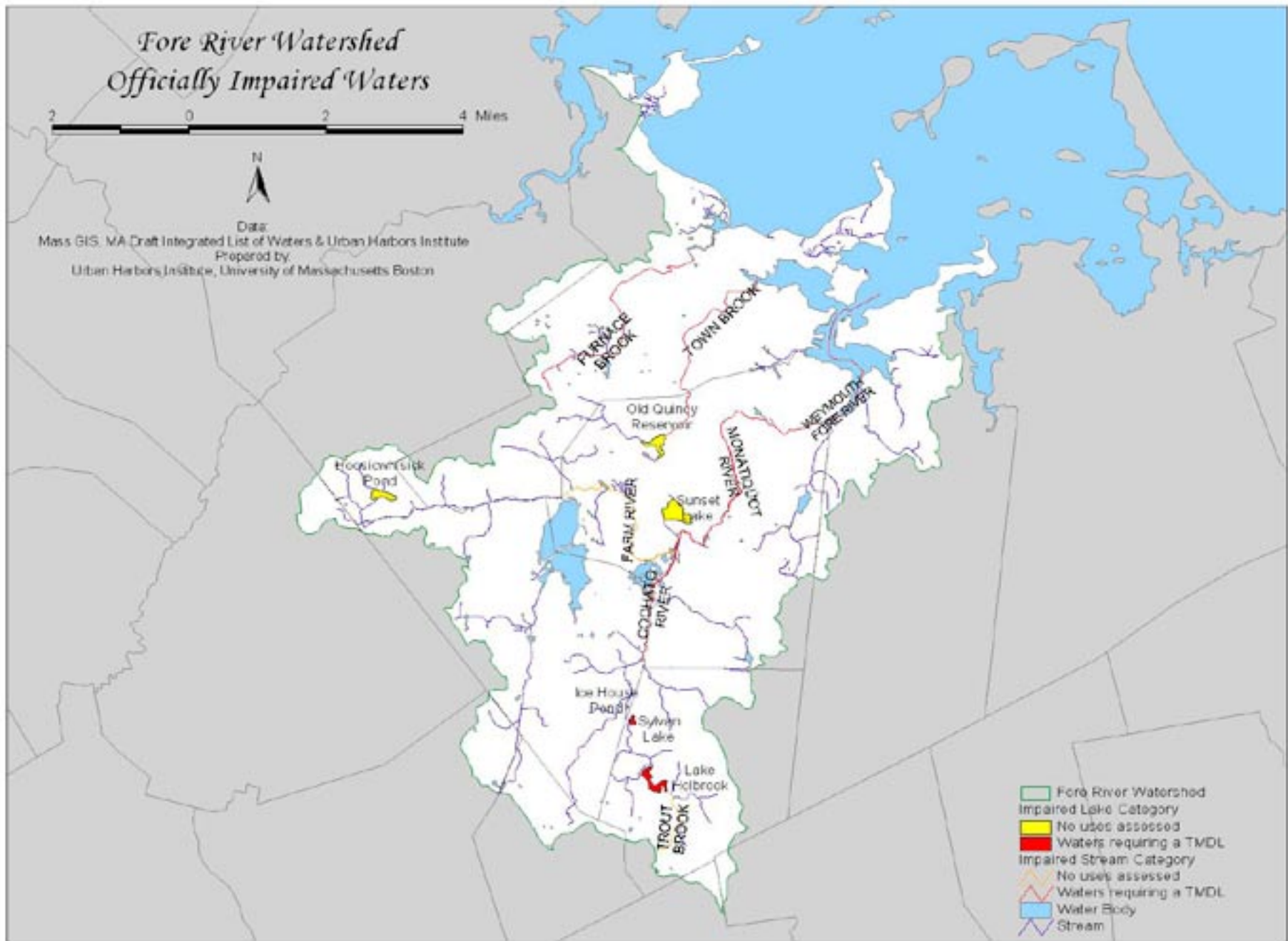


Figure 49: Fore Officially Impaired Waters



limited exceedances of the State Water Quality Standards for a class SB waterbody (MADEP 2002). According to the Massachusetts Division of Marine Fisheries, pathogens do not appear to impact the rainbow smelt population in the Fore River, which is one of the top smelt-producing rivers in Massachusetts Bay.

However, in 1989, Boston Edison Company conducted an Environmental Impact Report (EIR) (as required by the Massachusetts Environmental Protection Act (MEPA)) concerning the potential environmental impacts of a gas-powered facility along the Fore River in Weymouth. This research found that with respect to Mass Surface Water Quality Standards (MSWQS) and EPA criteria, the Fore River water quality, at times, violates criteria for dissolved oxygen and total coliform, and also raised questions about nickel and zinc levels. Another report prepared by Clean Harbors Inc. (1989), concerning potential environmental and other impacts of a proposed rotary kiln hazardous waste incinerator along the Fore River in East Braintree, documents historical accounts of coliform bacteria, nutrients, and some heavy metals exceeding state and federal water quality criteria.

Monitoring conducted as part of the MiniBays Baseline Assessment (Tellus Institute 1996) also indicated significant bacterial contamination at various locations in the Fore River on a periodic basis. This was evidenced by levels of fecal coliform above 1000 colonies per 100 ml or “too numerous to count,” and levels of Enterococcus colonies in the hundreds or thousands per 100 ml. The locations of the highest levels of bacterial contamination were at the points of freshwater inflows such as at the mouth of Phillips Creek along Pearl Street, Weymouth where it empties into Mill Cove, the mouth of Town River where it empties into the western side of Town River Bay, and the inflow from the Monatiquot River in East Braintree. Mill Cove contains nearly 200 acres of shellfish resources that have been closed for harvesting for about a decade (Tellus Institute 1996).

Bacterial contamination were found to be highest immediately after rain events; the levels were also high during dry periods, indicating significant sewerage-related inflows. Initial indications pointed to possible problems associated with inflow from improperly operating municipal sewers and residential septic systems. The fact that the highest levels of bacterial contamination were found at freshwater

inflows indicated that the sources were from upstream, making clear the need to expand the sampling to include the entire watershed.

The findings of the MiniBays Assessment resulted in a number of improvements that have eliminated the sources of bacteria during dry weather. Ongoing monitoring of the Fore River, however, continues to indicate that sanitary sewer overflows are seriously degrading habitat in the estuary. Advocates from the Fore River Watershed Association feel strongly that the only way to improve the water quality in the Fore River lies in eliminating sewer overflows.

Bacterial Pollution in Monatiquot River

This main tributary to the Fore River is listed by DEP as impaired and needs confirmation for organic enrichment/low dissolved oxygen and pathogens. This river is not in support of Aquatic Life Use as

Table 23: Fore Beach Closures During Summer 2002 (MA DPH 2002).

Name	Town	Type	Closures
George E. Lane Beach (or New Beach)	Weymouth	Marine	Not assessed
Wessagussett Beach	Weymouth	Marine	0
Johnson Beach	Weymouth	Marine	Not assessed
N. Porter Kenn Beach	Weymouth	Marine	Not assessed
King Cove Beach	Weymouth	Marine	Not assessed
Sandy Beach	Weymouth	Marine	Not assessed
Idlewell Beach	Weymouth	Marine	Not assessed
Smith Beach	Braintree	Marine	2
Sunset Beach	Braintree	Fresh	0
Avalon Beach	Quincy	Marine	1
Mound Beach	Quincy	Marine	0
Baker/Broader Beach	Quincy	Marine	1
Post Island Beach (Heron)	Quincy	Marine	1
Parkhurst Beach	Quincy	Marine	1
Rhoda Beach	Quincy	Marine	1
Edgewater Drive	Quincy	Marine	3
Wollaston Beach	Quincy	Marine	9
Nickerson Beach	Quincy	Marine	3
Orchard Beach	Quincy	Marine	0

there has been significant loss of habitat along the Montatiquot due to channelization, and the benthic community is moderately impacted (DEP 1999).

Bacterial Pollution in the Cochato River

This headwater to Monatiquot River is on the 2004 proposed List of Impaired Waters for pathogens, pesticides, and organic enrichment/low dissolved oxygen.

Bacterial Pollution in Farm River, Trout Brook, Lake Holbrook, Hoosicwhisick Pond, Sunset Lake, Old Quincy Reservoir

These waters are suspected not to meet the Massachusetts Surface Water Quality Standards for their class of water, but have not been assessed. DEP Clean Lakes Program measured high fecal coliform counts in Lake Holbrook in 1986 and 1987 (Tellus 1996).

Bacterial Pollution in Town Brook

This tributary to the Fore River estuary is on the 2004 proposed List of Impaired Waters for pathogens. The Massachusetts Bay Transit Authority is permitted to discharge wet weather flow and groundwater to Town Brook. Toxicity tests have revealed discharges in violation of the permit (MADEP 2002).

Does nutrient pollution pose a threat to aquatic life?

Yes, at least in portions of the watershed. The impact that nutrient enrichment and eutrophication may have on natural resources of the waterways, such as anadromous fish and eelgrass, is difficult to assess specifically for the Fore River watershed because no such study has been carried out as of yet. The complexity of determining acceptable nutrient levels is complicated by the fact that the Massachusetts Surface Water Quality Standards do not include specific numeric thresholds for nutrient levels, but rather a general narrative criteria under various “uses” including aquatic life use and aesthetics. Despite these drawbacks, it is possible to draw some conclusions from anecdotal evidence combined with some data presented here.

Suspected Sources of Nutrient Pollution

In general, stormwater runoff is suspected of contributing a large

component of the nutrient pollution in the watershed. There are also a number of pipes discharging high concentrations of nutrients into the Monatiquot River (Woods 1997).

Nutrient Pollution in the Fore River

Research conducted by Clean Harbors Inc. (1989) confirmed that, historically, high levels of nutrients have been measured in the Fore River.

Nutrient Pollution in the Monatiquot River

A 1997 study of the river suggests that, for the most part, this tributary to the Fore River is nitrogen limited with N:P ratios below 22:1 (Woods 1997). These findings were comparable to a previous study by D'Amore (1982). Both nitrates and phosphates were found to increase from upstream sites to downstream sites, which suggests greater inputs of nutrients from land-based sources as one moves downstream. A visual survey suggests that excess nutrients in regions of the Monatiquot River could be contributing to the growth of filamentous algae, which in turn could be affecting the usability of the river as spawning habitat for a small herring population (Woods 1997).

Nutrient Pollution in Lake Holbrook

In the late 1980's, DEP found Holbrook Lake in Braintree to be eutrophic.

Are dissolved oxygen levels high enough to support aquatic life?

Yes, at least in most of the watershed. Dissolved oxygen (DO) levels measured in excess of 5 mg/l are generally considered adequate to support aquatic life.

Dissolved Oxygen in the Fore River

The Massachusetts Water Resources Authority (MWRA) collected monthly surface and bottom water DO and found a range from 5.35 – 13.13 mg/l (MADEP 2002).

Dissolved Oxygen in the Monatiquot River

USGS measure DO in the Monatiquot River between June 1999 and June 2000 and found concentrations ranged between 7.7 – 11.8 mg/l

(Socolow et al. 2000, Socolow et al. 2001). However, none of these samples were taken at night, when plants are using oxygen rather than producing it.

Dissolved Oxygen in the Furnace Brook

This tributary to Black's Creek is on the 1998 303(d) list of impaired waters needing confirmation for organic enrichment/low DO (MADEP 1999). Rainbow smelt have been found to deposit eggs in a small stretch of the brook, but these spawning runs are suspected to be below capacity. Possible explanations include habitat degradation due to storm water runoff and a narrow tide gate that might limit adult passage (Chase 2000).

Are there other water quality indicators that limit use of the watershed?

Yes, there is evidence of contamination from pesticides and heavy metals

Heavy Metals in the Fore River Estuary

The Boston Edison Company EIR concerning the potential environmental impacts of a gas-powered facility along the Fore River in Weymouth raised questions about nickel and zinc levels in the estuary. Another report prepared by Clean Harbors Inc. (1989), concerning potential environmental and other impacts of a proposed rotary kiln hazardous waste incinerator along the Fore River in East Braintree, documents historical accounts of some heavy metals exceeding state and federal water quality criteria.

Pesticides in the Cochato River

This tributary to Monaquot River is on the 1998 303 (d) list of impaired waters for pathogens, pesticides, and organic enrichment/low dissolved oxygen. MPDH issued a fish consumption advisory for the Cochato River due to elevated levels of pesticides. The Baird & McGuire superfund site is 500 feet west of the Cochato River. Baird & McGuire operated a chemical mixing and batching company until 1983. Contaminated soil and Cochato River sediment cleanup was completed in 1997. A groundwater treatment facility, constructed in 1993 to address contamination, will continue to operate for the foreseeable future. In 1999, a light non-aqueous phase liquid (LNAPL) extraction

system was constructed and collects approximately 5 to 7 gallons of the liquid waste daily. DEP is scheduled to take over site-wide operations and management in June 2004 (USEPA 2004).

Pesticides in Sylvan Lake and Ice House Pond

These lakes are not in support of Aquatic Life Use due to pesticide contamination.

Do water supply, interbasin transfer or inflow and infiltration have a significant impact on instream flow levels?

Neither water supply activities nor interbasin transfers impact instream flow levels to any significant degree in the watershed. All of the communities within the Fore River watershed are serviced by the Massachusetts Water Resources Authority (MWRA) except for Avon. Evidence suggests that as much as 70% of wastewater delivered in sewer lines is from inflow and infiltration.

Weymouth Water Supply

The Town of Weymouth has a drinking water treatment facility located at each of its two water supply sources, Great Pond Reservoir and the Mill River Basin. The Great Pond Water Treatment Plant was constructed in 1936 and has since undergone a number of upgrades. At present, the facility can treat up to 8 million gallons per day (MGD) and supplies about 75% of the town. The town recently received loans from the Drinking Water State Revolving Fund to upgrade the plant. During periods of low rainfall, the 860 million gallons of usable water in Great Pond can be supplemented with water from the South Cove of Whitman's Pond. This has a usable volume of 165 million gallons. The Arthur J. Bilodeau Water Treatment Plant was built in 1975 and can treat up to 4 MGD. At present the water is drawn from four active wells in the Mill River Aquifer. This plant supplies approximately 25% of the town. Currently there are plans to reactivate the Winter Street #1 Well. This well was taken out of service in the early 1980s due to the costs of reducing high levels of iron and manganese (Woodard and Curren, 2002). The increase in demand for water and better treatment methodology mean that its reactivation is now thought to be essential to cope with future demand. The distribution network for both plants consists of 238 miles of pipes, some of which are over 110 years old.

Due to increasing demand for water, a number of initiatives have been implemented to attempt to reduce the stress on the town's limited water supplies. In 1994, the Department of Environmental Protection ordered the community to reduce its water use so that it did not exceed the "safe yield" of the sources. The safe yield is defined as the amount of water that a source can supply during a 100-year drought. At that time, this was estimated to be 4.51 MGD. Despite the order from the DEP, there was no significant reduction in water use and in 1997 the town's DPW entered into an Administrative Consent Order with the DEP to reduce water use from 4.9 to 4.51 MGD. In 1998, in an attempt to achieve this, a water supply emergency was issued.

In 2001, the safe yield was calculated at 4.48 MGD, and in 2002 this had risen to 4.93 MGD. A further increase is expected once the Winter Street #1 Well is activated.

In the last few years, reduced demand and effective initiatives by the DPW have resulted in water use falling to below the 4.51 MGD agreed with the DEP (to 4.49 MGD in 2001 and 4.2 MGD in 2002). In 2002, for the third consecutive year, the town did not implement a water ban even though much of the rest of New England was in a drought situation.

In order to maintain this situation, the Town of Weymouth enacted bylaws, funded studies to protect water supplies and water quality and filed a Water Conservation Plan for Public Water Suppliers. The DPW website summaries these efforts:

"The Town of Weymouth developed water restriction criteria and a plan based on the requirements of the town's water supply ACO with the DEP. The water restrictions are based on the water level of Great Pond, and the year to date total water production. At the beginning of each month, from May through November, these criteria are evaluated to determine the need for water restriction and the extent of the water restrictions.

"In the past several years, the Town of Weymouth has taken an aggressive approach to the water conservation program. Any new water use applications issued by the Town are required to complete a 2:1 water savings ratio. These savings may be

gained through the retrofitting of existing buildings with water savings devices. The retrofitting of all public buildings, schools, and some businesses and residences has been accomplished with the cooperation of the Town, new users, and contractors. These projects include the furnishing and installation of low flow toilets, low flow showerheads, low flow faucets, and low flow flushometers. The water conservation program has been a huge success and a key element in reducing our daily water demand.

Weymouth Sewer System

The Town of Weymouth has approximately 919,000 feet of gravity sewer pipe, 600,000 feet of building connections and an additional 20,000 feet of sewer force mains and pressure sewers. These are serviced through almost 5,000 sanitary sewer manholes. The system, containing 11 pump stations, 17 ejector stations and three submersible stations, was installed between 1947 and 1980. Much of the system was built as the town was being developed. As a result of this and the more-recent growth of the town, certain areas are unable to cope with the additional demand.

The town is divided into six interceptor sub-basins, each of which is divided into smaller sub-divisions. These feed into the MWRA system at 11 locations. From here the sewage travels to the Deer Island Wastewater Treatment Plant via Nut Island. In 1999, it was estimated that 85% of the town was sewerred, with only 1,100 homes remaining on septic systems.

Increasing demand has led to problems with the town's sewer system and the DPW has been working to address these issues since 1985. Initially an Infiltration/Inflow (I/I) analysis was commissioned which revealed that large quantities of groundwater and rainwater were entering the system. By 1994, the major problems had been eliminated. However, the system was still over taxed. Therefore, in 1998, the DEP and DPW entered into a Consent Order to reduce sewer demand and to link any new demand with a reduction in I/I. The DPW also implemented a multi-year sewer repair program know as the Town of Weymouth Capital Improvement Program. This aims to reduce the pressures on the existing system. It includes the construction of a new pump station at Libbey Industrial Parkway, which is scheduled to begin November, 2004. The DPW continues to undertake extensive studies and improvement programs. Additionally, a number of MWRA projects are expected

to further reduce the problems with the town's sewer system. Finally, the Town has received a loan from the Clean Water State Revolving Fund to conduct comprehensive Stormwater Management Planning in accordance with the USEPA Stormwater Phase II regulations.

Quincy Water Supply (from Carlisle 2004)

The city of Quincy's water supply is provided by MWRA from the Quabbin Reservoir. Quincy has an average water demand of 9.8 MGD. Quincy does not have any current or anticipated water supply shortages. Quincy has adopted a leak detection program – basically to account for unaccounted water (determining the differences in volume received from the MWRA versus what the city metered to its customers). The city is also in the process of adopting an ordinance with regard to Homeland Security concerns, which would allow the commissioner to restrict water usage .

Quincy Sewer System (from Carlisle 2004)

The Quincy sewer system connects into the MWRA system. Quincy has 230 miles of collection mains, 23,000 connections and 6 pump stations. The system dates back to the 1890's. The majority of the city is sewered, with less than 24 homes having septic systems. The city is working to eliminate inflow and infiltration in the Wollaston Beach area. Sewer system improvements are also being carried out in the Montclair area, due to suspected infiltration. Sewer improvement is also being carried out in North Quincy to ensure the system meets standard. The City has obtained a loan from the Clean Water State Revolving Fund to improve the sewers along Quincy Shore Drive.

Braintree Water Supply (from Feehan 2004; Scudder 2004)

Braintree is part of a tri-town water commission with Holbrook and Randolph. Water is supplied to Braintree from the Great Pond and Upper Reservoirs. Water is also pumped from the remote Richardi Reservoir to the Great Pond Reservoir. The average water demand is approximately 3.5 MGD. Braintree has 5 restriction levels, with the town normally at restriction level 1 due to limited capacity. An evaluation of the Great Pond Treatment plant by Environmental Partners Group "indicated that it would be more effective and economical to replace the existing facilities with a new treatment plant, given the extent and magnitude of the repairs and modifications necessary to address its deficiencies and performance limiting factors". The current tri-town water supply is non-compliant

with the EPA's rules. There are plans to build one plant to supply the three towns; Braintree, Holbrook and Randolph. Braintree has also set aside funds in order to study the feasibility of a desalinating plant.

Braintree Sewer System (from Feehan 2004; Scudder 2004)

The Braintree sewer system includes 140 miles of pipe carrying approximately 7 MGD of sewage which is passed to the MWRA system. Industrial waste is minimal. Ninety-five percent of the town is sewered, with the intention that most homes with septic systems be converted to the sewer system. The sewer system dates back to the 1950's and as a result upgrade, repair and redirection projects are on-going. The pump stations are also being upgraded; 1 has already been upgraded and 3 more are currently being upgraded. In response to a DEP consent order, the town adopted an Infiltration/Inflow (I/I) program which links any new demand with a reduction in I/I. The town has also implemented a Grease Control program, mandating restaurants to implement grease treatment in order to help prevent sanitary sewer overflows. Currently established restaurants have until 2006 to comply, with new restaurants required to comply immediately. The town currently has a contract to develop a sewer atlas, detailing the sewer system infrastructure.

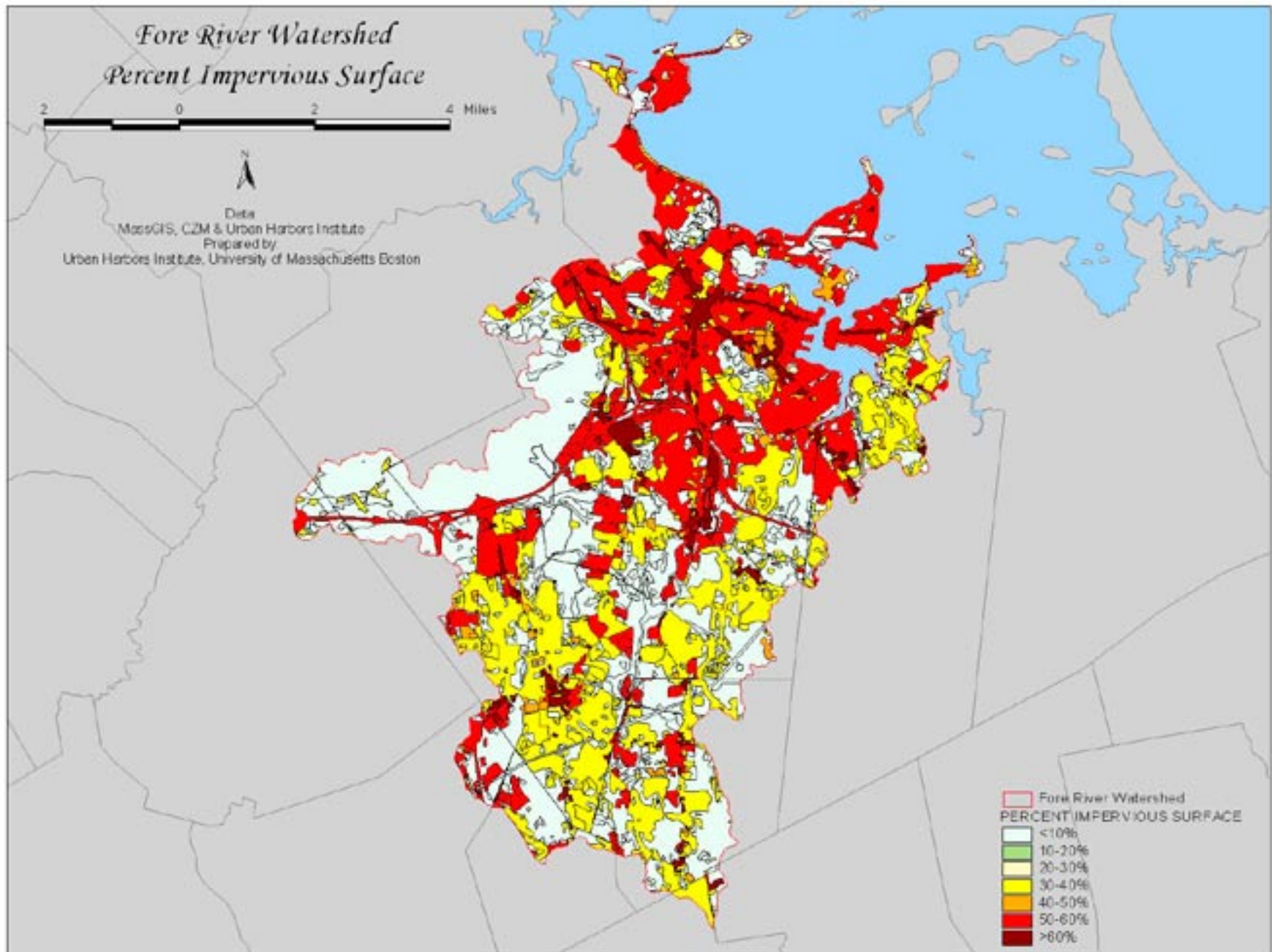
Other Information

An Inflow and Infiltration Task Force (including the Fore River Watershed Association) was formed in response to the DEP/MWRA consent order, which in turn followed from complaints and pending Clean Water Act litigation regarding sanitary sewer overflows.

Approximately what percentage of the watershed is impervious?

Approximately 14 square miles (29 percent) of the Fore River watershed is impervious surface, with the greatest amount of imperviousness concentrated closest to the coastline and along major thoroughfares. Figure 50 illustrates the impervious surface coverage for the watershed. Impervious coverage is an effect of land cover disturbance and is a widely-used indicator of human impact. A surface is considered impervious if it has been covered or compacted with a layer of material that substantially reduces or prevents rain or storm water from filtering into the ground. Estimates of impervious cover for disturbed land cover classes have been developed by University of Rhode Island's Department of Natural

Figure 50: Fore Impervious Surface



Resources Science Cooperative Extension (Joubert et al. 2000) for use with the 21 class data provided by MassGIS. Using these impervious surface coefficients, estimates of the total amount of impervious surface within the watershed can be made.

Rain water that flows overland or through storm drains and does not get absorbed into the ground is called stormwater or runoff and is a form of nonpoint source pollution. Stormwater is a leading source of water pollution. Common pollutants associated with stormwater include oil and grease (e.g., from vehicles, machinery, kitchen waste), heavy metals (e.g., from batteries, paints, pesticides), nutrients (e.g., fertilizers, animal waste), chemicals (e.g., from cleaning products, pesticides), sediment (e.g., from construction sites), litter (e.g., improperly disposed trash), and bacteria (from failing septic systems, animal waste).

Impervious surface is an important factor in determining the quality and quantity of stormwater flowing within and between the different waterways in a watershed. As more area within a watershed is covered by surfaces that shed water rather than absorb it, the volume and velocity of stormwater runoff carrying pollutants to streams, ponds, lakes, and the ocean increases. Using impervious surface coverage to evaluate environmental impacts from stormwater offers a cost-effective and realistic approach because these surfaces can be measured, managed, and controlled (Sleavin et al. 2000).

According to a three-tier classification scheme suggested by Schueler (1994), land area with less than 10 percent impervious coverage is considered protected, 10 to 25 percent is considered impacted, and 25 percent or more is considered degraded. Considering the Fore River watershed as a whole, it would be classified as degraded. According to the Center for Watershed Protection, with impervious surface coverage greater than 25%, the following effects may start to become apparent (1) stream bank erosion and channel instability; (2) poor to fair water quality; (3) possible risks to human health resulting from contact with the water; and (4) low biodiversity.

Are there current or expected water supply shortages ?

As discussed above, the Town of Weymouth DPW has implemented a number of measures in an attempt to reduce the demand on the town's water supplies. These seem to have been successful, and in 1999, 2000, 2001 and 2002 the town met its registered withdrawal limit of 4.51 MGD. The reactivation of the Winter Street #1 Well will supplement the existing sources. At present there are not expected to be shortages in water supply, and the DPW is striving to establish new water sources to meet predicted demand through 2020.

Do flooding or high flows cause problems for structures or aquatic life?

Flood control measures at Town Brook and Weymouth Landing have helped to reduce structural impacts of flooding but have also depleted the smelt runs in these areas. Overall, there is minimal flooding in the Fore River watershed except for the occasional storm drain back-ups at high tide.

Is the watershed considered hydrologically stressed based on the WRC definition?

The Fore River watershed has not been evaluated by the Massachusetts Water Resources Commission.

Are NHESP listed habitats or BioMap habitats present in the watershed?

Yes, there are both NHESP listed habitats and BioMap habitats in the watershed. An extensive area of BioMap habitats and their identified supporting natural landscapes are located primarily on the western border of the watershed. There are also smaller BioMap areas on the southeastern border of the Fore River watershed. In addition to these BioMap habitats there are other listed and/or protected areas in the watershed. These include priority habitats for state-protected rare species identified through NHESP in 2003 in the western, southwestern, and, to a lesser extent, eastern portion of the Fore River watershed. Some

Figure 51: Fore Floodplains and Vegetated Wetlands

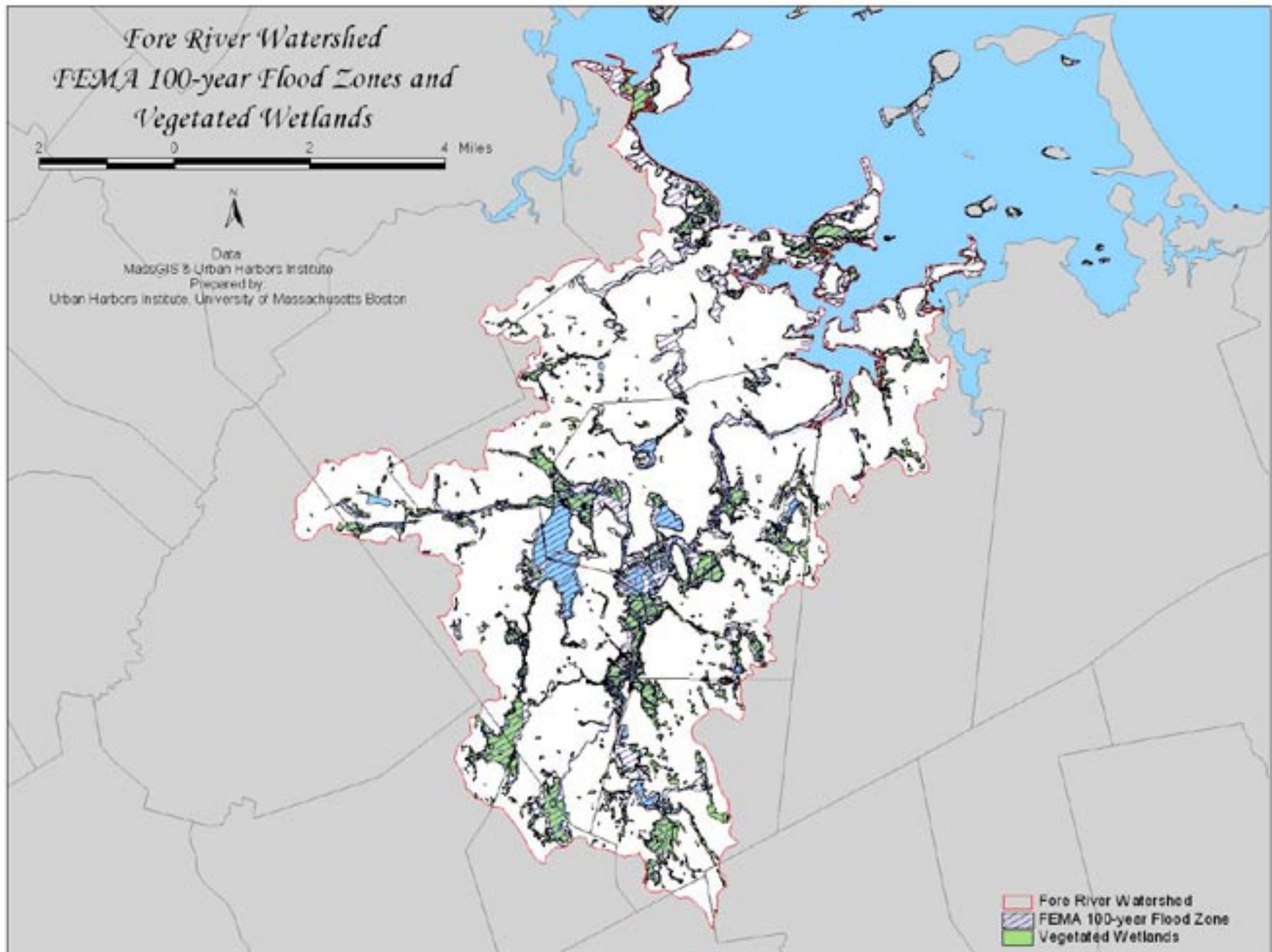


Figure 52: Fore Biomap Habitats

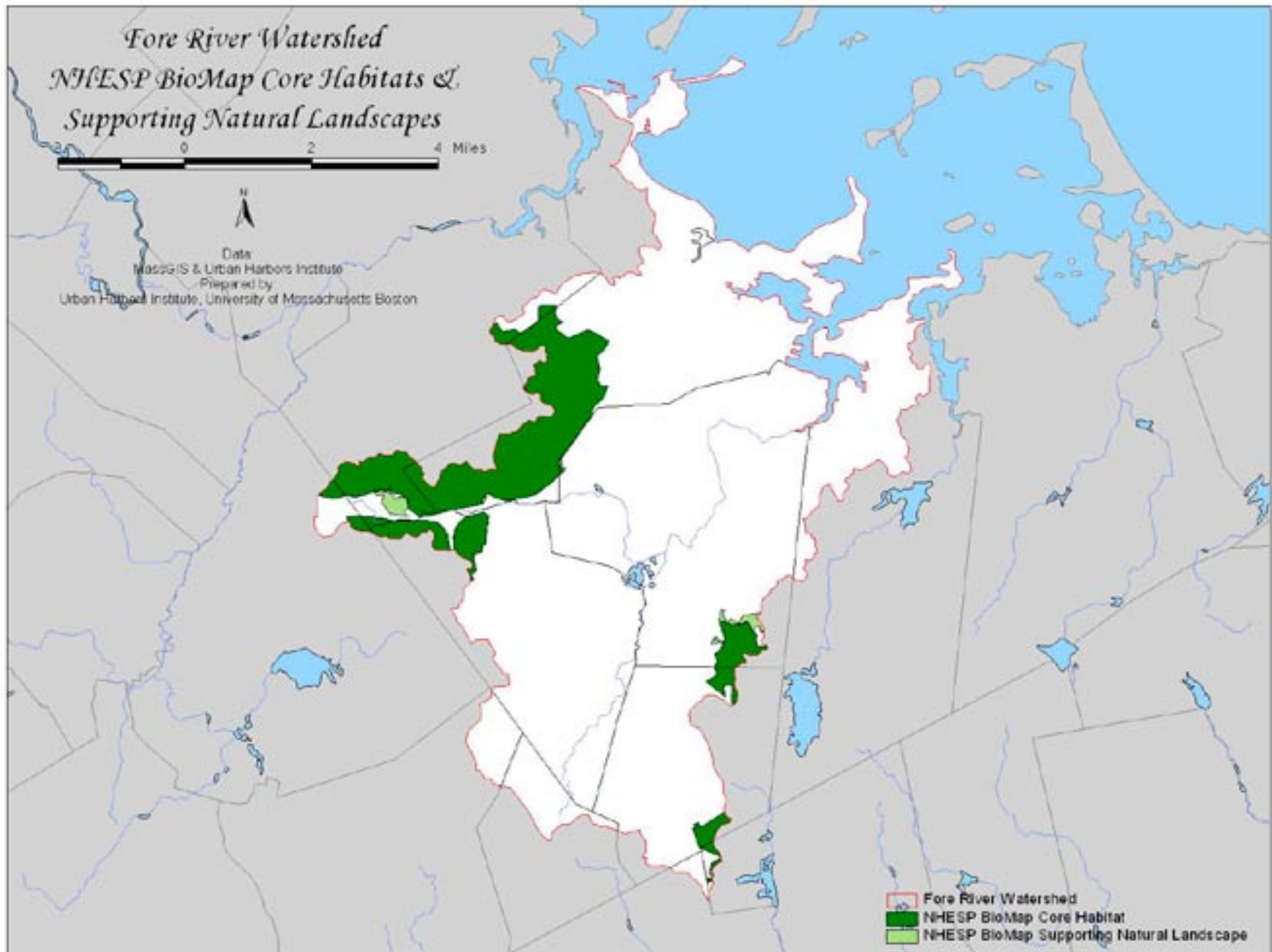


Figure 53: Fore Riparian Corridors and Contiguous Natural Lands

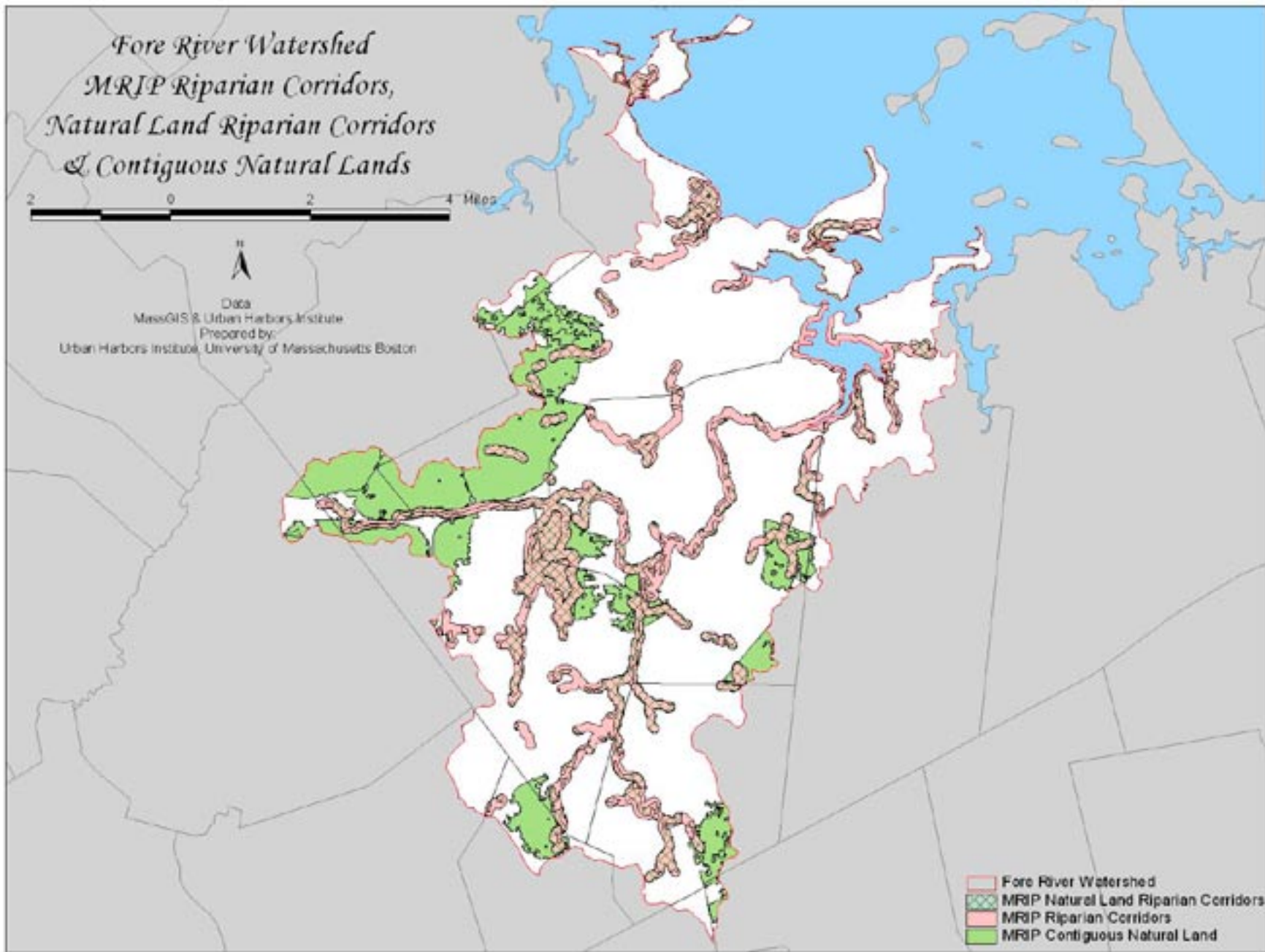


Figure 54: Fore Coastal and Vegetated Wetland Resource Areas

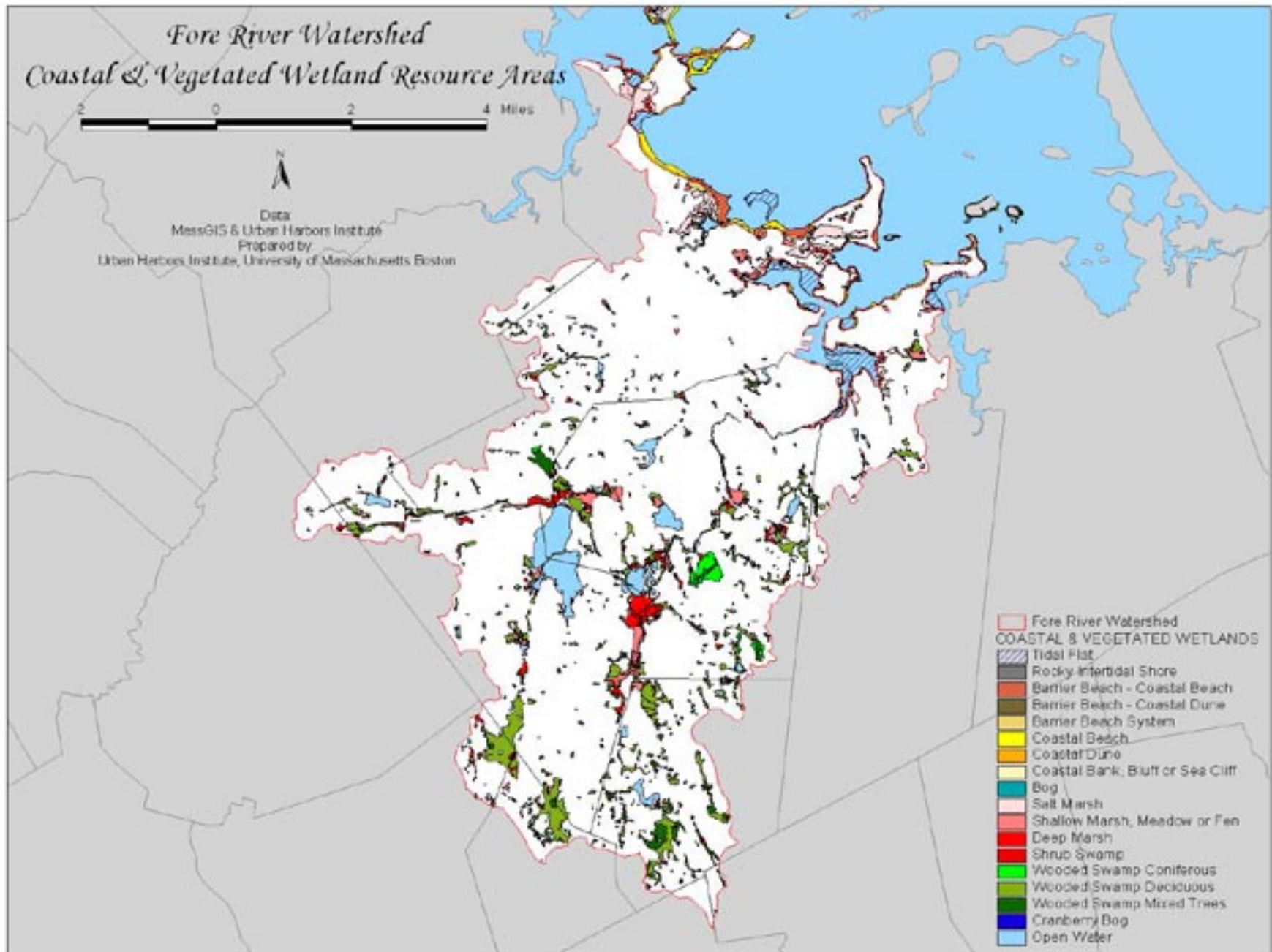


Figure 55: Fore Vernal Pools, ACECs, ORWs and Zone II

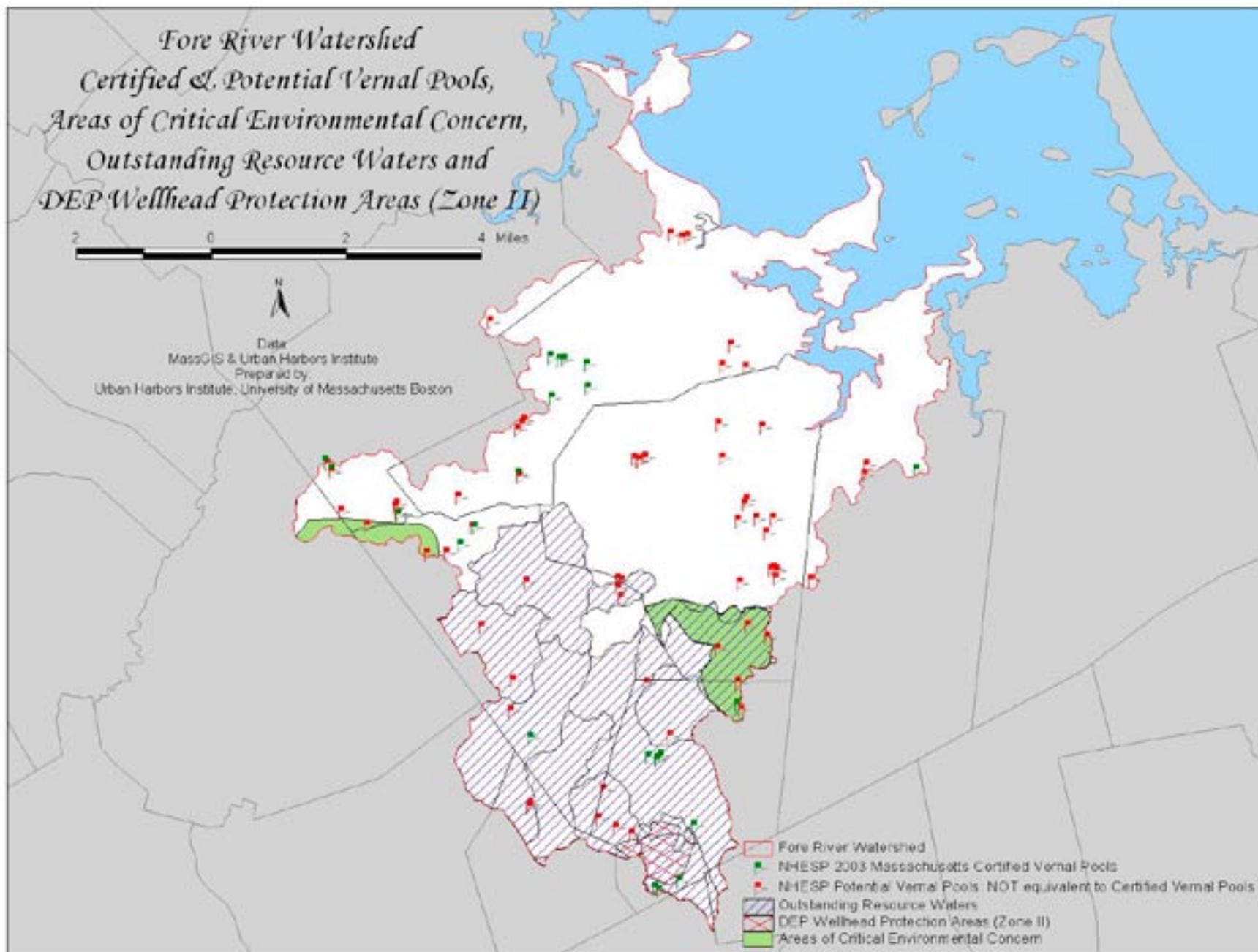


Figure 56: Fore Approximate DEP Regulated Wetlands

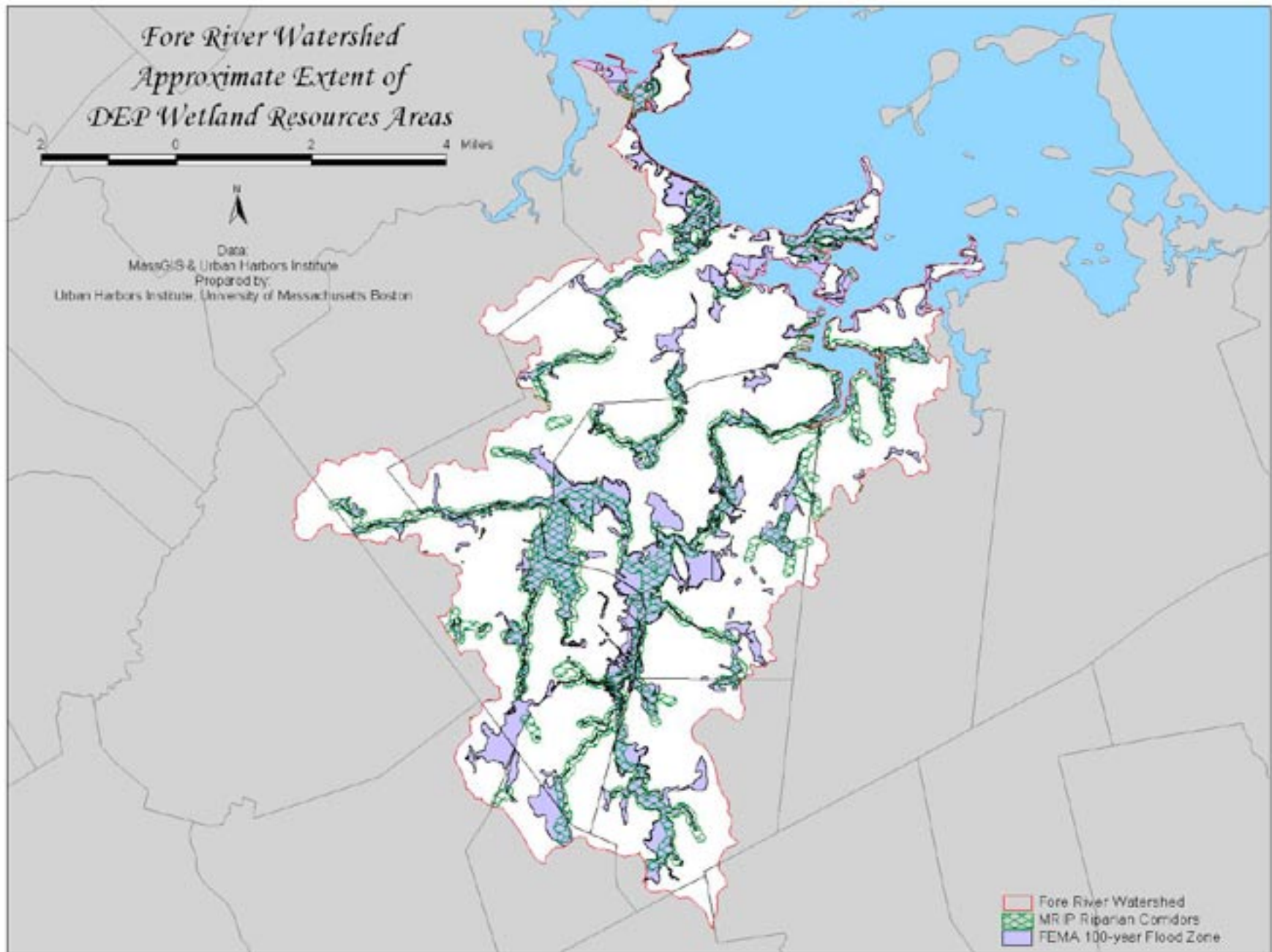
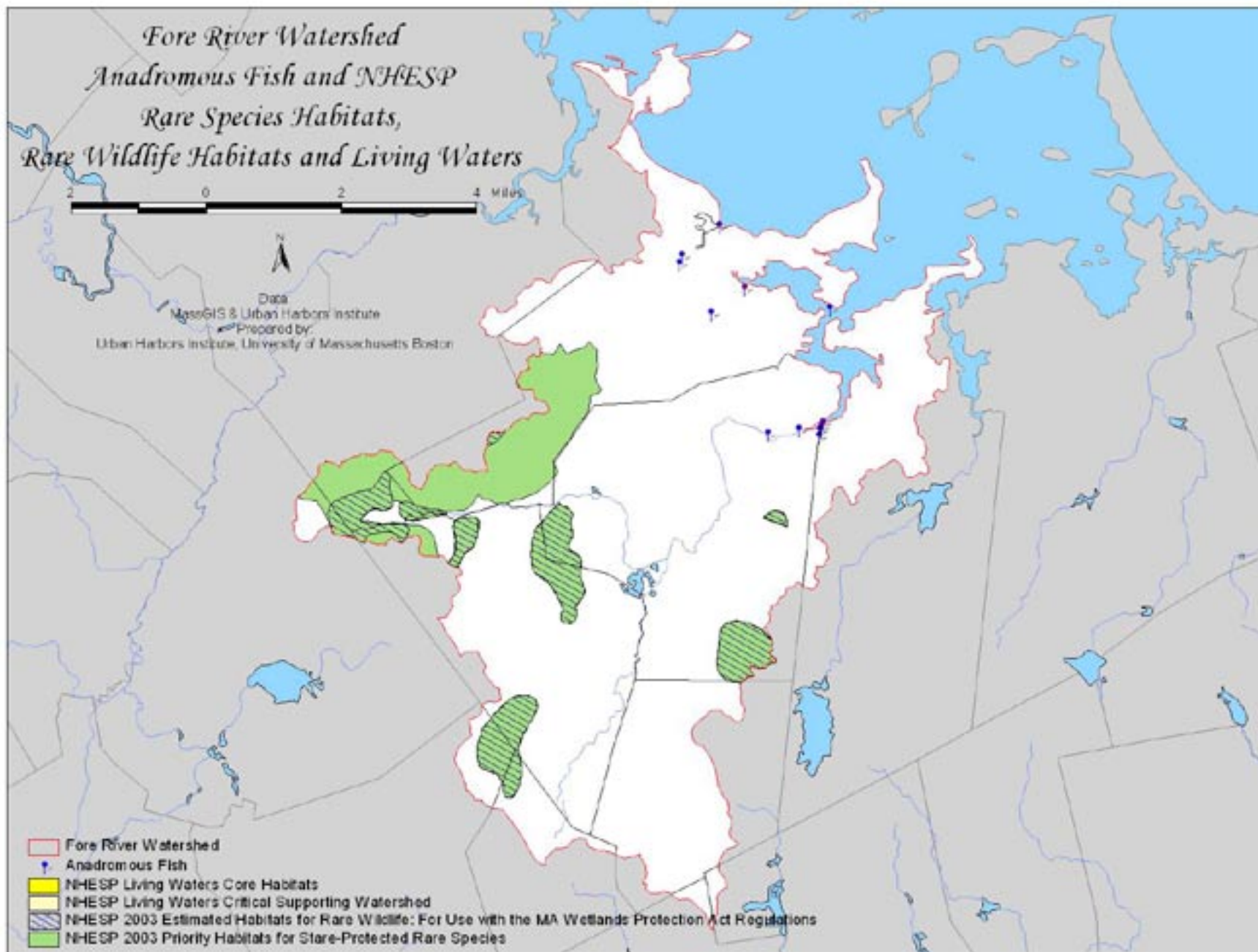


Figure 57: Fore Anadromous Fish and Rare Wildlife Habitats



of these areas overlap with NHESP's estimated habitats for rare wildlife. These rare wildlife habitats are used when employing Massachusetts Wetlands Protection Act regulations.

Are there other special habitat?

Yes, there are other special habitat types in the watershed. The Cranberry Brook Watershed Area of Critical Environmental Concern (ACEC) consists of 1,041 acres on the Fore River. Several vernal pools that were certified by the NHESP in 2003 as well as numerous potentially certifiable vernal pools have been identified in the Fore River sub-watershed. There are also areas in the watershed that are recognized as outstanding resource waters or areas of critical environmental concern by the state of Massachusetts. There are anadromous fish habitats in the coastal section of the watershed. Some of these areas, in conjunction with habitats in the Back River watershed, support two of the three largest smelt runs in Massachusetts Bay. There are also river herring runs (MA DMF 2001). After hatching, juvenile anadromous fish often spend the first portion of their lives growing in the rivers and estuaries of the area before heading for their marine habitats.

In the Fore River, a large spawning habitat is available for Rainbow Smelt, although it is impacted by stormwater and the Smelt Brook tributary is degraded by passage and habitat limitations (Chase 2004). Low numbers of Blueback Herring and Alewife are also found in the Fore River each spring. The spawning run of River Herring appears to be increasing in recent years and could be increased more through restoration efforts. Years ago, the Fore River was known for having many Atlantic Tomcod, but the population appears to have declined recently. White Perch were also found in Fore River; however no recent observations have been recorded. Seasonal feeding migrations of Striped Bass provide large benefits for local commercial and recreational fisheries, although there is no spawning run of Striped Bass in the Fore River. Catadromous American eel are also commonly observed in the Fore River, but little information is available on the eels.

Shellfish flats, lobster fisheries, and menhaden fisheries contribute significantly to the harvest of local commercial fishermen. In addition, the western portion of the watershed and other areas contain contiguous forested and wetland areas. Finally, the western part of the watershed as well as other areas contain three types of MRIP designated areas. These

include contiguous natural lands, riparian corridors, and natural land riparian corridors.

The Hough's Neck area has close to 170 acres of salt marsh wetlands surrounded by almost 7 miles of coastline. Into the 1980's, the area was abundant with Cod, Bluefish, Haddock, Striped Bass and Flounder (Foley 2004). One of the factors leading to declining fish stocks was the blockage (to prevent flooding) and neglect of the salt marshes. It is anticipated that the continued restoration of the salt marsh wetlands will provide a hatchery for fish.

Are wetland and vernal pool habitats healthy or degraded?

Bacterial contamination, low dissolved oxygen, and high nutrient levels impact the Fore River. These impacts affect the habitats of the watershed to differing degrees. For many years Fore River habitats were influenced by degraded water quality created, in part, by the discharge of MWRA's Nut Island treatment plant effluent into neighboring waters. There was also localized sewage contamination. The largest of these sources of contamination have been eliminated with the decommissioning of the Nut Island plant and repairs to sewer systems within the watershed in the 1990s. However, the quality of habitats throughout the watershed is still being degraded by runoff and other changes resulting from residential and commercial development (Woods 1997). The watershed hosts a mix of high-density residential areas and a few large industrial centers. Industrial activities include sludge pelletization and chemical manufacturing (QEN 2001). Stormwater discharges and sedimentation further contribute to both aquatic and terrestrial habitat deterioration in the watershed (MA DMF 2001). Sedimentation is particularly harmful to anadromous fish spawning habitat. If fish eggs are silted over, they do not mature.

Filling of marshes along the Southern Artery at YMCA and Faxon Field have adversely impacted tidal flow in Town River in Quincy (Ross 2004). Also, dredge spoil dumping along the Town River has negatively impacted salt marshes at Broad Meadows, Mound Street, and Germantown (Ross 2004). There are no specific studies of wetlands, salt marshes, or vernal pools in the Fore River watershed. Further information should be gathered on the status of these areas, plans to

alter them, and how they compare (in both form, function, and health) to similar areas in neighboring watersheds.

Are invasive species a significant threat to upland, wetland or aquatic habitats?

Invasive species are a threat to salt marsh and wetland habitats. It is suspected that restricted marsh flows mentioned above have encouraged the proliferation of invasive species (Ross 2004). As in many other areas on the south shore of Massachusetts, *Phragmites australis* communities have been found at spring high tide lines throughout the Fore River watershed. There is limited information on the extent of these communities and very little information on other invasive species. Despite this lack of information on invasive species, there is ample mention in reports since the 1970s of negative impacts on aquatic habitat from dams, waterway engineering, contaminated sediments, and sedimentation. These observations are not, however, especially useful because many of them are outdated or are either very specific or generalized. Further information on specific impacts of these physical habitat alterations in the Fore River sub-watershed is needed.

Illegal tidal restrictions in the culvert under the MWRA high-level sewer has reduced flow to the marsh along Sea Street in Houghs Neck section of Quincy (Ross 2004). It is suspected that these restrictions are impacting the viability of the marsh. Removal of restrictions to the Post Island marsh and to the 2nd and 3rd marshes in Quincy are being addressed (Ross 2004).

What percentage of the watershed is “built-out?”

The Fore River Watershed is comprised of approximately 31,458 acres in eleven towns. Table 22 presents the acreage of each town, acreage of the town in the Fore River watershed, the percentage of the town in the watershed, and the percent each town is of the watershed.

As can be seen in Table 24, forty percent of the Fore River watershed is developed as single-family homes on lots of one-half acre or less. The other major category of land cover is forest (28 percent) followed by commercial, industrial and transportation uses at an aggregate 13.3

percent.

Available land use and open space data are aggregated by, and build-out information is computed for, entire municipalities. Therefore, the following sections characterizing current and projected land use and population are based on data from towns whose land areas are entirely or predominantly in the watershed. For the Fore River watershed, this is Braintree, Holbrook, Quincy, and Randolph.

Table 24: Fore Land Use

Use Category	Total Acreage	% Acreage
Cropland	64.6	0.2
Pasture	84.6	0.3
Forest	8806.7	28.2
Wetland	735.4	2.4
Mining	275.3	0.9
Open Land	877.3	2.8
Participation Recreation	682.5	2.2
Spectator Recreation	48.2	0.2
Water Based Recreation	152.1	0.5
Residential (Multi-family)	550.8	1.8
Residential (Smaller than 1/4 acre lots)	5636.8	18.0
Residential (1/4 - 1/2 acre lots)	6483.7	20.8
Residential (Larger than 1/2 acre lots)	354.1	1.1
Salt Wetland	471.3	1.5
Commercial	1380.9	4.4
Industrial	1834.4	5.9
Urban Open	1080.9	3.5
Transportation	928.4	3.0
Waste Disposal	61.7	0.2
Water	716.0	2.3
Orchard, Nursery or Cranberry Bog	8.2	0.0
TOTAL	31,234.0	100

Figure 58: Fore Land Use

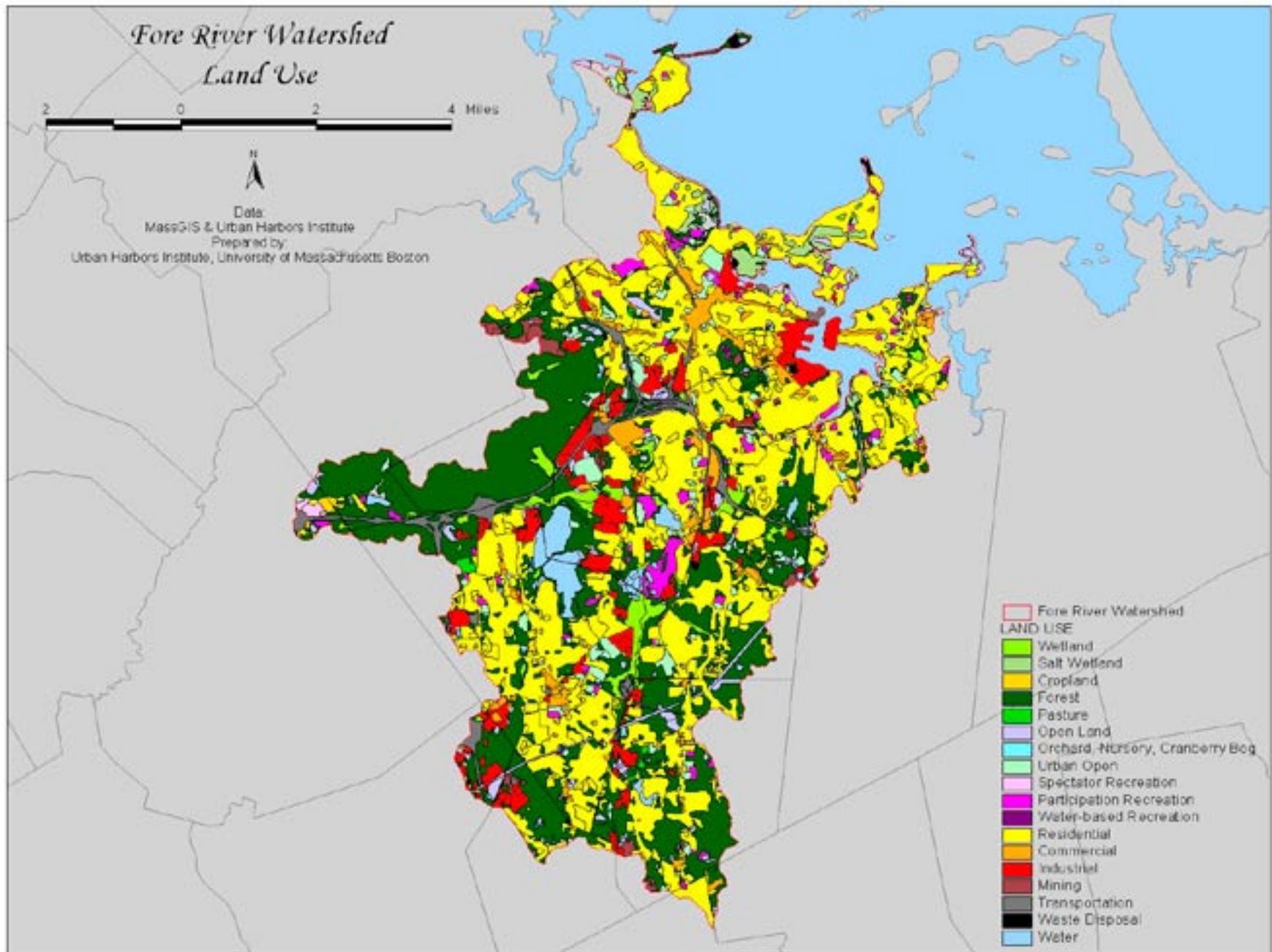
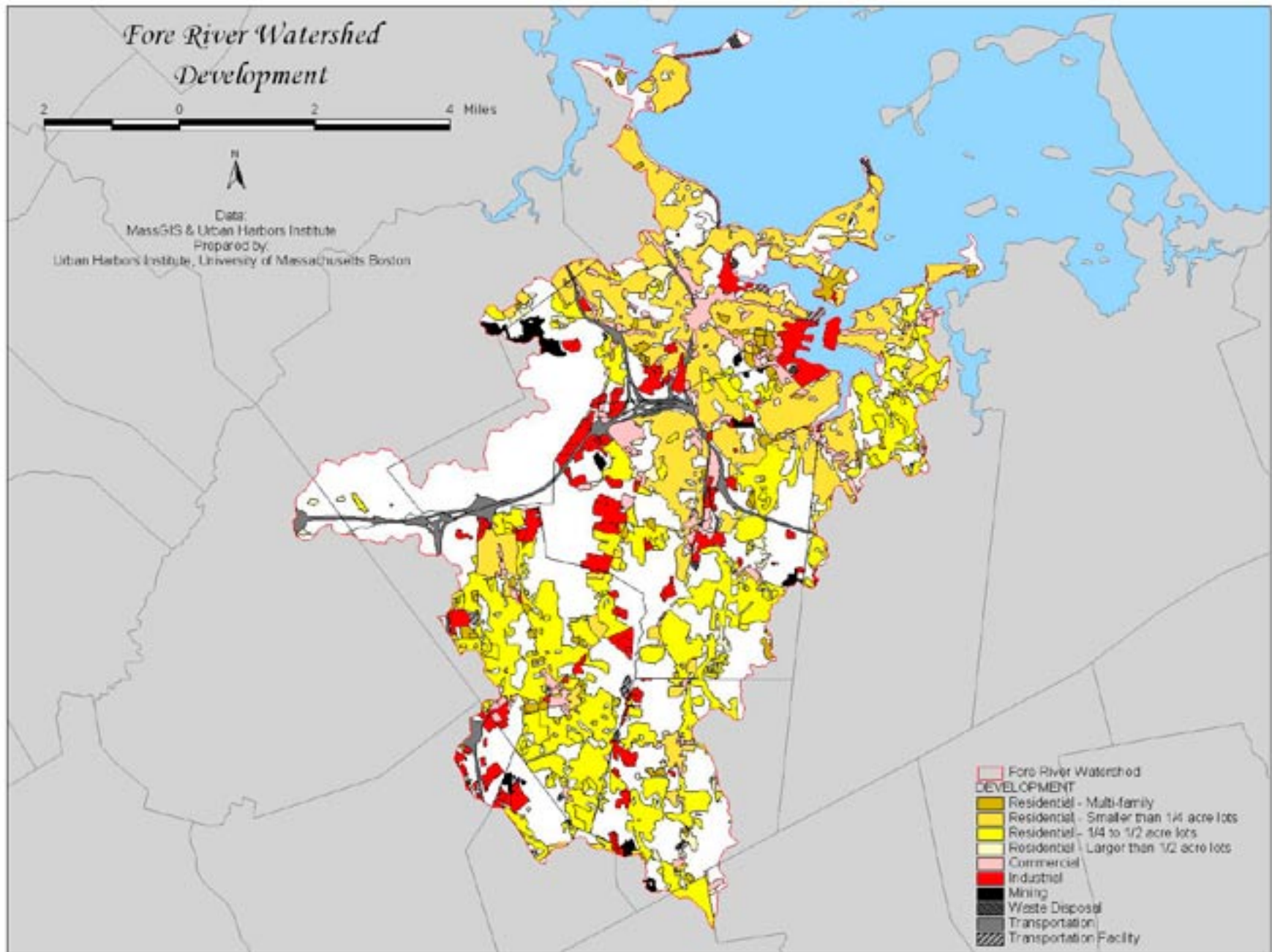


Figure 59: Fore Development



Are there significant brownfields or opportunities for redevelopment in the watershed?

The EPA Waste Site Cleanup and Reuse website lists the following sites in the watershed:

- Clean Harbors of Braintree is located in Braintree, MA, (11 acres). It is a site that has been used for petroleum refining and other operations. The property is undergoing on-going investigation, assessment and remediation.
- The J.G. Grant and Sons, Inc. property is a 19.41-acre property located in Braintree. It consists of a 12,000 square-foot building, approximately 9 acres of cleared land devoid of vegetation, and undeveloped wetland. Cranes, empty tanks, drums, tires, open-top trailers, and stockpiles of scrap metal, metal shavings, wood chips, and concrete blocks are located on the property. The property is currently listed as Phase II (Comprehensive Site Assessment) under the Massachusetts Contingency Plan (MCP). In Phase II the risks posed to public health, welfare, and the environment are determined.
- The South Weymouth Naval Air Station (1,442 acres) is listed on the EPA's Long Term/National Priorities List (NPL) - the NPL is a published list of hazardous waste sites that are eligible for extensive, long-term cleanup actions under the federal Superfund Program. Assessment and remediation are on-going at the Naval Air Station site.
- The Quincy Quarry is a 75 acre property. In 1999, a Phase IV Remedy Implementation Plan for the property was completed. The MA DEP lists the property as Class C, indicating a temporary cleanup. Although the site does not present a "substantial hazard", it has not reached a level of "no significant risk".
- The Baird & McGuire superfund site is located in Holbrook. Baird & McGuire operated a chemical mixing and batching company until 1983. Contaminated soil and Cochato River sediment cleanup was completed in 1997. A groundwater treatment facility, constructed in 1993 to address contamination, will continue to operate for the foreseeable future. In 1999, a

light non-aqueous phase liquid (LNAPL) extraction system was constructed and collects approximately 5 to 7 gallons of the liquid waste daily. The Massachusetts Department of Environmental Protection is scheduled to take over site-wide operations and management in June 2004.

- The Holbrook Landfill property is a 27-acre inactive landfill which was capped and closed in 1996. The last known action at the property was an EPA Site Inspection Prioritization (SIP) completed in 1996.
- Weymouth Neck Peninsula (19 acres) is the former location of a large scale fertilizer manufacturing facility which operated until 1966. Large amounts of hazardous waste by-products were reportedly disposed of and land-filled throughout Weymouth Neck Peninsula. Remediation is being overseen by the Massachusetts Department of Environmental Protection.
- Other sites with the potential for re-development; Fore River Shipyard, Souther Mill, Armstrong Plan Braintree, Gas Company property at Weymouth landing, Quincy DPW property and Jordan Marsh warehouse.

What are the major trends in population, land use, transportation and water needs?

The population of Braintree, Quincy, Holbrook and Randolph (the four municipalities predominantly in the Fore River Watershed) grew from 159,955 in 1990 to 163,701 in 2000, an increase of two percent.

There are an additional 3,573 acres of developable land in these four towns according to the EOEA build-out figures. Based on the formulas used by EOEA for its "build-out" analysis for these four towns, the increase in population at build-out is 173,749, for a total growth of six percent.

This increase in population translates to an additional demand for water of 2,194,832 gallons/day and additional solid waste produced of 5,206 tons per year. Build-out conditions would produce an additional 44 miles of roadway.

Figure 60: Fore Contaminated Sites

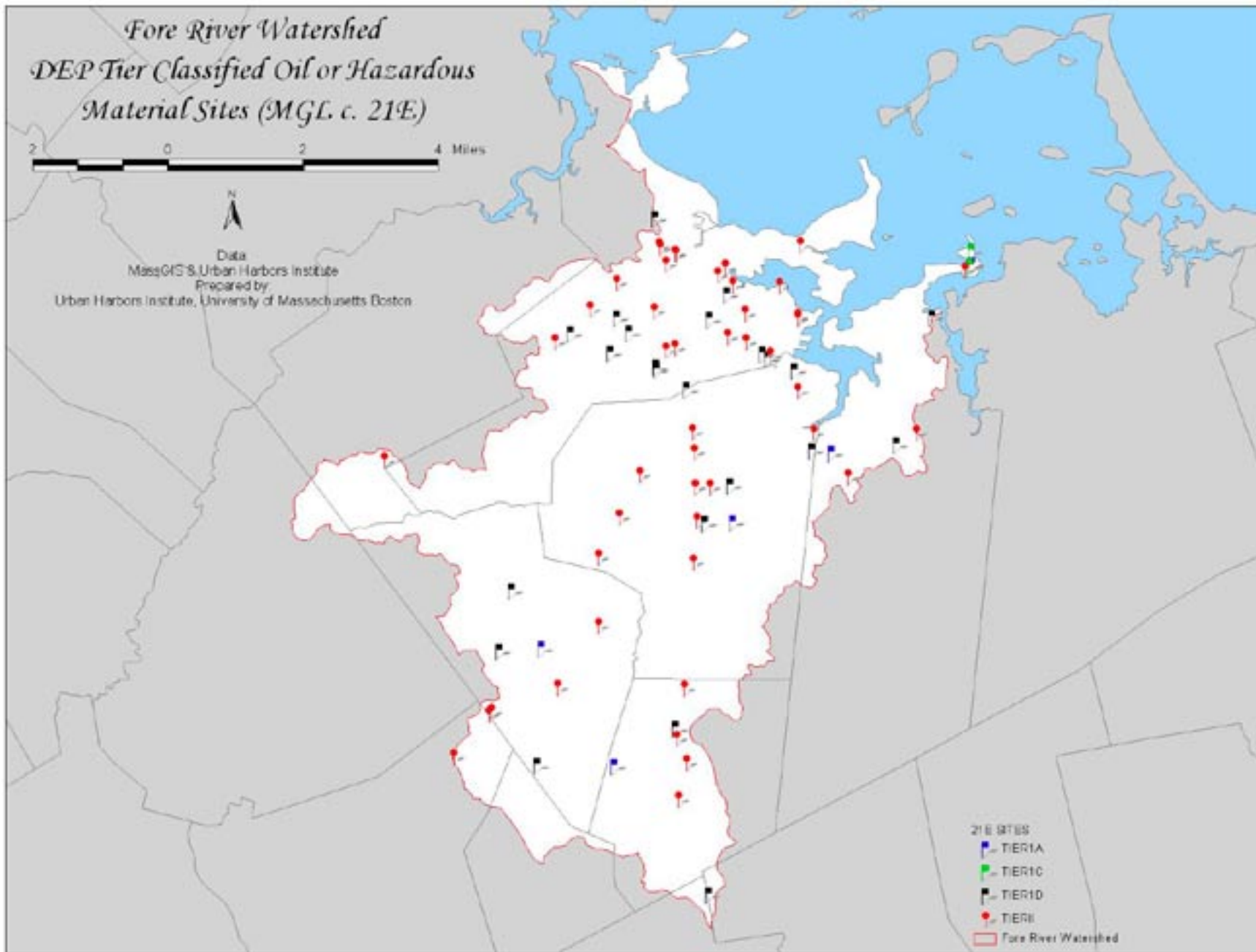


Table 25: Fore Summary of Population Increase at Buildout Relative to 2000 (EOEA)

Town	Population Increase	Percentage
Braintree	1,539	5%
Holbrook	4,300	40%
Quincy	1,727	2%
Randolph	2,582	8%
Total	10,148	6%

What % of the watershed’s area is currently comprised of permanently protected open space?

Twenty-six percent of the watershed (8,143 acres) is comprised of “protected and recreational open space”. Ninety-one percent of this open space is owned by some level of government, seven percent is owned by private for-profit organizations.

How much land is still undeveloped (and not protected)?

Just over 5,800 acres of land in the watershed is undeveloped.

How rapidly is open space being lost?

As noted above, the population of the four towns lying predominantly in the Fore River Watershed grew by 2 percent from the 1990 to 2000.

How much open space is still available and thus, in need of protection?

Per the City of Quincy’s Open Space Plan 2000-2004, proposed development of two parcels of land (Lot 23 in Squantum and Highpoint sight, Quarry St) have focused the community on the need for the protection of open space. The plan also refers to the acquisition two open space sites; Dickinson property in Squantum and a large site in Germantown.

The site at Germantown, unfortunately, was not afforded meaningful public shoreline access in the densely populated community. Neither is the site included under the Rivers Protection Act. (Jeff Thayer e-mail 6/24/04)

What % of the shoreline, both coastal and riparian, is publicly accessible?

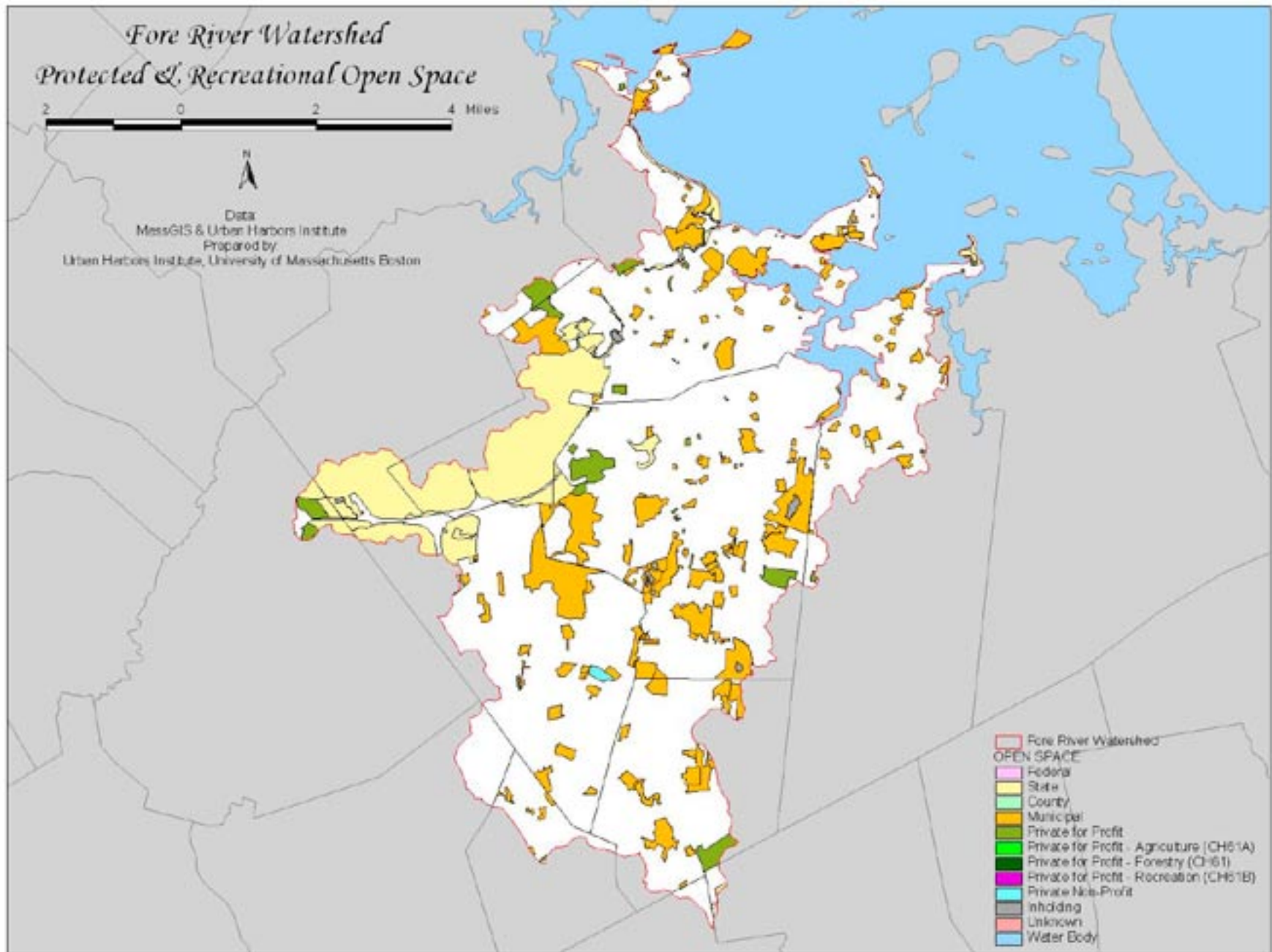
Per the City of Quincy’s, Open Space Plan 2000-2004, only a small percentage of the 27 miles of the city’s coastline is accessible to the public. The plan also states that continued development in Squantum and Marina Bay have restricted access to much of the coastline area.

A Beaches and Coastal Commission was established in order improve Quincy’s ten public beaches and educate residents as to the amenities available to them. Also major storm-drain repairs, sewer and water improvements, and flood alleviation projects have helped to improve the water quality at Wollaston Beach.

To what extent are key resources such as Zone II’s, wetlands, riparian buffers, NHESP habitats, and high recharge soils protected?

Per the City of Quincy’s Open Space Plan 2000-2004, the Quincy Conservation Commission has protected the city’s wetland areas from a development boom. The commission was able to stop development from infringing on the wetlands with the help of the state Wetland Protection Act and the Rivers Act.

Figure 61: Fore Open Space



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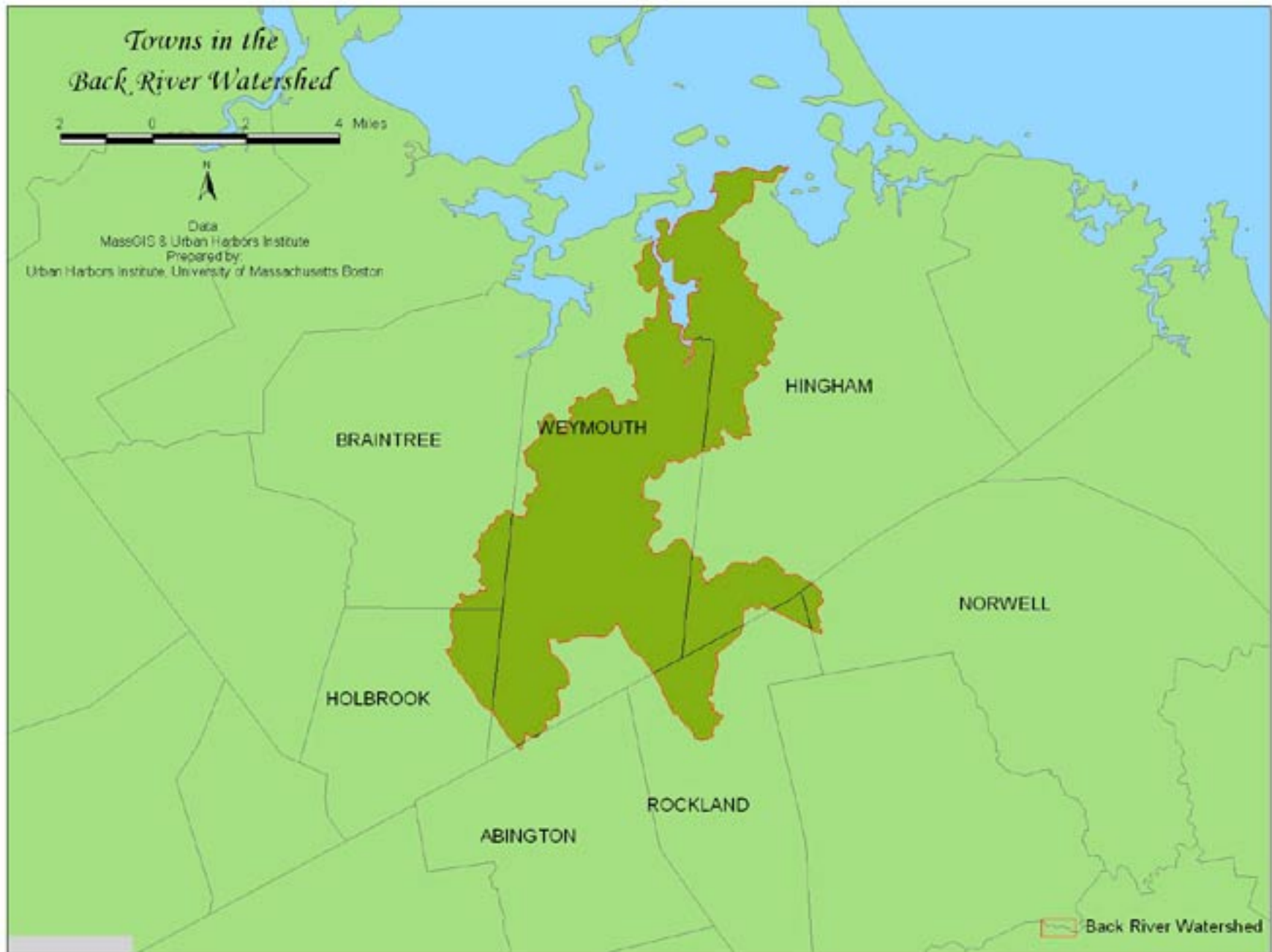
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Figure 62: Back Towns



Back River Watershed

Introduction

The Back River watershed is located in Plymouth and Norfolk counties south of Boston. It is a small watershed contained within the larger Weymouth and Weir watershed, which in turn is a component of the larger Boston Harbor watershed. The watershed has a drainage area of approximately 18.7 square miles and encompasses portions of Weymouth (60%), Hingham (26%), Rockland (6%), Holbrook (5%), Boston (3%), Norwell (<1%), and Abington (<1%).

The principal feature of the watershed is the Back River estuary. It is classified as a coastal plain estuary (Beal, Furber et al. 1982), meaning that it was formed by rising sea levels that flooded the valleys adjacent to the coastline. Nearly 50% of the Back River is intertidal, with mudflats exposed at low tide. Wetlands are prominent and provide essential breeding and nursery grounds for a wide array of fish and shore birds.

Table 26: Towns in the Back River Watershed

Town	Acreage of town	Acreage in watershed	Percent of town in watershed	Percent of the watershed
Abington	6,508.8	3.1	0.04	0.1
Braintree	9,193.1	375.5	4.1	3.1
Hingham	14513.8	3087.1	21.3	25.8
Holbrook	4,739.1	534.3	11.3	4.5
Norwell	13566.9	85.1	0.6	0.7
Rockland	6483.6	664.5	10.0	5.6
Weymouth	11250.4	7197.5	63.9	60.2
Totals	66255.7	11947.1		100.0

A ‘Great Esker’—a bank formed by retreating glaciers—forms the west boundary of the estuary and extends for over two miles (Beal, Furber et al. 1982). The Fresh River connects the estuary with water from Brewer Pond, Bouve Pond, and a number of surrounding wetlands and serves as a spawning area for smelt. Siltation of Bouve Pond poses a serious threat to its ecosystem (Beal, Furber et al. 1982).

Whitmans Pond is a prominent spawning and nursing habitat for alewife that enter the pond via a fish ladder network from Herring Brook on the northeast side of the pond. Whitmans Pond is an emergency supply for the town of Weymouth and also used sometimes to supplement the supply from Great Pond, which is the town’s main water supply. Old Swamp River is a tributary to Whitmans Pond.

Does pollution limit the use of water resources in the watershed?

Yes, pollution is evident in the Back River estuary, Whitmans Pond, Old Swamp River, Mill River, and Fresh River.

Does bacterial pollution limit fishing, or recreational use in the watershed?

Yes, high bacteria counts impact waterways throughout the watershed. Shellfishing for soft shell clams is prohibited in the upper reaches of the Back River, and conditionally restricted elsewhere due to elevated bacteria. Conditionally restricted flats can be harvested only at certain times of year under the supervision of a licensed master digger. All shellfish must be depurated (cleansed of bacteria) at a special facility prior to retail consumption. The upper estuary exhibits chronic bacterial contamination while conditions in the lower estuary are somewhat better

Figure 63: Back Orthophoto

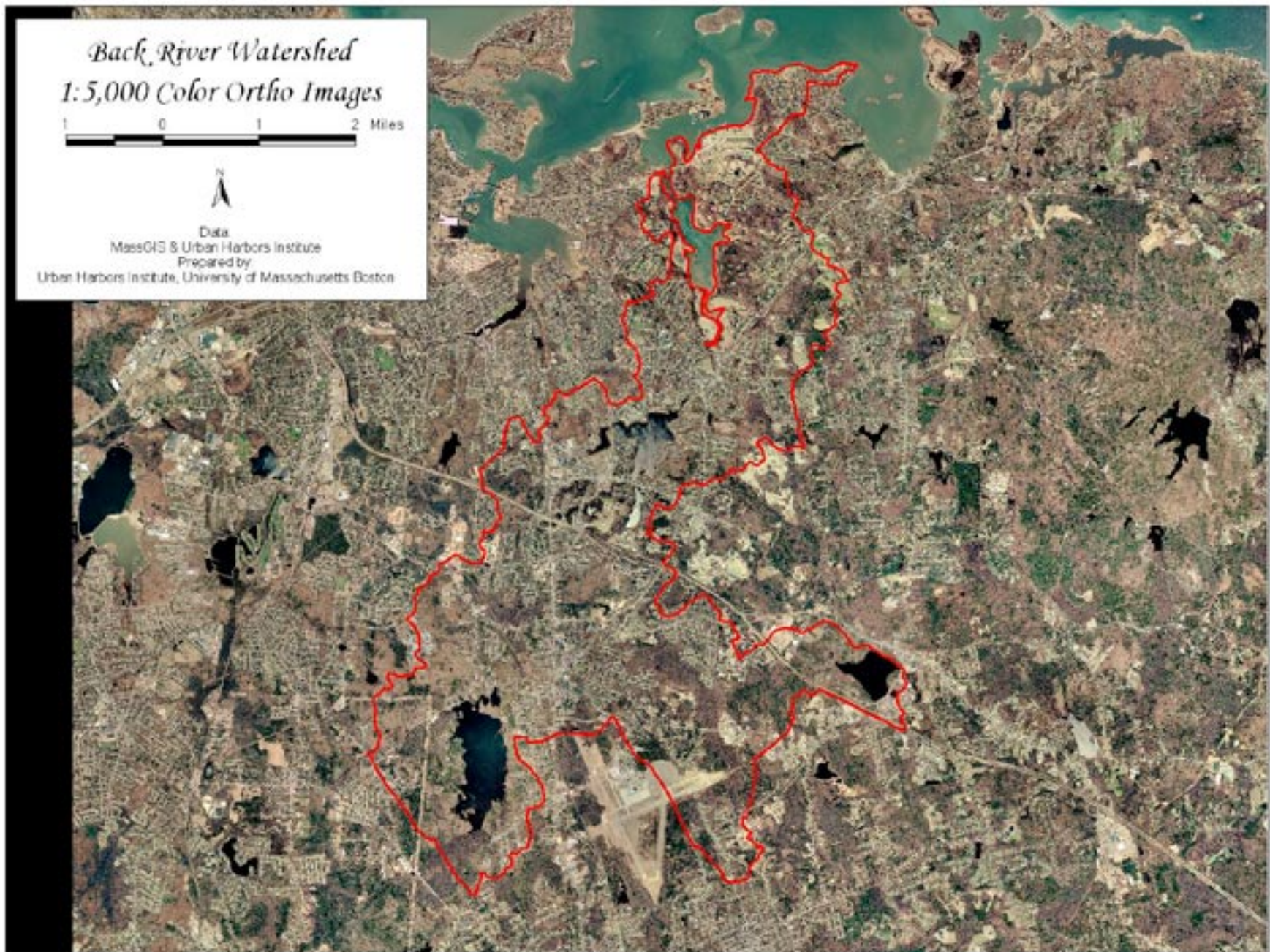
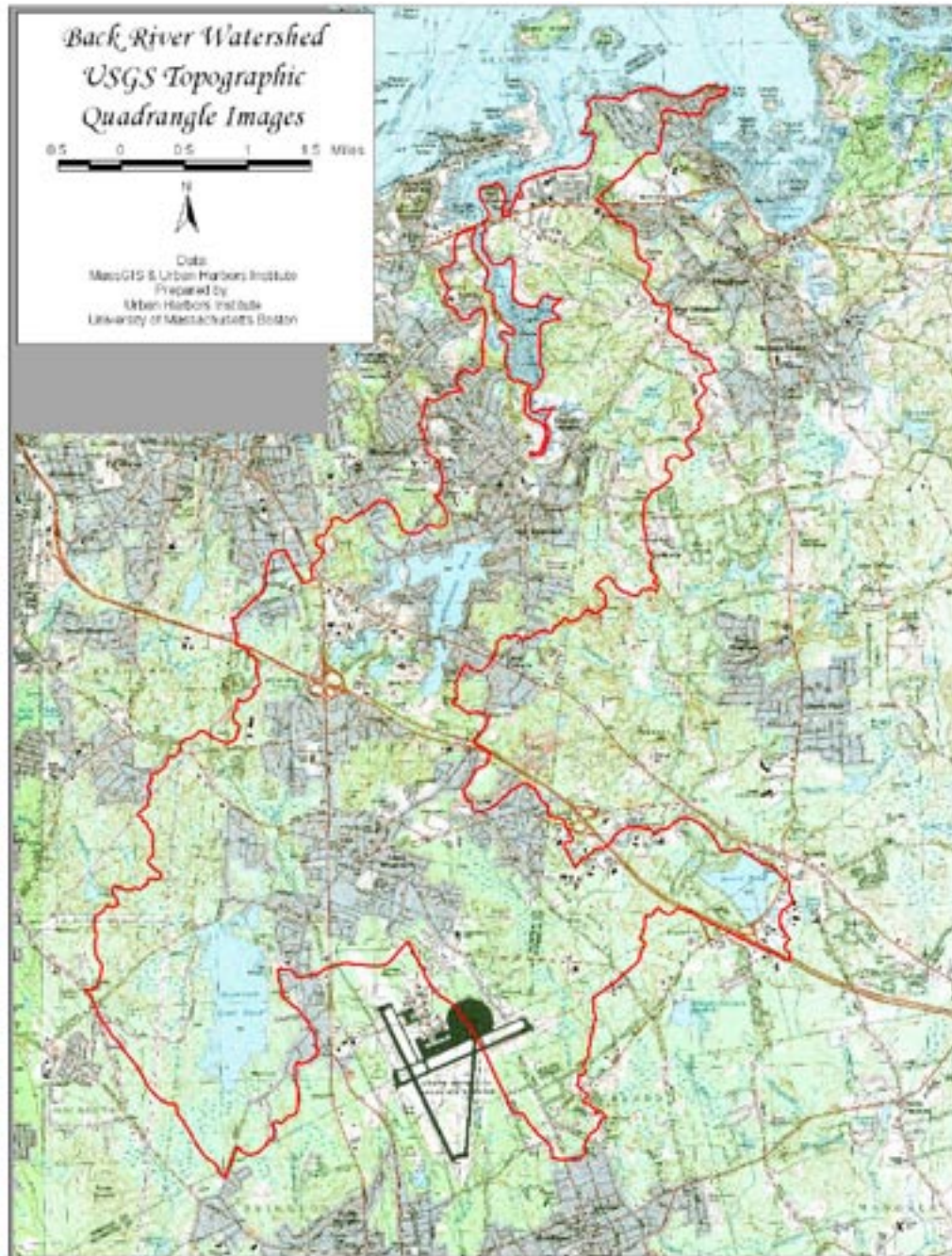


Figure 64: Back Topography



(Roach 2004). Stormwater is suspected to be a major source of bacteria, and beds are nearly always temporarily closed after heavy rains.

There are three marine beaches and one freshwater beach located in the Back River watershed: Belair, Kimball, Wampatuck, and Whitmans Pond. Weekly water quality monitoring required by the Massachusetts Department of Public Health, resulted in only one beach closing at Kimball in 2002 (Massachusetts Department of Public Health 2002).

According to a 1999 assessment by DEP (MADEP 2002), fish habitat quality in the Old Swamp River was rated as suboptimal. There is concern that water withdrawal practices are adversely affecting fisheries in the Mill River, but this has not been investigated formally (MADEP 2002).

Known or Suspected Sources of Bacterial Pollution

- Stormwater runoff
- Sanitary sewer overflows into Whitmans Pond, Mill River, Back River, and Old Swamp River
- Septic systems on Puritan Road
- Landfill leachate from Hingham landfill and Weymouth landfill at Wharf Street.
- Suspected Illegal sewer connections
- Suspected aging and deteriorating sewer infrastructure

Bacterial Problems in the Back River

The Back River estuary is on the proposed 2004 Integrated List of Waters as a Category 5 (impaired) for pathogens. In the Back River estuary, the degree of bacterial pollution is variable, increasing as you move inland up the estuary to where water is exchanged less frequently with adjacent Hingham Bay (Myers 1997). Based on elevated bacteria counts, the upper reach of the Back River is assessed as “non-support” for Primary and Secondary Contact Recreational Uses, and as “support” for Aquatic Life (MADEP 2002). Water quality is somewhat better in the lower portion of the estuary, which is assessed as “support” for Aquatic Life, Primary and Secondary Contact Recreation, and Aesthetics (MADEP

2002); Shellfishing is assessed as “partial support.”

Bacterial Problems in Old Swamp River

Old Swamp River is on the proposed 2004 Integrated List of Waters as a Category 5 (impaired) for pathogens. It is assessed as “support” for Aesthetics and “partial support” for Primary and Secondary Contact Recreation and Aquatic Life (in lower 2 miles).

Bacterial Problems in Mill River

Mill River is also on the proposed 2004 Integrated List of Waters as Category 5, needing confirmation for pathogens, nutrients and noxious plants. No use assessment has been conducted.

Does nutrient pollution pose a threat to aquatic life?

Yes, in portions of the watershed. The Mill River is on the proposed 2004 Integrated List of Waters for high nutrients but has not been assessed by DEP (MADEP 2002).

Known or Suspected Sources of Nutrient Pollution

- Stormwater runoff
- Sanitary sewer overflows

Do dissolved oxygen levels pose a threat to aquatic life?

Whitman’s Pond exhibits excessive plant growth that is suspected to adversely impact levels of dissolved oxygen, although no data could be found to support this conclusion. The Town of Weymouth has plans to remove the plant material using a York rake and to use an aerator to help restore concentrations of dissolved oxygen (Kramer 2004).

Known or Suspected Causes of Low DO and High Temperatures

- Excessive plant growth

Figure 65: Back Hydrological Features

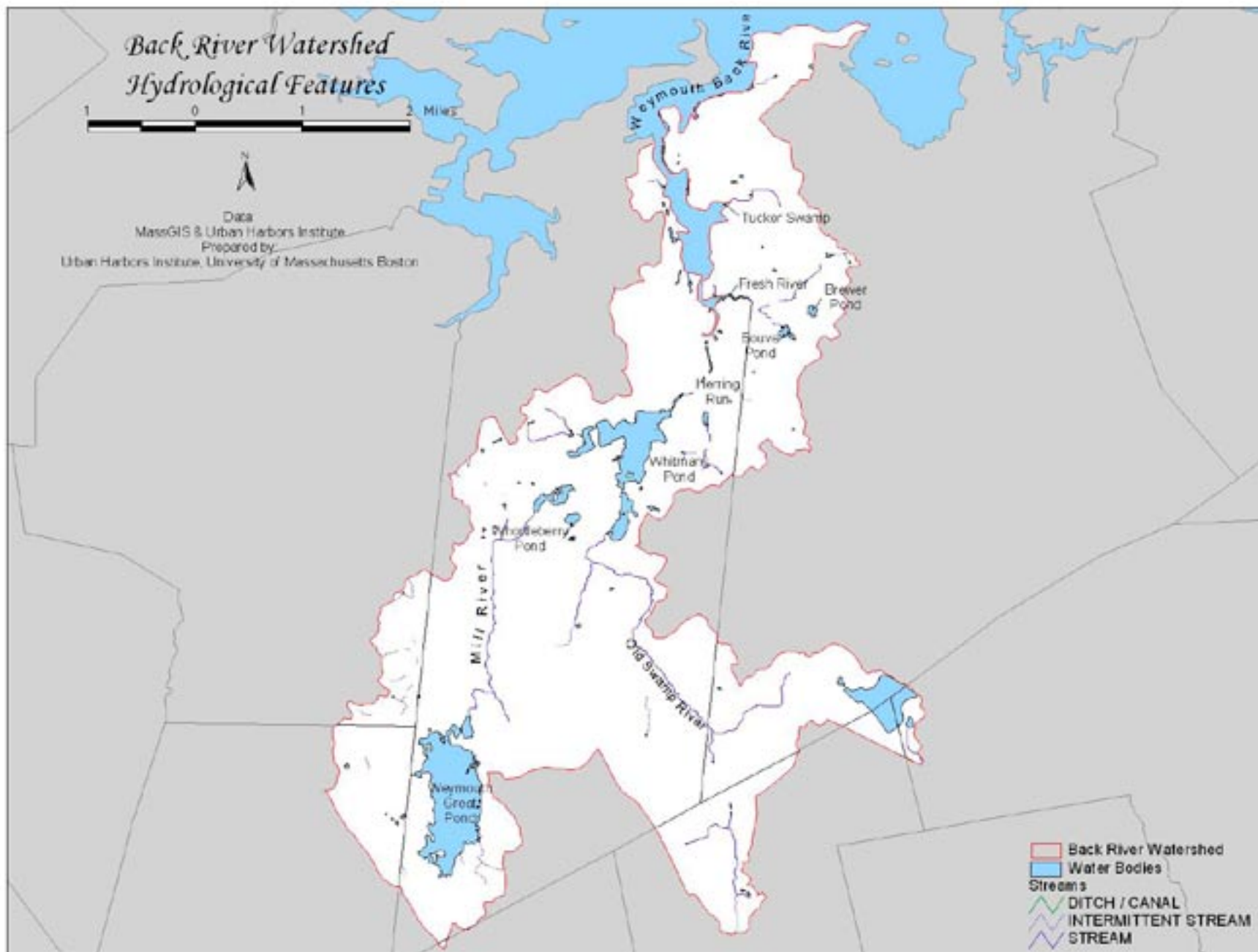
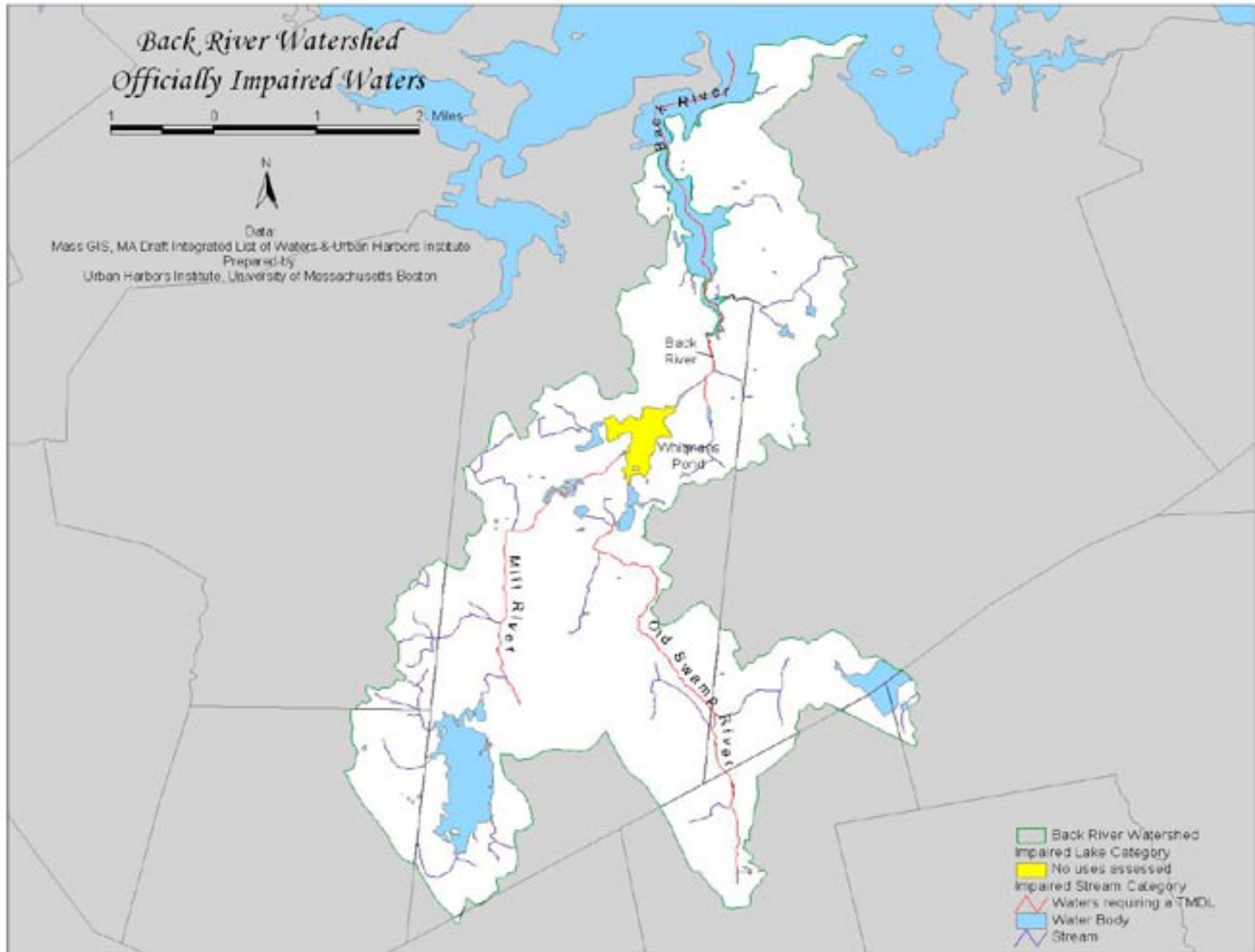


Figure 66: Back Officially Impaired Waters



Are there other water quality indicators that limit use of water resources within the watershed?

Yes. It is suspected that leachate from the Hingham sanitary landfill is polluting the Fresh River, a tributary to the Back River. “Pollution of the Fresh River may impact the fish runs and breeding areas along the river although no studies have been done to verify the source or measure the impacts.” (Myers 1997).

The Back River estuary was designated an Area of Critical Environmental Concern (ACEC) by the Massachusetts Secretary of Environmental Affairs in 1982. It comprises approximately 950 acres in the towns of Weymouth and Hingham. A decision to designate an area as an ACEC carries with it a requirement that all state environmental agencies acquire information about the resources of the ACEC; preserve, restore, or enhance the resources of the area; and ensure that activities within the ACEC minimize adverse effects on the natural and cultural values of the area. Projects within ACEC boundaries require a higher level of environmental review.

The Back River Estuary ACEC is classified as an Outstanding Resource Water (ORW) as part of its ACEC designation. The portion of the watershed south of Whitmans Pond is also classified ORW under the Massachusetts Surface Water Quality Standards of 1995. According to 314 CMR 4.00: “Certain waters shall be designated for protection under this provision in 314 CMR 4.06(3) including Public Water Supplies (314 CMR 4.06(1)(d)1.)” Weymouth Great Pond is the largest fresh water body at the southern-most end of the watershed. The pond is used for water supply and is therefore not normally available for other activities such as fishing or boating.

The South Weymouth Naval Air Station (SOWEY NAS) is listed on the EPA Superfund National Priority List (NPL). The station site is approximately 1,442 acres in size and was closed in 1997. The Old Swamp River flows through 4 culverts on the site. A study is being carried by the USGS and EPA to determine if the Old Swamp River has evidence of contamination (Chaffin 2004; USEPA 2004). Sediment and surface water samples will be taken upstream and downstream of the Navy site to make this determination. Also 2 tributaries collect storm

water from the runways and fish have been seen in these perennial streams. Among the activities performed at the site were aircraft maintenance, refueling and personnel training (Ivas 2004). The wastes from the site were reportedly disposed of in on-site landfills. Two major disposal sites are within the Back River watershed – the Rubble Disposal Area (3.83 acres – 8 feet deep) and the Small Landfill (0.8 acres – 9 feet deep). Part of the Rubble Disposal Area will be capped and the wetlands recreated. The remainder of the area (near the existing wetlands), which had been contaminated with PCB’s, will be excavated. The Small Landfill will be addressed by either covering it or by excavation. The East Matt area (where aircraft were parked) is also under review; to date, only minor problems are suspected.

Are streamflow and groundwater levels sufficient to meet the needs of recreation, fish and wildlife habitat, and water supply both now and in the future?

Currently there is no information to address the present or future stream and groundwater levels needed to support recreation or fish and wildlife habitats. Information on the present and future water supply is provided below.

Do water supply, interbasin transfers or inflow and infiltration have a significant impact on instream flow levels?

There are four USGS stream gauging stations located on the Back River. However, there is no available analysis of the data from these stations and therefore no conclusions can be drawn as to how water supply activities, interbasin transfers or inflow and infiltration may affect flow levels.

Weymouth Water Supply

Over 60% of the Back River watershed lies within the Town of Weymouth, which has a drinking water treatment facility located at each of its two water supply sources: Great Pond Reservoir and the Mill River

Table 27: Back River Gauging Stations

Station #	Location
01105600	OLD SWAMP RIVER NEAR SOUTH WEYMOUTH
01105606	WHITMANS POND DAM
01105607	WHITMANS POND FLOOD BY-PASS
01105608	WHITMANS POND FISH LADDER

Basin. The Great Pond Water Treatment Plant was constructed in 1936 and has since undergone a number of upgrades. At present, the facility can treat up to 8 million gallons per day (MGD) and supplies about 75% of the town. The Town recently received loans from the Drinking Water State Revolving Fund to upgrade the plant. During periods of low rainfall, the 860 million gallons of usable water in Great Pond can be supplemented with water from the South Cove of Whitman’s Pond. This has a usable volume of 165 million gallons. The Arthur J. Bilodeau Water Treatment Plant was built in 1975 and can treat up to 4 MGD. At present the water is drawn from four active wells in the Mill River Aquifer. This plant supplies approximately 25% of the town. Currently there are plans to reactivate the Winter Street #1 Well. This well was taken out of service in the early 1980s due to the costs of reducing high levels of iron and manganese (Woodard and Curren, 2002). The increase in demand for water and better treatment methodology mean that its reactivation is now thought to be essential to cope with future demand. The distribution network for both plants consists of 238 miles of pipes, some of which are over 110 years old.

Due to increasing demand for water, a number of initiatives have been implemented to attempt to reduce the stress on the town’s limited water supplies. In 1994, the Department of Environmental Protection ordered the community to reduce its water use so that it did not exceed the “safe yield” of the sources. The safe yield is defined as the amount of water that a source can supply during a 100-year drought. At that time, this was estimated to be 4.51 MGD. Despite the order from the DEP, there was no significant reduction in water use and in 1997 the town’s DPW entered into an Administrative Consent Order with the DEP to reduce water use from 4.9 to 4.51 MGD. In 1998, in an attempt to achieve this, a water supply emergency was issued.

In 2001, the safe yield was calculated at 4.48 MGD, and in 2002 this had risen to 4.93 MGD. A further increase is expected once the Winter Street #1 Well is activated.

In the last few years, reduced demand and effective initiatives by the DPW have resulted in water use falling to below the 4.51 MGD agreed with the DEP (to 4.49 MGD in 2001 and 4.2 MGD in 2002). In 2002, for the third consecutive year, the town did not implement a water ban even though much of the rest of New England was in a drought situation.

In order to maintain this situation, the Town of Weymouth enacted bylaws, funded studies to protect water supplies and water quality and filed a Water Conservation Plan for Public Water Suppliers. The DPW website summaries these efforts:

“The Town of Weymouth developed water restriction criteria and plan based on the requirements of the town’s water supply ACO with the DEP. The water restrictions are based on the water level of Great Pond, and the year to date total water production. At the beginning of each month, from May through November, these criteria are evaluated to determine the need for water restriction and the extent of the water restrictions.

“In the past several years, the Town of Weymouth has taken an aggressive approach to the water conservation program. Any new water use applications issued by the Town are required to complete a 2:1 water savings ratio. These savings may be gained through the retrofitting of existing buildings with water savings devices. The retrofitting of all public buildings, schools, and some businesses and residences has been accomplished with the cooperation of the Town, new users, and contractors. These projects include the furnishing and installation of low flow toilets, low flow showerheads, low flow faucets, and low flow flushometers. The water conservation program has been a huge success and a key element in reducing our daily water demand.

Weymouth Sewer System

The Town of Weymouth has approximately 919,000 feet of gravity sewer pipe, 600,000 feet of building connections and an additional 20,000 feet

of sewer force mains and pressure sewers. These are serviced through almost 5,000 sanitary sewer manholes. The system, containing 11 pump stations, 17 ejector stations and three submersible stations, was installed between 1947 and 1980. Much of the system was built as the town was being developed. As a result of this and the more-recent growth of the town, certain areas are unable to cope with the additional demand.

The town is divided into six interceptor sub-basins, each of which is divided into smaller sub-divisions. These feed into the MWRA system at 11 locations. From here the sewage travels to the Deer Island Wastewater Treatment Plant via Nut Island. In 1999, it was estimated that 85% of the town was sewered, with only 1,100 homes remaining on septic systems.

Increasing demand has led to problems with the town's sewer system, and the DPW has been working to address these issues since 1985. Initially an Infiltration/Inflow (I/I) analysis was commissioned which revealed that large quantities of groundwater and rainwater were entering the system. By 1994, the major problems had been eliminated. However, the system was still over taxed. Therefore, in 1998, the DEP and DPW entered into a Consent Order to reduce sewer demand and to link any new demand with a reduction in I/I. The DPW also implemented a multi-year sewer repair program known as the Town of Weymouth Capital Improvement Program. This aims to reduce the pressures on the existing system. The DPW continues to undertake extensive studies and improvement programs. Additionally, a number of MWRA projects are expected to further reduce the problems with the town's sewer system. Finally, the Town has received a loan from the Clean Water State Revolving Fund to conduct comprehensive Stormwater Management Planning in accordance with the USEPA Stormwater Phase II regulations.

Hingham Water Supply

The Town of Hingham encompasses a little over 25% of the Back River watershed. As the town lies mostly within the Weir River watershed, details of its water supply can be found in the Weir River Watershed Assessment.

Hingham Sewer System

The area of Hingham that falls within the Back River watershed is serviced by the North Sewer District of Hingham's municipal sewer system. This district is directly connected to the MWRA system and, as

with Weymouth, the sewage is pumped via Nut Island to the Deer Island Wastewater Treatment Plant.

Approximately what percentage of the watershed is impervious?

The Back River watershed covers almost 12,000 acres and it is estimated that over 2,600 acres (or 22.5%) of the watershed are impervious. This estimate is derived by combining land use data from MassGIS and the Office of Coastal Zone Management's estimates of average impervious cover for each land use type. The CZM estimates range from a high of 64% for commercial areas and a low of 1.6% imperviousness for saltwater wetlands. Over 1,000 acres (39.5%) of the watershed's total impervious surface is associated with residential lots of between ¼ and ½ acre. While it is estimated that such areas generally only have about 30% impervious cover, almost a third of the watershed is covered by this type of residential land use. Forest is the most common land use and accounts for 37% of the watershed. However, there is generally little imperviousness associated with forest (less than 8%) and therefore forest impervious surfaces account for less than 13% of the watershed's total imperviousness. While only 4.5% of the watershed is classified as commercial, such areas account for almost the same percentage of the total impervious surface as forest. This is due to the fact that commercial areas are estimated to have the highest proportion of imperviousness. The following land use types, in descending order, each account for between 3.1 and 7.9% of the total imperviousness of the watershed: industrial, residential (multi-family), urban open, transportation, residential (smaller than ¼ acre lots) and residential (larger than ½ acre lots). The remaining 12 land use types each account for less than 1% of the watershed's total imperviousness.

According to the Center for Watershed Protection (1998), imperviousness of between 11 and 25% will have the following effects on the rivers, streams, lakes and ponds:

- Some signs of degradation
- Some channel erosion and widening
- Fair to good water quality
- Fair to good biodiversity.

The Back River watershed is approaching the higher end of this range,

Figure 67: Back Development

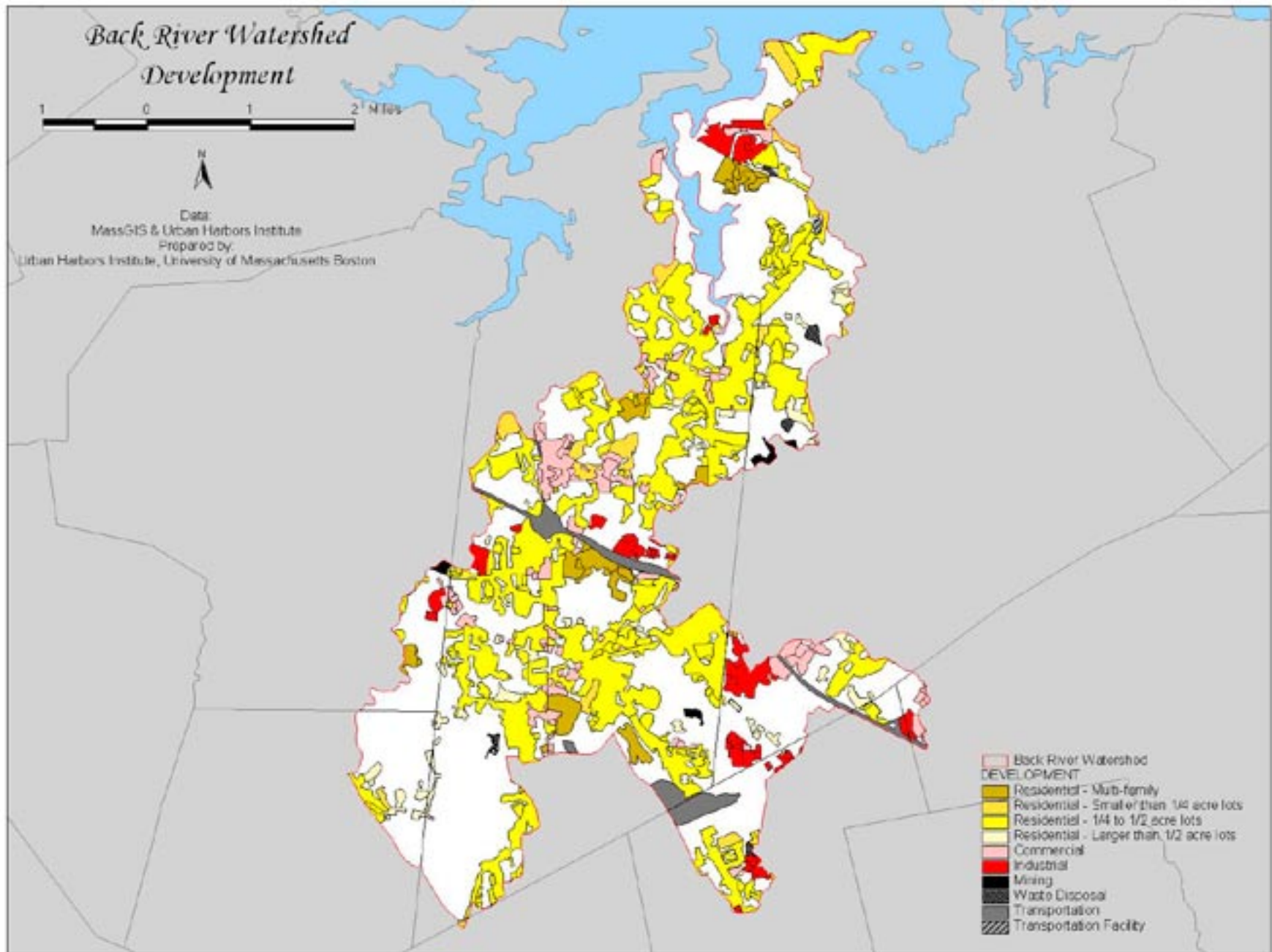
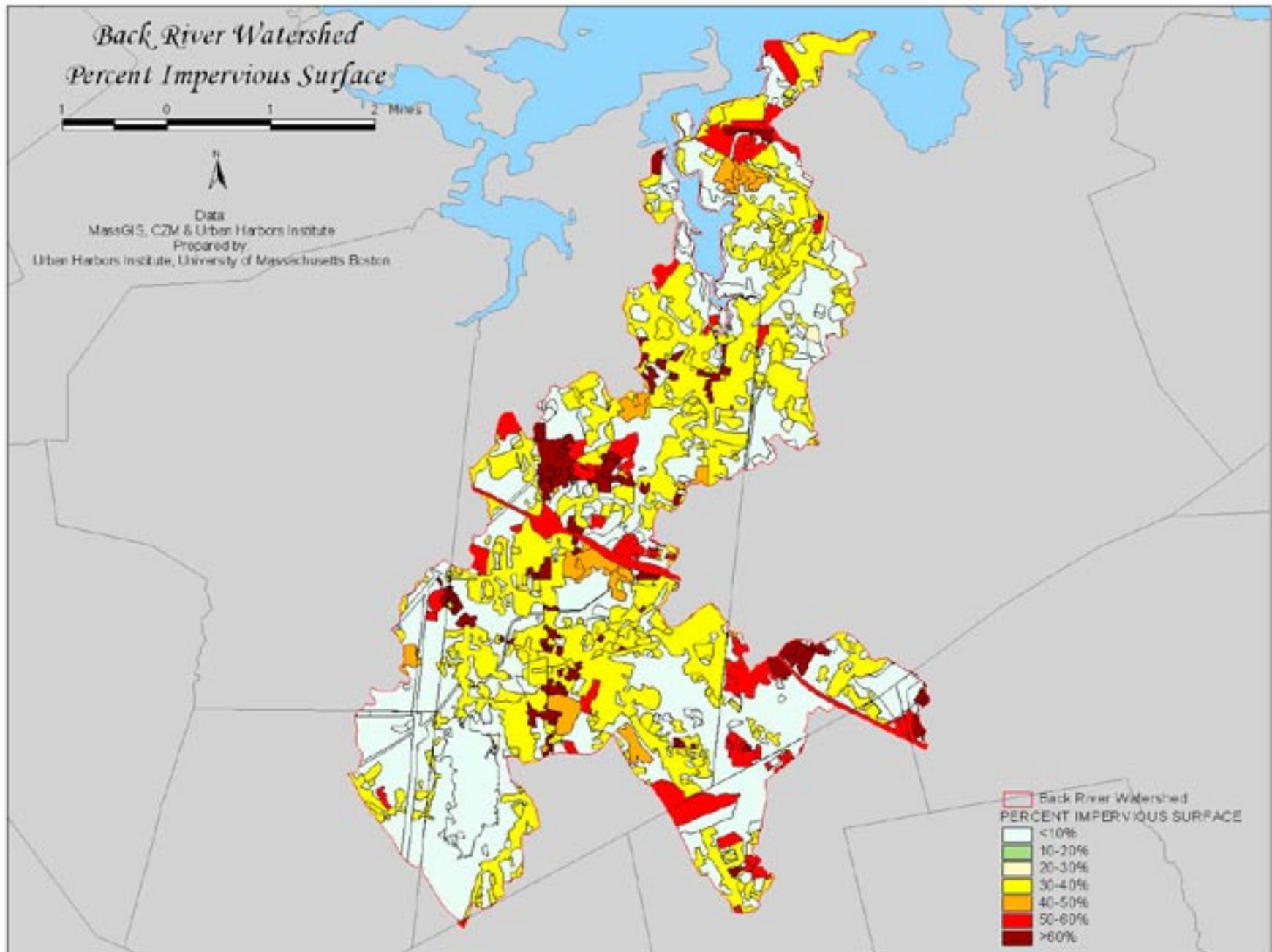


Figure 68: Back Impervious Surface



and if the amount of impervious surface increases to greater than 25%, the following effects may start to become apparent:

- Stream bank erosion and channel instability
- Poor to fair water quality

- Possible risks to human health resulting from contact with the water
- Low biodiversity

Table 28: Estimated Acreage And Percentage Of Impervious Surface In The Back River Watershed Based On MassGIS Land Use Data And CZM’s Estimates Of Impervious Surface By Land Use Type

Land Use Type	Mean Impervious Area Ratio	Total Acreage	Total Impervious	Percentage of Total Impervious
Residential (1/4 - 1/2 acre lots)	0.305	3457.3	1054.5	39.5
Forest	0.078	4389.6	342.4	12.8
Commercial	0.640	530.9	339.8	12.7
Industrial	0.547	384.4	210.3	7.9
Residential (Multi-family)	0.454	339.4	154.1	5.8
Urban Open	0.311	466.8	145.2	5.4
Transportation	0.508	280.8	142.6	5.3
Residential (Smaller than 1/4 acre lots)	0.543	240.0	130.3	4.9
Residential (Larger than 1/2 acre lots)	0.304	274.7	83.5	3.1
Water	0.029	645.7	18.7	0.7
Open Land	0.029	398.2	11.5	0.4
Water Based Recreation	0.343	32.2	11.0	0.4
Participation Recreation	0.060	145.8	8.7	0.3
Waste Disposal	0.218	35.4	7.7	0.3
Wetland	0.055	69.1	3.8	0.1
Mining	0.067	34.6	2.3	0.1
Salt Wetland	0.016	118.5	1.9	0.1
Cropland	0.090	16.6	1.5	0.1
Pasture	0.080	16.3	1.3	0.0
Spectator Recreation	0.050	0.0	0.0	0.0
Orchard, Nursery or Cranberry Bog	0.154	0.0	0.0	0.0
TOTAL		11876.1	2671.2	
% of Sub-Watershed Impervious			22.5	

Do biological or other data indicate significant impacts to the aquatic community due to hydrologic stress?

There is no information available on the effects of hydrologic stress on aquatic communities in the Back River watershed.

Are there current or expected water supply shortages in watershed communities?

As discussed above, the Town of Weymouth DPW has implemented a number of measures in an attempt to reduce the demand on the town’s water supplies. These seem to have been successful and in 1999, 2000, 2001 and 2002 the town met its registered withdrawal limit of 4.51 MGD. The reactivation of the Winter Street #1 Well will supplement the existing sources. At present there are not expected to be shortages in water supply and the DPW is striving to establish new water sources to meet predicted demand through 2020.

Do flooding or high flows cause problems for structures or aquatic life?

There is little information available on problems associated with flooding or high flows in the Back River watershed. The Inventory of Natural Resources and Land Use in the Weymouth Back River ACEC (Myers 1997) states that the coastal area of the Back River watershed is susceptible to flooding during storms. However, the Back River and the immediate vicinity have not suffered significant flood damage in the past.

The existing salt marsh provides some degree of flood control and a seawall below Upper Neck Cove on the Back River provides some local flood protection and helps to reduce shoreline erosion.

Is the watershed considered hydrologically stressed based on the WRC definition?

The Back River watershed has not been evaluated by the Massachusetts Water Resources Commission.

Are NHESP listed habitats or Biomap habitats present in the watershed?

Yes, both Natural Heritage and Endangered Species Program (NHESP) listed habitats and BioMap habitats are present in the watershed. NHESP listed habitats occur primarily in the northeastern and southern areas of the Back River watershed. These habitats include NHESP living waters core habitats, living waters critical supporting watershed, 2003 estimated habitats for rare wildlife, and 2003 priority habitats for state-protected rare species. NHESP species with designated habitat along the river include the Osprey, Short-eared Owl, Northern Harrier, Sharp shinned Hawk, Loggerhead Shrike, American Bittern, Common Loon, Eastern Box Turtle, and the Wood Turtle (Myers 1997). NHESP BioMap core habitat and supporting natural landscape are located exclusively in the southwestern portion of the Back River sub-watershed.

Are there other special habitat types in the watershed?

Yes. There are a number of other significant habitat types in the Back River Watershed.

Area of Critical Environmental Concern

In addition to finfish habitat, 950 acres of the river and its banks have been designated as an area of critical environmental concern (ACEC) since 1982. The Back River ACEC extends from the Route 3A Bridge to the last fish ladder in Whitman's Pond (Weymouth Waterfront Plan). The ACEC provides habitat for thirty-one species of finfish, one hundred-fifty species of birds, and numerous mammalian and reptilian/amphibious species (Myers 1997). The ACEC protects an unusual part of the watershed - an extensive undeveloped riparian area in an increasingly urban setting. The ACEC contains 100 acres of salt marsh and 100 acres of clam flats. In recognition of the unusual quality and characteristics of the Back River and surrounding lands, efforts to protect the area of the ACEC began in 1966.

The ACEC also contains part of what has been identified as perhaps the largest esker on the east coast (Myers 1997). The Great Esker (ninety feet in height and approximately two miles in length) bounds on the Back River estuary (Beal, Furber et al. 1982). Between Bare Cove Park in Hingham (469 acres) and Great Esker Park in Weymouth a large portion of contiguous salt marsh, wetlands, meadows, and upland wooded areas are protected on both sides of the river. As mentioned previously, the size of the protected lands and waters, when coupled with the relatively good habitat quality observed, make for an unusually high quality ecological system in an otherwise rapidly developing, highly populated area. Other sizeable areas in the watershed also contain forest, wetlands, and additional open space but the quality of, and level of protection for, these areas vary.

Outstanding Resource Waters

More than half of the Back River watershed is comprised of listed outstanding resource waters. The watershed also contains numerous NHESP certified and potentially certifiable vernal pools, as well as a significant amount of land identified as riparian corridors, natural land riparian corridors, and contiguous natural lands.

Figure 69: Back Floodplains and Vegetated Wetlands

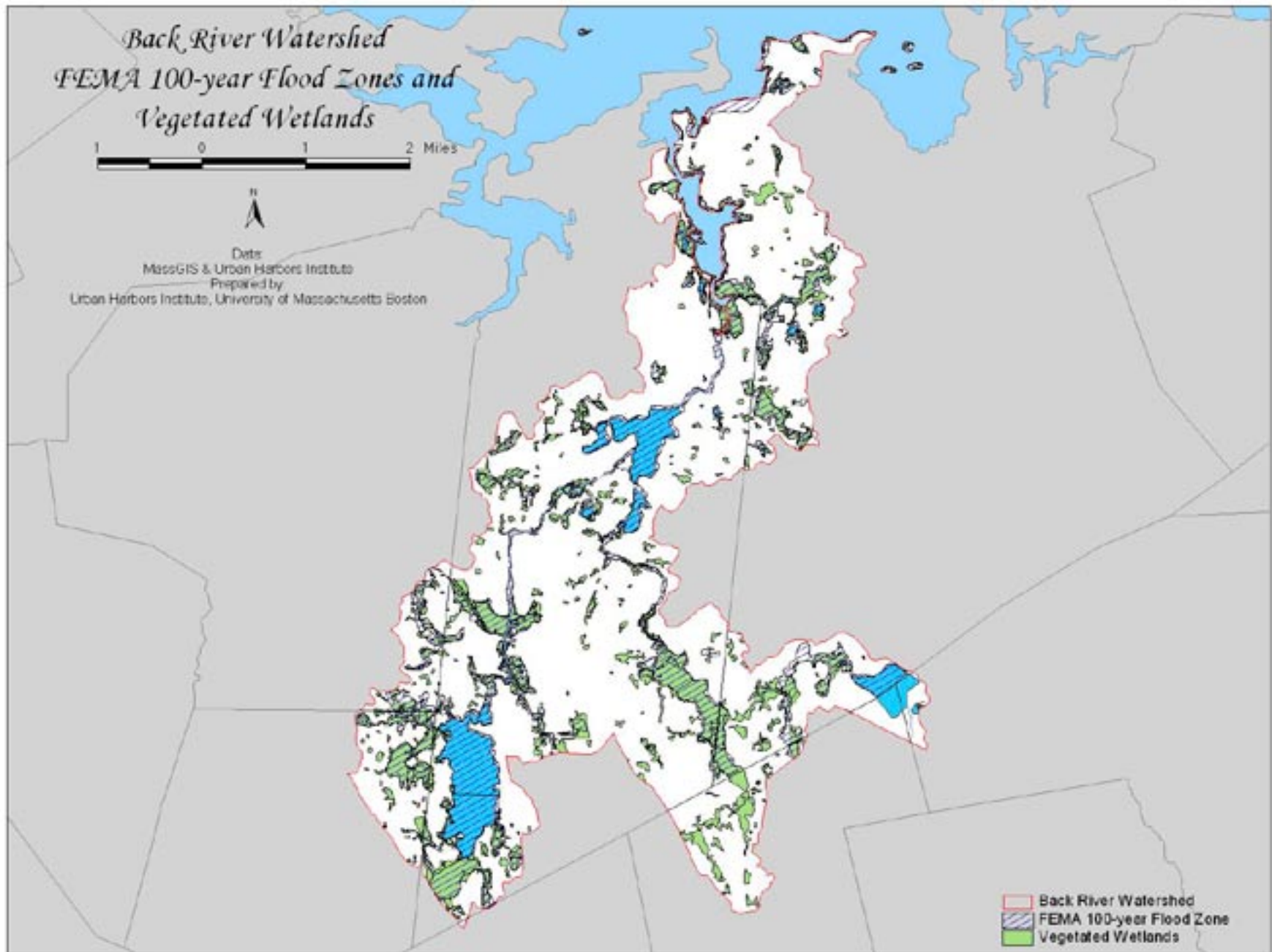


Figure 70: Back Biomap Habitats

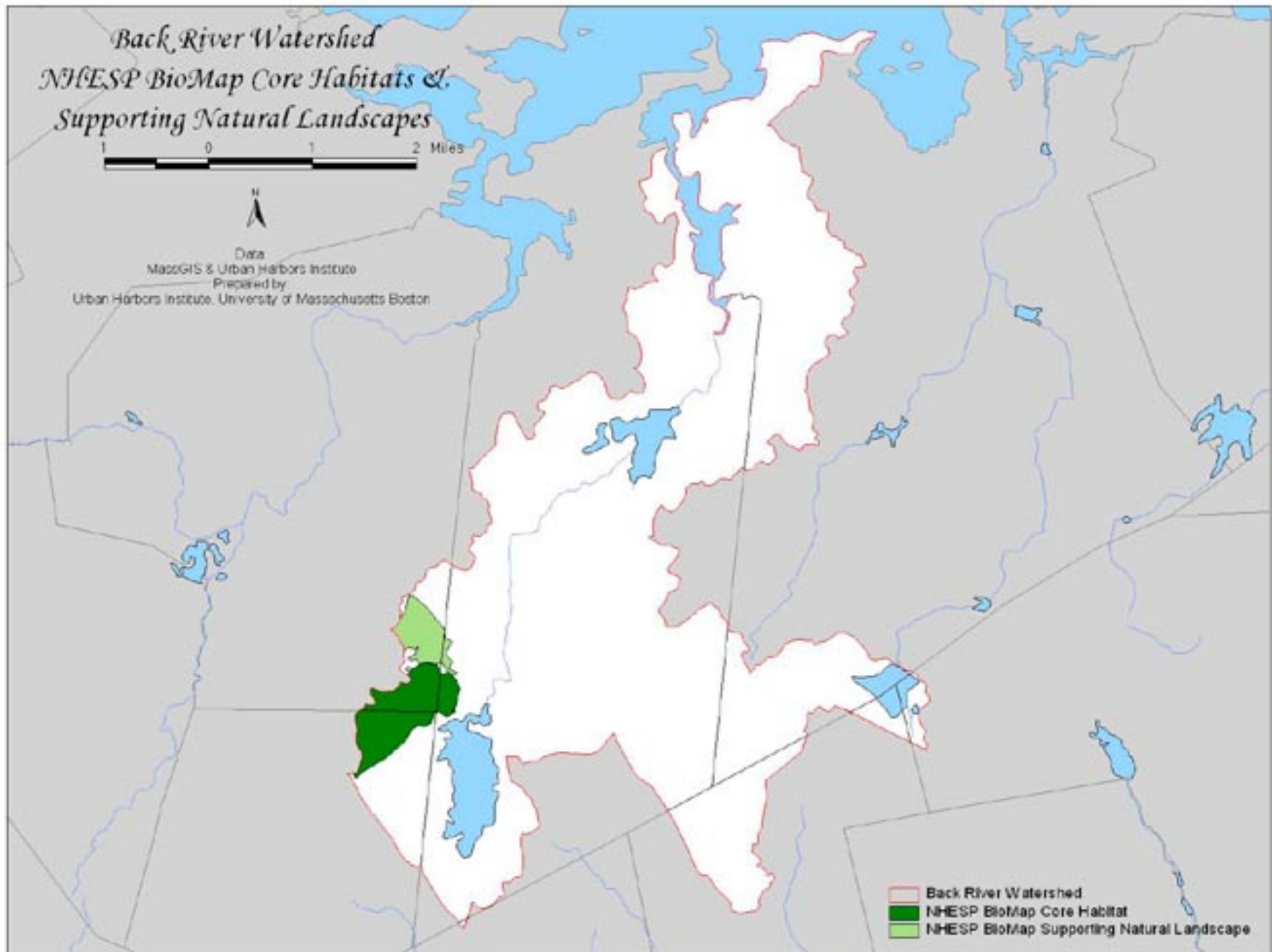


Figure 71: Back Riparian Corridors and Contiguous Natural Lands

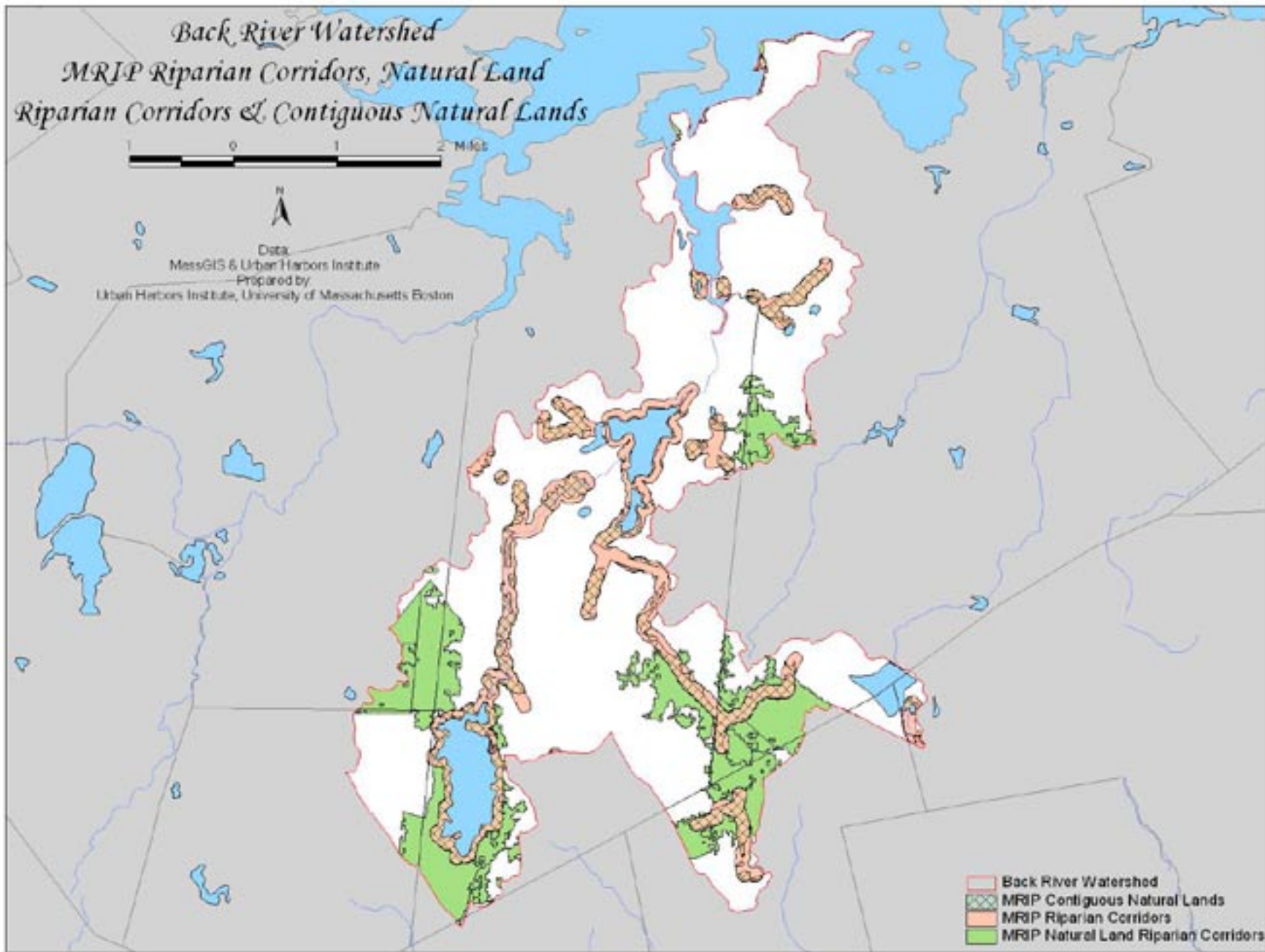


Figure 72: Back Coastal and Vegetated Wetland Resource Areas

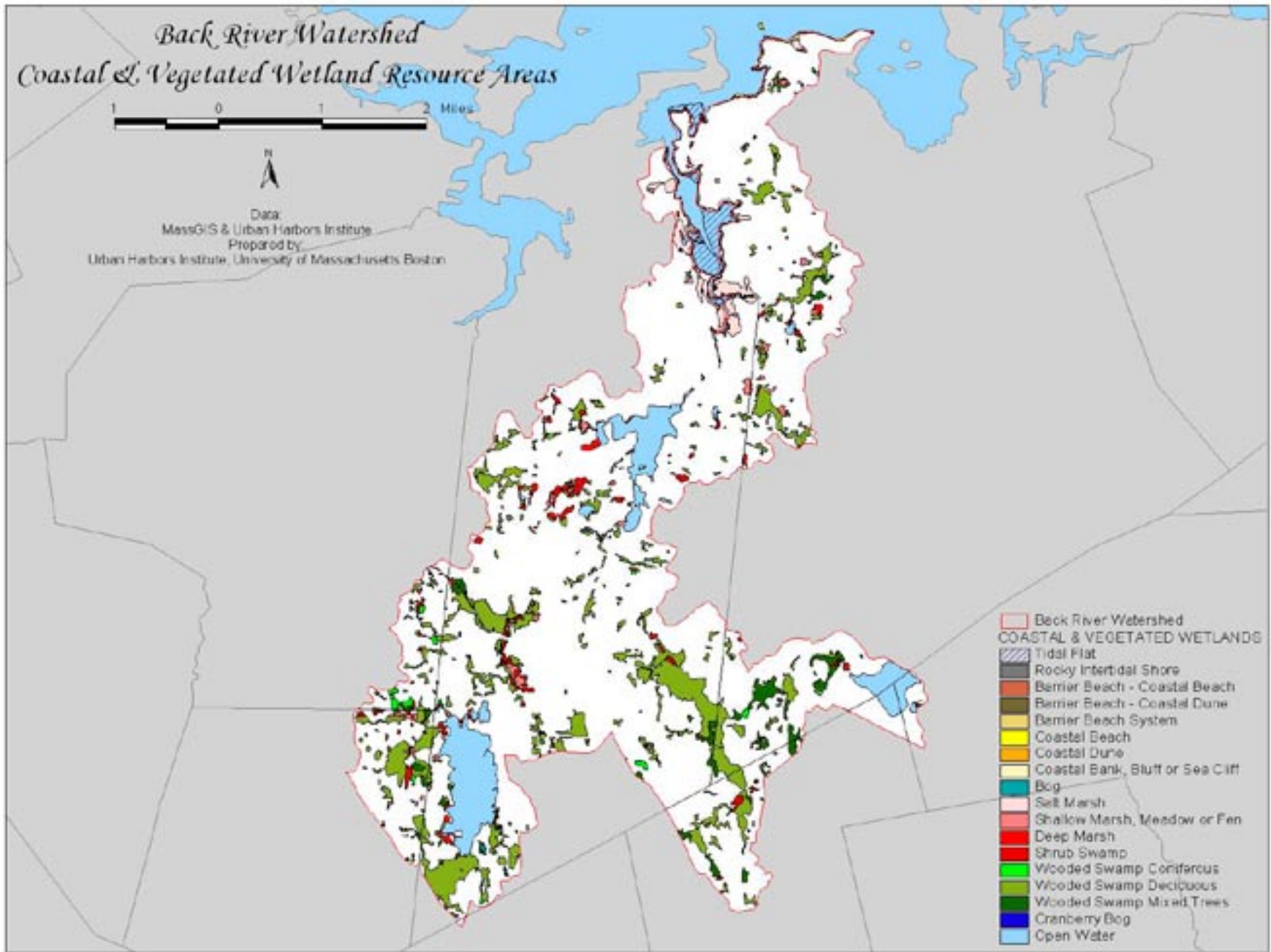


Figure 73: Back Vernal Pools, ACECs, ORWs and Zone II

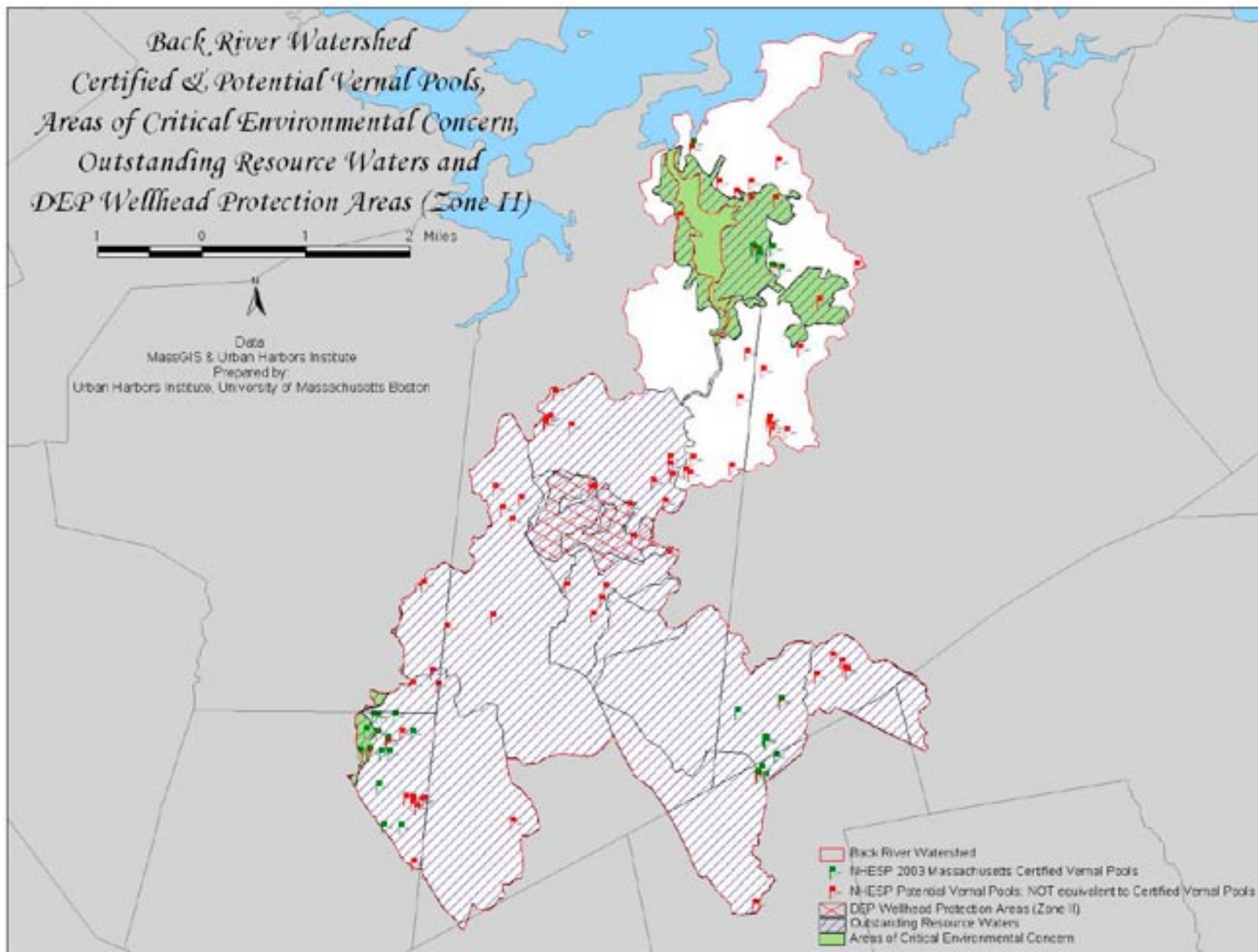


Figure 74: Back Approximate DEP Regulated Wetlands

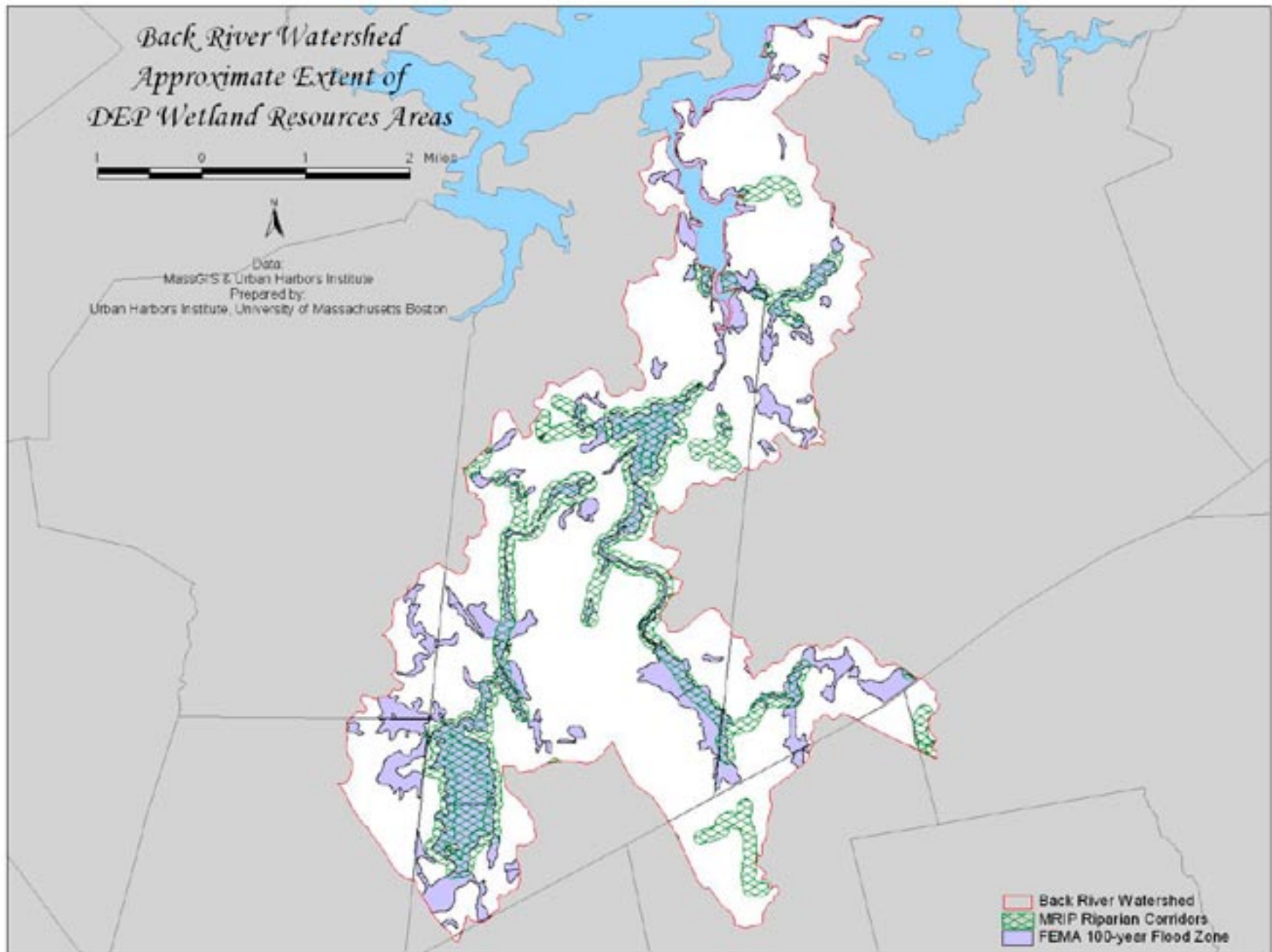
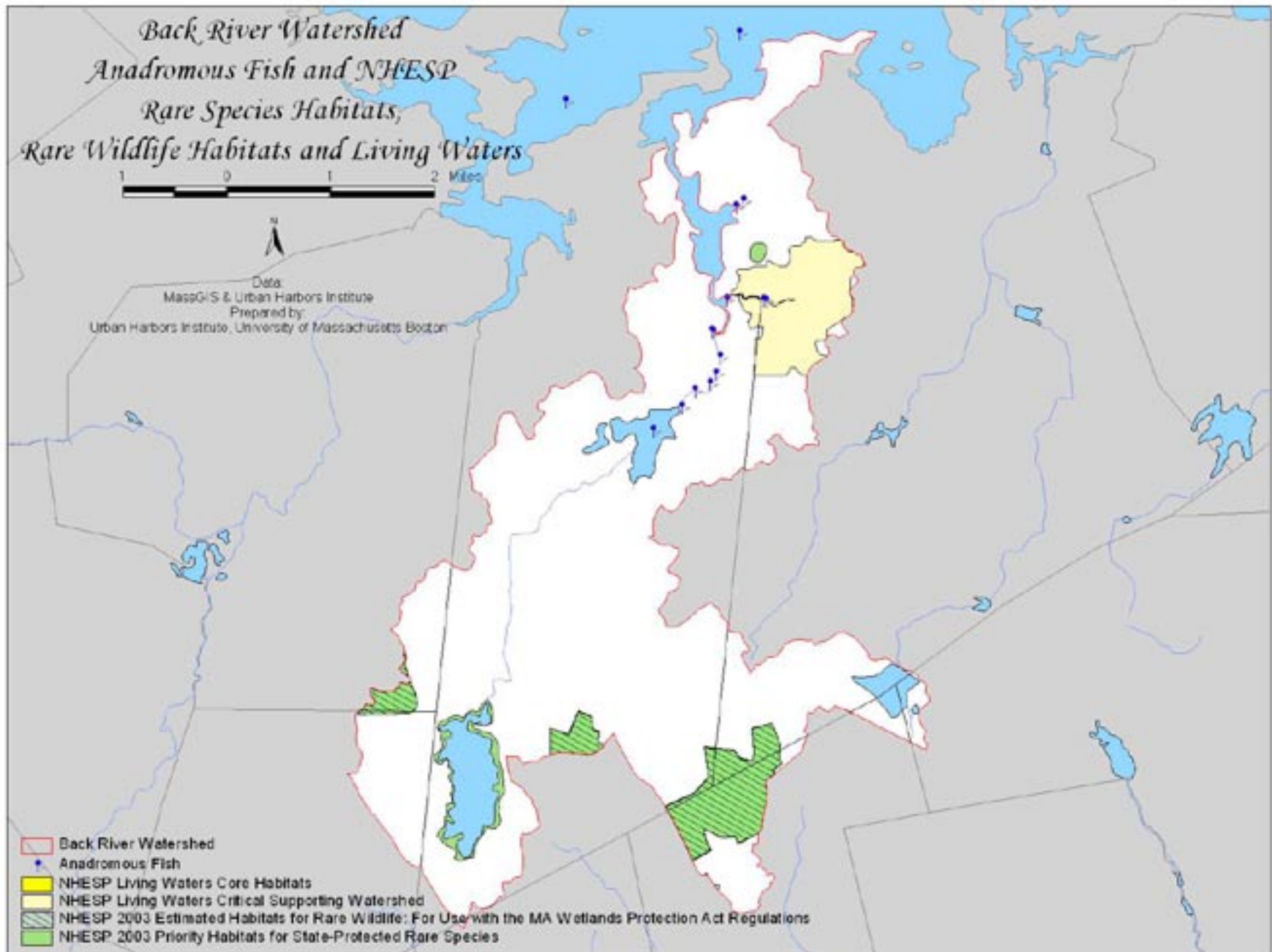


Figure 75: Back Anadromous Fisheries and Rare Species Habitats



Cold and Warm Water Fisheries

Anadromous and catadromous fish spawning habitat and runs are located throughout the watershed's river system. The river has six fishways, and Whitman's Pond is the major spawning area in this system (Iwanowicz et al. 1973). The Back River, in conjunction with the Fore River, supports two of the three largest smelt runs in Massachusetts Bay. Herring runs, eel runs, productive shellfish flats (primarily soft shell clam), lobster fisheries, and menhaden fisheries are also present in the area. American eels are found in the mainstem and Fresh River although no population data are available, it is thought that there are fewer eels present now than in previous decades. In a 1970 survey of the Back River, Atlantic silverside, stickleback, mummichog, rainbow smelt, and striped killifish were collected (Iwanowicz, et al. 1973). However, rainbow smelt populations have declined in recent decades. A prominent concern is stormwater impacts on the water and habitat quality at the Jackson Square spawning habitat. Alewife and mackerel also frequently utilize habitat in the Back River. A large population of alewife run up into Whitman's Pond at a consistently high level. Atlantic tomcod and white perch are thought to be present but have not been assessed. This wide variety of finfish has led to the development of a healthy sport fishery in Hingham Bay and the Back River. Striped Bass arrives during the summer as part of their seasonal feeding migration. They are an abundant and popular sportfish in the Back River estuary.

Are wetland and vernal pool habitats healthy or degraded?

In general, wetland habitats are healthy when compared with neighboring areas. However, they are somewhat compromised when considered in the light of pristine areas. Sedimentation and erosion caused by new residential development threaten the area's salt marshes. Some wetland areas in Bouve Pond and along the Fresh River (which feeds into the Back River), both salt and fresh, are deteriorating for unknown reasons. There has been some speculation that the deterioration has been caused by pollution from past industrial processes (Myers 1997). This deterioration makes it easier for exotic species to invade.

While the Back River watershed, especially in the ACEC, has a

reputation as one of the healthiest riparian systems in the area, shellfish beds, anadromous spawning areas, and other habitat were negatively impacted by industry and sewage pollution. The degradation caused by these inputs meant that shellfish beds were closed until 1996. The bulk of these sources have been either eliminated or corrected, but a 1973 study found discernable concentrations of a wide variety of pesticides in Back River sediments, and it is known that for a period leachate from a town incinerator landfill was entering the river (Town of Weymouth Year Unknown).

There are efforts being made to improve the extensive shellfish beds in the area through the Massachusetts Shellfish Bed Restoration Program (Myers 1997).

In addition to industrial pollution and sewage, the upper portion of Back River has inadequate flushing (Myers 1997) and Whitman's Pond is undergoing eutrophication due to an overabundance of nutrients from residential and road runoff. (Beal et al. 1982) Water quality issues at Whitman's Pond are exacerbated when it is used as an emergency water supply by Weymouth or is used to supplement Great Pond (Beal et al. 1982). As mentioned previously, Whitman's Pond provides major spawning habitat. This habitat is negatively impacted by degraded water quality and changing water levels.

There is little information available on the status of vernal pools. Further information should be gathered.

Are invasive species a significant threat to upland, wetland or aquatic habitats?

Yes, they are a threat. *Phragmites australis* has been found within the watershed. The wetland areas in Bouve Pond and along the Fresh River that are deteriorating for unknown reasons are starting to experience invasion from exotic species. The extent of the spread of *Phragmites* needs to be delineated.

The Back River has a number of fish ladders and other devices, but the river does suffer from low water levels in its upper reaches and is dammed (Myers 1997).

What percentage of the watershed is “built-out?”

The Back River watershed is comprised of approximately 11,900 acres in seven towns. Table 26 presents the acreage of each town, acreage of the town in the watershed, the percentage of the town in the watershed, and the percent each town is of the watershed.

As can be seen in Table 29, 37% of the Back River watershed is forest. The other major category of land use is residential (1/4-1/2 acres lots), which accounts for 29% of the land use in the watershed.

Table 29: Land Use in the Back River Watershed

Land Use Category	Total Acreage	Percent acreage
Cropland	16.6	0.1
Pasture	16.3	0.1
Forest	4389.6	37.0
Wetland	69.1	0.6
Mining	34.6	0.3
Open Land	398.2	3.4
Participation Recreation	145.8	1.2
Spectator Recreation	0.0	0.0
Water Based Recreation	32.2	0.3
Residential (Multi-family)	339.4	2.9
Residential (Smaller than 1/4 acre lots)	240.0	2.0
Residential (1/4 - 1/2 acre lots)	3457.3	29.1
Residential (Larger than 1/2 acre lots)	274.7	2.3
Salt Wetland	118.5	1.0
Commercial	530.9	4.5
Industrial	384.4	3.2
Urban Open	466.8	3.9
Transportation	280.8	2.4
Waste Disposal	35.4	0.3
Water	645.7	5.4
Orchard, Nursery or Cranberry Bog	0.0	0.0
TOTAL	11,876.1	100

Available land use and open space data are aggregated by, and build-out information is computed for, entire municipalities. Therefore, the following sections characterizing current and projected land use and population are based on data from towns whose land areas are entirely or predominantly in the watershed. For the Back River watershed, this is Weymouth and Hingham.

Are there significant brownfields or opportunities for redevelopment in the watershed?

Two sites within the watershed were identified on the EPA “Waste Site Cleanup & Reuse” website (<http://www.epa.gov/region1/superfund/findsite/fndindex.htm>); South Weymouth Naval Air Station and Merriman Division of Quamco Inc (Hingham). The South Weymouth Naval Air Station (1,442 acres) is listed on the EPA’s Long Term/ National Priorities List (NPL) - the NPL is a published list of hazardous waste sites that are eligible for extensive, long-term cleanup actions under the federal Superfund Program. Assessment and remediation are on-going at the Naval Air Station site.

The Merriman Division of Quamco Inc. site (15.88 acres) is listed as a “site awaiting NPL decision” by the EPA. The site was developed as a foundry and metal working operation. Per the EPA website, the site is still active. Waste products generated on-site have included wastewater, metal cuttings, foundry sand, waste oil, spent chlorinated and non-chlorinated solvents, and spent coolant.

What are the major trends in population, land use, transportation and water needs?

The population for the two towns referenced above remained almost constant from 1990 to 2000.

There are an additional 3,725 acres of developable land in the two towns according to the EOEA build-out figures. Based on the calculations of EOEA for its build-out analysis for these two towns, the increase in

Figure 76: Back Land Use

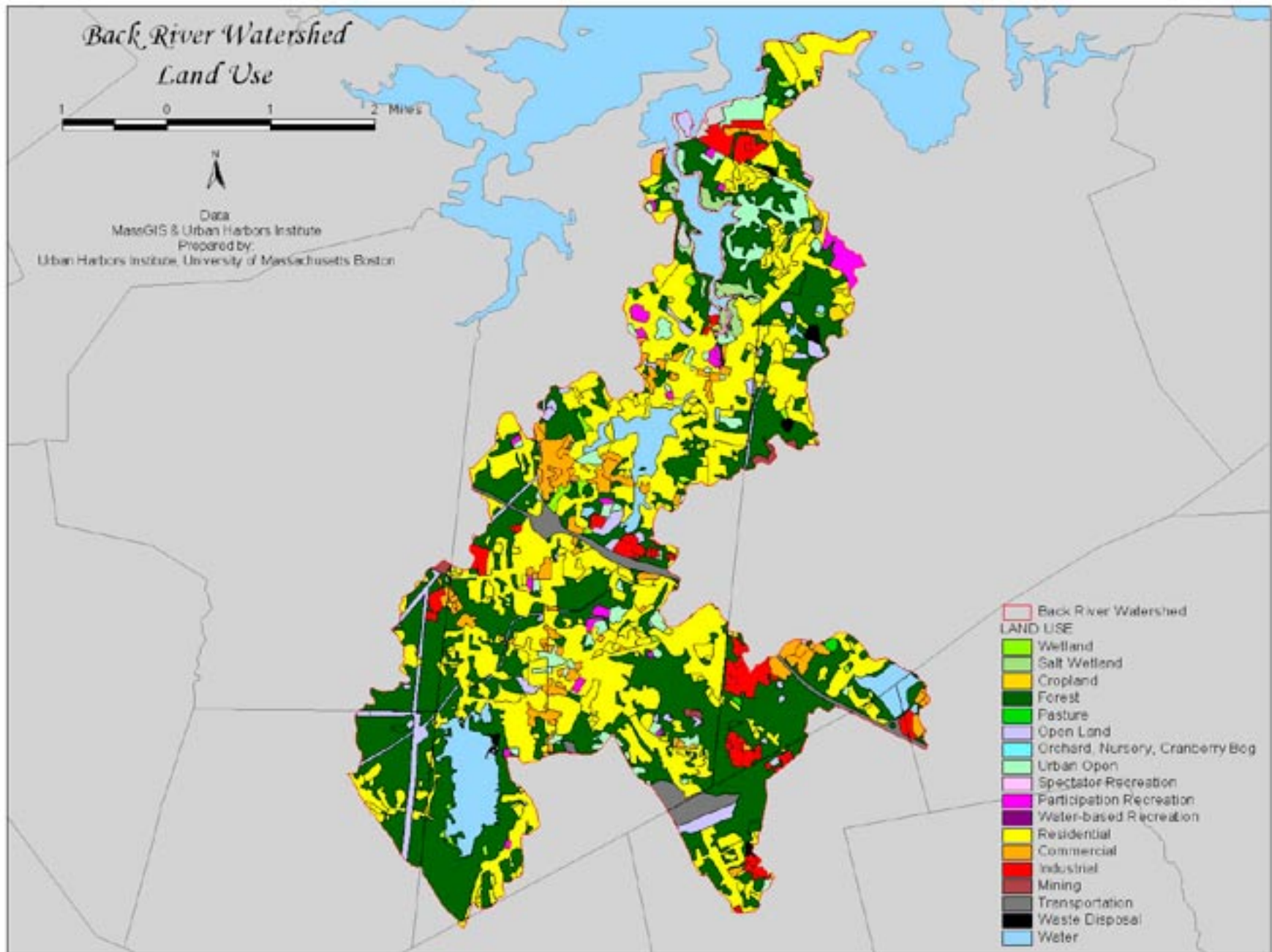


Figure 77: Back Contaminated Sites

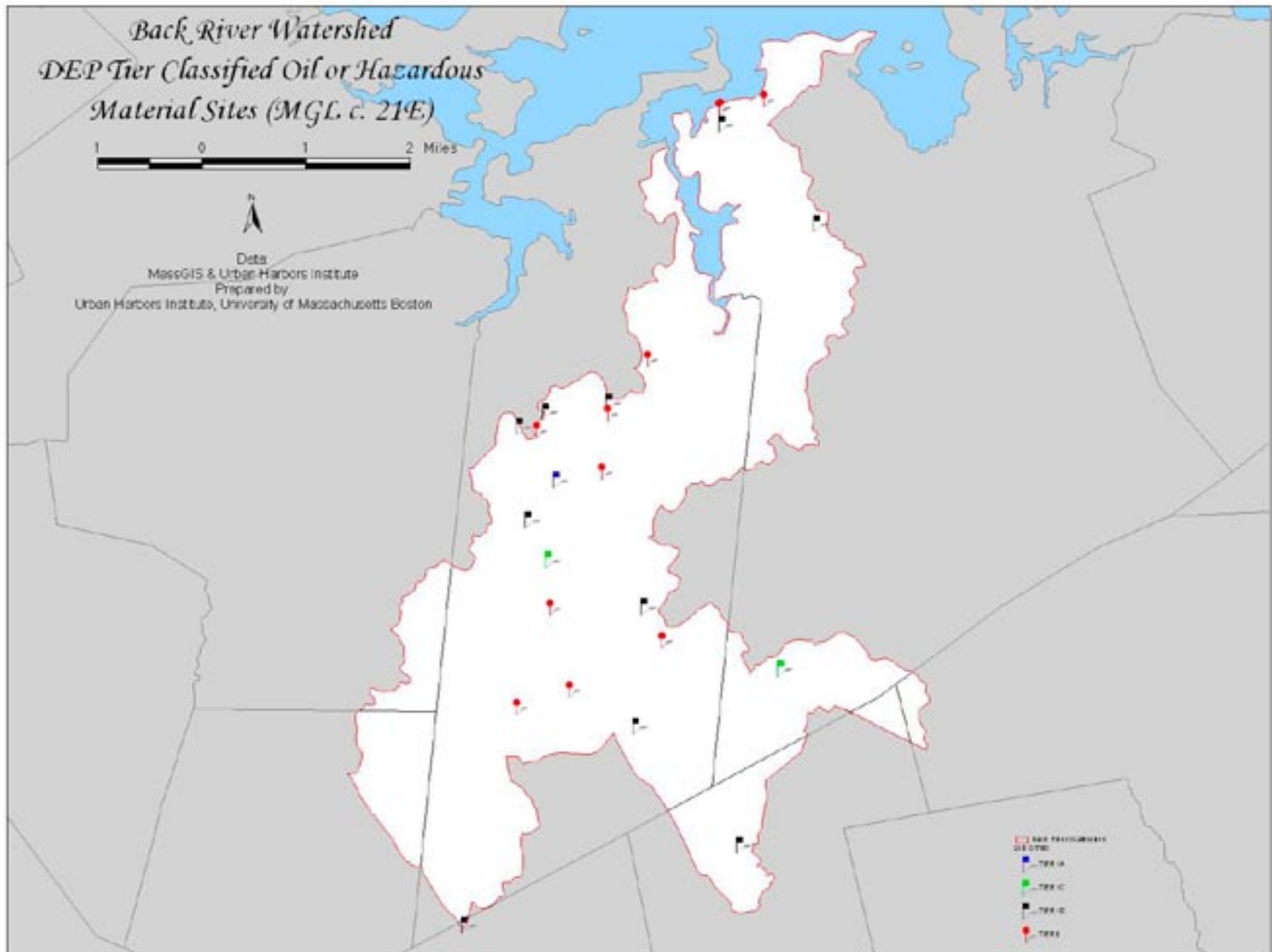
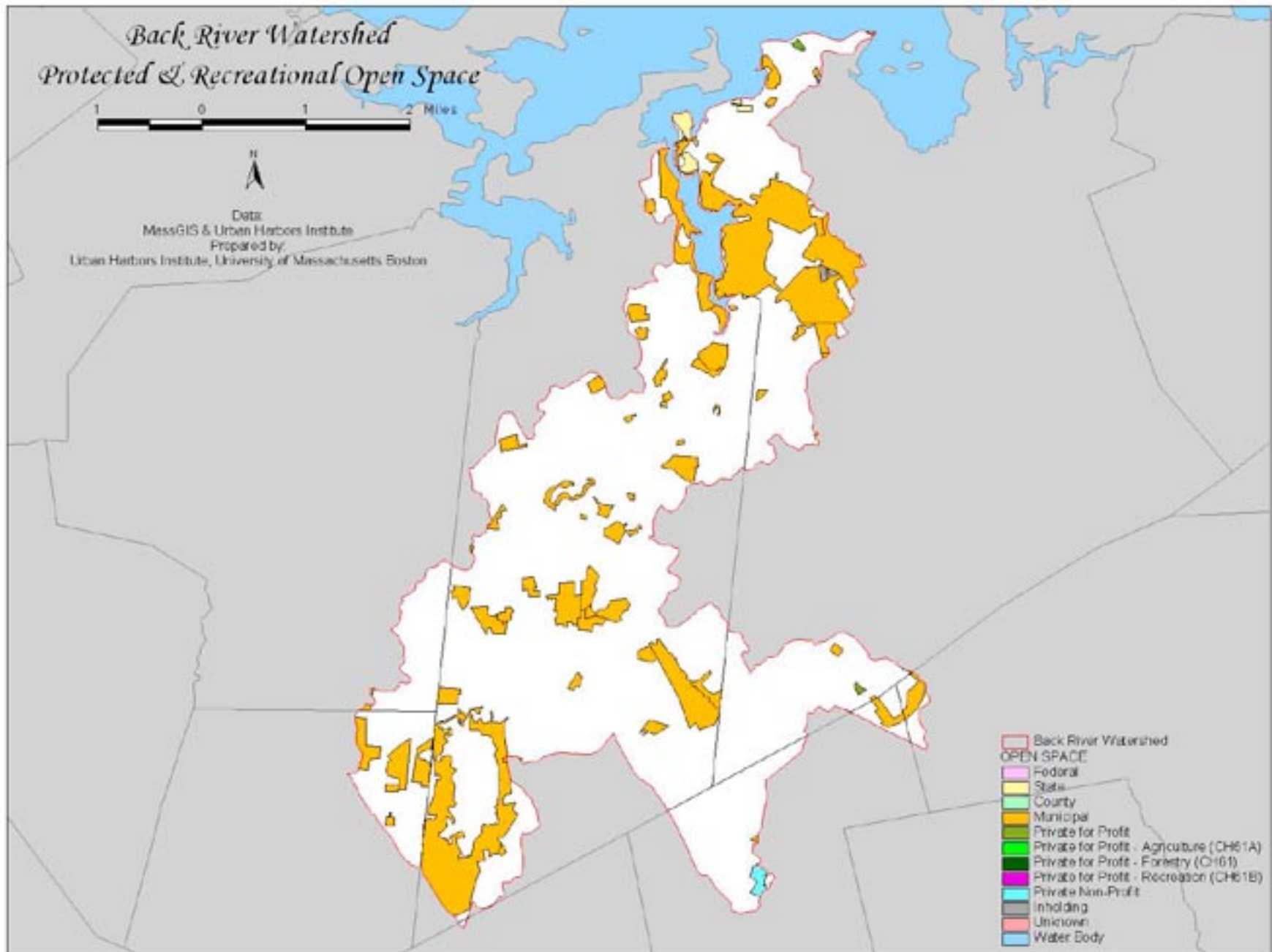


Figure 78: Back Open Space



population at build-out would be 82,905, for a total growth of 12 percent. The buildout for these two towns projects an additional 3,602 residential units and 9,848,970 square feet of additional commercial/industrial buildable floor area.

This increase in population and development translates to an additional water demand of 1,416,303 gallons/day and additional solid waste produced of 4,635 tons per year. The ‘build-out’ conditions would produce an additional 40 miles of roadway.

Table 30: Back Population Increase over 2000 at Buildout (EOEA)

Town	Population Increase	Percentage
Weymouth	5,527	
Hingham	3,508	
Total	9,035	12%

What % of the watershed’s area is currently comprised of permanently protected open space?

Nineteen percent of the watershed (2,211 acres) is comprised of “protected and recreational open space”. Ninety-eight percent of this open space is owned by some level of government.

How much land is still undeveloped (and not protected)?

Approximately 4,088 acres of land in the watershed is undeveloped.

How rapidly is open space being lost?

As noted above, the population changed little from 1990 to 2000 based on the towns of Weymouth and Hingham. EOEA’s buildout analysis indicates that there is further potential for 12% population growth.

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Weir River Watershed Assessment

Introduction

The Weir River watershed is located in Plymouth and Norfolk counties approximately 15 miles south of Boston. It is a small watershed contained within the larger Weymouth and Weir watershed, which in turn is a component of the larger Boston Harbor watershed. The watershed has a drainage area of approximately 22.6 square miles and encompasses all or portions of the towns of Hull (100%), Hingham (72%), Cohasset (9%), Weymouth (4%), and Norwell (4%). The watershed is home to approximately 30,000 residents. Most of the land in the watershed is residential with a pocket of more industrial zoning close to the southern boundary of the watershed. Population densities and potential stressors to the watershed increase as the Weir River flows toward Hull.

The main watercourse in the watershed is the Weir River, which is supplied by a number of tributaries including Accord Brook, Plymouth River/Crooked Meadow River, and Fulling Mill Brook. The Weir River

drains into the Weir River estuary below Foundry Pond. According to a report prepared for the Massachusetts Department of Environmental Management (now Department of Conservation and Recreation) by the GZA Geoenvironmental, Inc. (“Status of and Potential Impacts on Water Budget for the Weir River Watershed” (2000)), the Weir River watershed is characterized by “low-gradient watercourses with well-defined channels, broad floodplains, and seasonally variable flow.” The largest fresh water body is Accord Pond at the southern-most point and highest elevation of the watershed. The pond is used for water supply and is therefore not normally available for other activities such as fishing or boating. The Massachusetts-American Water Company owns the pond area and maintains an intake pump station near the dam on the northern side of the lake. All of the ponds have been artificially constructed or modified for industrial or recreational purposes.

The watershed is at the southern edge of the geologic depression known as the Boston Basin. Numerous bedrock outcroppings, drumlins, and generally shallow soils (less than 6 feet) are typical of the geology of the watershed. The surface geology of the watershed is divided into two distinct sections. The eastern section is till over bedrock, leading to low water infiltration and high surface runoff rates. The western section is mostly coarse sand and gravel deposits with higher infiltration rates more favorable to supporting productive aquifers (GZA 2000). Overall, the nature of the soils and relatively undeveloped character of the western portion of the watershed result in the watershed being relatively well-draining with fairly high infiltration rates.

Table 31: Weir Watershed Town Make Up

Town	Acreage of town	Acreage in watershed	Percent of town in watershed	Percent of the watershed
Cohasset	6431.8	1320.5	20.5	9.1
Hingham	14513.8	10375.2	71.5	71.5
Hull	1640.2	1640.2	100	11.3
Norwell	13566.9	634.9	4.6	4.4
Weymouth	11250.4	537.0	4.8	3.7
Totals	47403.1	14507.8		100.0

Figure 79: Weir Towns:



Figure 80: Weir Orthophoto:

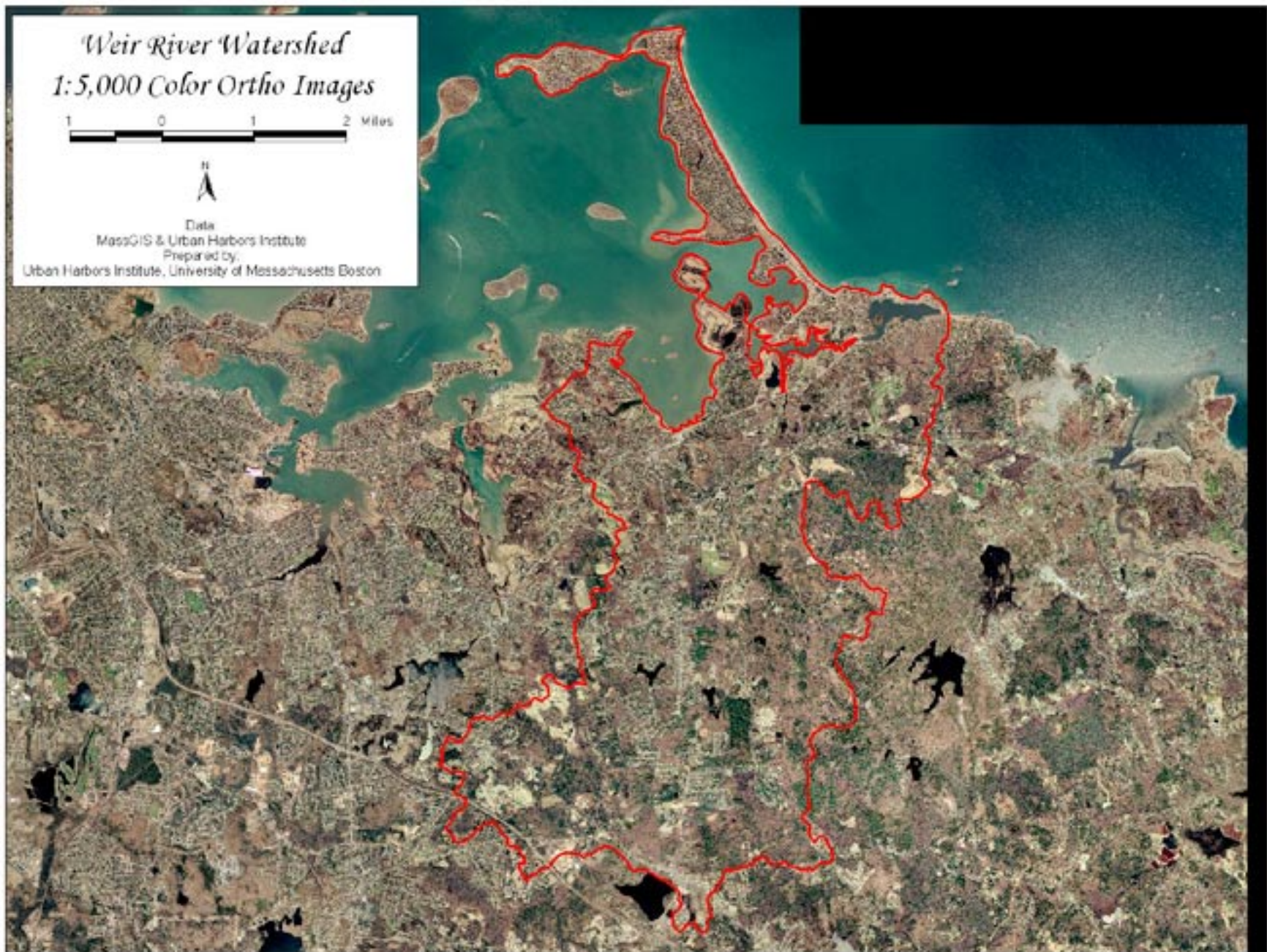
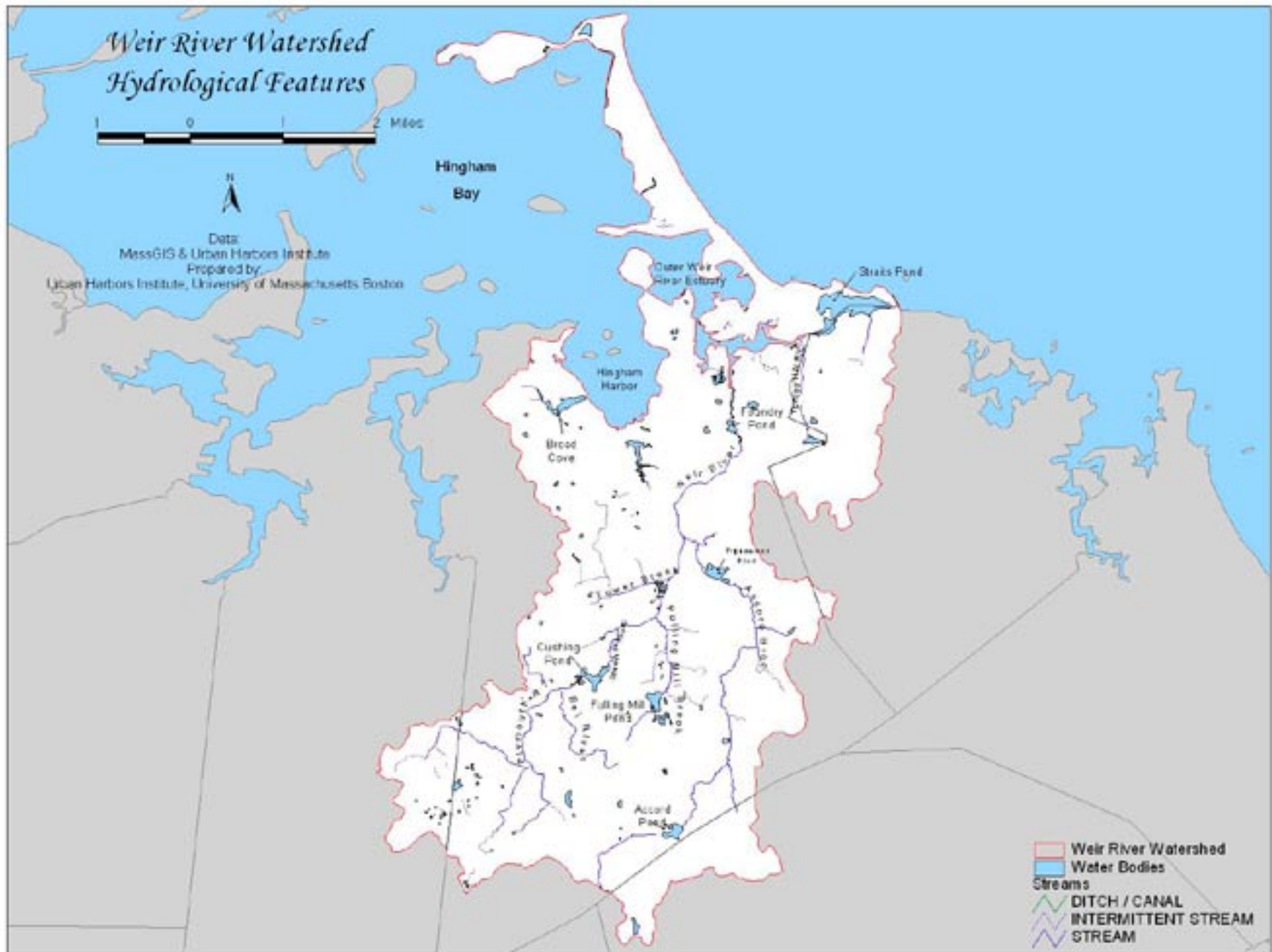


Figure 81: Weir Topography



Figure 82: Weir Hydrological Features



Does pollution limit the use of water resources in the watershed?

Yes, pollution from bacteria, nutrients, and other contaminants is evident or suspected in water bodies in the lower reaches of the watershed. The Massachusetts Department of Environmental Protection's (DEP's) Boston Harbor 1999 Water Quality Assessment (2002) provides a summary of current water quality data/information used to assess the status of the designated uses as defined in the Massachusetts Surface Water Quality Standards. There are five categories of use assessment: (1) Aquatic Use, (2) Fish Consumption, (3) Primary Contact (swimming), (4) Secondary Contact (boating), and (5) Aesthetics. Each use is individually assessed as: "support," "partial support," or "non-support." When insufficient current data/information or unreliable data are available, the use is "not assessed." It is important to note that not all waters are assessed; the status of their designated uses is never reported. The majority of the Weir River watershed has not been assessed by DEP. Also, according to the Boston Harbor 1999 Water Quality Assessment (2002), no data/information were available to assess the Aquatic Life, Recreational, and Aesthetics uses for the lakes in the Weir River watershed.

In July 2001, the Massachusetts Department of Public Health issued statewide consumer advisories on the risk of mercury in fish from all freshwater bodies.

The proposed Massachusetts Year 2004 Integrated List of Waters (DEP 2004) categorizes waters from 1 to 5 and lists the reasons for impairment, if any:

1. Unimpaired and not threatened for all designated uses;
2. Unimpaired for some uses and not assessed for others;
3. Insufficient information to make assessments for any uses;
4. Impaired or threatened for one or more uses but not requiring a TMDL
5. Impaired or threatened for one or more uses and requiring a TMDL

Once a waterbody is identified as impaired, DEP is required by the

Federal Clean Water Act to essentially develop a "pollution budget" to restore the health of the impaired waterbody. The process of developing this budget, generally referred to as a Total Maximum Daily Load (TMDL), includes identifying the causes (types of pollutant) and source(s) (where the pollutants come from) of the pollutant from direct discharges (point sources) and indirect discharges (non-point sources), determining the maximum amount of the pollutant that can be discharged to a specific water body to meet water quality standards, and developing a plan to meet that goal. Category 5 impaired waters constitute what was formerly known as the "303d list."

Does bacterial pollution limit fishing, or recreational uses?

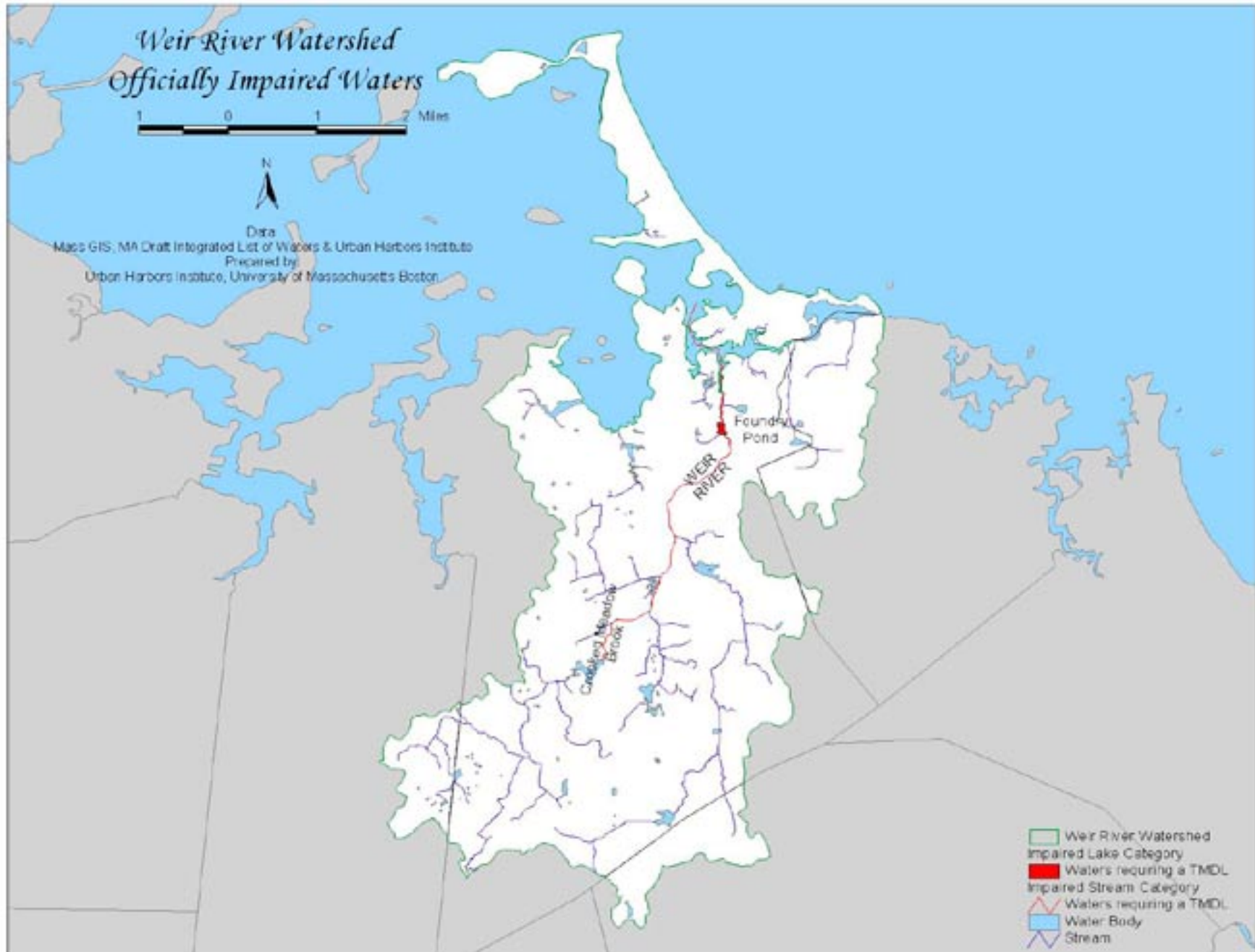
Yes, at least in the lower portion of the watershed. There are relatively little data to suggest the nature or severity of water quality problems in the upper reaches of the Weir River, but data are available for the lower portion of the watershed and are the focus of this discussion. The data that are available seem to indicate specific areas (i.e. Straits Pond and the Weir River inlet to the estuary) that are more impacted than others, and the degree of pollution is likely related to rain events and the amount of stormwater runoff.

Known or Suspected Sources of Bacterial Pollution

Without more testing, both spatially and temporally, it is difficult to pinpoint the dominant sources of bacteria in the Weir River watershed. DNA testing to distinguish human from wildlife sources is recommended. Suspected sources include:

- The abundant on-site sewage disposal systems in Hingham, which comprises the largest part of the watershed and is not well sewered. Hull and Cohasset are mostly sewered, especially near the estuarine region of the watershed.
- In Straits Pond there is a mix of waterfowl, geese, and swans that use the pond as a feeding habitat and are a likely source of bacteria to the system.
- Storm drains and nonpoint source urban runoff.

Figure 83: Weir Officially Impaired Waters (note majority of watershed is unassessed)



Bacteria Problems in the Weir River and Weir River Estuary

The Weir River and the Weir River estuary are designated as Category 5 (impaired) on the proposed 2004 Integrated List of Waters, but still need confirmation for pathogens and nutrients, which means they are suspected not to meet the water quality standards for primary and secondary contact, but have not been assessed. Shellfish growing areas in Hull Bay/outer Weir River estuary are conditionally restricted to commercially licensed master shellfish diggers and prohibited to recreational shellfishing due to historically high bacterial counts; shellfishing in areas in the inner estuary are prohibited altogether (DFWELE, 2000).

Between June 1999 and June 2000, USGS collected water quality samples in the Weir River at the Route 3A bridge in Hingham. Fecal coliform counts at this location ranged from 25 to 570 colonies/100 ml. Counts exceeded 400 colonies/100 ml in two samples, both taken during primary contact season (DEP 2002). The Weir River Watershed Association has conducted two years worth of bacterial sampling beginning in 2002. The samples were taken largely in the lower estuary portion of the watershed. In 2003, one sample was taken in the upper Weir River off Union Street in Hingham that was TNTC (too numerous to count). Samples from the estuary generally had low bacteria counts. However, Straits Pond, Foundry Pond, and one sample taken in the estuary at George Washington Blvd had counts exceeding the swimmable/fishable standard of 200 fecal coliform/100 ml.

Does nutrient pollution pose a threat to aquatic life?

Yes, at least in portions of the watershed. The impact that nutrient enrichment and eutrophication may have on natural resources of the waterways, such as anadromous fish habitat and eelgrass, is difficult to assess specifically for the Weir River watershed because no such study has been carried out as of yet. The complexity of determining acceptable nutrient levels is complicated by the fact that the Massachusetts Surface Water Quality Standards do not include specific numeric thresholds for nutrient levels, but rather a general narrative criteria under various “uses”, including aquatic life use and aesthetics. Despite these drawbacks, it is possible to draw some conclusions from anecdotal evidence combined with some data presented here.

Nutrient enrichment is evident in the watershed. This finding is based on fragmented water quality data that were collected by means of spatially and temporally constrained studies of Straits Pond and Foundry Pond, as well as shellfish monitoring for classifying harvesting conditions in the lower estuary (ENSR 2002; Lefebvre et al. 2002). The data that have been collected through these means indicate eutrophication, particularly in Foundry Pond and Straits Pond, and bacterial contamination in the lower estuary and in Straits Pond. Triphammer Pond, which is higher up in the watershed, also shows symptoms of eutrophication though no water quality data are available to confirm elevated nutrient concentrations. Spatially, the mainstem of the river seems to contribute high nutrient loading into the estuary. Not enough water quality data have been collected to determine any nutrient trends over time, and data do not exist for all segments of the Weir River watershed.

Known or Suspected Sources of Nutrient Pollution

In general, stormwater runoff is suspected to be a large component of the contribution to nutrient pollution in the watershed. In Straits Pond, nutrient enrichment is magnified by a prolonged residence time of the water. A recent report identified low rates of water exchange through the tide gates connecting Straits Pond and the Weir River Estuary (ENSR, 2002).

Nutrient Problems in Foundry Pond and Straits Pond.

Water quality data from April-August, 2002 indicate that combined nitrate and nitrite levels are elevated in the freshwater in Foundry Pond (greater than 25 mg/l) (WRWA 2002)), but quite low in Straits Pond (less than 5 mg/l).

Both Straits Pond and Foundry Pond have historical alewife populations (Lefebvre et al. 2002) whose numbers seem to have declined in recent years. It is suspected that there are a number of factors that have lead to their decline, including dam obstructions, improperly designed or poorly maintained fish ladders, and lack of fresh water during the summer season for juveniles to make their way down stream. The decline could also be due, in part, to nutrient loading and eutrophication impacts to their spawning habitats. As for eelgrass beds, there have been some beds mapped in the lower estuary, but their health and status are unknown.

Nutrient Problems in the Weir River.

The US Geological Survey conducted sampling of the Weir River in 1999 at a station south of the Weir River Estuary Area of Critical Environmental Concern, near East Street in Hingham (Lefebvre et al. 2002). Total nitrogen ranged from 0.33 mg/l – 0.67 mg/l. Combined nitrate and nitrite ranged from 0.31 mg/l - 0.64 mg/l. Total phosphorous and phosphate over the sampling period ranged from 0.021-0.044 mg/l and 0.02 – 0.04 mg/l, respectively.

Foundry Pond is formed by a dam in the Weir River, and marks the beginning of tidal waters listed as Category 5 on the proposed 2004 Integrated List of Waters needing confirmation for nutrients, siltation and noxious aquatic plants. It is suspected not to meet water quality standards for certain uses, but has not been assessed.

Nutrient Problems in the Crooked Meadow Brook.

This stream, which begins at the Cushing Pond dam is a Category 5 on the 2004 Integrated List of Waters needing confirmation for nutrients, organic enrichment/low DO and noxious aquatic plants. It is suspected not to meet water quality standards for certain uses, but has not been assessed.

Are dissolved oxygen levels high enough to support aquatic life?

Yes. Dissolved oxygen (DO) levels measured in the estuary and in Straits Pond are generally above 5 mg/l, which is the threshold deemed adequate to support aquatic life. There are limited data for the upper reaches of the watershed, but what are available are not indicative of poor DO.

In Foundry Pond and likely in Triphammer Pond—both shallow man-made impoundments—warm water fish species are present. Temperatures may exceed their tolerances in summer, resulting in fish kills, but there is no documentation of such occurrences. The following dissolved oxygen, temperature and salinity data were taken in 2002 and are excerpted from the Weir River Water Quality Sampling Results 2002 Draft Report.

Known Causes of High Temperatures and Low DO

The extremes with respect to high temperatures and low DO are found in shallow, man-made impoundments. Data from the mainstem of the Weir River are not available to reach any decisive conclusions.

The Weir River Estuary ACEC is classified as an Outstanding Resource Water (ORW) as part of its ACEC designation. The area surrounding Accord Pond also is classified ORW under the Massachusetts Surface Water Quality Standards of 1995. According to 314 CMR 4.00: “Certain waters shall be designated for protection under this provision in 314 CMR 4.06(3) including Public Water Supplies (314 CMR 4.06(1)(d)1.)” Accord Pond is the largest fresh water body at the southern-most point and highest elevation of the watershed. The pond is used for water supply and is therefore not normally available for other activities such as fishing or boating.

Sediment samples from Straits Pond indicate high concentrations of lead, cobalt, zinc, and arsenic. Chemical sprays including DDT, lead arsenate, Aquathol, and Abata have historically been applied to treat the midges in the pond, and it is likely that these toxins have accumulated concentrations in the underlying sediments of the pond, but no studies have confirmed this assumption.

Dissolved Oxygen in Straits Pond

Sampling in Straits Pond conducted by ENSR in May 2001, by the Straits Pond Watershed Association in May 2001, and by the WRWA in April and May 2002 found DO levels well above the 5 mg/l threshold (Lefebvre et al. 2002). Water quality monitoring by WRWA in July and August 2002 found that bottom dissolved oxygen (DO) in Straits Pond was below the state water quality minimum threshold of 5 mg/l necessary for healthy aquatic life. Surface DO was below the state standard in August 2002. There were marked differences between stations in Straits Pond, which suggests reduced circulation and exchange in the stations furthest from the tide gate.

Dissolved Oxygen in the Weir River

USGS monitoring in the Weir River at the Route 3A bridge in 1999 found dissolved oxygen concentrations ranging from 6.2 – 11.3 mg/l. In 2002, measurements made by WRWA were 8.57 mg/l in April and 10.10 mg/l in May.

In July 1999, the DEP Division of Watershed Management conducted a benthic macroinvertebrate survey of the Weir River upstream of Route 228. Their findings were that the macroinvertebrate community is non-to slightly-impacted, with good diversity, a balanced trophic structure, and multiple food sources (DEP 2000). In addition, a rather pollution intolerant species was found to dominate the community.

Are there other water quality indicators that limit use of water resources within the watershed?

The Weir River estuary was designated an Area of Critical Environmental Concern (ACEC) by the Massachusetts Secretary of Environmental Affairs in 1986 in recognition of one of the largest and most productive salt marsh ecosystems in the Boston Harbor area. A decision to designate an area as an ACEC carries with it a requirement that all state environmental agencies acquire information about the resources of the ACEC; preserve, restore, or enhance the resources of the area; and ensure that activities within the ACEC minimize adverse effects on the natural and cultural values of the area. Projects within ACEC boundaries required stricter environmental review.

Are streamflow and groundwater levels sufficient to meet the needs of recreation, habitat, and water supply both now and in the future?

No. The Weir River watershed currently exhibits seasonal water supply shortages, driven by a high demand for water for irrigation in summer months that places considerable strain on the watershed's hydrological system. From 1996 – 2000, total withdrawals from the watershed exceeded the registered limit permitted by DEP during three separate years. Water bans are typical throughout the watershed, but are just one repercussion of a dwindling water supply.

Low flow rates, which measure the flow of water in a stream during

prolonged dry weather, are important in determining impacts to watershed plant and animal life. Applying a water balance model under dry weather conditions, GZA (2000) estimated low flow rates of baseflow throughout the Weir River watershed under three scenarios: virgin (predevelopment), developed (existing), and future conditions. Their model indicates a direct correlation between the amount of water demand and the reduction of stream flow. It is predicted that many stream reaches within the watershed can be expected to run dry for extended periods of time, with effects most pronounced in the Weir River and Accord Brook. A deficit in the amount of groundwater stored in the watershed's aquifers is anticipated along with a total loss in storage in the watershed of about 750 million gallons based on current development conditions. This is comparable to the amount of water needed to fill roughly 1,515 Olympic-sized, 50 meter swimming pools.

Under virgin conditions in Accord Pond, low flow falls to 0 cfs from July to December, a condition which has been verified in the field. This low flow condition is exacerbated by withdrawals under developed and future conditions. In Accord Brook, low flow falls to near zero in September and October under dry, virgin conditions. Under current and future conditions, this period of hydrological drought is extended from June to December. Low flow estimates in the Plymouth River under virgin conditions are estimated to approach 0 cfs in September-October. Water supply withdrawals in this river's subbasin are minimal, inferring that developed and future condition scenarios would yield similar results. In the Crooked Meadow River, low flow under dry, virgin conditions approaches zero in September and October. Again, since there are no major withdrawals in this subbasin, results are similar under current and future conditions. Low flow rates in the mainstem of the Weir River are estimated at 0.06 cfs in October under dry, virgin conditions. Under current and future conditions, flows approach zero in September and October.

The general trend for optimal, or at least stable, habitat requires flows of 2 – 5 cfs in Accord Brook and 5 – 10 cfs in the Weir River. Hydrologic analysis suggests that these flows cannot be sustained under virgin conditions during dry periods. Flow is only diminished under current or future conditions, so optimum habitat is not a realistic expectation even under damper conditions with average precipitation.

Do water supply, interbasin transfer or inflow and infiltration have a significant impact on instream flow levels?

Yes. A report prepared for the MA Department of Environmental Management (now Department of Conservation and Recreation), “Status of and Potential Impacts on Water Budget for the Weir River Watershed” (GZA 2000), suggests that under current water withdrawal and development conditions the flow in the Weir River mainstem is reduced by 42% over what it would be under predevelopment conditions:

“To evaluate the interaction of water supply demand and the natural aquatic environment, a water budget model was created by GZA for the watershed. The water budget model was used to estimate the in-stream flows which would have been expected to occur in the watershed under virgin, pre-development conditions. The water budget was also used to evaluate flows under current and potential future water demand conditions. Low flow conditions typically occur, as would be expected, in the summer months.

“The streamflow data indicate that water withdrawals and development have significantly reduced streamflow during the summer in Accord Brook and the Weir River. The Plymouth River is currently much less affected by water withdrawals. The Future Conditions scenario represents an increase in demand forecast using Massachusetts Department of Environmental Management methods and assuming continued utilization of current supply sources. The impacts of proposed major developments in the Plymouth River subbasin and elsewhere in Hingham are not included in the future conditions scenario presented above.

The following description is based on the Status of and Potential Impacts on Water Budget for the Weir River Watershed (GZA 2000):

“Water from the Weir River watershed is used both within and outside the watershed. Some of the withdrawn water is recycled within the watershed—e.g., recharge from septic systems, lawn

irrigation systems. Other water is immediately exported from the watershed for use in portions of Hingham and Norwell that are outside of the watershed, or as wastewater that is treated and disposed of outside the basin. In general, only approximately 27 percent of water pumped from the Weir River watershed is expected to be returned to the watershed.

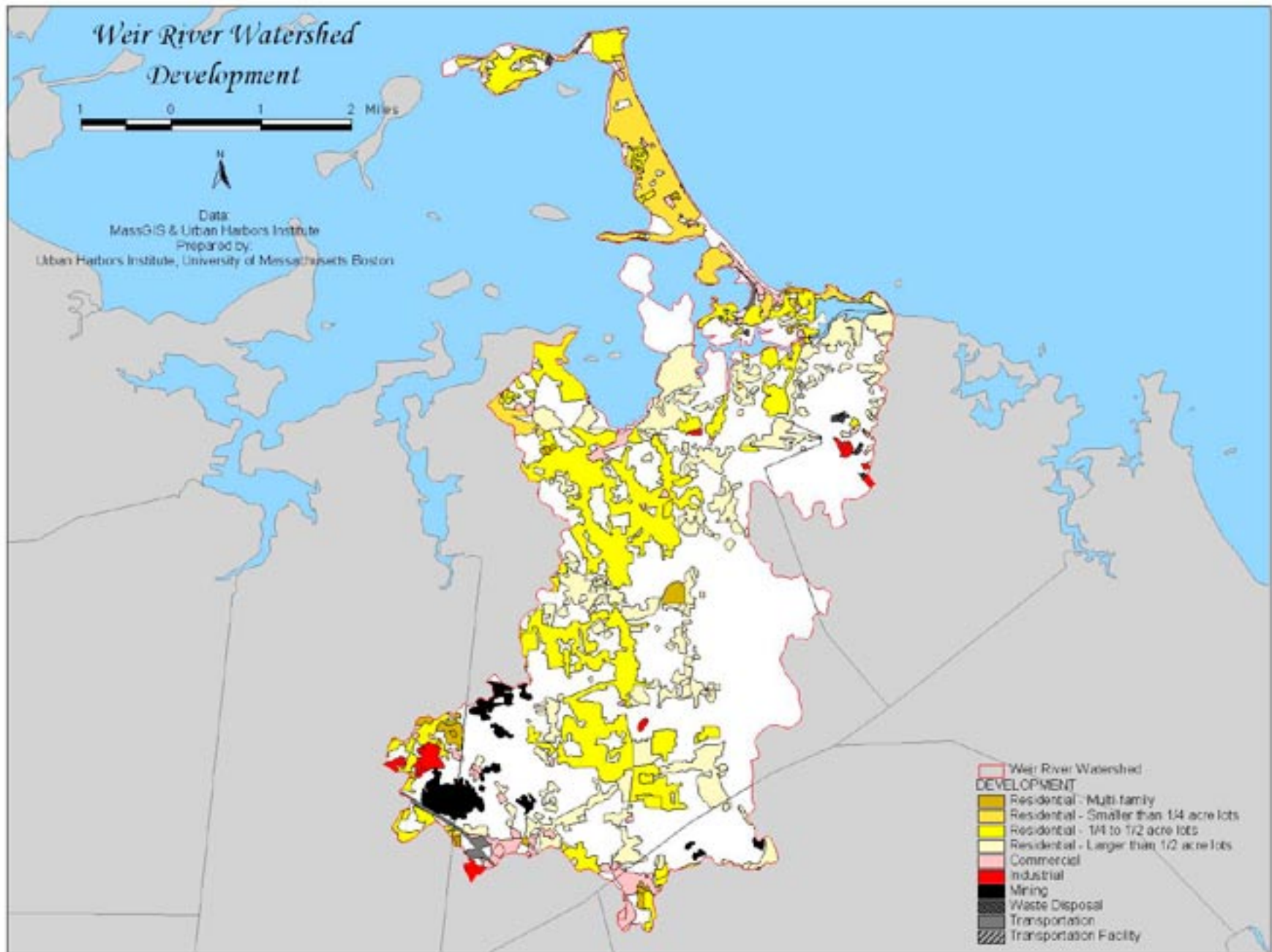
“Two public water suppliers withdraw water from the Weir River watershed in order to provide supply for different areas. The Aquarian Water Company (AWC) (formerly known as the Massachusetts-American Water Company) serves all of the Town of Hingham, all of the Town of Hull, and the northwest portion of the Town of Cohasset. The Town of Norwell Water Department uses wells within and near the watershed to supply the northwestern portion of the Norwell water distribution network. The portions of Rockland and Weymouth which are within the Weir River watershed are supplied from sources outside the basin.

“Water withdrawn from the Weir River watershed is used by domestic, commercial, industrial, and municipal users. Virtually all water users receive their water from the two water utilities that operate in the watershed. It was estimated that only 125 residential units (approximately 398 persons) in Hingham are self-supplied. It appears from GZA’s field observations that some residential users also withdraw water directly from streams and ponds for lawn watering.

“Two golf courses located within the Weir River basin are major seasonal consumers of water. The Cohasset Golf club draws from one irrigation well and a small 0.2 acre pond; water usage for 1999 was estimated at 7.51 million gallons. The South Shore Country Club draws from three irrigation wells and two surface water ponds. Annual water usage in 1999 was estimated at 21.2 million gallons. Combined, these facilities use approximately 2% of the total water used in the watershed, or enough water to fill roughly 148 Olympic-size, 50-meter swimming pools.

“Wastewater is collected in the Weir River watershed through a

Figure 84: Weir Development



combination of public sewer systems and private septic systems. In general, much of north Hingham and all of Hull are sewered. Less than half of Cohasset residents use septic systems, but all Norwell residents have septic systems. Virtually all of Weymouth is connected to municipal sewers.

“After use, water is discharged to either a municipal sewer system or an on-site septic system. Both Cohasset and Hull have recently received loans from the Clean Water State Revolving Fund to upgrade their sewage treatment plants and, in the case of Cohasset to upgrade their sewer system as well. Wastewater is discharged from the wastewater treatment plants to the ocean, thus effectively removing it from the watershed without the possibility of further use. Sanitary sewers also may cause loss of groundwater due to infiltration and inflow. However, this effect is typically unimportant to flows in the streams and rivers of the Weir River basin since the sewered areas are in north Hingham and Hull, which are within the tidal portion of the watershed.

“The treatment of wastewater by septic systems generally relies on small underground tanks to collect wastewater and treat it through sedimentation and biological action. After passing through the tank, the wastewater is removed by allowing it to infiltrate into the ground, usually through buried perforated pipes. Some of the water discharged from septic systems may be transpired by overlying plants, but most of it filters through the soil and infiltrates to the water table below. If the septic system is within the Weir River watershed, then the water is once again available for use as outflow to streams or as supply to be withdrawn from wells. The majority of the water is, in essence, recycled.

“The ultimate fate of wastewater is therefore important to the entire basin water balance. Overall, approximately 42 percent of the watershed’s wastewater is discharged via septic systems, resulting in an estimated 1.14 MGD return flow to the watershed. This accounts for approximately 27.6 percent of water withdrawn from within the watershed.

“The stormwater system is separate from the sanitary sewers. Stormwater and street drainage systems were observed by GZA during field reconnaissance throughout the watershed. Stormwater runoff appears to discharge to nearby streams (i.e., in-basin discharge). Stormwater is considered to be part of overall surface runoff in the water balance.

“GZA’s water balance models indicate that water withdrawals in the Weir River watershed lead to a reduction of base flow, and a corresponding reduction in stream flow. In fact, a direct correlation is observed between the amount of demand and the reduction of base flows. Under average conditions it is expected that many streams within the basin could run dry for extended periods of time. Anecdotal evidence from local residents combined with flow measurements in the Weir River by GZA and the Weir River Watershed Association confirm this prediction. A deficit in the amount of groundwater stored in the basin also is expected. Based on current development conditions, the water balance suggests that 750 million gallons of water stored in the watershed will be lost each year. It is expected that base flow during extended drought conditions is expected to fall to essentially zero in many cases. Conceptually it appears that a wet year or a decrease in pumping would help restore groundwater levels to previous maximums.

Approximately what percentage of the watershed is impervious?

Approximately 2,855 acres (20 percent) of the Weir River watershed is impervious surface, with the greatest amount of imperviousness concentrated closer to the coastline and along major thoroughfares. The figures and table below illustrate the impervious surface coverage for the watershed. Impervious coverage is an effect of land cover disturbance and is a widely-used indicator of human impact. A surface is considered impervious if it has been covered or compacted with a layer of material that substantially reduces or prevents rain or storm water from filtering into the ground. Estimates of impervious cover for disturbed land cover classes have been developed by University of Rhode Island’s Department of Natural Resources Science Cooperative Extension (Joubert et al. 2000) for use with the 21 class data provided by MassGIS. Using these

Figure 85: Weir Impervious Surface

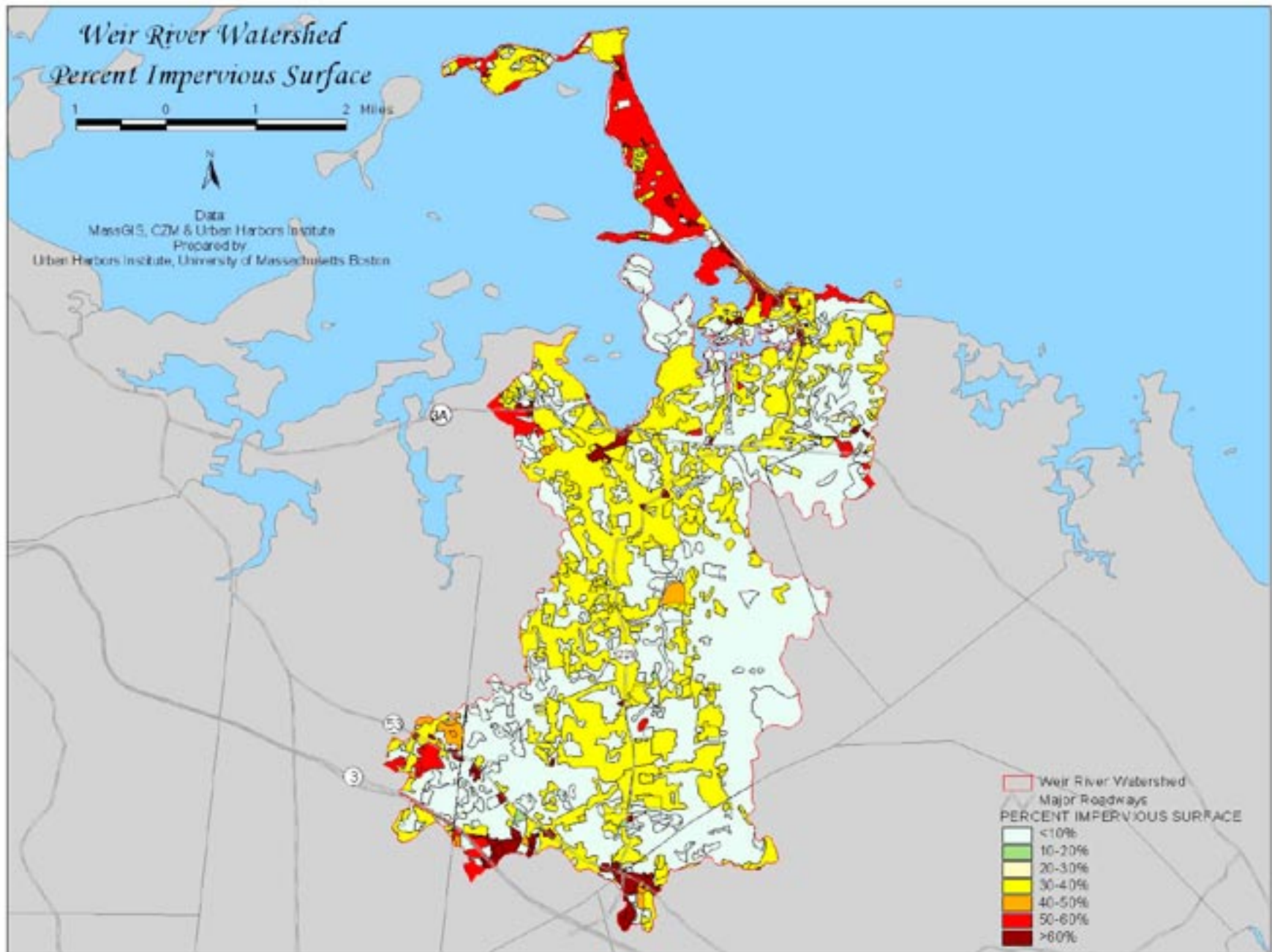


Table 32: Estimated Acreage And Percentage Of Impervious Surface In The Weir River Watershed Based On MassGIS Land Use Data And CZM's Estimates Of Impervious Surface By Land Use Type

Land Use Type	Mean Impervious Area Ratio	Weir River Sub-Watershed	
		Total Acreage	Total Impervious
Cropland	0.090	97.9	8.8
Pasture	0.080	244.6	19.6
Forest	0.078	6019.3	469.5
Wetland	0.055	221.3	12.2
Mining	0.067	258.0	17.3
Open Land	0.029	263.8	7.7
Participation Recreation	0.060	457.4	27.4
Spectator Recreation	0.050	0.0	0.0
Water Based Recreation	0.343	83.4	28.6
Residential (Multi-family)	0.454	142.8	64.8
Residential (Smaller than 1/4 acre lots)	0.543	674.6	366.3
Residential (1/4 - 1/2 acre lots)	0.305	2603.2	794.0
Residential (Larger than 1/2 acre lots)	0.304	2005.8	609.8
Salt Wetland	0.016	168.9	2.7
Commercial	0.640	348.2	222.9
Industrial	0.547	116.1	63.5
Urban Open	0.311	301.0	93.6
Transportation	0.508	63.6	32.3
Waste Disposal	0.218	21.5	4.7
Water	0.029	228.3	6.6
Orchard, Nursery or Cranberry Bog	0.154	15.1	2.3
TOTAL		14334.9	2854.6
% of Sub-Watershed Impervious			19.9

impervious surface coefficients, estimates of the total amount of impervious surface within the watershed can be examined.

Rain water that flows overland or through storm drains and does not get absorbed into the ground is called stormwater or runoff and is a form of nonpoint source pollution. Stormwater is a leading source of water pollution. Common pollutants associated with stormwater include oil and grease (e.g., from vehicles, machinery, kitchen waste), heavy metals (e.g., from batteries, paints, pesticides), nutrients (e.g., fertilizers, animal waste), chemicals (e.g., from cleaning products, pesticides), sediment (e.g., from construction sites), litter (e.g., improperly disposed trash), and bacteria (from failing septic systems, animal waste). Impervious surface is an important factor in determining the quality and quantity of stormwater flowing within and between the different waterways in a watershed. As more area within a watershed is covered by surfaces that shed water rather than absorb it, the volume and velocity of stormwater runoff carrying pollutants to streams, ponds, lakes, and the ocean increases. Using impervious surface coverage to evaluate environmental impacts from stormwater offers a cost-effective and realistic approach because these surfaces can be measured, managed, and controlled (Sleavin et al. 2000).

According to a three-tier classification scheme suggested by Schueler (1994), land area with less than 10 percent impervious coverage is considered protected, 10 to 25 percent is considered impacted, and 25 percent or more is considered degraded. Considering the Weir River watershed as a whole, it would be classified as impacted. However, given the concentration of impervious coverage on the eastern side of the watershed, it is necessary to weigh the environmental impacts on a smaller scale. Much of the land area in Hull, for example, has surfaces greater than 30 percent impervious coverage, and should be considered as degraded.

Do biological or other data indicate impacts to the aquatic community due to hydrologic stress?

Yes. GZA (2000) used an interdisciplinary approach to investigate the availability of water in the watershed and the role of water in maintaining suitable aquatic habitat. Their water balance model suggests that during low flow and during years with average precipitation—even under undeveloped conditions—habitat conditions are sub-optimal during summer and early fall. It is therefore possible that the limiting conditions of a low flow period lead to a decline in fish populations even before development of the region.

Incorporating current and predicted levels of water withdrawals into the model indicates that streamflows are reduced throughout the watershed during years with average precipitation. The most considerable impact is on summertime streamflows, which in turn impacts aquatic habitat. During dry year scenarios, low flow effects are quite pronounced and habitat is severely impaired.

Are there current or expected water supply shortages in watershed communities?

Yes, there are sharp increases in water withdrawals in summer months, as noted in the GZA report (2002). From this report it is inferred that summertime shortages are largely driven by withdrawals for irrigation, but no specific study has been conducted to confirm this assumption.

From 1996 to 2002, total water withdrawals in the Weir River were 4.12 MGD. During this time, average daily demands in Hingham and Hull consistently approached or exceeded the reported safe system yield of 5.99 MGD. In the summer of 1999 and 2002, in particular, outdoor water use restrictions were implemented in Hingham and Hull. During these times, pond levels throughout the watershed were low and Accord Brook was dry in some reaches. Total average withdrawals from the watershed are anticipated to increase up to 4.63 MGD by 2020, but could go as high as 5.12 MGD (GZA 2000).

Do flooding or high flows cause problems for structures or aquatic life?

Yes, there have been some historic accounts of flooding in the Weir River just above Foundry Pond. In the 1950s, the Weir River above the pond was channelized and straightened in part because of the river's flooding. Unfortunately, during that time there were no environmental regulations to guide the channelization of the river and apparently a large amount of sediment was washed downstream and deposited in Foundry Pond. This pond has now been infilling and is scheduled to be dredged by the town in the future. There is a Hingham resident who lives upstream of Foundry Pond who has pointed to the infilling in the pond as one reason his property floods. Others have conjectured it is because the property lies within the floodplain.

As for the estuarine portion of the watershed, flooding does not pose serious problems. During large coastal storm events with storm surges, there is some flooding around the estuary but significant property damage has not been reported.

Is the watershed considered hydrologically stressed based on the WRC definition?

The Weir River watershed has not been evaluated by the Massachusetts Water Resources Commission, nor has it been monitored by USGS since 1971. The report prepared by GZA, however, concludes that the Weir River watershed is highly stressed.

Are NHESP listed habitats or BioMap habitats present in the watershed?

Yes, NHESP listed habitats and BioMap habitats are present in the watershed. The NHESP listed habitats include Living Waters Core Habitats, Living Waters Critical Supporting Watershed, Estimated Habitats for Rare Wildlife and Priority Habitats for State-Protected Rare Species. These listed habitats are located primarily on the eastern half of the Weir River watershed where a large portion of state-owned property exists. Priority habitat for state-protected rare species is also located in western, northern, and southern areas of the watershed.

NHESP BioMap core habitats, as well as BioMap supporting natural landscapes, are located in the eastern and southern areas of the Weir River sub-watershed. Similar to the NHESP listed habitat areas, BioMap habitat areas cluster around a large portion of state-owned property on the eastern boundary of the watershed. There is some overlap between NHESP listed habitat and BioMap habitat, but there are also areas that are only covered by one program.

In addition to habitats listed through Massachusetts programs, there is a significant amount of land within the watershed that is listed under the Massachusetts Resource Identification Program (MRIP). This program is a joint effort between the Region 1 Office of the USEPA and MassGIS to identify and protect the state's most vital natural resources. The watershed contains MRIP Contiguous Natural Lands, Riparian Corridors, and Natural Land Riparian Corridors.

At World's End, several rare species have been identified, including Showy goldenrod, Hickory Hairstreak, and Glossy Ibis (Lefebvre et al. 2002).

Are there other special habitat types in the watershed?

Yes, other special habitat types are present in the watershed. Anadromous fish are present, and some of their habitat has been protected through NHESP Living Waters Core Habitat identification. Other special habitat types include an area of critical environmental concern (ACEC) encompassing the mouth of the Weir River and its estuary. This Weir River estuary area is popular with outdoor sport enthusiasts as well as individuals interested in bird watching and other nature appreciation activities. In addition to the ACEC and anadromous fish habitat, there is a significant amount of contiguous forested areas and linked wetland areas, both salt and fresh, throughout the watershed.

There are numerous NHESP 2003 Certified Vernal Pools in the sub-watershed. In addition, there are many areas that are identified as potential sites for NHESP Certified Vernal Pools. As many as 200 bird species, 25 mammal species (including harbor seals), and 15 reptile/amphibian species are found in the vicinity of the Weir River (Town

of Hull 2000). Softshell clams, blue mussels, and surf clams are also in abundance and support an important commercial shellfish industry in Boston Harbor.

The Weir River watershed is home to a number of cold water fisheries. Both the Plymouth River and the Weir River are listed by the DFW on its 1999 list of springtime "trout stocked waters." In addition, a report prepared by GZA (2000) confirmed that the Weir River and Accord Brook support anadromous fish runs as far inland as Triphammer Pond, about 5 miles from the mouth of the Weir River. According to the report:

"A public fishery was established in the river by the legislature in 1805 on the basis of the smelt and alewife runs. The dams in the watershed have severely restricted the runs, but the fish ladders at Foundry Pond Dam and Triphammer Pond Dam are meant to make upstream fish passage possible. Fish sampling by the Massachusetts Division of Fisheries and Wildlife (DFW) in 1988 found Largemouth bass, Chain pickerel, Bluegill, Alewife, Black crappie, and Brown bullhead in Foundry Pond. The New England Aquarium sampled Triphammer Pond in the Fall of 1995 and found Largemouth bass, Bluegill sunfish, Pumpkinseed sunfish, Banded sunfish, Black crappie, Golden shiner, Chain pickerel, and Swamp darter. DFW reports from 1996 lists American eel and Redfin Pickerel as having been present in Accord Brook and American eel, Chain pickerel, Golden shiner, White sucker, Brown bullhead, Pumpkinseed sunfish, Bluegill sunfish, Smallmouth bass, Largemouth bass, and Yellow perch as having been found in Accord Pond. The DFW reports were included with a letter from DFW to the Hingham Conservation Commission which stated that Accord Brook, "probably sustained a wild brook trout population and possibly an alewife run before the area was developed.

Are wetland and vernal pool habitats healthy or degraded?

There is very little information available regarding the status of wetland and vernal pool habitats. The fact that significant acreage encompassing both wetlands and vernal pools is listed and/or protected through NHESP

Figure 86: Weir Floodplains and Vegetated Wetlands

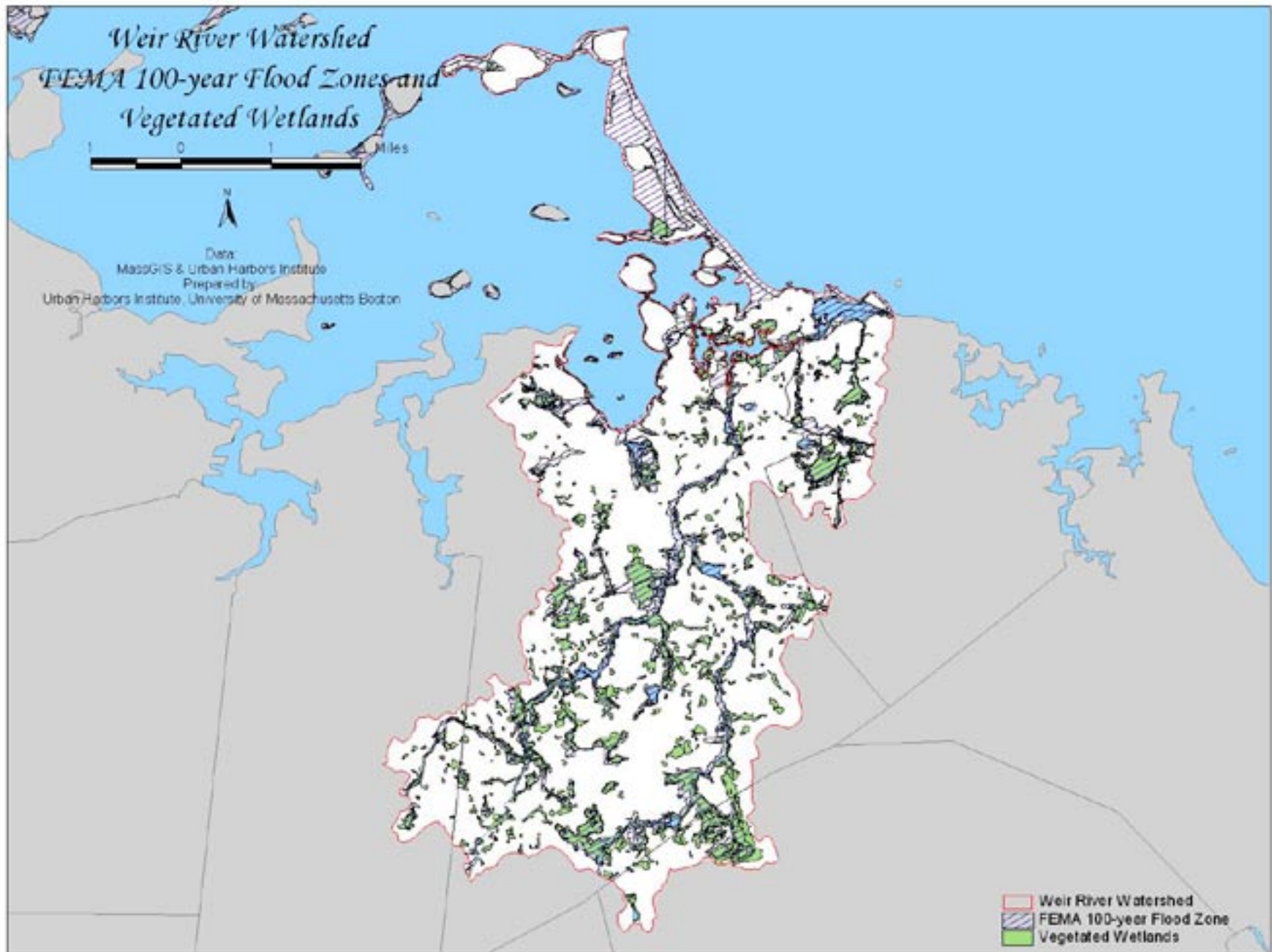


Figure 87: Weir Biomap Habitats

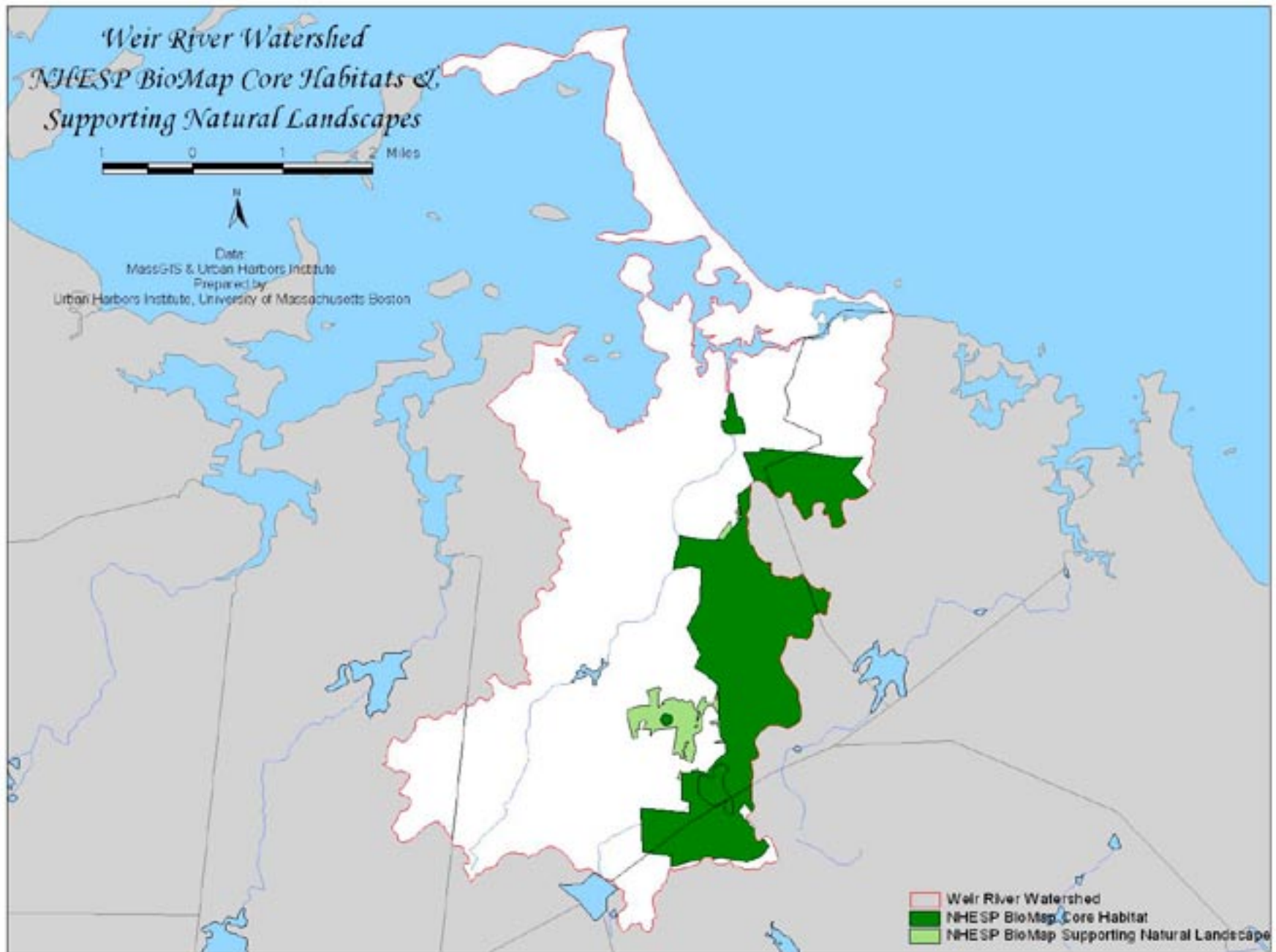


Figure 88: Weir Riparian Corridors and Contiguous Natural Lands

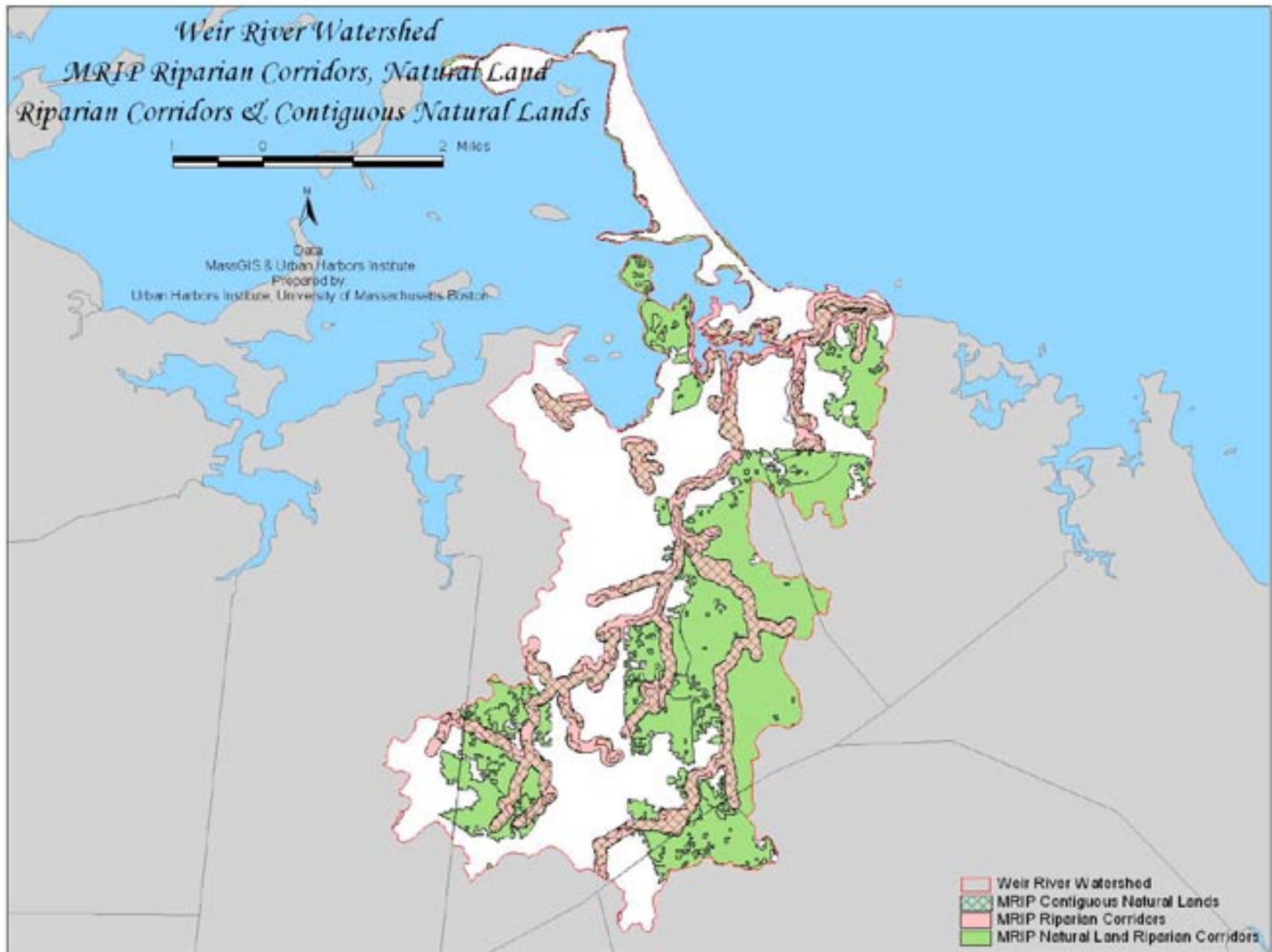


Figure 89: Weir Coastal and Vegetated Wetland Resource Areas

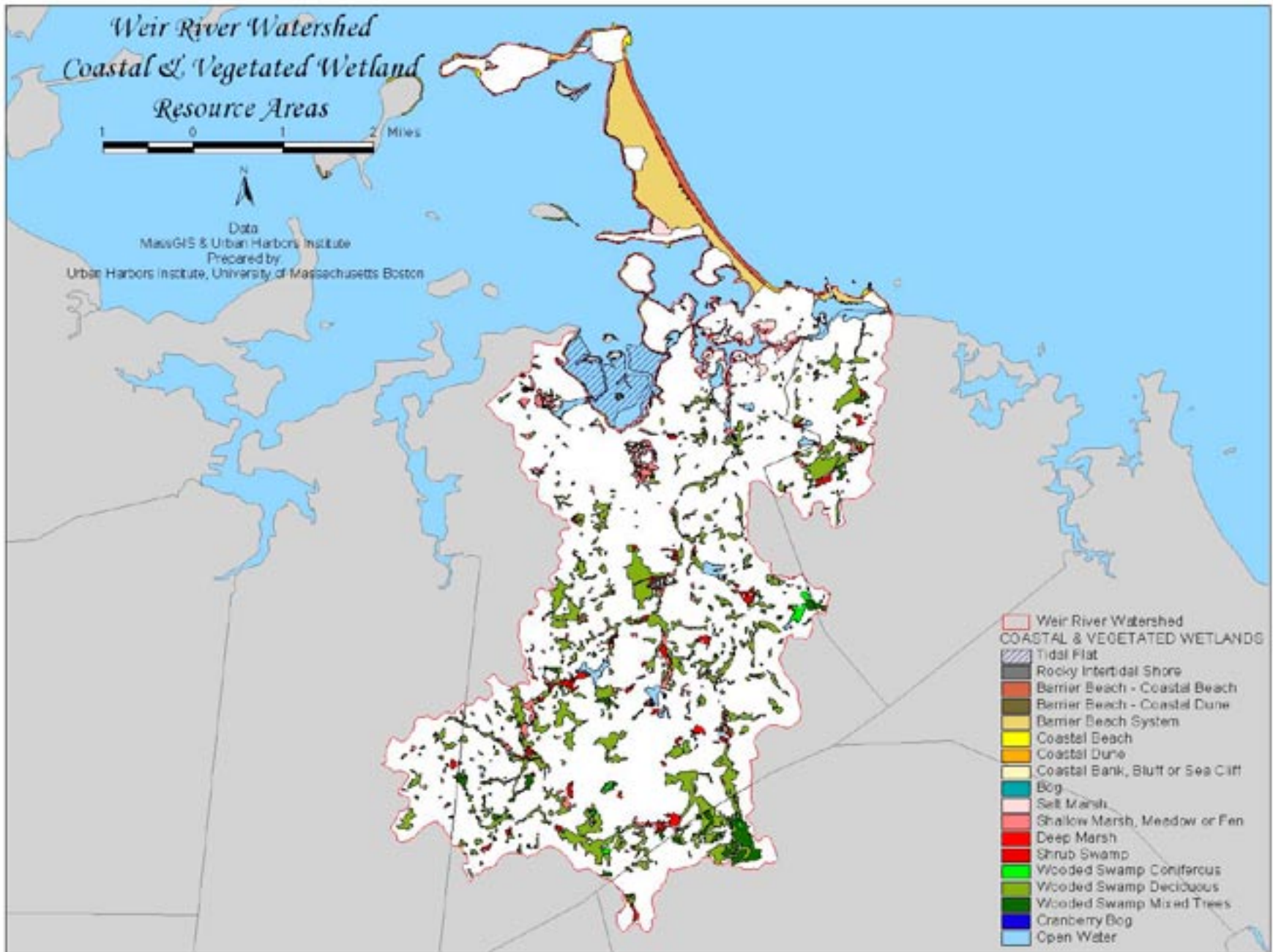


Figure 90: Weir Vernal Pools, ACECs, ORWs and Zone II

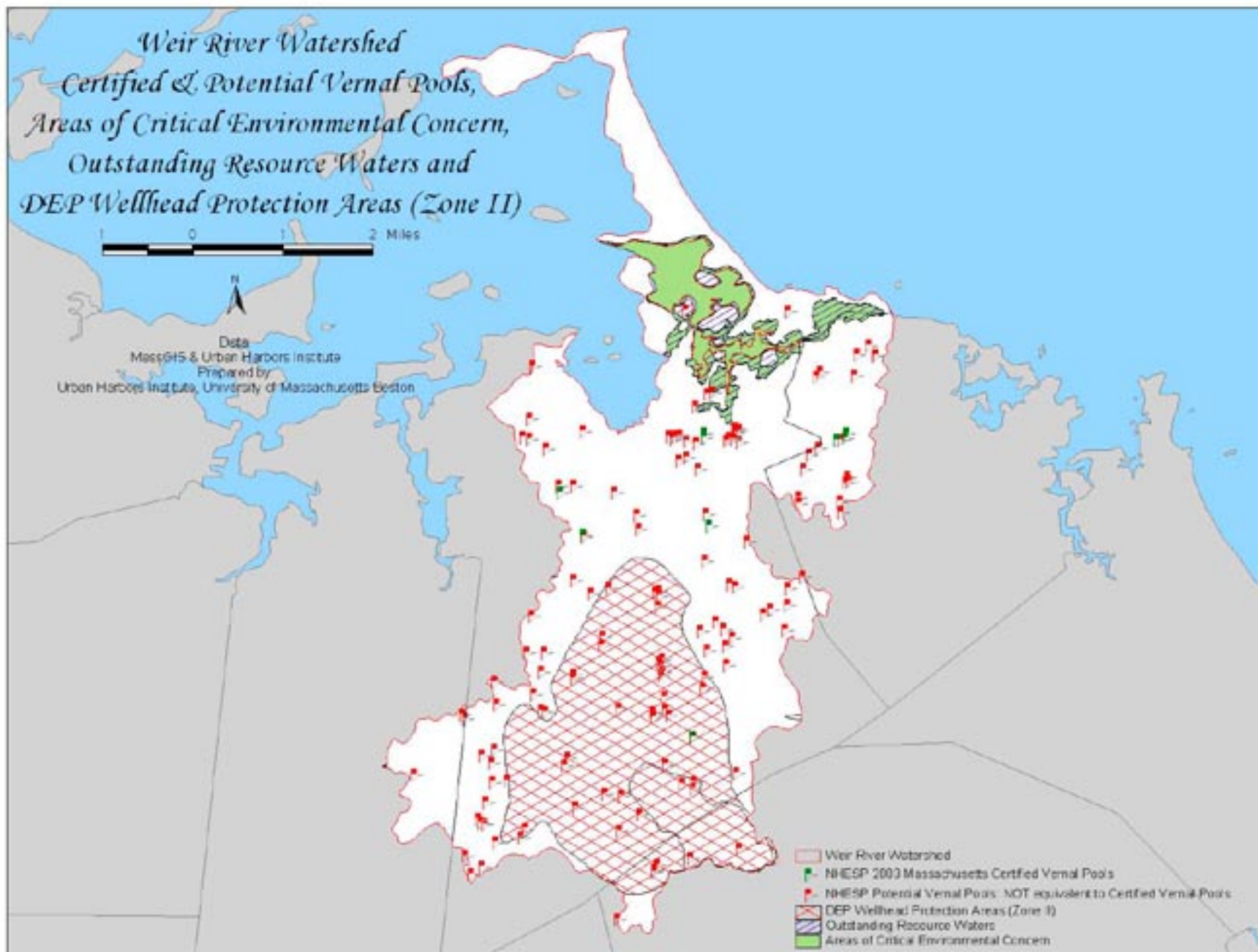


Figure 91: Weir Approximate DEP Regulated Wetlands

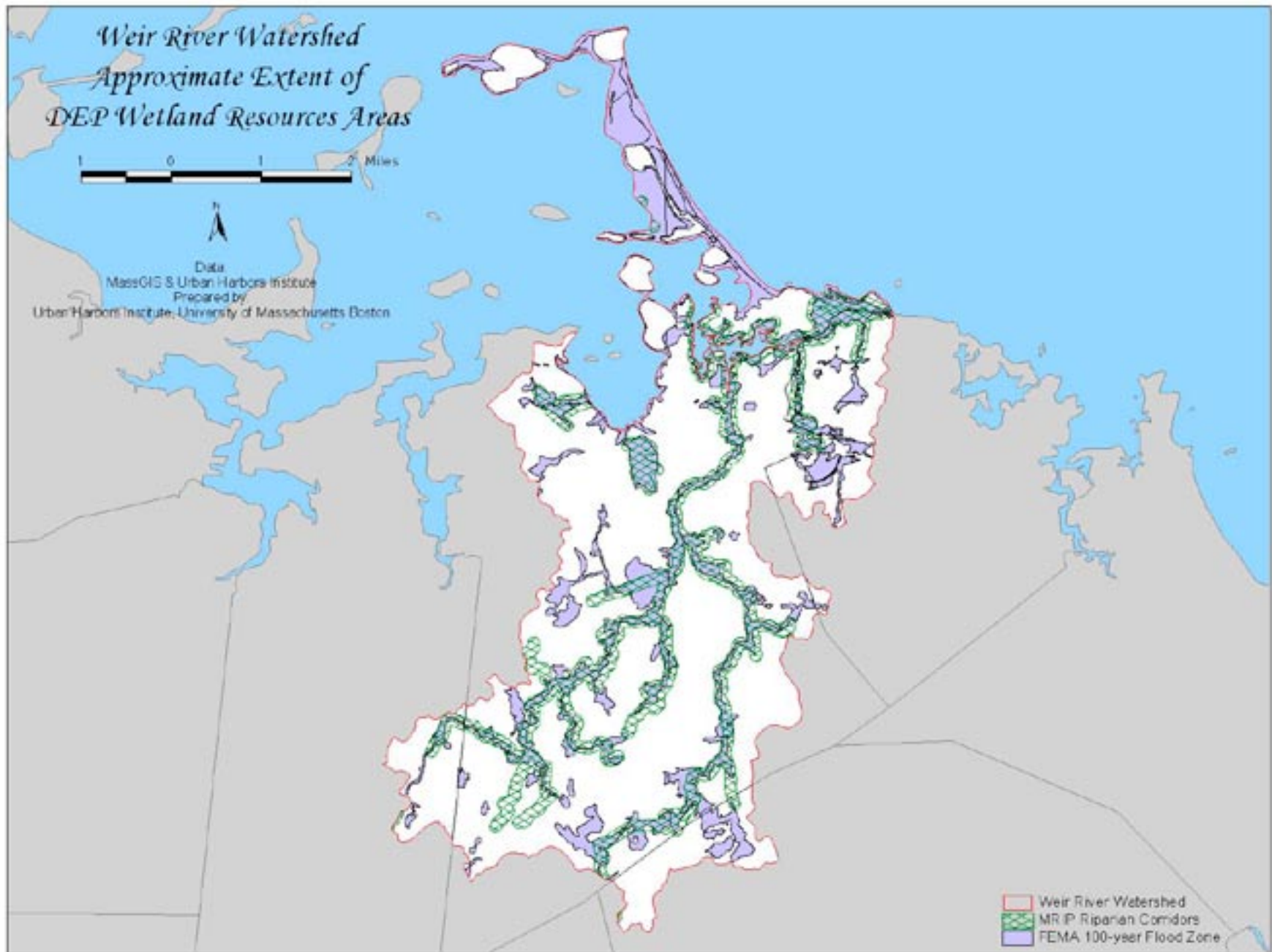
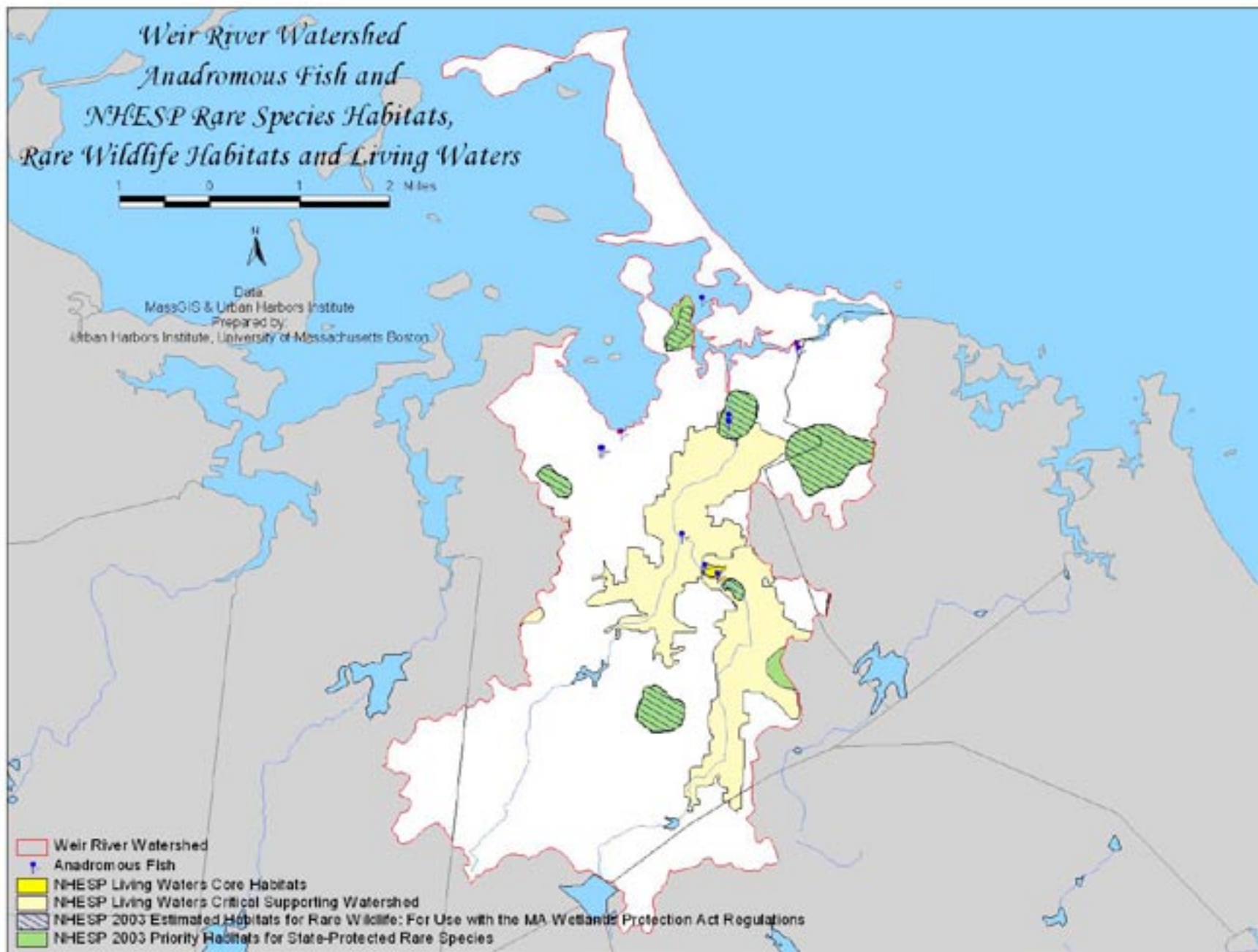


Figure 92: Weir Anadromous Fisheries and Rare Species Habitats



and other programs suggests that these areas are of a sufficient quality to provide important habitat. The land surrounding the Weir River is under pressure from development like so many South Shore areas, and is probably experiencing the stressors brought by increasing development and population density. Over time, this area will continue to experience development pressures, but there is an awareness of the importance of protecting, maintaining, and perhaps improving the habitat quality of both wetlands and vernal pools in the Weir River watershed.

Table 33: Land Use in the Weir River Watershed

Land Use Category	Total Acreage	Percent acreage
Cropland	97.9	0.7
Pasture	244.6	1.7
Forest	6019.3	42.0
Wetland	221.3	1.5
Mining	258.0	1.8
Open Land	263.8	1.8
Participation Recreation	457.4	3.2
Spectator Recreation	0.0	0.0
Water Based Recreation	83.4	0.6
Residential (Multi-family)	142.8	1.0
Residential (Smaller than 1/4 acre lots)	674.6	4.7
Residential (1/4 - 1/2 acre lots)	2603.2	18.2
Residential (Larger than 1/2 acre lots)	2005.8	14.0
Salt Wetland	168.9	1.2
Commercial	348.2	2.4
Industrial	116.1	0.8
Urban Open	301.0	2.1
Transportation	63.6	0.4
Waste Disposal	21.5	0.2
Water	228.3	1.6
Orchard, Nursery or Cranberry Bog	15.1	0.1
TOTAL	14334.9	100

There are a number of large shellfishing areas at the mouth of the Weir River and near the Weir River estuary. The 2002 Weir River ACEC Natural Resource Inventory notes that these beds are often closed due to bacterial contamination. Consistent closings for the past several years suggest that the estuary, wetlands, and waters of the Weir River watershed are somewhat degraded. The sources of this degradation have not been specifically identified beyond increasing development.

Overall, studies of habitat quality and the impact of development on the watershed in its entirety need to be conducted. The Weir River ACEC Natural Resources Inventory of 2002 states that plans are underway for the restoration of the Damde Meadows salt marsh on the World’s End property.

Are invasive species a significant threat to upland, wetland or aquatic habitats?

There is limited information available regarding the threat posed by invasive species to upland, wetland, or aquatic habitats. However, the 2002 Weir River ACEC Natural Resource Inventory notes that invasive species such as *Phragmites australis* do pose a threat to the complex salt marsh ecosystem protected by the Weir River ACEC by replacing native vegetation and therefore altering the habitat for fish and wildlife. This inventory further notes that *Phragmites* exists along the shores of the Weir River; however no studies have been implemented to determine if they are spreading.

Throughout the region, impediments such as structures, low water, contaminated sediments, and channel alterations impact aquatic habitats. Structures and low water can block spawning runs of anadromous fish. Altered flushing patterns and contaminated sediments can also harm other aquatic species.

What percentage of the watershed is “built-out?”

The Weir River Watershed is comprised of approximately 14,500 acres. Table 31 presents the acreage of each town, acreage of the town in the Weir river watershed, the percentage of the town in the watershed, and the percent each town is of the watershed.

Figure 93: Weir Land Use

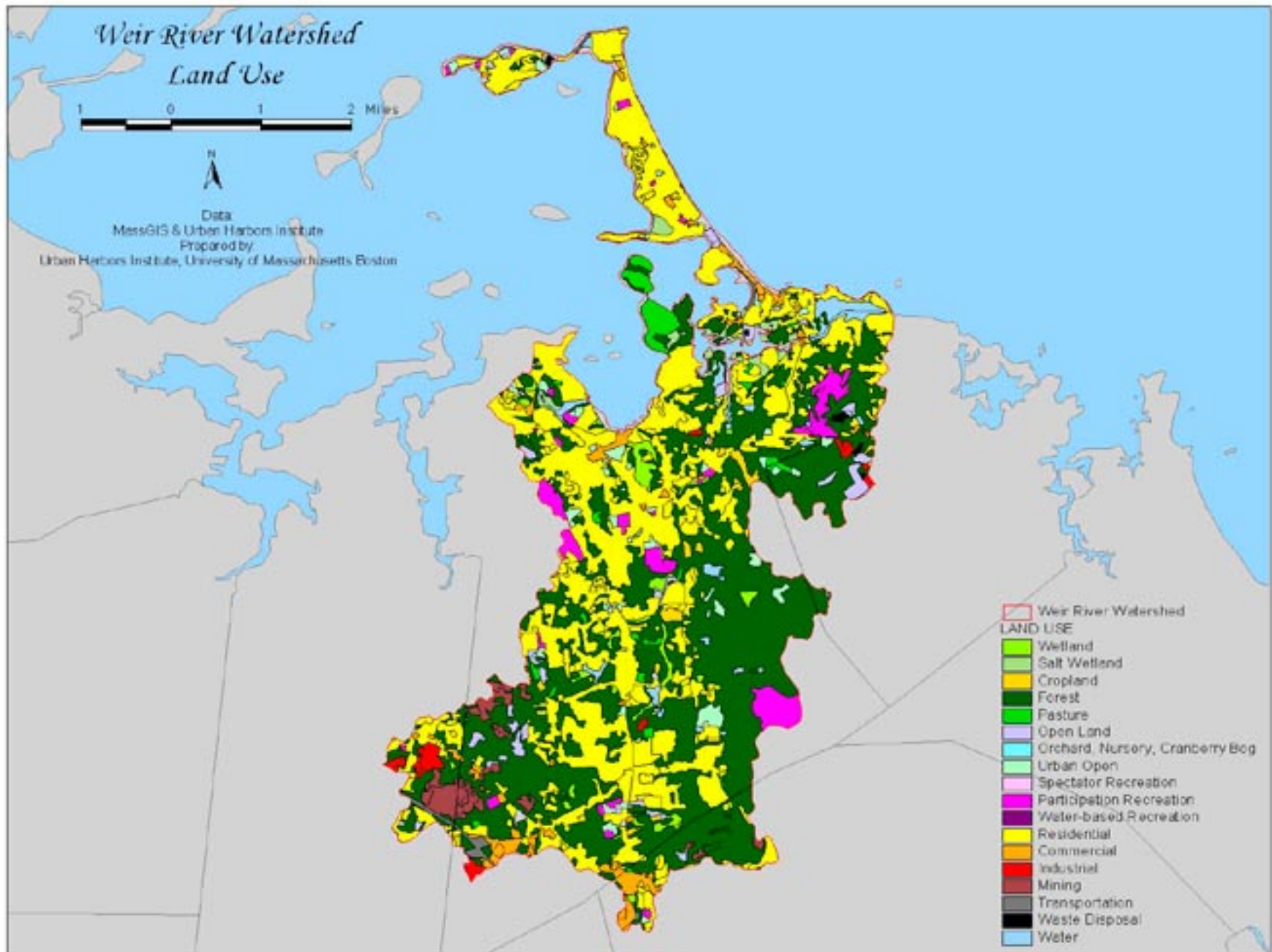


Figure 94: Weir Contaminated Sites

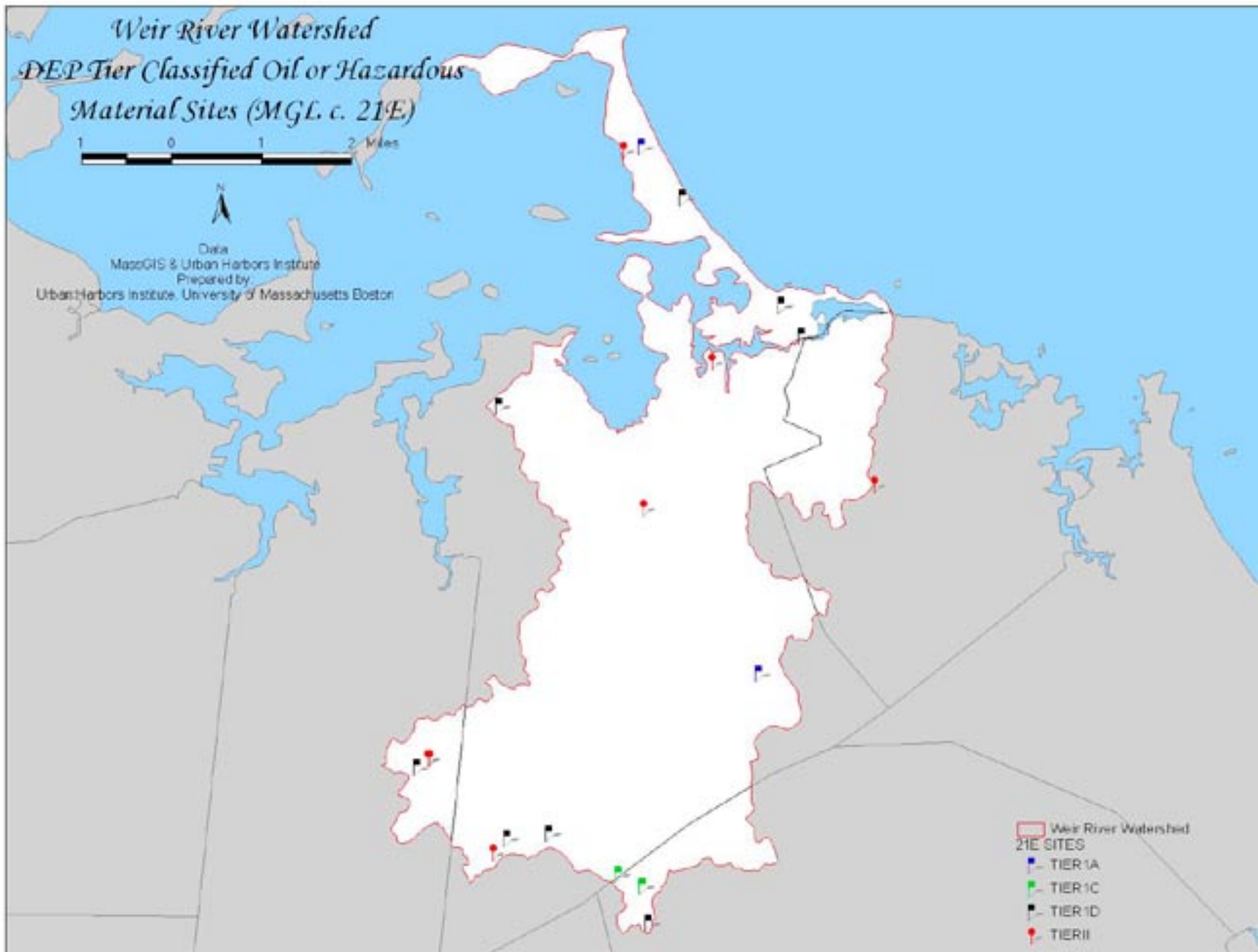
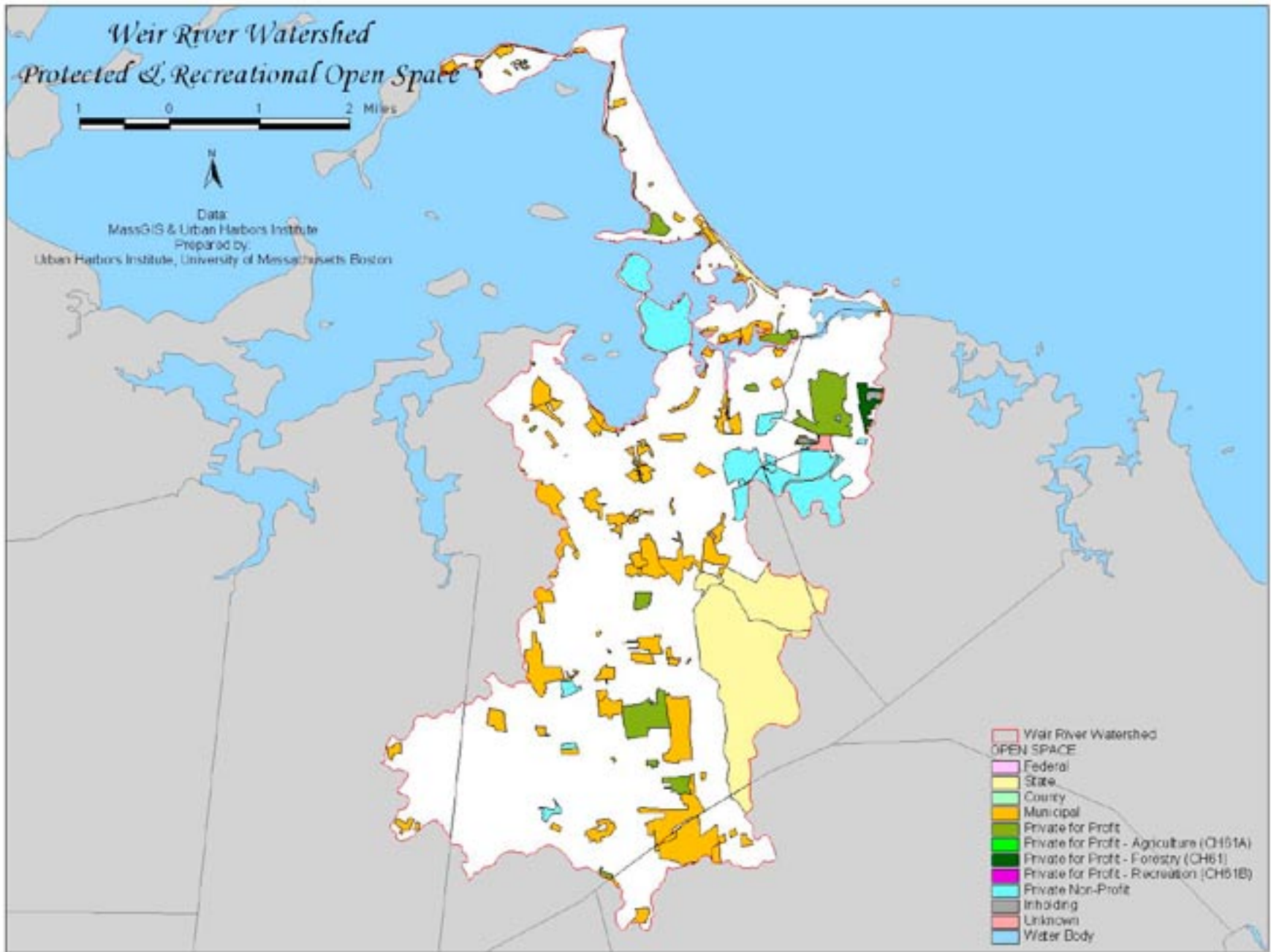


Figure 95: Weir Open Space



As can be seen in Table 33, nearly one-half (42 percent) of the watershed is forested. The only other significant category of land use is residential, at almost 40 percent.

Available land use and open space data are aggregated by, and build-out information is computed for, entire municipalities. Therefore, the following sections characterizing current and projected land use and population are based on data from towns whose land areas are entirely or predominantly in the watershed. For the Weir River watershed, this is Hingham and Hull.

Are there significant brownfields or opportunities for redevelopment in the watershed?

The former Margetts & Son Septic Lagoons property is a 5.31 acres property located in Hingham. From 1925 until 1981, the lagoons on the property were used for disposal of raw septage and waste cutting oil. The former lagoons have subsequently been covered with 15 feet of soil and granite. The Massachusetts Department of Environmental Protection identified the site as class A3. Class A3 indicates that a permanent solution has been achieved, that contamination has not been reduced to background levels and that limitations have been implemented on use of the property.

What are the major trends in population, land use, transportation and water needs?

The population for the two towns referenced above grew from 30,287 in 1990 to 30,932 in 2000, an increase of approximately 2 percent.

There are an additional 2,112 acres of developable land in the two towns according to the EOEAs build-out figures. Based on the formulas used by EOEAs for its build-out analysis for these two towns, the increase in population at build-out would be 4,235, for a total growth of 14 percent.

The build-out analysis projects an additional 1,592 residential units and 2,601,264 square feet of additional commercial/industrial buildable floor area.

This increase in population and development translates to an additional demand for water of 525,507 gallons/day and additional solid waste produced of 2,173 tons/yr. The ‘build-out’ conditions would produce an additional 20 miles of roadway.

Table 34: Weir Additional Population at Buildout vs. Year 2000 (EOEA)

Town	Population Increase	Percentage
Hull	727	
Hingham	3,508	
Total	4,235	14%

What % of the watershed’s area is currently comprised of permanently protected open space?

Twenty-eight percent of the watershed (3,964 acres) is comprised of “protected and recreational open space”. 69% of this open space is owned by some level of government. Twelve percent is owned by private for-profits and eighteen percent by private non-profits.

How much land is still undeveloped (and not protected)?

Approximately 4, 137 acres of land in the watershed is undeveloped.

How rapidly is open space being lost?

As noted above, the population grew by two percent from 1990 to 2000 in Hingham and Hull. EOEAs buildout analysis indicates that there is further potential for 14 percent population growth.

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