CHARLES RIVER WATERSHED
2002-2006 WATER QUALITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS
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Division of Watershed Management

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Division of Watershed Management
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- Bureau of Waste Site Cleanup (BWSC)

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- Division of Marine Fisheries (DMF)

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Cover photo credit: Charles River at Dean Street in Millis Massachusetts, Susan Connors, MassDEP.

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LIST OF ACRONYMS AND ABBREVIATIONS

7Q10 ..... seven day, ten year low flow	MA DFG ..... Massachusetts Department of Fish and Game
ACOE ..... Army Corps of Engineers (United States)	MA DPH ..... Massachusetts Department of Public Health
BMP ..... best management practice	MassGIS ..... Massachusetts Geographic Information System
BPJ ..... best professional judgment	MS4 ..... Municipal Separate Stormwater System
BWSC ..... Bureau of Waste Site Cleanup	MWRA ..... Massachusetts Water Resources Authority
CMR ..... Code of Massachusetts Regulations	NAS/NAE .... National Academy of Sciences/National Academy of Engineering
CNOEC ..... chronic no observed effect concentration	NAWQA ..... National Water-Quality Assessment Program
CPR ..... Coastal Pollution Remediation Grant Program	NCCW ..... non-contact cooling water
CRWA ..... Charles River Watershed Association	NPDES ..... National Pollutant Discharge Elimination System
CSO ..... combined sewer overflow	NPS ..... non-point source pollution
CWA ..... Clean Water Act	PAH ..... polycyclic aromatic hydrocarbon
DDD ..... dichlorodiphenyldichloroethane	PCB ..... polychlorinated biphenyls
DDE ..... dichlorodiphenyldichloroethylene	RBP ..... rapid bioassessment protocol
DDT ..... dichlorodiphenyltrichloroethane	QAPP ..... quality assurance project plan
DO ..... dissolved oxygen	S-EL ..... severe effect level
DPW ..... Department of Public Works	SWQS ..... Surface Water Quality Standards
DWM ..... Division of Watershed Management	TIE/TRE ..... toxicity identification evaluation/toxicity reduction evaluation
EOEEA ..... Executive Office of Energy and Environmental Affairs	TMDL ..... total maximum daily load
EPA ..... United States Environmental Protection Agency	TOXTD ..... MassDEP DWM Toxicity Testing Database
EPT ..... Ephemeroptera, Plecoptera, and Tricoptera	USFWS ..... United States Fish and Wildlife Service
FPOM ..... fine particulate organic matter	USGS ..... United States Geological Survey
LC_{50} ..... lethal concentration to 50% of the test organisms	WBS ..... Waterbody System database
L-EL ..... low effect level	WMA ..... Water Management Act
MA DCR ..... Massachusetts Department of Conservation and Recreation	WWTP ..... wastewater treatment plant
MassDEP ..... Massachusetts Department of Environmental Protection	

LIST OF UNITS

cfs ..... cubic feet per second	MW ..... megawatt
cfu ..... colony forming unit	NTU ..... nephelometric turbidity units
fps ..... foot per second	ppb ..... parts per billion
MG ..... million gallons	ppm ..... parts per million
MGD ..... million gallons per day	ppt ..... parts per thousand
m ..... meters	SU ..... standard units
ml ..... milliliters	µS/cm ..... micro seimens per centimeter
mg/L ..... milligram per liter	

COMMON AND SCIENTIFIC NAMES OF FISHES IN THE CHARLES RIVER WATERSHED

alewife	Alosa pseudoharengus	fallfish	*Semotilus corporalis*
American eel	*Anguilla rostrata*	golden shiner	*Notemigonus crysoleucas*
American shad	*Alosa sapidissima*	largemouth bass	*Micropterus salmoides*
Atlantic tomcod	*Microgadus tomcod*	pumpkinseed	*Lepomis gibbosus*
black crappie	*Pomoxis nigromaculatus*	rainbow smelt	*Osmerus mordax*
blueback herring	*Alosa aestivalis*	rainbow trout	*Oncorhynchus mykiss*
bluegill	*Lepomis macrochirus*	redbreast sunfish	*Lepomis auritus*
brook trout	*Salvelinus fontinalis*	redfin pickerel	*Esox americanus*
brown bullhead	*Ameiurus nebulosus*	smallmouth bass	*Micropterus dolomieu*
brown trout	*Salmo trutta*	striped bass	*Morone saxatilis*
chain pickerel	*Esox niger*	white perch	*Morone americana*
common carp	*Cyprinus carpio*	white sucker	*Catostomus commersonii*
common shiner	*Luxilus cornutus*	yellow bullhead	*Ameiurus natalis*
creek chubsucker	*Erimyzon oblongus*	yellow perch	*Perca flavescens*
fallfish	*Semotilus corporalis*		

EXECUTIVE SUMMARY
CHARLES RIVER WATERSHED 2002-2006 WATER QUALITY ASSESSMENT REPORT

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which surface waters in the state shall be protected. The assessment of current water quality conditions is a key step in the successful implementation of the Watershed Approach. This critical phase provides an assessment of whether or not the designated uses are supported or impaired or are not assessed, as well as basic information needed to focus resource protection and remediation activities later in the watershed management planning process.

This report presents a summary of current water quality data/information in the Charles River Watershed used to assess the status of the designated uses as defined in the SWQS. The designated uses, where applicable, include: *Aquatic Life, Fish Consumption, Drinking Water, Primary* and *Secondary Contact Recreation* and *Aesthetics*. Each use, within a given segment, is individually assessed as ***support*** or ***impaired***. When too little current data/information exists or no reliable data are available the use is ***not assessed***. However, if there is some indication of water quality impairment, which is not "naturally-occurring", the use is identified with an "Alert Status". It is important to note that not all waters are assessed. Many small and/or unnamed rivers, lakes, and estuarine areas have never been assessed; the status of their designated uses has never been reported to the EPA in the Commonwealth's Summary of Water Quality Report (305(b) Report) nor is information on these waters maintained in the Waterbody System (WBS) or the new Assessment Database (ADB). These are considered ***not assessed other waters***.

The summary of the assessments for the *Aquatic Life, Fish Consumption, Primary* and *Secondary Contact Recreation,* and *Aesthetics* uses in the Charles River Watershed segments are illustrated in Figures 1 through 5, respectively. Where sufficient data/current information were not available, the uses were not assessed.

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Aquatic Life Use Assessments

Rivers
(total length included in report - 164.5 miles)
Support - 33.9 miles (21%)
Impaired - 123.9 miles (75%)
Not Assessed - 6.7 miles (4%)

Lakes
(total area included in report - 2,826 acres)
Support - 49 acres (2%)
Impaired - 1,198 acres (42%)
Not Assessed - 1,579 acres (56%)

See main report for segment specific detail on river segment causes and sources of impairment.

CAUSES:
barriers to fish passage
biological indicators of organic and/or nutrient enrichment
elevated chlorophyll a
elevated total phosphorus concentrations
elevated water temperature
excess algal growth
habitat quality degredation (siltation/sedimentation, culverting/channelization, sediment contamination, sediment toxicity, loss of riparian vegetative cover)
high pH
low dissolved oxygen or high dissolved oxygen saturation
low flow or other flow regime alterations
moderately impacted benthic community
non-native aquatic species infestation
relative absence of fluvial specialists/dependant fish species
poor Secchi disk transparency
poor survival P. promelas
salinity

SOURCES:
changes in ordinary stratification and bottom water hypoxia/anoxia
discharges from municipal separate storm sewer systems, urban stormwater runoff, wet weather discharges (point source and combination of stormwater, SSO or CSO)
entrainment from cooling water intake structure
golf course
habitat alteration associated with dams/impoundments, flow regime alterations, water diversions
habitat modification (channelization/culverting, sediment contamination, loss of riparian habitat, post development erosion and sedimentation)
habitat modification from thermal discharge
introduction of non-native species
municipal NPDES discharges
nonpoint sources of pollution
unknown
upstream sources of pollution

Lake Archer (MA72002)
Beaver Pond (MA72006)
Dug Pond (MA72034)
Factory Pond (MA72037)
Hardys Pond (MA72045)
Lymans Pond (MA72070)
Morses Pond (MA72079)
Noannet Pond (MA72084)
Nonesuch Pond (MA72085)
Scarboro Golf Course Pond (MA72107)
Lake Waban (MA72125)
Lake Winthrop (MA72140)
IMPAIRED
Cause: Non-native aquatic macrophyte
Source: Introduction of non-native macrophyte

Chandler Pond (MA72017)
IMPAIRED
Causes: Non-native aquatic macrophyte infestation, biological indicators of nutrient enrichment, elevated total phosphorus, excessive algal growth
Sources: Introduction of non-native macrophyte, unknown

Jamaica Pond (MA72052)
IMPAIRED
Causes: Low dissolved oxygen, elevated total phosphorus,
Source: Internal nutrient (phosphorus) recycling

Populatic Pond (MA72096)
IMPAIRED
Causes: Low dissolved oxygen, biological indicators of nutrient/eutrophication, excess algal growth, and high DO saturation
Sources: Municipal NPDES discharge in upstream segment, internal nutrient recycling

Mirror Lake (MA72078)
IMPAIRED
Causes: Non-native aquatic macrophyte, biological indicators of nutrient enrichment, elevated total phosphorus
Sources: Introduction of non-native organism, unknown

Lake Pearl (MA72092)
Uncas Pond (MA72122)
Cedar Swamp Pond (MA72016)
IMPAIRED
Causes: Non-native aquatic macrophyte, low dissolved oxygen
Sources: Introduction of non-native macrophyte, unknown

LEXINGTON
LINCOLN
ARLINGTON
BELMONT
SOMERVILLE
CAMBRIDGE
WALTHAM
WATERTOWN
WAYLAND
WESTON
BOSTON
NEWTON
BROOKLINE
WELLESLEY
NATICK
NEEDHAM
DEDHAM
ASHLAND
SHERBORN
DOVER
WESTWOOD
HOPKINTON
HOLLISTON
MEDFIELD
MILLIS
MILFORD
MEDWAY
WALPOLE
HOPEDALE
NORFOLK
MENDON
FRANKLIN
BELLINGHAM
FOXBOROUGH
WRENTHAM

LEGEND
Support
Impaired
Not Assessed
Never been assessed
Town Boundaries
Watershed Outline
Lake Label Key: ### = MA72###

5 0 5 10 Miles

Figure 1. *Aquatic Life Use* assessment summary for rivers and lake segments in the Charles River Watershed.
Note: The *Aquatic Life Use* is supported when suitable habitat (including water quality) is available for sustaining a native, naturally diverse, community of aquatic flora and fauna. Impairment of the *Aquatic Life Use* may result from anthropogenic stressors that include point and/or non-point source(s) of pollution and hydrologic modification. Causes and/or sources of impairments, when known, are noted in the callouts.

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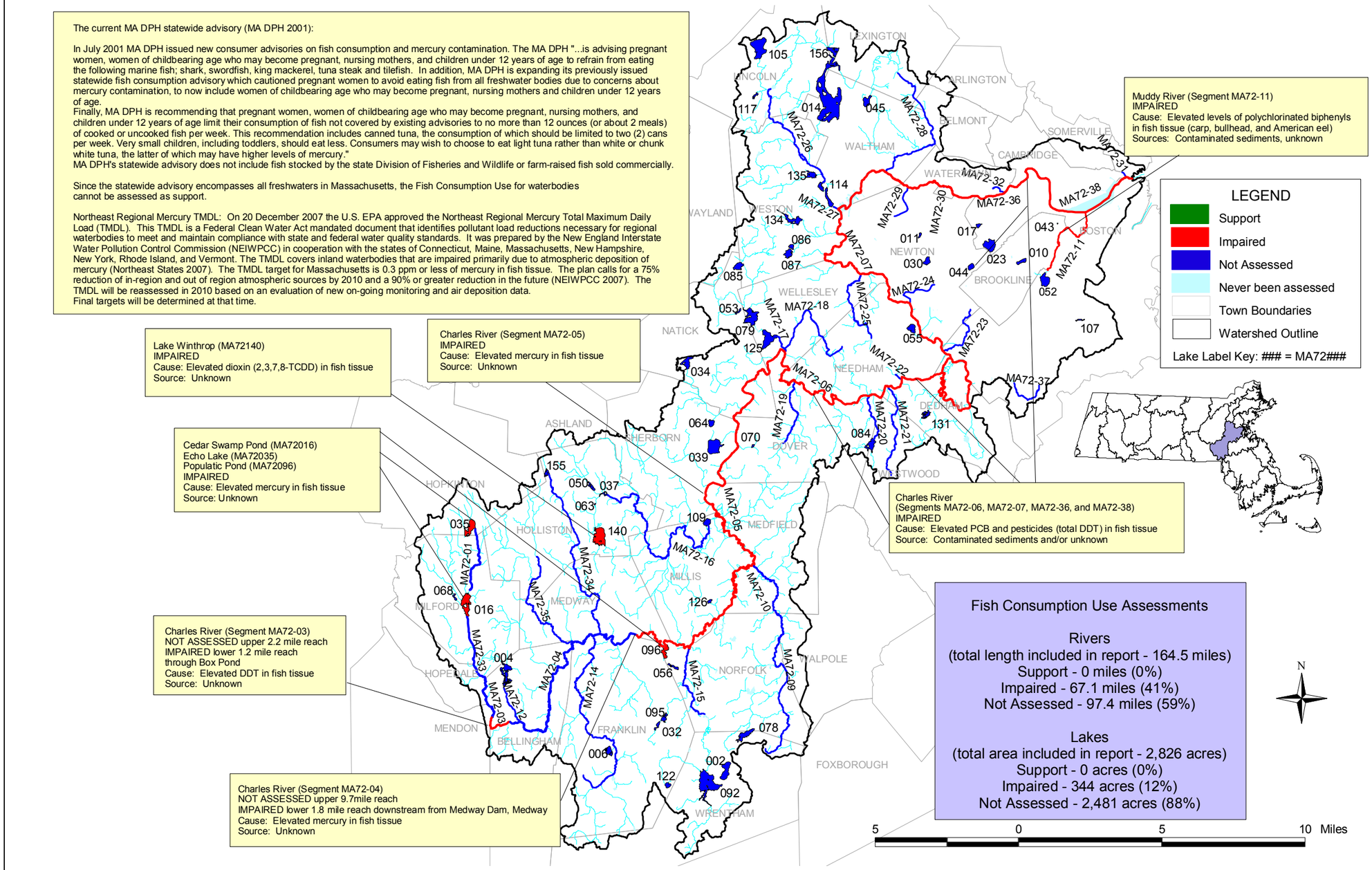

Figure 2. *Fish Consumption Use* assessment summary for rivers and lake segments in the Charles River Watershed.
Note: The *Fish Consumption Use* is supported when there are no pollutants present that result in unacceptable concentrations in edible portions (as opposed to whole fish - see *Aquatic Life Use*) of fish, other aquatic life or wildlife for human consumption. The assessment of the *Fish Consumption Use* is made using the most recent list of Fish Consumption Advisories issued by the Massachusetts Executive Office of Health and Human Services, Department of Public Health (MA DPH), Bureau of Environmental Health Assessment (MA DPH 2007). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption; hence, the *Fish Consumption Use* is assessed as impaired in these waters. In July 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination (MA DPH 2001). Because of these statewide advisories no waters can be assessed as support for the *Fish Consumption Use*. These waters default to "not assessed". Causes and/or sources of impairments, when known, are noted in the callouts.

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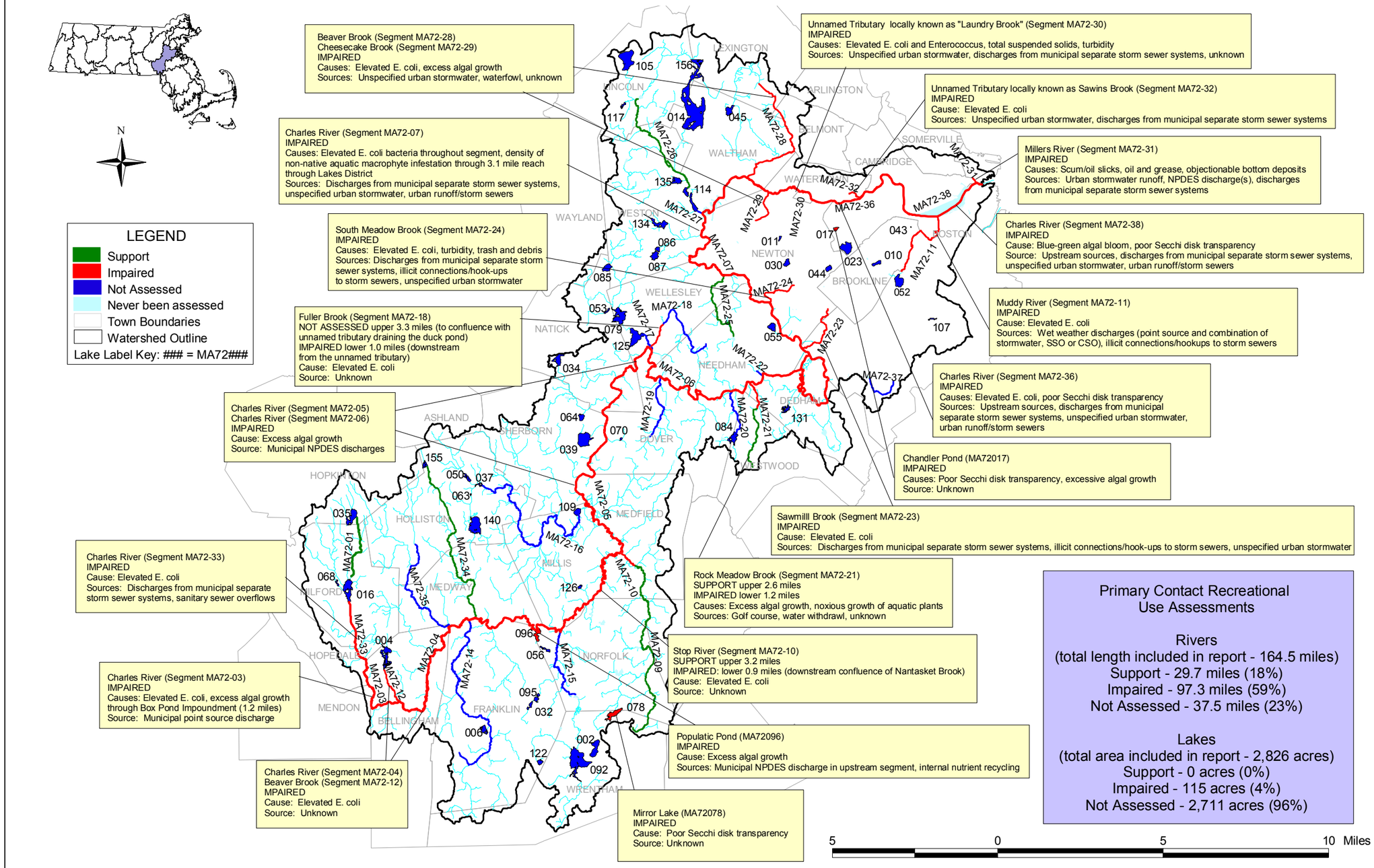

Figure 3. *Primary Contact Recreational Use* assessment summary for rivers and lake segments in the Charles River Watershed.
Note: The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, turbidity and aesthetics meet the SWQS and/or the MA DPH Bathing Beaches State Sanitary Code and/or guidance) for any recreational or other water related activity during which there is prolonged and intimate contact with the water and there exists a significant risk of ingestion. Activities include, but are not limited to, wading, swimming, diving, surfing and water skiing. Causes and/or sources of impairments, when known, are noted in the callouts.

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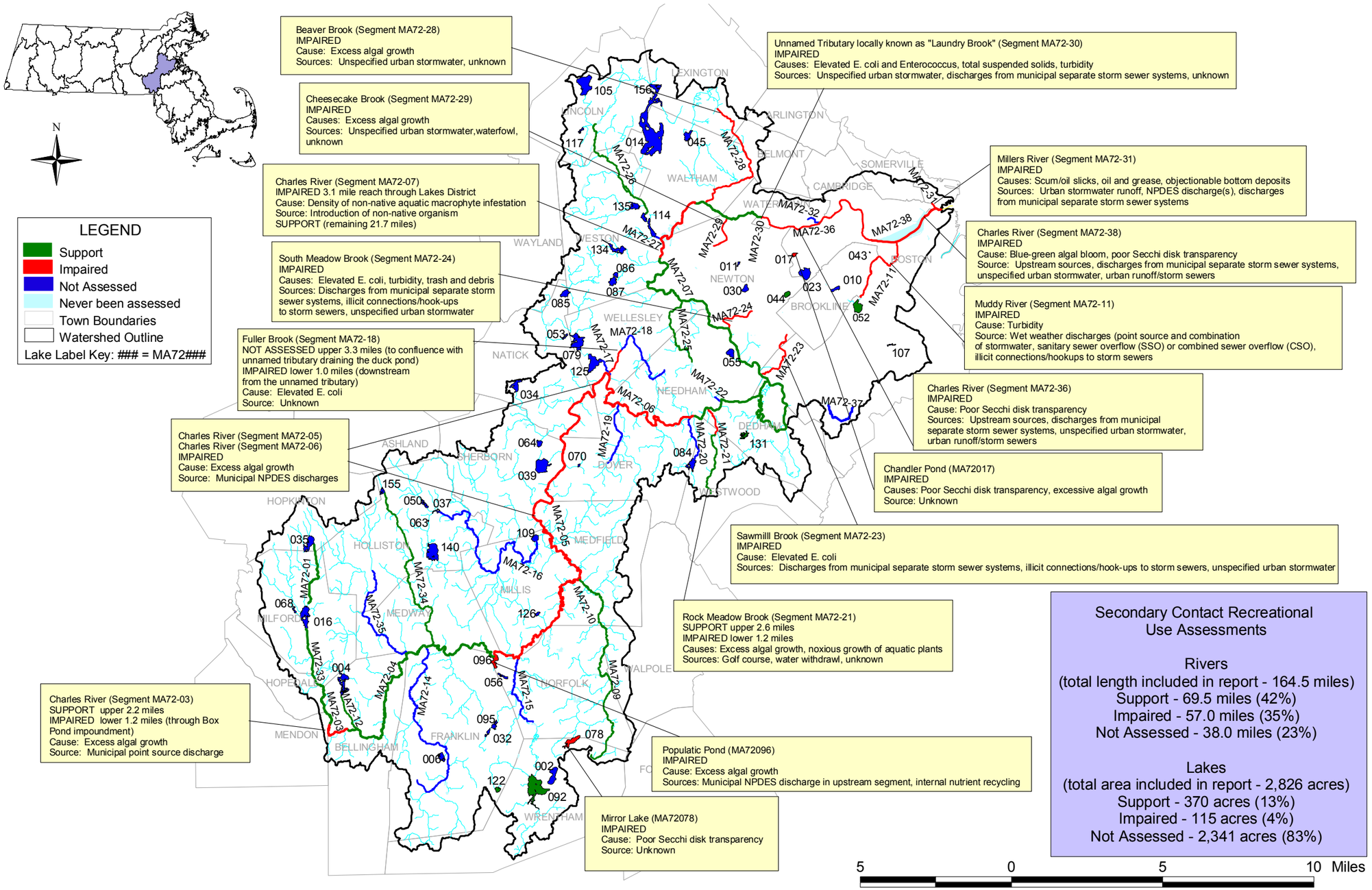

Figure 4. *Secondary Contact Recreational Use* assessment summary for rivers and lake segments in the Charles River Watershed.
Note: The *Secondary Contact Recreational Use* is supported when conditions are suitable for any recreational or other water use during which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact related to shoreline activities. For lakes, non-native aquatic macrophyte cover and/or transparency data (Secchi disk depth) are evaluated to assess the status of the recreational uses. Causes and/or sources of impairments, when known, are noted in the callouts.

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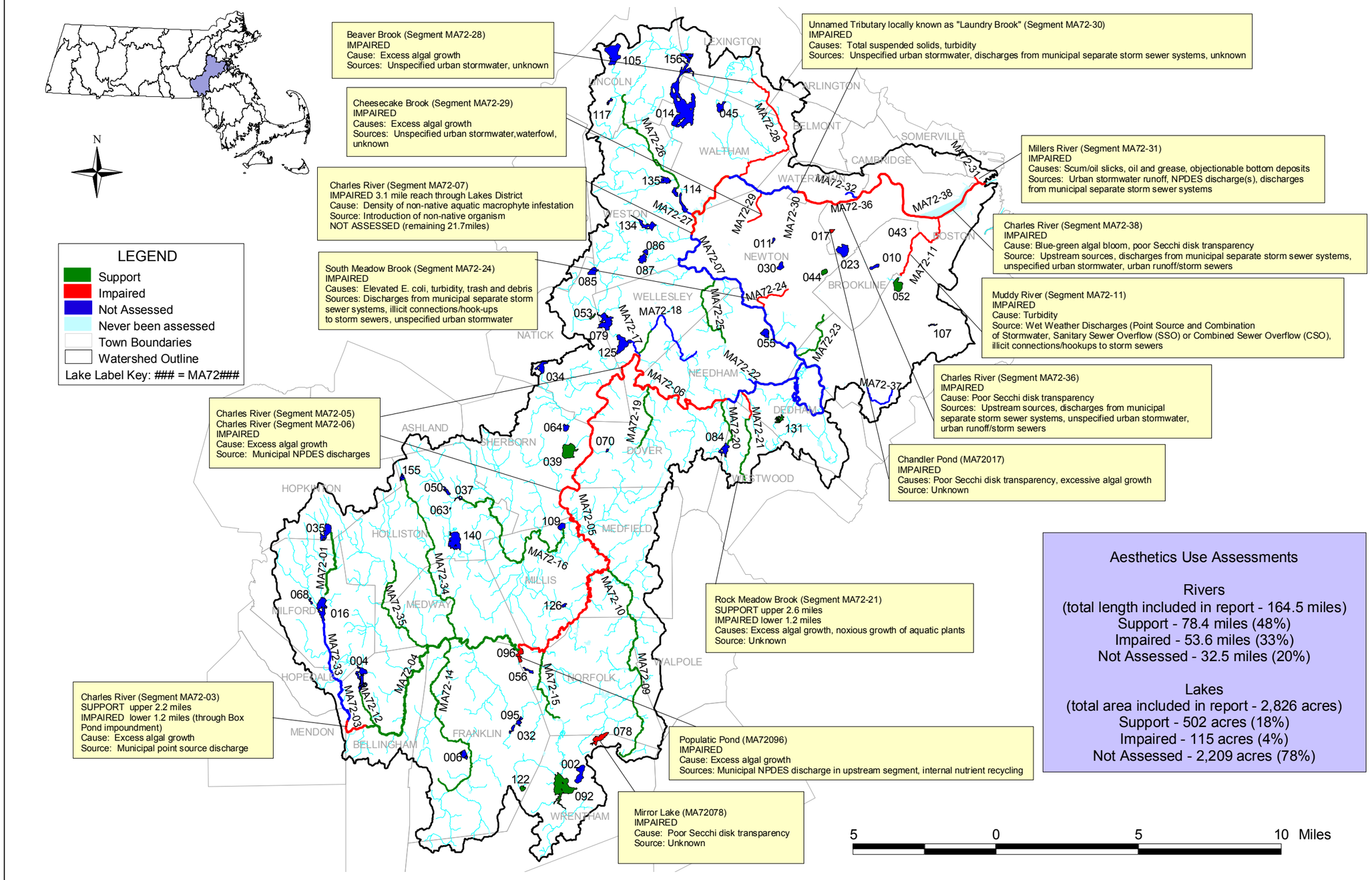

Figure 5. *Aesthetics Use* assessment summary for rivers and lake segments in the Charles River Watershed.
Note: The *Aesthetics Use* is supported when surface waters are free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life. Causes and/or sources of impairments, when known, are noted in the callouts.

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INTRODUCTION

The goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). To meet this objective, the CWA requires states to develop information on the quality of the Nation's water resources and report this information to the U.S. Environmental Protection Agency (EPA), the U.S. Congress, and the public. Together, these agencies are responsible for implementation of the CWA mandates. Under Section 305(b) of the Federal Clean Water Act, every two years MassDEP must submit a statewide report which describes the status of water quality in the Commonwealth to the EPA. Until 2002 this was accomplished as a statewide summary of water quality (the 305(b) Report). States are also required to submit, under Section 303(d) of the CWA, a list of impaired waters requiring a total maximum daily load (TMDL) calculation. In 2002, however, EPA required the states to combine elements of the statewide 305(b) Report and the Section 303(d) List of Impaired Waters into one "Integrated List of Waters" (Integrated List). This statewide list is based on the compilation of information for the Commonwealth's 27 watersheds. Massachusetts has opted to write individual watershed surface water quality assessment reports and use them as the supporting documentation for the Integrated List. The assessment reports utilize data compiled from a variety of sources and provide an evaluation of water quality, progress made towards maintaining and restoring water quality, and the extent to which problems remain at the watershed level. Quality assured in-stream biological, habitat, physical/chemical, toxicity data and other information are evaluated to assess the status of water quality conditions. This analysis follows a standardized process described in Appendix A (Assessment Methodology) of this report.

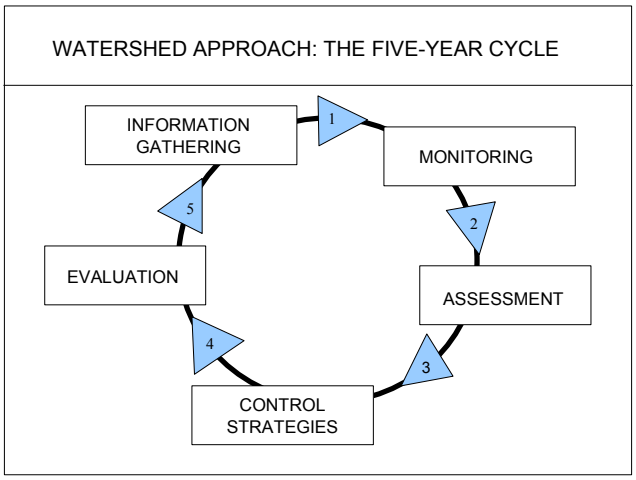


Figure 6. Five-year cycle of the Watershed Approach

This report presents the current assessment of water quality conditions in the Charles River Watershed. The assessments are based on information researched and developed by the Massachusetts Department of Environmental Protection (MassDEP) through the first three years (information gathering, monitoring, and assessment) of the five-year cycle (Figure 6) as well as more recent data collected in the watershed in partial fulfillment of MassDEP's federal mandate to report on the status of the Commonwealth's waters under the CWA. Specifically, water quality monitoring data collected by MassDEP Division of Watershed Management staff primarily in 2002 as well as 2003 through 2006 were utilized to make assessment decisions. All of these data are provided as Appendices to this report. Other sources of water quality data (see Acknowledgements) used to make use assessment attainment decisions are also provided.

MASSACHUSETTS INTEGRATED LIST OF WATERS

Section 305(b) of the CWA defines the process whereby states monitor and assess the quality of their surface and groundwater and report on the status of those waters every two years. Section 303(d) of the CWA requires states to periodically identify and list those waterbodies for which existing controls on point and nonpoint sources of pollutants are not stringent enough to attain or maintain compliance with applicable surface water quality standards. Through the year 2000 the MassDEP fulfilled the 305(b) and 303(d) reporting requirements in two completely separate documents. In 2001 the EPA released guidance that provided states with the option of preparing a single Integrated List of Waters to be submitted that would meet the reporting requirements of both sections 305(b) and 303(d) of the CWA.

The Massachusetts Year 2006 Integrated List of Waters was approved by the EPA in September 2007 (MassDEP 2007). In that report each waterbody segment was placed in one of five major categories. Category 1 included those waters that were meeting all designated uses. No Massachusetts waters were listed in Category 1 because a statewide health advisory pertaining to the consumption of fish precludes any waters from being in full support of the fish consumption use. Waters listed in Category 2 were found to support some of the uses for which they were assessed but other uses were unassessed. Category 3 contained those waters for which insufficient or no information was available to assess any uses.

Waters exhibiting impairment for one or more uses were placed in either Category 4 (impaired but not requiring a TMDL) or Category 5 (impaired and requiring one or more TMDLs) according to the EPA guidance. Category 4 was further divided into three sub-categories – 4A, 4B and 4C – depending upon the reason that TMDLs were not needed. Category 4A included waters for which the required TMDL(s) had already been completed and approved by the EPA. However, since segments could only appear in one-category waters that had an approved TMDL for some pollutants, but not others, remained in Category 5. Category 4B was to include waters for which other pollution control requirements were reasonably expected to result in the attainment of the designated use before the next listing cycle (i.e., 2008). Because of the uncertainty related to making predictions about conditions in the future the MassDEP made a decision not to utilize Category 4B in the 2006 Integrated List. Finally, waters impaired by factors, such as flow modification or habitat alteration, that are not subjected to TMDL calculations because the impairment is not related to one or more pollutants were included in Category 4C. See individual segment assessments for information pertaining to the 2006 Integrated List category and causes of impairment.

CHARLES RIVER WATERSHED DESCRIPTION

The Charles River Watershed is geographically and economically a vital part of the largest employment and population complex in New England. The watershed contains all or portions of five cities and thirty towns. The Charles River Watershed (Figure 7) has an hourglass shape, which encompasses 310 square miles. The Charles River is the longest river in Massachusetts, meandering in a generally northeasterly direction approximately 80 miles from its headwaters to its mouth in Boston Harbor.

The terrain in the upper Charles River Watershed is generally gently rolling to hilly with the highest altitudes approaching 500 feet. The Charles River begins as a spring on the southerly slope of Honey Hill about a mile from Hopkinton Center. One mile downstream and nearly 150 feet lower is Echo Lake, often referred to as the source of the Charles. The Charles River meanders through extensive wetland areas, which border the river through much of its course. There are two natural valley storage areas in the upper and middle sections of the watershed, the so-called "marshes" of the upper Charles and the "Dedham Loop", respectively. The Mother Brook Diversion, originally constructed for hydropower, is also capable of diverting up to one-third the flow of the Charles to the Neponset River for the current flood control use. While the many dams along the mainstem Charles River account for much of its gradient change, they also alter the natural flow of the river and hinder or obstruct fish passage. The lower third of the watershed area is densely populated and intensively developed except for several major public or semi-public reservations.

OBJECTIVES

This report summarizes information generated in the Charles River Watersheds since the last water quality assessment report that was published in February 2000 (Fiorentino *et al.* 2000). The methodology used to assess the status of water quality conditions of rivers, estuaries and lakes in accordance with EPA's and MassDEP's use assessment methods is provided in Appendix A. Data collected by DWM in 2002 are provided in Appendices B through G of this report. Appendix H provides a summary of Water Management Act (WMA) registration/permit holders and National Pollutant Discharge Elimination System (NPDES) permittees in the Charles River Watershed. Appendix I is a technical memorandum "*Review of water temperature data from the Lower Basin of the Charles River, 2003-2005."*

Not all waters in the Charles River Watershed are included in the MassDEP/EPA databases (either the waterbody system database -- WBS, or the newer assessment database – ADB) or this report.

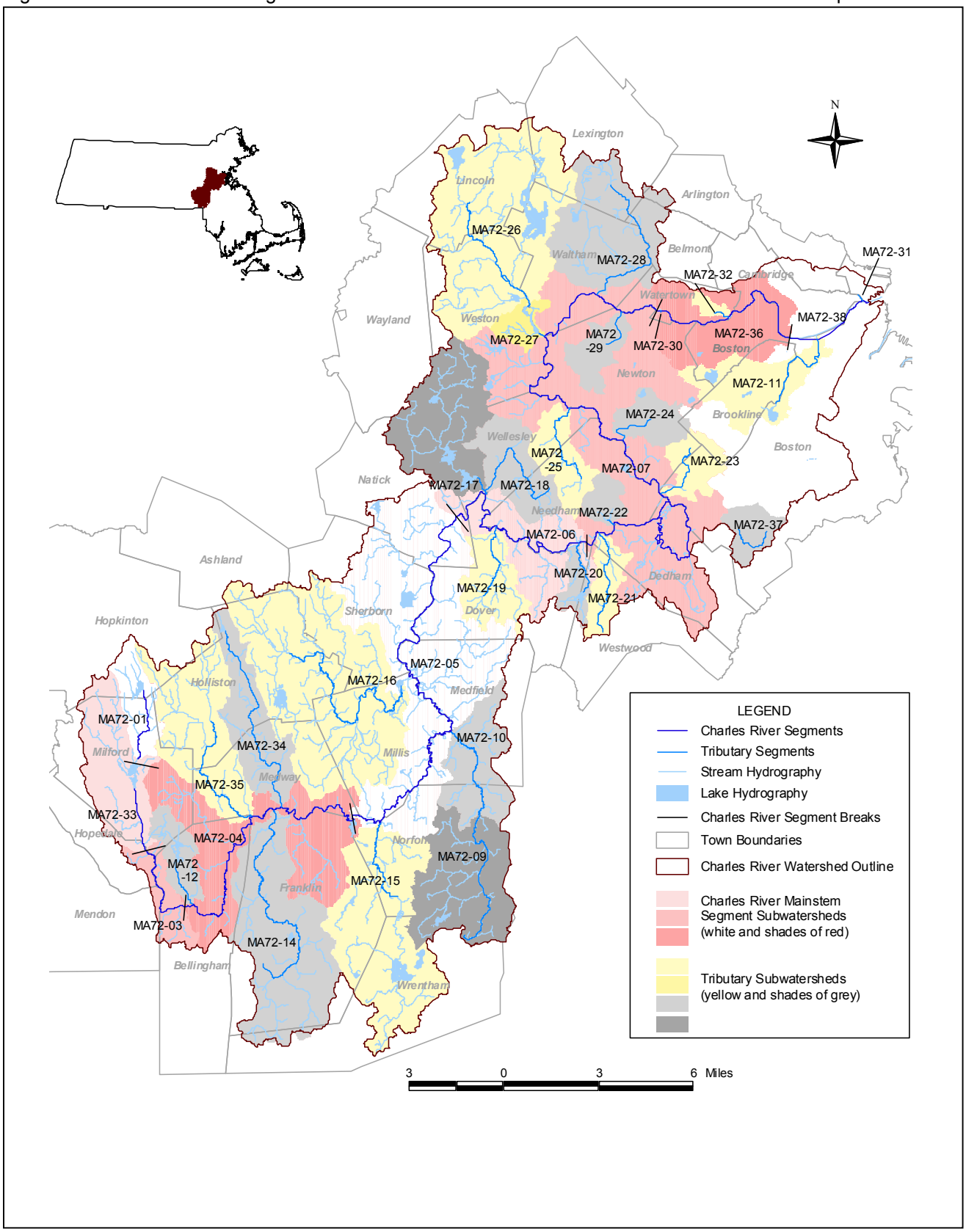
The objectives of this water quality assessment report are as follows.

1. evaluate whether or not surface waters in the Charles River Watershed, defined as segments in the MassDEP/EPA databases, currently support their designated uses (i.e., meet surface water quality standards),
2. identify water withdrawals (habitat quality/water quantity) and/or major point (e.g., wastewater discharges, storm sewer system) and non-point (e.g., land-use practices, overland runoff, etc.) sources of pollution that may impair water quality conditions,
3. identify the presence or absence of any non-native macrophytes in lakes,
4. identify waters (or segments) of concern that require additional data to fully assess water quality conditions,
5. recommend additional monitoring needs and/or remediation actions in order to better determine the level of impairment or to improve/restore water quality, and
6. provide information for the development of an action plan.

Land use estimates provided for each segment were generated using the MassGIS Land Use datalayer: interpreted from 1:25,000 aerial photography taken in 1999 and with the most recent updates made in January of 2002 (MassGIS 2002).

CHARLES RIVER WATERSHED RIVER SEGMENT ASSESSMENTS

Figure 7 illustrates the river segments in the Charles River Watershed that are included in this report.



CHARLES RIVER (SEGMENT MA72-01)
Location: Headwaters, outlet Echo Lake, Hopkinton, to Dilla Street (just upstream from Cedar Swamp Pond), Milford.
Segment Length: 2.5 miles
Classification: Class A.

Land-use estimates (top 3, excluding water) for the 3.4 mi^2 subwatershed.
- Forest..... 68%
- Residential..... 19%
- Open land 3%

The estimated percent impervious area for this subwatershed is 7.5%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients, flow alteration, and pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Milford Water Department registration/permit (22018501/9P22018501).

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Although no Quality Assurance Project Plan (QAPP) was approved for this project, CRWA staff completed habitat assessments of the Charles River downstream from Echo Lake on three occasions: 26 October 2001, 15 May 2002, and 15 July 2002 (CRWA 2002). Habitat quality was limited most by low flow conditions encountered during the fall and summer sampling events (poor velocity/depth regimes, limited channel flow status and limited riffle habitat).

CRWA volunteers were not able to sample the Charles River downstream from Echo Lake (Station 00CS) as part of the Upper Charles River Watershed TMDL Project because of the lack of flow (CRWA 2004a). The river was also dry on all four sampling dates (August 13 and October 16, 17, and 18 2002) at Cedar Street (Station 12CS) (CRWA 2004a).

MassDEP DWM personnel observed severely diminished water levels over the outlet structure for Wildcat Pond during the July, August and September 2002 survey dates. Low flow (sometimes discontinuous puddling) at DWM Station CR72.1, downstream from Wildcat Pond, was evident during the July, August and September surveys. Additionally, the riverbed was completely dry in the vicinity of Route 85 in Milford during field reconnaissance in September 2001 and again in late summer 2002.

Water Chemistry
MassDEP DWM conducted water quality monitoring in this segment of the Charles River downstream from Wildcat Pond (Station CR72.1) between April and September 2002 (Appendix B). Dissolved oxygen measurements violated SWQS for the July, August and September sampling dates (pre- and post-dawn).

The *Aquatic Life Use* for this segment of the Charles River is assessed as impaired based on the low dissolved oxygen concentrations (SWQS violations) and the lack of streamflow for frequent and prolonged periods of time. The impacts are due to flow regime modification at the dams/impoundments (sampling sites downstream from both dams had little to no water). These conditions are likely exacerbated by water supply withdrawals/manipulations.

Primary and Secondary Contact Recreation and Aesthetics Uses
MassDEP DWM conducted bacteria monitoring in this segment of the Charles River downstream from Wildcat Pond (Station CR72.1) on five dates between April and September 2002 (Appendix B, Table 4). None of the fecal coliform bacteria, *E. coli* or *Enterococcus* sp. results violated criteria. Field observations were also made on 14 dates between April and September 2002 at Station CR72.1. On occasion aesthetically objectionable conditions were recorded (e.g., rust floc, turbidity, surface scum), but for the majority of the sample period the reach was free from odors, turbidity, scums, objectionable deposits and nuisance growths.

The *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based on the bacteria data and the absence of objectionable conditions (i.e., conditions observed were neither frequent nor prolonged).

Charles River (MA72-01) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low dissolved oxygen, low flow alterations, and other flow regime alterations Sources: Flow alterations from water diversions, dams/impoundments
Fish Consumption		NOT ASSESSED
Drinking Water*		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS

Milford Water Department should evaluate their ability to maintain downstream releases in this section of the Charles River, while also meeting their drinking water needs.

CHARLES RIVER (SEGMENT MA72-33)
Location: Outlet Cedar Swamp Pond, Milford, to the Milford WWTF discharge, Hopedale.
Segment Length: 2.0 miles
Classification: Class B, Aquatic Life.

Land-use estimates (top 3, excluding water) for the 11.75 mi^2 subwatershed.
Forest..... 41%
Residential 40%
Open land 7%
The estimated percent impervious area for this subwatershed area is 15.5%.

Note: This segment was formerly part of Segment MA72-02 and was shortened to exclude Cedar Swamp Pond (MA72016). Segment MA72-02 is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of metals, nutrients, organic enrichment/low DO, noxious aquatic plants, pathogens, and other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Milford Water Department registration/permit (22018501/9P22018501).
NPDES (See Appendix H, Tables H2 and H4)
A.J. Knott & Mfg. Co (MA0031127) permit was terminated by EPA in October 2005.
Saint-Gobain Containers, L.L.C. (MAG250911)

USE ASSESSMENT
Aquatic Life Use
Biology
Milford Power Limited Partnership was required to conduct biological monitoring in the Charles River as part of their Sewer Extension Permit. To fulfill this monitoring requirement, multiplate samplers were deployed by ENSR personnel in the Charles River just south of Howard Street, Milford, between 6 August and 27 September 2001 and again between 22 August and 14 October 2002 (ENSR 2002 and ENSR 2003). The isopod *Caecidotea* sp. and the amphipod *Hyalella* sp. were the two most abundant macroinvertebrate taxa, comprising 26% and 22% of the total sample, respectively, in 2001 (Fiorentino 2006). These taxa are known to thrive in areas of very poor water quality. Both taxa are highly tolerant of organic pollutants and are able to withstand prolonged periods of reduced oxygen levels. They are opportunistic in their feeding tendencies and mainly act as gathering-collectors--foraging on deposited forms of organic matter. The limpet Ancylidae represented the third most abundant taxon. An algal grazer (scraper), its presence suggests a well-established benthic algae community in this portion of the river. These ancylids are most likely *Laevapex fuscus* (based on past collections in the watershed by MassDEP), which also display a fairly high tolerance of organic pollution. Samples collected in 2002 were codominanted by *Caecidotea* sp. and Ancylidae, while the pollution tolerant midge *Dicrotendipes* sp. and snail *Physella* sp. (another gathering-collector) were slightly less abundant (ENSR 2003 and Fiorentino 2006).

ENSR personnel also collected fish from this segment of the Charles River (ENSR 2002). Eight species of fish (n=52) were collected on 5 September 2001 at two sampling locations in this segment of the Charles River (near Howard Street and just upstream from the Milford WWTP discharge) (ENSR 2002). Only two of these species (common shiner - *Luxilus cornutus* and white sucker - *Catostomus commersonii*, n=8 individuals) are classified as fluvial. Overall sampling efficiencies were poor due to thick growth of aquatic macrophytes and highly turbid conditions (ENSR 2002). Fish population and benthic sampling has since been dropped from the monitoring program because of poor sampling efficiencies and habitat quality differences upstream and downstream from the diversion.

Toxicity
Ambient
The Milford WWTP staff collected water from the Charles River upstream from the effluent channel for use as dilution water in the facility's whole effluent toxicity tests. In six test events, January 2006 through April 2007, survival of *C. dubia* exposed (approximately 7 days) to the Charles River water was $\geq$90% (n=5). River water hardness ranged from 40 to 93 mg/L.

Water Chemistry (Use *Class C* DO and temperature criteria because segment is classified "Aquatic Life"). CRWA volunteers sampled a total of three locations along this segment of the Charles River as part of their Upper Charles River Watershed TMDL Project or their monthly monitoring project (CRWA 2004a, CRWA 2004b, CRWA 2006, and CRWA 2007). TMDL sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16, 17, and 18 October 2002 and 19, 20, and 21 October 2004 (CRWA 2004a and CRWA 2006). None of the data collected represent worst-case (predawn) sampling.

From upstream to downstream the CRWA sampling locations are as follows.

Downstream from Cedar Swamp Pond at the Fino Field footbridge (Station 31CS) (TMDL project), near the Central Street Bridge in Milford (Station 35CS) (monthly sampling), and upstream from Howard Street (Station 48CS) (TMDL project).

DO was extremely low (0.86 and 2.31 mg/L) in the river downstream from Cedar Swamp Pond at the Fino Field footbridge (Station 31CS) on both dry weather sampling occasions (24 August 2005 and 15 August 2002, respectively) but was above 5.0 mg/L on all other sampling events (CRWA 2004a and CRWA 2006). Other water quality data reported by CRWA was indicative of good conditions.

The CRWA collected monthly water quality data from the river near the Central Street Bridge in Milford (Station 35CS) (CRWA 2007). These data included analytes such as ammonia-nitrogen, pH, temperature, nutrients, and chlorophyll *a*. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 are summarized below. None of the temperature measurements (n=62) taken between February 2000 and October 2006 exceeded 28.3°C (maximum measurement was 25°C in August 2006). A total of 23 pH measurements were taken between February 2000 and April 2002. Four measurements were slightly low (6.4 SU). Between February 2000 and December 2003 total suspended solids concentrations ranged from <2 to 31 mg/L (n=40) and only two samples were >25 mg/L. A total of 24 total phosphorus and ammonia-nitrogen samples were collected between March 2000 and December 2006. Of these six total phosphorus samples were above 0.05 mg/L (maximum concentration 0.24 mg/L) while the maximum ammonia-nitrogen concentration was 0.6 mg/L (CRWA 2007). Chlorophyll *a* concentrations between March 2000 and December 2003 (n= 14) were low (0.46 to 18.7 μg/L with only one measurement greater than 10 μg/L). (Note two pipes sampled by CRWA near Central Street – 35CD (n=39) and 35C2 (n=25) were found to have elevated concentrations of total suspended solids (max 54 mg/L with 5 measurements > 25 mg/L and max 120 with 8 measurements >25 mg/L, respectively.)

Only one of eight DO measurements reported by CRWA for the river upstream from Howard Street was below the criterion (4.97 mg/L 24 August 2005) (CRWA 2004a and CRWA 2006). Total phosphorus concentrations were slightly elevated in samples collected from the river near Howard Street (as high as 0.12 mg/L during the October 2002 wet weather sampling event). The pH, temperature, ammonia-nitrogen, and chlorophyll *a* data were indicative of good water quality conditions.

The *Aquatic Life Use* for this segment of the Charles River is assessed as impaired based primarily on best professional judgment of DWM biologists. Their interpretation of the benthic community data was that the benthic assemblage in the Charles River was impaired to some degree due to organic enrichment and possibly associated low levels of dissolved oxygen. Sources of organic inputs and other factors impacting water quality and biological integrity in this portion of the river are numerous, however, urban runoff (stormwater, illicit sewer connections, Godfrey Brook pollution inputs, etc.) associated with the City of Milford, which is located just upstream from these reaches, has historically been considered the major perturbation in this part of the watershed. Naturally-occurring nutrient/organic loads and related DO reductions from upstream wetland contributions also likely contribute to the degraded benthic community. The lentic nature of this portion of the river probably precludes the specialized feeding and/or oxygen requirements of some of the more sensitive forms of invertebrates such as EPT taxa, which occur in highly reduced densities. The fish community reflects this aforementioned lentic nature with macrohabitat generalists heavily dominating samples.

Primary and Secondary Contact Recreation and Aesthetics Uses

CRWA volunteers sampled three locations in Milford along this segment of the Charles River as part of the Upper Charles River Watershed TMDL Project or as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling was conducted on 13 August 2002 and 24

August 2005, representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems), as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 at both sampling stations 31CS and 48CS (CRWA 2004a and CRWA 2006).

From upstream to downstream the CRWA sampling locations are as follows.

Downstream from Cedar Swamp Pond at the Fino Field footbridge (Station 31CS) (TMDL project), near the Central Street Bridge in Milford (Station 35CS) (monthly sampling), and upstream from Howard Street (Station 48CS) (TMDL project).

None of the *E. coli* counts for samples collected from the river at the Fino Field footbridge (Station 31CS) were >100 cfu/100 ml (CRWA 2004a and CRWA 2006).

Monthly *E. coli* samples were collected by CRWA from the Charles River near Central Street Bridge in Milford (Station 35CS) between 2002 and 2006 (CRWA 2007 and Eleria 2007). A total of 38 samples were collected, 23 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 35CS	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	# Samples	5	5	2	6	5
	Maximum cfu/100 ml	7,400	13,900	800	2,000	2,420
	Minimum cfu/100 ml	210	30	120	10	100
126 cfu/100 ml	Geometric Mean	1075	325	310	323	548
Max 235 cfu/100 ml	Number of Exceedances	4	2	1	4	4
Secondary Contact	# Samples	7	9	4	11	7
	Maximum cfu/100 ml	7,400	13,900	800	2,000	2,420
	Minimum cfu/100 ml	75	10	10	10	35
630 cfu/100 ml	Geometric Mean	523	187	99	193	385
Max 1260 cfu/100 ml	Number of Exceedances	3	1	0	1	1

E. coli data (cfu/100 ml) for the Charles River upstream from Howard Street (Station 48CS) are summarized below.

13-Aug-02	15-Aug-02	16-Oct-02	17-Oct-02	18-Oct-02	19-Oct-04	20-Oct-04	21-Oct-04	24-Aug-05
Dry	Dry	Wet	Wet	Wet	Wet	Wet	Wet	Dry
<10	<10	400	<100	1400	3600	700	200	100 (duplicate <100)

Godfrey Brook, which discharges to this segment of the Charles River, is also known to receive sewer overflows on occasion. CRWA conducted water quality monitoring of the brook in 2002, one dry and one wet weather event, because of previously identified illicit connections in this subwatershed. Furthermore, EPA issued an enforcement order against Milford to identify and remove illicit connections to their storm sewer system (Eleria 2007 and CRWA *et al*. 2003).

The *Primary Contact Recreational Use* is assessed as impaired for this segment of the Charles River because of elevated bacteria *(E. coli*) counts. The *Secondary Contact Recreational Use* is assessed as support since none of the geometric means exceeded the criterion of 630 cfu/100 ml and few samples (particularly in the most recent sampling years) exceeded 1260 cfu/100 ml (the stated maximum not to be exceeded for secondary contact recreation). The *Secondary Contact Recreational Use* is identified with an Alert Status however because of the occasionally highly elevated *E. coli* counts. Counts were notably higher during storm events. Efforts to remediate illicit connections have been ongoing. The *Aesthetics Use* is not assessed (too limited data).

Charles River (Segment MA72-33) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Biological indicators of enriched conditions Suspected causes: Low DO, elevated total phosphorus, habitat degradation from urban runoff Sources: Discharges from municipal separate storm sewer systems, urban runoff/stormwater
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Elevated *E. coli* Sources: Discharges from municipal separate storm sewer systems, sanitary sewer overflows
Secondary Contact		SUPPORT*
Aesthetics		NOT ASSESSED

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Additional field reconnaissance and habitat quality assessments should be conducted along this segment of the Charles River to identify potential sources of sediment inputs. If anthropogenic sediment inputs are identified best management practices to control these inputs should be developed and implemented.

A multiprobe water quality meter should be deployed in this segment of the Charles River in the vicinity of Howard Street Hopedale/Milford to collect long-term DO, pH, and temperature data to assess water quality conditions and the *Aquatic Life Use*.

Water quality monitoring (including nutrients and bacteria source tracking) should be conducted during next MassDEP Charles River watershed survey. Bacteria sampling in Godfrey Brook should be conducted to evaluate whether or not illicit connection problems have been remediated.

Reissue Saint-Gobain Containers, L.L.C. (MAG250911) non-contact cooling water permit with appropriate limits/monitoring requirements.

CHARLES RIVER (SEGMENT MA72-03)
Location: Milford WWTF discharge, Hopedale, to outlet Box Pond, Bellingham.
Segment Length: 3.4 miles
Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 14.7 mi^2 subwatershed (including MA72-01 and MA72-02)

Forest..... 43%
Residential..... 36%
Open land 7%

The estimated percent impervious area for this subwatershed area is 14.4%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, nutrients, organic enrichment/low do, noxious aquatic plants, pathogens, and other habitat alterations (MassDEP 2007).

Note: Box Pond (MA72008) will not be assessed as a lake segment in this report since the estimated retention time of this 40.7-acre waterbody is approximately six days. It will be considered a run-of-the river impoundment (McVoy 2006). Box Pond is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of pesticides, nutrients, siltation, and noxious aquatic plants (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H2 and H4)
Town of Milford (MA0100579)
Westinghouse Electric Corp (MA0035572)
OTHER
Milford Power Limited Partnership – Sewer Extension Permit MA DEP#133926.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
The Milford Power facility began power generation in January 1994 and began diversion of Milford Wastewater Treatment Plant (WWTP) effluent in July 1994. During facility operations the cooling towers are supplied with treated wastewater from the Milford WWTP (Heim 2007). To protect flows in the Charles River, diversion of the treated wastewater is not authorized if the flow in the Charles River at the reference gage (the railroad bridge upstream from South Howard Street in Milford) is $\leq$ 3.06 cfs. Discharge monitoring is conducted by the Milford Power Limited Partnership as part of their Sewer Extension Permit at the railroad bridge upstream from South Howard Street in Milford (ENSR 2007). This site is referred to as (Station 55CS) as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006).

Biology
Milford Power Limited Partnership was required to conduct biological monitoring in the Charles River as part of their Sewer Extension Permit. To fulfill this monitoring requirement, multiplate samplers were deployed by ENSR personnel in this segment of the Charles River near the Mellen Street Bridge, Milford, between 6 August and 27 September 2001 and again between 22 August and 14 October 2002 (ENSR 2002 and ENSR 2003). In the 2001 sample *Caecidotea* sp. and *Hyalella* sp. were the codominant taxa with relative abundances of 24 and 51%, respectively (ENSR 2002 and Fiorentino 2006). These taxa are known to thrive in areas of very poor water quality. Both taxa are highly tolerant of organic pollutants and are able to withstand prolonged periods of reduced oxygen levels. They are opportunistic in their feeding tendencies and mainly act as gathering-collectors--foraging on deposited forms of organic matter. The limpet Ancylidae represented the third most abundant taxon. An algal grazer (scraper), its presence suggests a well-established benthic algae community in this portion of the river. These ancylids are most likely *Laevapex fuscus* (based on past collections in the watershed by MassDEP), which also display a fairly high tolerance of organic pollution. In the 2002 samples *Cheumatopsyche* and *Triaenodes* sp. were the dominant taxa (ENSR 2003 and Fiorentino 2006). While both are EPT taxa (Ephemeroptera, Plecoptera, and Tricoptera are generally considered the most sensitive of all insects/invertebrates), these two taxa are both some of the more tolerant of the tricopteran taxa. It is possible that the sudden change

in flow regimes (i.e., increased current velocity) below the Milford WWTP has resulted in the availability of a new food resource. *Cheumatopsyche* sp. are filter-feeding macroinvertebrates that use silken nets to capture suspended organic particulates as they flow downstream. As shredders, *Triaenodes* sp. may gain access to newly uncovered course particulate organic materials previously buried under deposits of organic matter that have been swept downstream.

Milford Power Limited Partnership was required to conduct biological monitoring in the Charles River as part of their Sewer Extension Permit. To fulfill this monitoring requirement ENSR personnel collected fish from this segment of the Charles River (ENSR 2002). Six species of fish (n=19) were collected on 6 September 2001 at two sampling locations in this segment of the Charles River (just downstream from Mellen Street) (ENSR 2002). Only two of these species (common shiner and white sucker, n=10 individuals) are classified as fluvial. Overall sampling efficiencies were poor due to thick growth of aquatic macrophytes, highly turbid conditions, and excessive depth in pool habitat just downstream from Mellen Street (Maietta 2007). Survey crews noted the presence of several additional fish not captured. In light of the poor sampling efficiencies and inconsistent results of past fish monitoring surveys, fish population and benthic sampling has since been dropped.

In July 2002 MA MA DFG conducted backpack shocking in the Charles River upstream from Mellon Street (Station 686). The sampled reach passes through a cow pasture and the habitat was described as being silty and "very poor" (Richards 2006). A total of 87 fish (10 species) were collected. The sample was heavily dominated by bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*) and yellow bullhead (*Ameiurus natalis*). Nine of the 10 species collected were macrohabitat generalists. The only fluvial species was white sucker (n=3). Although the stream gradient within the sampled reach is moderate, there are large areas of wetland dominated low gradient habitat both upstream and downstream from this location. The proximity to this habitat appears to be driving the fish population at this sampling location.

Free-floating plants (duckweed, watermeal, algal mats) and rooted submergent vegetation were commonly observed in the Box Pond impoundment during the survey conducted by CRWA in August 2005 (CRWA 2006).

Toxicity

Effluent

Both acute and chronic whole effluent toxicity tests have been conducted on the Milford WWTP treated effluent. Between March 2000 and April 2007 30 tests were conducted using *C. dubia*. The LC_{50}s were all $\geq$100% effluent with only one test (April 2003) not meeting the permit limit $LC_{50} \geq 100\%$ effluent. Results of the *C. dubia* chronic whole effluent toxicity tests ranged from <6.25 to 100% effluent. Of the 27 valid chronic tests eight did not meet the CNOEC $\geq$100% effluent limit; CNOEC=6.25% effluent in January 2007, <6.25% effluent in October 2005, and 50% effluent in five test events in April 2002 and 2003, July and October 2003, and January 2006). The presence of chronic toxicity in the Milford WWTP effluent is noted as a concern.

CRWA volunteers sampled the Milford WWTP effluent (Station 54CW) as part of the Upper Charles River Watershed TMDL Project (CRWA 2004a and CRWA 2006). The concentrations of total phosphorus ranged from 0.04 to 0.256 mg/L (n=4) for samples collected between 13 August 2002 and 24 August 2005. It should be noted that total phosphorus concentrations in the effluent were much lower in the samples collected in 2004 and 2005 than those collected in 2002. These results corroborate the facility's DMR reported data for total phosphorus (see Appendix H, Table H2).

Water Quality

CRWA volunteers sampled one location in Bellingham along this segment of the Charles River: at the Mellen Street Bridge (Station 59CS) as part of the Upper Charles River Watershed TMDL Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) and during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the five surveys conducted, the DO, pH and temperatures all met water quality criteria. Six of the eight total phosphorus concentrations were elevated (0.0621 to 0.26 mg/L). Chlorophyll *a* concentrations were slightly elevated

(17 µg/L) during the 16 October 2002 wet-weather sampling event. The CRWA also collected monthly water quality data from the river at the Mellen Street Bridge (Station 59CS) (CRWA 2007). These data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. A total of 23 pH measurements were taken at Station 59CS between February 2000 and March 2002. The pH measurements ranged from 6.3 to 7.3 SU and one measurement was slightly low (6.3 SU). None of the temperature measurements (n=57) taken between February 2000 and December 2003 exceeded 28.3°C (CRWA 2007). Total suspended solids concentrations were all low (≤ 16 mg/L, n=36).

The deepest point in the Box Pond (approximately 7.5 feet) is in the eastern end slightly upstream from the dam (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity at the deep hole between 17 September 2002 and 24 September 2002. DO concentrations were not less than 8.8 mg/L and were as high as 12.8 mg/L. Dissolved oxygen depletion only seems to occur near the sediment-water interface in deeper portions of the impoundment (CRWA 2004a). The pH measurements ranged from 8.3 to 9.1 SU indicative of high productivity.

Water quality monitoring (*in-situ* measurements of DO and temperature) as well as total phosphorus, chlorophyll *a*, and pheophytin *a* samples were taken at three locations in Box Pond on 22 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 7.14 to 13.7 mg/L and all but one measurement indicated supersaturation (saturations ranged from 100.5 to 153.3%). Both total phosphorus and chlorophyll *a* concentrations were fairly low, ranging from 0.029 to 0.04 mg/L and 0.70 and 9.18 µg/L, respectively.

Sediment

As part of the Upper Charles River TMDL Project sediment cores were collected in June 2005 at three locations in Box Pond to measure rates of sediment oxygen demand and sediment nutrient release during aerobic and anaerobic conditions (Schlezinger and Howes 2006). These samples had some of the highest sediment oxygen demand of all of the sites sampled.

The *Aquatic Life Use* for this segment of the Charles River is assessed as impaired. The benthic community downstream from the Milford WWTP discharge is somewhat unbalanced and appears to be structured in response to organic/nutrient enrichment. Moderately elevated concentrations of total phosphorus were measured in samples collected from the river near the Mellen Street Bridge. However, it should also be noted that while water quality most certainly limits biological integrity in this portion of the Charles River, habitat constraints related to flow regime and epifaunal habitat availability probably are factors as well--the lack of habitat diversity and availability and the lentic nature of this portion of the river probably precludes the specialized feeding and/or oxygen requirements of some of the more sensitive forms of invertebrates such as EPT taxa. The relative absence of fluvial fish species reflects the lentic nature of the reach sampled. Most species present are considered tolerant of pollution. Although common shiner were present in this segment they were underrepresented when compared to the Charles River Target Fish Community developed by Meixler (2006). Fallfish (*Semotilus corporalis*), the second highest-ranking fish in the Target Fish Community, were missing. Additionally, high primary productivity was evidenced by both supersaturation and high pH conditions in the downstream reach of this segment of the Charles River in Box Pond. At the same time total phosphorus and chlorophyll *a* concentrations were moderate to low in this impoundment. Based on these results and plant mapping data it is apparent that periphytic algae and aquatic macrophytes in Box Pond are the major source of the productivity. The presence of chronic toxicity in the Milford WWTP discharge is also of concern.

Fish Consumption Use

In October 2002 fish were collected from Box Pond, Bellingham/Mendon, and edible fillets were analyzed for select metals and organochlorine pesticides (Appendix E, Table E1). Due to the presence of DDT, DDE, and DDD in white sucker, MA DPH issued the following advisory (MA DPH 2007) recommending the following:

> *"Children under 12 years of age, pregnant women, nursing mothers, and women of childbearing age who may become pregnant should refrain from consuming white sucker from Box Pond to prevent exposure of developing fetuses, nursing infants and young children to DDT" and "The general public should not consume white sucker caught from Box Pond."*

Because of the site-specific fish consumption advisory for Box Pond due to DDT contamination, the *Fish Consumption Use* is assessed as impaired for the 1.2 mile reach of this segment of the Charles River through Box Pond. The upper 2.2 mile reach of this segment of the Charles River is not assessed for the *Fish Consumption Use*.

Primary and Secondary Contact Recreation and Aesthetics Uses

CRWA volunteers sampled this segment of the Charles River at the Mellen Street Bridge in Bellingham (Station 59CS) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 at 59CS (CRWA 2004a and CRWA 2006). Between these two projects, a total of 38 samples were collected, 23 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 59CS	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	4	2	7	5
	Maximum cfu/100 ml	4,200	2,180	230	270	1,200
	Minimum cfu/100 ml	150	50	180	70	15
126 cfu/100 ml	Geometric Mean	728	203	203	165	170
Max 235 cfu/100 ml	Number of Exceedances	4	1	0	1	2
Secondary Contact	Samples Assessed	7	8	6	11	6
	Maximum cfu/100 ml	4,200	2,180	1,100	3,200	1,200
	Minimum cfu/100 ml	150	50	10	70	15
630 cfu/100 ml	Geometric Mean	724	312	129	252	174
Max 1260 cfu/100 ml	Number of Exceedances	3	2	0	1	0

Secchi disk measurements were taken at three locations in Box Pond on 22 June 2005 (Schlezinger and Howes 2006). Secchi disk measurements met the 1.2 m recommended guidance at two locations while the third was inconclusive because of shallow depth.

Free-floating plants (duckweed, watermeal, algal mats), as well as rooted submergent vegetation were commonly observed in the Box Pond impoundment during the survey conducted by CRWA in August 2005 (CRWA 2006).

The *Primary Contact Recreational Use* is assessed as impaired for this segment of the Charles River based on elevated *E. coli* bacteria (water quality criteria exceeded in 2002 and two single sample exceedances in 2006) in the upper reach 2.2-mile reach as well as aesthetic problems through Box Pond. The *Secondary Contact Recreational Use* is assessed as support for the upper 2.2-mile reach but is identified with an Alert Status because of occasional high *E. coli* counts. The *Aesthetics Use* is not assessed in the upper 2.2-mile reach of this segment. The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired in the lower 1.2 mile reach of this segment of the Charles River (through the Box Pond impoundment) because of objectionable growths of nuisance vegetation (water meal, duckweed, algal mats).

Charles River (Segment MA72-03) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Biological indicators of organic enrichment, elevated total phosphorus, excess algal growth and high DO saturation through Box Pond (lower 1.2 miles of this segment) Source: Municipal point source discharge Suspected sources: Discharges from municipal separate storm sewer systems, urban runoff/stormwater
Fish Consumption		NOT ASSESSED upper 2.2 mile reach IMPAIRED lower 1.2 mile reach through Box Pond Cause: DDT Source: Unknown
Primary Contact		IMPAIRED Cause: Excess algal growth through Box Pond (1.2 miles), elevated *E. coli* Source: Municipal point source discharge Suspected sources: Discharges from municipal separate storm sewer systems, urban runoff/stormwater
Secondary Contact		SUPPORT upper 2.2 miles* IMPAIRED lower 1.2 miles (through Box Pond) Cause: Excess algal growth Source: Municipal point source discharge Suspected sources: Discharges from municipal separate storm sewer systems, urban runoff/stormwater
Aesthetics		NOT ASSESSED upper 2.2 miles IMPAIRED lower 1.2 miles (through Box Pond) Cause: Excess algal growth Source: Municipal point source discharge Suspected sources: Discharges from municipal separate storm sewer systems, urban runoff/stormwater

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

In light of the fact that a large amount of fish data are available from the lower gradient reaches in this segment of the Charles River, additional monitoring should be conducted in the lower portion of this segment of the Charles River downstream from Hartford Avenue and upstream from Box Pond in Bellingham. This reach of the river is moderate gradient and should support a fish assemblage more typical of a free flowing river. These data can then be used to compare to the targeted fish community as developed for CRWA (Meixler 2006).

Continue to carefully monitor the results of the Milford Wastewater Treatment Facility (MA0100579) whole effluent toxicity tests. Evidence of chronic toxicity in three of the seven most recent test events is of concern. A toxicity testing identification and toxicity testing reduction evaluation (TIE/TRE) may be warranted if chronic whole effluent toxicity continues to be detected.

Continue to conduct water quality monitoring (i.e., physico-chemical and nutrient sampling) in this segment of the Charles River to evaluate the status of the *Aquatic Life, Recreational*, and *Aesthetic* uses.

CHARLES RIVER (SEGMENT MA72-04)
Location: Outlet Box Pond, Bellingham, to inlet Populatic Pond, Norfolk/Medway.
Segment Length: 11.5 miles
Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 66.6 mi^2 subwatershed.
Forest..... 46%
Residential..... 31%
Open land 8%

The estimated percent impervious area for this subwatershed area is 12.4%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of metals and pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Franklin DPW Water Division (9P22010101, 22010102)
Bellingham DPW Water & Sewer Division (9P22002501, 22002501)
Medway Water Department (9P422017701, 22017701)
NPDES (See Appendix H, Tables H2 and H4)
Photofabrication Engineering, Inc (MAG250333)

Stormwater BMP
A stormwater treatment system consisting of a degritter, oil/water separator, and infiltration trenches was constructed on town owned property along the Charles River on Plymouth Road in Bellingham between August 2004 and the spring of 2005 (SEA 2006). This project (01-16/319) was funded by the 319 Nonpoint Source Grant Program and the Town of Bellingham. The system was designed to divert flows up to a 2-year 24-hour storm for the removal of total suspended solids (80% removal goal), total phosphorus, total and fecal coliform bacteria. The goal of this Plymouth Road stormwater BMP was to reduce the concentration of "first flush" pollutants received by the BMP system as well as to increase groundwater recharge upstream from the stormwater outfall to help decrease peak flows into the Charles River.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
There are four dams along this segment of the Charles River: the North Bellingham Dam (also known as the Maple Street Pond Dam), Caryville Dam, Bellingham, West Medway Dam (near the confluence with Mine Brook), and the Medway Dam (also known as the Sanford Mill Pond Dam) in Medway (Schlezinger and Howes 2006).

The Charles River was sampled by DWM over the course of the summer of 2002 at one sampling location upstream from Maple Street in Bellingham (Station CR60.5) (Appendix B). The river was approximately 40 feet wide at this station. Good riffle areas were present throughout the survey dates and large cobbles were the only substrate exposed.

DWM fisheries biologists conducted a habitat assessment of the Charles River downstream from Maple Street in Bellingham in August and September 2002 (Appendix G). Habitat quality was limited most by development adjacent to the river that reduced bank stability and vegetative protection and resulted in some erosion areas, but in-stream cover for fish was considered optimal. The final habitat score was 127 (of a possible score of 160).

The USGS maintains a gage on the Charles River at Walker Street in Medway, MA (Gage 01103280). The drainage area at this site is 65.7 mi^2. Since December 1997, the average annual discharge was 112 cfs (period of record water years 1998 to 2005) while the minimum daily mean discharge was 2.1 cfs (4 September 1999) and the maximum daily mean discharge was 1,490 cfs (23 March 2001) (USGS 2007d). The estimated 7Q10 of the river at this location is approximately 3.4 cfs (EOEEA 2007).

The Charles River was sampled by DWM over the course of the summer of 2002 at one sampling location upstream from Walker Street in Medway (Station CR03) (Appendix B). The river was approximately 60 to 70 feet wide at this station. Good riffle areas were present throughout the survey dates and the only substrates exposed were along the margins.

On 15 July 2002 DWM biologists conducted a habitat assessment of the Charles downstream from Walker Street, Medway (Station CR03). This site received a total habitat assessment score of 158 out of a possible 200 (Appendix C). The river was about nine meters wide and minimally shaded. Benthic habitat was characterized as excellent with an abundance of cobble substrates with in-stream vegetation and mosses providing additional microhabitat. In-stream cover for fish was somewhat limited. Channel flow status was generally good. DWM field survey crews also observed flows in the river near Walker Street during the 2002 sampling season (Station CR03) (Appendix B). Stream velocity decreased from April to September from approximately 3 feet per second (fps) to less than 1 fps and the average depth decreased from 2 feet to less than 1 foot. However, ample riffle areas were present throughout the survey dates and any exposed substrates were along the margins of the river. Although no Quality Assurance Project Plan was approved for this project, CRWA staff also completed habitat assessments of the Charles River near Walker Street in Medway on three occasions: 17 October 2001, 30 May 2002, and 15 July 2002 (CRWA 2002). Habitat quality was limited most by the disturbed/limited riparian zone associated with development.

Biology

There were no aquatic plants observed in the Charles River upstream from Maple Street in Bellingham (Station CR60.5) during the summer of 2002 except for sparse coverage of moss on the larger substrates (Appendix B). Electrofishing was also conducted in the reach of the river downstream from Maple Street on 5 August and then again on 9 September 2002 (Appendix G). Only nine yellow bullhead, a tolerant macrohabitat generalist species, were collected during the August survey. Re-sampling resulted in the collection of twelve yellow bullhead, three pumpkinseed (*Lepomis gibbosus*), two redfin pickerel (*Esox americanus*), and two young-of-the-year largemouth bass. Although more fish were captured, numbers were still extremely low. All fish collected were macrohabitat generalists, which are tolerant or moderately tolerant to pollution (Appendix G).

The aquatic plant density was sparse in the Charles River upstream from Walker Street in Medway (Station CR03) with only emergent plant growth towards the shoreline and on one occasion a submerged milfoil species was observed (Appendix B). In early June a sparse amount of filamentous algae was attached to the substrates and by early August there was dense coverage of green and brown algal mats (comprised of *Lyngbya* sp. and lots of diatoms, naviculoids – Appendix F) attached to the river bottom. A benthic sample was collected from the Charles River downstream from Walker Street, Medway (Station CR03). This site was used as a reference station, however, the metric values calculated as part of the RBP III analysis reflect a healthy benthic community one would expect to find in a “least impacted” stream (Appendix C). Despite only 30% canopy cover in the stream reach sampled, algal cover was low (reported as <5%) for the sample collected on 15 July 2002 (Appendix F). The dominant algal genera were *Chlorophyceae-Mougeotia sp*. and *Ulothrix sp.*

On 10 September 2001 MA DFG biologists conducted backpack electrofishing in the Charles River upstream from the Walker Street Bridge in Medway (Richards 2006). Electrofishing was conducted at two stations.: The furthest upstream station was described as a rocky “higher gradient reach” than the downstream site. MA DFG noted problems with one of the backpack shockers at the upstream location. A total of 95 fish were collected, representing five species. The dominant taxa were redbreasted sunfish (*Lepomis auritus*) (n=63) and American eel (*Anguilla rostrata*) (n=22). White sucker (n=2) were the only fluvial species present. All fish species collected are classified as being tolerant or moderately tolerant to pollution. Although redbreasted sunfish (n=64) also dominated the sample collected at the downstream location, species diversity increased greatly (n=13). Although a total of 105 fish were collected, with the exception of an individual brown trout (most likely stocked), white sucker (n=2) were again the only fluvial species present. In addition all species collected (except for the brown trout - *Salmo trutta*) are classified as being tolerant or moderately tolerant to pollution.

Toxicity

Ambient

The Charles River Water Pollution Control District staff collected water from the Charles River in at the Walker Street Bridge for use as dilution water in the facility’s whole effluent toxicity tests. Between

January 2000 and April 2007 survival of *C. dubia* exposed (approximately 7 days) to the Charles River water ranged from 70 to 100% (n=32). Only one test event (April 2004) was survival <75%. Between January 2000 and January 2007 survival of *P. promelas* exposed (approximately 7 days) to the Charles River water ranged from 53 to 100% (n=29). Survival of *P. promelas* was <75% in four test events (April 2000, April 2002, April 2005, and October 2006) (TOXTD database). River water hardness ranged from 31 to 100 mg/L (n=33).

Water Chemistry

CRWA volunteers sampled eight locations along this segment of the Charles River: six sites were sampled as part of the Upper Charles River Watershed TMDL Project (CRWA 2004a and CRWA 2006) and two sites were sampled monthly. Depot Street Bridge, Bellingham (Station 86CS), Maple Street Bridge in Bellingham (Station 13CS), Pearl Street Bridge in Bellingham (Station 143S), Franklin Street/Pond Street bridge in Medway/Franklin (Station 156S), downstream West Medway Dam in Medway (Station 159S), and Walker Street Bridge in Medway (Station 184S) were sampled as part of the Upper Charles River Watershed TMDL Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). Monthly sampling by CRWA has also been conducted in the river at the Route 126 bridge in Bellingham (Station 90CS) and at the Shaw Street Bridge in Franklin (Station 165S) between February 2000 and October 2006. In 2002, water quality monitoring was conducted by DWM at two of these sites: near the Maple Street Bridge in Bellingham (Station CR60.5) and near the Walker Street Bridge in Medway (Station CR03) (Appendix B).

Water quality monitoring (*in-situ* measurements of DO and temperature) as well as total phosphorus, chlorophyll *a*, and pheophytin *a* samples were also taken upstream from the impoundments along this segment of the Charles River (Schlezinger and Howes 2006). Samples were collected at two locations upstream from the North Bellingham Dam, at two locations upstream from the Caryville Dam, Bellingham, at three locations above the West Medway Dam (near the confluence with Mine Brook), and at two locations above the Medway Dam in Medway on 22 June 2005.

The CRWA collected several types of water quality data at Depot Street Bridge, Bellingham (Station 86CS) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO was low during one dry weather sampling event on one occasion (3.54 mg/L on 15 August 2002). Temperature and pH all met water quality criteria. The highest total phosphorus concentrations were measured in 2002 during wet weather sampling events (0.05 mg/L). Chlorophyll *a* concentrations were slightly elevated (17 µg/L) during the 16 October 2002 wet-weather sampling event.

The CRWA also collected monthly water quality data from the river at the Route 126 Bridge (North Main Street) in Bellingham (Station 90CS) (CRWA 2007). These data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. A total of 23 pH measurements were taken at Station 90CS between February 2000 and December 2001. The pH measurements ranged from 6.3 to 7.9 SU. None of the temperature measurements (n=65) taken between February 2000 and October 2006 exceeded 28.3°C (CRWA 2007). Total suspended solids concentrations were all low ($\leq$ 11 mg/L, n=38). The total phosphorus concentrations ranged from 0.027 to 0.222 mg/L (n=24) for samples collected from March 2000 through December 2006. Of these 17 samples were >0.05 mg/L. It should be noted, however, that the concentrations of total phosphorus have been declining slightly over this sampling period. The maximum ammonia-nitrogen concentration was 0.3 mg/L (n=25).

Maple Street Pond Dam

The deepest area (approximately 2 feet) in the Maple Street Pond impoundment (also referred to as the North Bellingham Dam) is in the eastern end slightly upstream from the dam (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity at the deep hole between 4 September 2002 and 9 September 2002. DO concentrations were not less than 5.3 mg/L and were as high as 10.3 mg/L. Saturations were as high as 121%. No obvious dissolved oxygen depletion occurred near the sediment-water interface (CRWA 2004a). Water quality monitoring (*in-situ* measurements of DO and temperature) as well as nutrient (total phosphorus and chlorophyll *a* and

pheophytin *a* samples were taken at two locations in the Maple Street Pond impoundment on 22 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 8.0 to 8.6 mg/L. Both total phosphorus and chlorophyll *a* concentrations were fairly low ranging from 0.028 to 0.033 mg/L and 1.15 and 1.77 µg/L, respectively.

MassDEP DWM conducted water quality monitoring of the Charles River at Maple Street in Bellingham (Station CR60.5) between April and September 2002 (Appendix B). In-stream DO concentrations were good, ranging from 5.6 to 10.9 mg/L (n=9) and representing both daytime and worse case (pre-dawn) conditions. The maximum temperature was 26.7°C and all pH measurements (6.8 to 8.0 SU) met criteria. The diurnal variation of DO for this site was somewhat high (up to 3.9 mg/L). Total phosphorus concentrations ranged from 0.037 to 0.068 mg/L and were slightly elevated in two of the four samples. Total suspended solids concentrations were all low ($\leq$ 8.5 mg/L, n=5). The CRWA also collected TMDL and monthly water quality data from the river at the Maple Street in Bellingham (Station 130S and/or 13CS) (CRWA 2007 and Kaplan 2007). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, ammonia-nitrogen, and chlorophyll a were all indicative of good water quality. One total phosphorus concentration measured in 2002 was slightly elevated (0.06 mg/L) during a wet weather sampling event. The monthly data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. A total of 26 pH measurements were taken at Station 130S between February 2000 and April 2002. The pH measurements ranged from 6.3 to 7.9 SU and only one measurement was <6.5 SU. Total suspended solids concentrations were all low ($\leq$ 5.2 mg/L, n=39).

Upstream from Carryville Dam
The deepest area in the Carryville Dam impoundment (approximately 3 feet) is in the northeastern end slightly upstream from the dam (CRWA 2004a). Water quality monitoring (*in-situ* measurements of DO and temperature) as well as total phosphorus, chlorophyll *a*, and pheophytin *a* samples were taken at two locations in the impoundment on 22 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 6.8 to 7.8 mg/L. Total phosphorus concentrations ranged from 0.029 to 0.062 mg/L, while chlorophyll *a* concentrations were fairly low ranging from 0.79 and 2.49 µg/L, respectively.

The CRWA collected several types of water quality data at Pearl Street Bridge in Bellingham (Station 143S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO was low during one dry weather sampling event (2.49 mg/L on 13 August 2002) and once during a wet weather sampling event (3.36 mg/L on 17 October 2002). Temperature and pH measurements all met water quality criteria and total phosphorus and chlorophyll *a* concentrations were low (0.0443 mg/L and 5 µg/L, respectively).

The CRWA collected several types of water quality data at Franklin Street/Pond Street bridge in Medway/Franklin (Station 156S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO was low on 13 August 2002 (2.2 mg/L). Temperatures and pH measurements all met water quality criteria and total phosphorus and chlorophyll *a* concentrations were low (0.0472 mg/L and 5.4 µg/L, respectively).

West Medway Dam
The deepest area in the West Medway Dam impoundment (approximately 4 feet) is in the northeastern end slightly upstream from the dam (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity in the impoundment between 23 August 2002 and 27 August 2002. DO concentrations were not less than 5.7 mg/L and were as high as 8.6 mg/L. Saturations ranged from 62 to 101%. No substantial dissolved oxygen depletion occurred near the sediment-water interface (CRWA 2004a). Water quality monitoring (*in-situ* measurements of DO and temperature) as well as total phosphorus, chlorophyll *a*, and pheophytin *a* samples were taken at three locations in West Medway Dam impoundment on 22 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 7.0 to 7.8 mg/L. Both total phosphorus and chlorophyll *a* concentrations were fairly low ranging from 0.040 to 0.045 mg/L and 0.65 and 1.19 µg/L, respectively.

The CRWA collected several types of water quality data downstream from West Medway Dam in Medway (Station 159S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. This sampling location is also downstream from the confluence of Mine Brook. Of the surveys conducted, DO, pH, and temperatures all met water quality criteria. Total phosphorus concentrations (were slightly elevated ranging from 0.0302 to 0.0821 mg/L representing both dry and wet weather sampling conditions. Half of the measurements (excluding the duplicate sample) were >0.05 mg/L. The chlorophyll *a* concentrations were low (≤ 8 µg/L).

The CRWA also collected monthly water quality data from the river at the Shaw Street Bridge in Franklin (Station 165S) (CRWA 2007). These data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected since 2000 as part of this monitoring program were reviewed as part of this assessment. A total of 17 pH measurements were taken at Station 165S between February 2000 and March 2002. The pH measurements ranged from 6.1 to 7.5 SU and only two measurements were <6.5 SU. None of the temperature measurements (n=56) taken between February 2000 and October 2006 exceeded 28.3°C (CRWA 2007). Total suspended solids concentrations were all low (≤ 7.8 mg/L, n=34).

Medway Dam in Medway
The deepest area in the Medway Dam impoundment (approximately 8 feet) is in the eastern end slightly upstream from the dam (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity at the deep hole between 17 September 2002 and 24 September 2002. DO concentrations were not less than 5.6 mg/L and were as high as 8.7 mg/L. Saturations ranged from 62 to 98%. Dissolved oxygen depletion only seems to occur near the sediment-water interface in deeper portions of the impoundment (CRWA 2004a). Water quality monitoring (*in-situ* measurements of DO and temperature) as well as nutrient (total phosphorus and chlorophyll *a* and pheophytin *a* samples were taken at two locations in the Medway Dam impoundment on 22 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 6.4 to 7.5 mg/L. Both total phosphorus and chlorophyll *a* concentrations were fairly low ranging from 0.020 to 0.021 mg/L and 0.57 and 0.85 µg/L, respectively.

MassDEP DWM conducted water quality monitoring in this segment of the Charles River at Walker Street in Medway (Station CR03) between April and September 2002 (Appendix B). In-stream DO concentrations were good, ranging from 7.3 to 11.8 mg/L (n=10) and representing both daytime and worse case (pre-dawn) conditions. The maximum temperature was 26.0°C and all pH measurements (6.9 to 8.2 SU) met criteria. The diurnal variation of DO for this site was somewhat high (up to 2.8 mg/L). Total phosphorus concentrations ranged from 0.026 to 0.055 mg/L (n=5 including one duplicate) and was slightly elevated in one sample. Total suspended solids concentrations were all low (≤ 3.0 mg/L, n=6 including one duplicate). The CRWA also collected several types of water quality data at Walker Street in Medway (Station 184S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, and temperatures all met water quality criteria with the exception of one pH measurement that was high (8.8 SU). Total phosphorus concentrations ranged from 0.0259 to 0.0508 mg/L (n=8 excluding one duplicate) with only one sample >0.05 mg/L. The highest measurement represented wet weather sampling conditions. The chlorophyll *a* concentrations were low (≤ 10 µg/L).

Sediment Chemistry
Sediment cores were collected in June 2005 along this segment of the Charles River at two locations - upstream from the North Bellingham Dam and at two locations upstream from the Caryville Dam, Bellingham, at three locations above the West Medway Dam (near the confluence with Mine Brook), and at two locations above the Medway Dam in Medway, to measure rates of sediment oxygen demand and sediment nutrient release during aerobic and anaerobic conditions (Schlezinger and Howes 2006). Sediment oxygen demand at these sites was similar to those measured in Milford Pond (upstream from the Milford WWTP discharge).

The *Aquatic Life Use* is assessed as impaired in the upper 7.5 mile reach of this segment of the Charles River (to the West Medway Dam) and is assessed as support in the lower 4.0 mile reach (downstream from the West Medway Dam). In the upper segment of the river few fish were collected during two surveys by DWM and MA DFG biologists despite excellent habitat. Fluvial dependant/specialist fish species were absent from the samples. In addition, the fish assemblage at this location was missing

three of the top four ranking species in the Charles River Target Fish Community developed by Meixler (2006) and the third ranking species was underrepresented. The dams along this segment alter the natural flow regime and create habitat more conducive to macrohabitat generalists. While most of the water quality data collected from this reach of the river were indicative of good conditions, there was some evidence of enrichment (low DO, supersaturation of oxygen, and/or large diurnal swings in DO) at sampling stations between the outlet of Box Pond and the West Medway Dam in August/September 2002. These conditions are not as severe as the problems in the river upstream and through Box Pond (Segment MA72-03) and it should be noted that concentrations of total phosphorus have been declining in the river over the course of the sampling period (2000 to 2006 at the Route 126 sampling station), which likely results from upgrades at the Milford WWTP (Appendix H). Downstream from the West Medway Dam, the river is assessed as support for the *Aquatic Life Use* based primarily on the benthic macroinvertebrate community data and the generally good water quality data. The number of fish/species collected in the river near Walker Street in Medway were much better than the upstream site, but the assemblage was still missing the two top ranking species in the Charles River Target Fish Community and the fourth ranking species was underrepresented. The relative absence of fluvial fish species is likely the result of the lentic nature that comprises much of this segment of the Charles River. In this lower reach of the river the poor survival of *P. promelas* exposed to Charles River water collected at Walker Street in Medway is of concern, as were slightly elevated concentrations of total phosphorus so the *Aquatic Life Use* is identified with an Alert Status.

Fish Consumption Use

A fish consumption advisory is in effect for the lower portion of this segment of the Charles River. Due to the presence of elevated mercury in largemouth bass, MA DPH recommends the following (MA DPH 2007).

> *"Children under 12 years of age, pregnant women, nursing mothers, and women of childbearing age who may become pregnant should not consume largemouth bass from the Charles River between the Medway Dam, Medway and the South Natick Dam, Natick and the general public should limit consumption of largemouth bass fish to two meals per month."*

It should be noted here that fish toxics monitoring was conducted in Populatic Pond in June 2007 (Maietta *et al.* 2008). Mercury concentrations not only exceeded the MA DPH trigger level in largemouth bass but also in black crappie. Although trace concentrations of PCB aroclors, PCB congeners, DDT (or it's metabolites DDD and DDE) and chlordane were found in a number of fillet samples from Populatic Pond in 2007, most concentrations appear to be low. The combination of DDE and DDD in carp, however, exceeded the MA DPH trigger level. Although no advisory update has been issued as of March 2008, the 2007 survey will likely result in modification of the Charles River fish consumption advisory (Maietta *et al.* 2008).

Because of the site-specific fish consumption advisory for the Charles River between the Medway Dam, Medway, and the South Natick Dam, Natick, due to elevated concentrations of mercury, the *Fish Consumption Use* is assessed as impaired for the lower 1.8 mile reach of this segment of the Charles River. The upper 9.7-mile reach of this segment of the Charles River is not assessed for the *Fish Consumption Use*.

Primary and Secondary Contact Recreation and Aesthetics Uses

CRWA volunteers sampled eight locations along this segment of the Charles River: Depot Street Bridge, Bellingham (Station 86CS), Route 126, North Main Street in Bellingham (Station 90CS), Maple Street Bridge in Bellingham (Station 13CS), Pearl Street Bridge in Bellingham (Station 143S), Franklin Street/Pond Street bridge in Medway/Franklin (Station 156S), downstream West Medway Dam in Medway (Station 159S), Shaw Street Bridge in Franklin (Station 165S), and Walker Street Bridge in Medway (Station 184S) were sampled as part of the Upper Charles River Watershed TMDL Project or as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16, 17, and 18 October 2002 and 19, 20, and 21 October 2004 at six sampling stations (excluding 90CS and 165S) (CRWA 2004a and CRWA 2006). *E. coli* samples were also collected from stations 90CS and 165S between March 2004 and April 2005 (n=10 and 9 samples each, respectively).

Bacteria sampling of the Charles River was conducted at Depot Street Bridge, Bellingham (Station 86CS) as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry

weather conditions as well as during two wet weather surveys 18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts were all reported as ≤100 cfu/100 ml.

Monthly bacteria sampling was conducted in the Charles River at North Main Street in Bellingham (Station 90CS) by CRWA. These data can be summarized as follows.

Station 90CS	(CRWA 2007)	Year					Total
Period	Summary Statistic	2002	2003	2004	2005	2006	
Primary Contact	Samples Assessed	5	6	3	6	5	25
	Maximum cfu/100 ml	2,400	12,000	220	300	210	12,000
	Minimum cfu/100 ml	60	10	20	30	88.2	
126 cfu/100 ml	Geometric Mean	221	159	91	102	143	
Max 235 cfu/100 ml	Number of Exceedances	2	1	0	2	0	
Secondary Contact	Samples Assessed	7	10	7	10	7	41
	Maximum cfu/100 ml	3,500	12,000	220	2,500	210	12,000
	Minimum cfu/100 ml	60	10	10	30	5	
630 cfu/100 ml	Geometric Mean	324	105	64	150	76	
Max 1260 cfu/100 ml	Number of Exceedances	2	1	0	1	0	

MassDEP DWM personnel recorded field observations of the Charles River near Maple Street in Bellingham (Station 60.5) between April and September 2002 (Appendix B). The water column was very slightly turbid in-stream with no odor, scum or other objectionable conditions on all survey dates. Occasionally small amounts of naturally-occurring, organic foam were observed. CRWA volunteers sampled the Charles River at the Maple Street in Bellingham (Station 13CS) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 at Station 13CS (CRWA 2004a and CRWA 2006). Between these two projects, a total of 48 samples were collected, 26 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 13CS	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	6	6	3	6	5
	Maximum cfu/100 ml	1,120	1,440	40	2,000	110
	Minimum cfu/100 ml	10	10	10	40	55
126 cfu/100 ml	Geometric Mean	117	44	23	113	80
Max 235 cfu/100 ml	Number of Exceedances	2	1	0	1	0
Secondary Contact	Samples Assessed	11	10	10	11	6
	Maximum cfu/100 ml	1,120	1,440	100	2,000	110
	Minimum cfu/100 ml	10	10	10	10	10
630 cfu/100 ml	Geometric Mean	160	30	49	72	57
Max 1260 cfu/100 ml	Number of Exceedances	0	1	0	1	0

One water quality monitoring station on the Charles River at Pearl Street Bridge in Bellingham (Station 143S) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from 20 to 300 cfu/100 ml (only one count exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

The Charles River at Franklin Street/Pond Street bridge in Medway/Franklin (Station 156S) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and

CRWA 2006). *E. coli* counts ranged from <10 to 300 cfu/100 ml (only one count exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

One water quality monitoring station on the Charles River downstream from the West Medway Dam in Medway (Station 159S) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <10 to 600 cfu/100 ml (only one count exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

Monthly bacteria sampling was conducted in the Charles River at Shaw Street Bridge in Franklin (Station 165S) by CRWA. These data can be summarized as follows.

Station 165S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	5	3	4	5
	Maximum cfu/100 ml	2,900	6,280	310	380	210
	Minimum cfu/100 ml	110	20	200	40	15
126 cfu/100 ml	Geometric Mean	348	377	249	151	81
Max 235 cfu/100 ml	Number of Exceedances	2	3	2	1	0
Secondary Contact	Samples Assessed	6	8	6	8	7
	Maximum cfu/100 ml	2,900	6,280	310	380	210
	Minimum cfu/100 ml	110	10	10	20	5
630 cfu/100 ml	Geometric Mean	351	156	85	98	57
Max 1260 cfu/100 ml	Number of Exceedances	1	2	0	0	0

MassDEP DWM personnel recorded field observations of the Charles River near Walker Street Bridge in Medway (Station CR03) between April and September 2002 (Appendix B). The water column was described as slightly turbid on the survey dates. On one occasion (6 August 2002) an oily sheen, floating algae and white foam were observed. There were no odors or other objectionable conditions noted on the remainder of the survey dates. DWM biologists did not note any objectionable deposits or other conditions (e.g., oils, odors, other deposits) when the benthic sampling was conducted on 15 July 2002 (Appendix C). The *E. coli* bacteria counts were all low (<78 cfu/100 ml, n=5) (Appendix B). The Charles River at Walker Street Bridge in Medway (Station 184S) was also sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <10 to 600 cfu/100 ml (two counts exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

The *Primary Contact Recreational Use* is assessed as impaired for this segment of the Charles River based on the occasionally elevated *E. coli* bacteria counts. Elevated counts were generally documented during wet weather sampling conditions. Failing on-site residential septic systems in the Beaver Brook subwatershed (see Segment MA72-12, MassDEP 2002c) may also be problematic in the upper reach of this segment of the Charles River. The *Secondary Contact Recreational* and *Aesthetics* uses are both assessed as support for this segment of the Charles River based on the lack of objectionable conditions and the *E. coli* bacteria data.

Charles River (Segment MA72-04) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED upper 7.5 mile reach (to the West Medway Dam) Causes: Fishes bioassessments, other flow regime alterations associated with dams/impoundments, other - relative absence of fluvial specialists/dependant fish species Suspected causes: Elevated total phosphorus, occasionally low DO Sources: Habitat alteration associated with dams/impoundments Suspected sources: Municipal NPDES discharge in upstream segment, discharges from municipal separate storm sewer systems, urban runoff/stormwater SUPPORT* lower 4.0 mile reach
Fish Consumption		NOT ASSESSED upper 9.7 mile reach IMPAIRED lower 1.8 mile reach downstream from Medway Dam, Medway Cause: Elevated mercury in fish tissue Source: Unknown Suspected Source: Atmospheric deposition
Primary Contact		IMPAIRED Cause: Elevated *E. coli* Source: Unknown Suspected sources: failing septic systems, stormwater runoff
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Future biological monitoring should include macroinvertebrate sampling as well as fish population sampling in the Charles River near Maple Street in Bellingham (Appendix G).

Support efforts to restore habitat conditions conducive to fluvial fishes.

Continue to monitor in-stream water quality conditions including *in-situ* measurements of DO, pH, and temperature as well as total phosphorus concentrations.

Continue to conduct bacteria monitoring to evaluate current conditions. Bacteria source tracking should be conducted to verify high densities and identify sources. Source(s) should be remediated as necessary.

The Plymouth Road stormwater BMP in Bellingham should be properly maintained and repaired as necessary to achieve pollutant removal goals.

BEAVER BROOK (SEGMENT MA72-12)
Location: Headwaters, outlet Beaver Pond, Bellingham to confluence with Charles River, Bellingham.
Segment Length: 1.4 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 2.8 mi^2 subwatershed.
Forest..... 52%
Residential 27%
Industrial 6%
The estimated percent impervious area for this subwatershed area is 10.3%. From the outlet of Beaver Pond in Bellingham, Beaver Brook flows in a southeasterly direction until it joins the Charles River. The majority of development in the subwatershed is in the immediate land area adjacent to the brook. Sand and gravel operations extend half way down Beaver Brook along the right bank and the entire left bank is medium and high-density residential areas.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Bellingham DPW Water & Sewer Division (9P22002501, 22002501)
Northeast Energy (9P22002502)
NPDES (See Appendix H, Table H4)
OTHER
Northeast Energy is a 300-megawatt, combined-cycle, cogeneration power plant in Bellingham, MA.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Beaver Brook exits Beaver Pond and then skirts a large sand and gravel operation (Varney Brothers Sand & Gravel, Inc. ready mix concrete) for much of its length (Appendix G).

Beaver Brook was sampled by DWM over the course of the summer of 2002 at one sampling location along a footpath off Taunton Street in Bellingham (Station BV01) (Appendix B). The brook was approximately 10 feet wide at this station. Both water levels and velocities decreased over the course of the sampling season. Flows were so low in the brook on 11 September that *in-situ* measurements could not be taken. In a reach of the brook just downstream from this sampling station, DWM biologists conducted a habitat assessment of Beaver Brook on 5 August 2002 as part of a fish population survey (Appendix G). The brook was described as a low gradient stream comprised primarily of shallow run habitat. Epifaunal substrates associated with riffles were essentially non-existent. Substrates were predominantly sand and mud. Overhanging streambank vegetation provided most of the fish habitat. In-stream cover for fish, velocity depth combinations, and channel flow status all scored marginal due to the low flow condition of the stream at time of sampling. It should be noted that even at higher flows these parameters would have scored less than optimal. The final habitat score was 122 out of 200.

Biology
MassDEP DWM conducted a fish population survey in Beaver Brook on 5 August 2002 (Appendix G). The fish community was comprised of eighteen redfin pickerel and three yellow bullhead. There were three locations within the reach with impassable tangles of shrubs and vegetative growth that had to be bypassed. Fish present were macrohabitat generalists, which are classified as tolerant and moderately tolerant to degraded conditions. Although redfin pickerel are classified as moderately tolerant they have been observed in other streams impacted by sedimentation. In-stream flow is also a concern in this stream as reduced in-stream flow seriously reduces available fish habitat.

Water Chemistry
MassDEP DWM conducted water quality monitoring in Beaver Brook at Station BV01 between April and September 2002 (Appendix B). Dissolved oxygen readings were collected on nine occasions (pre and post-dawn). One dissolved oxygen measurement was slightly below criteria (4.9 mg/L, pre-dawn on 07/10/02). Although most of the pH measurements met criteria, the lowest pHs taken (6.1 and 6.2 SU) were representative of wet weather sampling events. It is best professional judgment that these conditions are naturally occurring given the shallow, dystrophic nature of Beaver Pond at the headwaters of this brook (Maietta 2008). All of the total phosphorus, ammonia-nitrogen and total suspended solids

data were indicative of good water quality conditions. No measurements were taken on 11 September because the flow was too low.

The *Aquatic Life Use* is assessed as support for Beaver Brook based primarily on the water quality data. This use is identified with an Alert Status however because of potential habitat quality degradation associated with sediment inputs and the low flow conditions which may be exacerbated by water withdrawals in this subwatershed. It is unclear whether or not the sandy substrates that presently predominate the lower reach of the brook are natural, or whether sediments from the sand and gravel operations have impacted the brook over time. The potential impacts associated with the water withdrawals are also unknown.

Primary and Secondary Contact Recreation and Aesthetics Uses
MassDEP DWM conducted bacteria monitoring in Beaver Brook at Station BV01 on five dates between April and September 2002. *E. coli* counts ranged from 20 to 530 cfu/100 ml (Appendix B, Table 4) and two of the five counts exceeded 235 cfu/100 ml.

Some failing or otherwise inadequately treated wastewater from septic systems was identified as discharging leachate into the town's aquifers (MassDEP 2002c).

MassDEP DWM recorded field observations on 14 dates between April and September 2002 (Appendix B). The water column was clear with no odor, scum or other objectionable conditions on all survey dates, except for one date after a rainfall when the water clarity was recorded as slightly turbid. No aquatic plant or periphyton growth was observed in-stream on the survey dates.

Based on the elevated *E. coli* bacteria data, Beaver Brook is assessed as impaired for the *Primary Contact Recreation Use*, but supports the *Secondary Contact Recreation Use*. Based on the absence of objectionable conditions, Beaver Brook is assessed as supporting the *Aesthetics Use*.

Beaver Brook (Segment MA72-12) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Elevated *E. coli* Source: Unknown Suspected source: failing on-site residential septic systems
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Conduct additional field reconnaissance to identify any areas contributing to instream sediment deposition. Develop and implement remediation plans to reduce sediment inputs to the river where necessary.

Conduct additional bacteria monitoring to evaluate current conditions. Bacteria source tracking should be conducted to verify elevated counts and identify sources. Source(s) should be remediated as necessary. Determine whether or not sewer connections are planned or have been implemented in this subwatershed.

Additional monitoring and evaluation of flow conditions should be conducted in Beaver Brook to assess the *Aquatic Life Use*.

HOPPING BROOK (SEGMENT MA72-35)
Location: Source in Cedar Swamp, Holliston to the confluence with the Charles River, Bellingham/Medway.
Segment Length: 4.9 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 11.0 mi^2 subwatershed.
- Forest..... 60%
- Residential..... 27%
- Open land 8%

The estimated percent impervious area for this subwatershed area is 7.2%.

This is a new segment so it does not appear on the 2006 Integrated List.

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Holliston Water Department (9P422013602, 22013601)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
On 15 July 2002 DWM biologists conducted a habitat assessment of Hopping Brook downstream from West Street in Medway (Station HB01). This site received a total habitat assessment score of 136 out of a possible 200 (Appendix C). The stream was two meters wide and shaded well by riparian trees. Benthic habitat was characterized as good with a diverse mix of substrate (cobble, pebble and old dam remnants) and with mosses providing additional microhabitat. The effects of drought (channel flow status marginal, exposed substrates and lack of fish habitat) along with observed in-stream sediment deposition contributed most to habitat scoring reductions. A habitat assessment was also conducted on 8 August 2002 by DWM biologists. Poor channel flow status, limited velocity/depth combinations, a limited vegetative riparian zone width, as well as sediment deposition, were found to limit habitat quality. The overall habitat assessment score was 155 out of 200 (Appendix G).

Streamflow estimates of Hopping Brook at Route 126 between Beach and Village Streets in Bellingham (Station 148T) from July 2002 through December 2005 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 0.1 to 362 cfs. The average flow for the period of record was 37.5 cfs. The lowest average monthly flows were documented between July through October 2002 (0.59 to 1.5 cfs), in September 2003 (2.37 cfs), and August and September 2005 (0.53 to 1.14 cfs).

Biology
DWM biologists noted that approximately 10% of the reach was covered with mosses. Other aquatic vegetation (submerged macrophytes and algae) was also sparse. The RBP III analysis indicated that the benthic community sampled from Hopping Brook was slightly impacted compared to the Stony Brook reference station (ST01) (Appendix C). In-stream sedimentation was identified as a major concern for this waterbody.

Backpack electroshocking at four sites along Hopping Brook was conducted in August and September 2002 (Appendix G and Richards 2006). The fish community was heavily dominated by redfin pickerel and other macrohabitat generalists. White sucker (n=2) and one stocked brown trout were the only fluvial species collected. Although there appears to be adequate fish habitat present under higher flow conditions, the low flow conditions encountered during the surveys limited available habitat (Maietta 2007).

Water Chemistry
One water quality monitoring station on Hopping Brook at Route 126 between Beach and Village Streets in Bellingham (Station 148T) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16

and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Continuous *in-situ* temperature measurements of Hopping Brook at this site were also taken from July 2002 through December 2005 at 15-minute intervals as part of these projects.

The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the six surveys conducted, all *in-situ* data (with the exception of one low DO measurement (2.0 mg/L recorded on 15 August 2002) met criteria. Results of the other water quality samples indicated slightly elevated total phosphorus levels during wet weather sampling in October 2004 (0.08 mg/L maximum). The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 25.9°C (n=121,649 measurements).

The *Aquatic Life Use* is assessed as support based primarily on the benthic macroinvertebrate community data. This use is identified with an Alert Status because of the very low flow conditions encountered that resulted in exposed substrates and lack of fish habitat during the summer of 2002 and the relative absence of fluvial fish species. In-stream sedimentation and riparian zone habitat degradation were also noted concerns.

Primary and Secondary Contact Recreation and Aesthetics Uses

One water quality monitoring station on Hopping Brook at Route 126 between Beach and Village Streets in Bellingham (Station 148T) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Bacteria samples were collected on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* data reported are summarized below.

E. coli Counts for CRWA Station 148T (cfu/100 ml)					
13-Aug-02	16-Oct-02	17-Oct-02	19-Oct-04	20-Oct-04	24-Aug-05
Dry	Wet	Wet	Wet	Wet	Dry
3000	300	<100	100	<100	100

DWM biologists described the water column in Hopping Brook downstream from West Street, Medway **(**Station HB01) to be clear and free of objectionable conditions such as oils, odors, and other deposits (MassDEP 2002b).

Too few bacteria data are available to effectively assess *Primary* and *Secondary Contact Recreational* uses (i.e., six samples over four years) so these uses are not assessed. The *Aesthetics Use* is assessed as support due to the lack of objectionable deposits.

Hopping Brook (Segment MA72-35) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

* Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

DWM biologists recommend the following (Appendix C):

investigate possible sources of sediment inputs—implement BMPs as needed and outreach to address NPS inputs (yard waste) from adjacent residences.

Field reconnaissance should be conducted to examine potential source(s) contributing to low streamflow conditions (e.g., beaver activity, impoundments, culverting). Additional monitoring and evaluation of flow conditions should be conducted in Hopping Brook to assess the *Aquatic Life Use*.

USGS estimated base flow (the portion of streamflow originating from ground-water recharge to streams) at the mouth of Hopping Brook (Station HB2) under dry and average weather conditions and for three water-use scenarios (no withdrawals, average withdrawals, and maximum permitted pumping) (Eggleston 2004). USGS has indicated the aquifer below Hopping Brook is limited in extent and therefore has less ability to augment summer base flow compared to other areas in the Upper Charles River Watershed. This information may be helpful to better understand flow regimes in this system.

Conduct long-term monitoring (DO and temperature) to assess the *Aquatic Life Use*.

Additional bacterial sampling should be conducted over a single recreation season to assess the *Primary* and *Secondary Contact Recreational* uses.

MINE BROOK (SEGMENT MA72-14)
Location: Headwaters in Franklin State Forest, Franklin to the confluence with the Charles River, Franklin.
Segment Length: 8.9 miles
Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 15.8 mi^2 subwatershed.
Forest..... 43%
Residential..... 28%
Open land 10%
The estimated percent impervious area for this subwatershed area is 14.3%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown and other habitat alterations (MassDEP 2007).

Note: Mine Brook Pond (MA72077) will not be assessed as a lake segment in this report. This 4.7-acre waterbody will be considered a run-of-the river impoundment. Examination of orthographic images was used to determine the status since there was no dam data available to use to estimate retention time (McVoy 2006). This pond was on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and turbidity (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Franklin DPW Water Division (9P42010101, 42010102)
Maplegate Country Club (9P222010102)
Stanley Marszalkowski (V22010101) (Note registration terminated in 2003.)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
On July 15, 2002 MassDEP DWM biologists conducted a habitat assessment of Mine Brook downstream from Route 140 in Franklin, MA (Station MB02). The reach received a total habitat assessment score of 130 out of a possible 200 (Appendix C). In-stream habitat was most negatively impacted by sedimentation and trash deposits. The removal of riparian vegetation and small width of the riparian zone along the left bank and shallow water levels also negatively impacted habitat quality. On 5 August 2002 DWM biologists also conducted electrofishing in the brook at station MB02. The sampled reach was of moderate gradient and contained mostly riffle/run habitat. Pools were lacking. The limited vegetative zone and limited velocity-depth combinations were the most limiting of the assessed factors. The final habitat score was 144 (of a possible 200) (Appendix G).

DWM conducted water quality monitoring in Mine Brook near Pond Street in Franklin (Station MB01) in 2002 (Appendix B). The brook was 20 to 30 feet wide in this reach. By early June the water level in the brook had dropped approximately 1 foot from an original depth of 1.5 to 2 feet, however, there were very few exposed substrates and the station remained a large riffle area. The land use in the Mine Brook subwatershed is mostly forest and residential, but the brook runs through wetland habitat for approximately 2.5 miles upstream from Station MB01.

Although no Quality Assurance Project Plan was approved for this project, CRWA staff completed habitat assessments in Mine Brook just upstream from the confluence with the Charles River on three occasions: 6 December 2001, 30 May 2002, and 15 July 2002 (CRWA 2002). Habitat quality was found to be limited most by flow conditions (scoring in the suboptimal range for channel flow status and velocity/depth regimes) as well as some evidence of sedimentation. However, overall habitat quality was good.

Streamflow estimates of Mine Brook near Pond Street in Franklin (Station 157T1) from July 2002 through December 2005 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 0.9 to 259 cfs. The average flow for the period of record was 32.1 cfs. The lowest average monthly flows were documented between July and August 2002 (2.63 to 2.77 cfs) and August 2005 (2.56 cfs).

Biology

The RBP III analysis indicated that the benthic community in Mine Brook (Station MB02) was slightly impacted compared to the reference station, ST01 (Appendix C). DWM biologists found a diverse assemblage of macroinvertebrates at this station relative to the reference station and although a low EPT index was found, the EPT index at this station was one of the highest in the Charles River Watershed during 2002 sampling (Appendix C). This site "appears to support a fairly well-balanced community" (Appendix C).

DWM biologists conducted electrofishing in Mine Brook downstream from Route 140 in Franklin in August 2002 (Appendix G). Fish species captured included yellow bullhead, and an individual each of brown trout, golden shiner (*Notemigonus crysoleucas)*, pumpkinseed, and redfin pickerel. Fish sampling efficiency at MB02 was rated as good. Although a few additional cyprinids were observed but not netted, the total number of fish collected (or observed) was very low for the amount of habitat available. The brown trout was the only fluvial species collected, but it appeared to be a stocked fish as evidenced by deformed pectoral fins. The remaining fish captured were macrohabitat generalists which are tolerant or moderately tolerant of pollution.

DWM biologists collected three periphyton samples at benthic Station MB02 on July 15, 2002 (Appendix C). Canopy cover at Station MB02 was reported as 90%, algal cover was <5%, and the dominant algal genera was Chlorophyceae-*Rhizoclonium* sp. (Appendix F).

On 19 August 2003, MA DFG biologists conducted barge shocking in Mine Brook upstream from Pond Street in Franklin (Richards 2006). The stream reach sampled was a very low gradient section in a wetland meadow. A total of 10 species (n=197 fish) were collected. The community was dominated by redfin pickerel and other macrohabitat generalists, but two species of fluvial specialists were also collected (creek chubsucker - *Erimyzon oblongus* and white sucker).

By early June moderate coverage of aquatic plants and periphyton were observed by DWM personnel in Mine Brook near Pond Street (Station MB01). The plant growth was mainly emergent grasses and arrowhead (*Sagittaria* sp.) in the stream channel and cattails (*Typha* sp.) on the shoreline. By early July sparse coverage (approximately 25%) of green algal mats and green filamentous algae were present on the substrates and on plants. They remained through September.

Water Chemistry

Mine Brook was sampled by DWM near Pond Street (Station MB01) on 10 occasions for multiprobe parameters only in 2002. (Note: the first survey on 29 April 2002 mistakenly took place at Beech Street in Franklin, which is one road crossing upstream from Pond Street. These data can be found in Appendix B, Table 3 as Station MB01B). Two of the ten DO measurements were slightly (~0.1 mg/L) below the standard (5.0 mg/L) and two pH measurements were slightly low (6.4 SU).

One water quality monitoring station on Mine Brook near Pond Street in Franklin (Station 157T1) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and two sampling events on 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Continuous *in-situ* temperature measurements of Mine Brook at this site were also taken from July 2002 through December 2005 at 15-minute intervals as part of these projects. The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the six surveys conducted, two DO concentrations were below 5.0 mg/L (2.75 and 4.1 mg/L measured during both dry weather sampling events), and two pH measurements were very low during one storm event (5.5 and 5.7 SU). Results of the other water quality samples indicated one slightly elevated total phosphorus level of 0.07 mg/L during a wet weather survey.

The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 31.7°C (n=121,299 measurements). The highest measurements (>28.3°C) occurred in both July and August 2002 and 2005. The warm water fishery temperature criterion (28.3°C) was exceeded on 17 days for a total of 96.75 hours. The average amount of time above 28.3°C was 5.7 hours per day for those days where an exceedance occurred. The number of days per year with an exceedance was 14 for 2002 and 3 for 2005 (CRWA 2006).

The *Aquatic Life Use* for Mine Brook is assessed as impaired because of the frequency and magnitude of elevated water temperatures documented in the summers of 2002 and 2005, which exceeded the warm water fishery criterion of 28.3°C. The low number of fish and the relative absence of fluvial species suggest water and/or habitat quality problems. Low DO and pH were noted as concerns for this brook. While the benthic community analysis indicated a fairly well-balanced community, in-stream habitat was limited most by sedimentation and trash deposits, removal of riparian vegetation and small width of the riparian zone along the left bank, and shallow water levels. The Mine Brook sub-watershed has undergone an incredible amount of development (commercial and industrial) over the last 20 years, especially in the vicinity of Route 140 putting it at risk from road and stormwater runoff from impervious areas. Water withdrawals are also a concern.

Primary and Secondary Contact Recreation and Aesthetics Uses

DWM biologists noted that the water column in Mine Brook downstream from Route 140 in Franklin (Station MB02) was slightly turbid and considerable amounts of in-stream trash and moderate sedimentation were observed (Appendix C). No other objectionable conditions (e.g., oils, odors) were noted.

One water quality monitoring station on Mine Brook near Pond Street in Franklin (Station 157T1) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and two sampling events on 19 October 2004 (CRWA 2004a and CRWA 2006). Three of the six bacteria samples collected exceeded 235 cfu/100 ml for *E. coli* (maximum count of 400 cfu/100 ml). The high counts represented wet weather samples. Follow-up bacteria source tracking efforts in 2006 by DWM confirmed elevated counts during wet weather sampling conditions (Meek 2007).

DWM field survey crews noted that water column was slightly turbid in the brook near Pond Street in Franklin (Station MB01) with no odor, scum or other objectionable conditions on the survey dates. Occasionally naturally occurring organic foam was present.

Too few bacteria data are available to effectively assess *Primary* and *Secondary Contact Recreational* uses (i.e., six samples over four years) so these uses are not assessed. The *Primary Contact Recreational Use* is identified with an Alert Status because several samples exceeded 235 cfu/100 mL. The *Aesthetics Use* is assessed as support due to the lack of objectionable deposits.

Mine Brook (Segment MA72-14) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Elevated temperature Source: Unknown Suspected sources: Combination of factors including loss of riparian habitat, impervious surface/parking lot runoff
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

DWM biologists recommend the following (Appendix C):

BMPs to address sediment deposition from road runoff at Route 140,
improve vegetative buffer along left bank,
stream clean-up to address trash along left bank and in-stream, and
signage to discourage dumping along Route 140.

Additional monitoring and evaluation of flow conditions should be conducted in Mine Brook.

Conduct long-term monitoring (DO and temperature) to assess the *Aquatic Life Use*.

Conduct additional bacteria sampling to better evaluate *Primary* and *Secondary Contact Recreational Uses*. Follow-up bacteria source tracking to identify sources if counts are elevated.

USGS estimated base flow (the portion of streamflow originating from ground-water recharge to streams) at the mouth of Mine Brook (Station MB2) under dry and average weather conditions and for three water-use scenarios (no withdrawals, average withdrawals, and maximum permitted pumping) (Eggleston 2004). This information may be helpful to better understand flow regimes in this system.

CHICKEN BROOK (SEGMENT MA72-34)
Location: Source, outlet Waseeka Sanctuary Pond, Holliston to the confluence with the Charles River, Medway.
Segment Length: 7.4 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 6.9 mi^2 subwatershed.
Forest..... 46%
Residential..... 31%
Agriculture..... 11%
The estimated percent impervious area for this subwatershed area is 9.6%.

This is a new segment so it does not appear on the 2006 Integrated List.

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
There are no registered/permitted sources in the Chicken Brook subwatershed.
NPDES (SEE APPENDIX H, TABLE H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Chicken Brook was sampled by DWM twice near Prentice Street in Holliston (Station CK06) and on ten occasions near Washington Street in Holliston (Station CK05) in 2002. The brook was approximately 5 feet wide in April and June but by early July drops in water level resulted in exposed substrates and reduced velocities (velocity decreased from medium velocity with fast riffles in June to low velocity in July and almost no velocity in August) (Appendix B).

On 15 July 2002 DWM biologists conducted a habitat assessment of Chicken Brook downstream from Winthrop Street in Medway (Station CK01). The total habitat assessment score was 158 out of a possible 200 (Appendix C). While epifaunal habitat was considered excellent given the abundance of cobble substrate there was a lack of good fish habitat with the exception of overhanging bank vegetation and channel flow status was also noted as suboptimal.

DWM fisheries biologists also conducted a habitat assessment of Chicken Brook near the confluence with the Charles River in August 2002. The final habitat score was 139 (of a possible 200) (Appendix G). Habitat quality was limited most by low flow conditions present.

Streamflow estimates of Chicken Brook near Cottage Street in Medway (Station 159T) from July 2002 through March 2006 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 0.2 to 333 cfs. The average flow for the period of record was 11.8 cfs. The lowest average monthly flows were documented between July through September 2002 (0.85 to 1.8 cfs) and August and September 2005 (1.0 to 1.43 cfs).

Biology
DWM biologists collected one periphyton sample from the brook near Winthrop Street in Medway (Station CK01) on 15 July 2002 (Appendix C). Canopy cover was reported as 30%, algal cover was <5%, and the dominant algal genera was Chlorophyceae-siphonous filamentous (Appendix F). DWM biologists noted mosses, small areas of bur-reed (*Sparganium* sp.), and water starwort (*Calltriche* sp.) but characterized the aquatic vegetation and algal cover as minimal (Appendix C).

The RBP III analysis indicated that the benthic macroinvertebrate community of Chicken Brook was slightly impacted compared to the reference tributary (Appendix C). DWM biologists found a high density of chironomids and many filter-feeding caddisflies, which "may be indicative of elevated organic enrichment" (Appendix C). This station was also found to have a low EPT index (taxa that are sensitive to organic enrichment).

Fish species captured in order of abundance included brown bullhead (*Ameiurus nebulosus*), bluegill, pumpkinseed, chain pickerel (*Esox niger*), redbreast sunfish, largemouth bass, redfin pickerel, yellow bullhead and white sucker (Appendix G). All fish collected (with the exception of an individual white sucker)

are macrohabitat generalists either tolerant or moderately tolerant to pollution. The majority of fish collected (65%) were young-of-the-year macrohabitat generalists, though the presence of impoundments upstream may be contributing young-of-the-year to this reach of Chicken Brook. This population distribution indicates that in-stream flow may be a problem in this sub-basin. Flows were very low during the survey.

Water Chemistry

Chicken Brook was sampled by DWM twice near Prentice Street in Holliston (Station CK06) and on ten occasions near Washington Street in Holliston (Station CK05) in 2002. Both DWM Chicken Brook stations were sampled for multiprobe parameters and nutrients. These data can be found in Appendix B, Tables 3 and 4 (Stations CK06 and CK05). All data collected indicated good water quality.

One water quality monitoring station on Chicken Brook near Cottage Street in Medway (Station 159T) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Continuous *in-situ* temperature measurements of Chicken Brook at this site were also taken from July 2002 through March 2006 at 15-minute intervals as part of these projects. The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the six surveys conducted, one DO concentration was below 5.0 mg/L (2.83 mg/L measured during dry weather survey in August 2002), and one pH measurement was slightly low during one storm event (6.2 SU – 16 October 2002). Results of the other water quality samples indicated two elevated total phosphorus and chlorophyll *a* concentrations during a wet weather survey (0.18 and 0.08 mg/L for phosphorus and 11 and 30 µg/L for chlorophyll *a* in October 2002).

The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 30.3°C (n=130,708 measurements). The highest measurements (>28.3°C) occurred in both July 2002 and 2005. The warm water fishery temperature criterion (28.3°C) was exceeded on 3 separate days (twice in 2002 and once in 2005) for a total of 14.5 hours of exceedance. The average amount of time above 28.3°C was 4.8 hours per day for those days where an exceedance occurred (CRWA 2006). While these exceedances are of concern, they were not frequent or prolonged.

The *Aquatic Life Use* for Chicken Brook is assessed as support based primarily on the benthic community data and the generally good water quality conditions. However, this use is identified with an Alert Status because of elevated temperature documented in the summers of 2002 and 2005 that exceeded the warm water fishery criterion of 28.3°C as well as the low number of fish and the absence of fluvial species and year class distribution. Discharge of the brook during the summers of both 2002 and 2005 was also extremely low and low DO during low flow periods and low pH and elevated total phosphorus concentrations during a storm event are also noted as concerns.

Primary and Secondary Contact Recreation and Aesthetics Uses

DWM personnel recorded field observations during the surveys conducted between April and September 2002 at two locations along Chicken Brook: Prentice Street in Holliston (Station CK06) and near Washington Street in Holliston (Station CK05). The water column at Station CK05 was slightly turbid, with no odor or scum from June to September. No other objectionable conditions were noted except for silt deposits on the stream bottom. A few emergent aquatic plants were present, along with some moss on rocks. A total of five bacteria samples were collected by DWM at these two stations – CK06 and CK05 (Appendix B, Table 4). Of these, a single *E. coli* count exceeded the primary contact standard (235 cfu/100 ml). This count (290 cfu/100 ml) likely represented dry weather conditions.

DWM biologists noted on 15 July 2002 that the water was clear in the brook near Winthrop Street in Medway (Station CK01). No other objectionable conditions were noted either (e.g., oils, odors, other deposits).

One water quality monitoring station on Chicken Brook near Cottage Street in Medway (Station 159T) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). One of the six bacteria samples (2,800

cfu/100 ml) exceeded both the primary (235 cfu/100 ml) and secondary contact (1,260 cfu/100 ml) water quality criteria for *E. coli*. This count represented a wet weather sample.

The *Primary and Secondary Contact Recreation Uses* are assessed as support based primarily on the low *E. coli* bacteria counts. However, these uses are both identified with an Alert Status because of single sample exceedance during the primary and secondary contact recreational seasons (290 cfu/100 ml at CK05 and 2,800 cfu/100 ml at 159T, respectively). The *Aesthetics Use* is assessed as support due to the lack of objectionable conditions.

Chicken Brook (Segment MA72-34) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT*
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

DWM biologists recommend the following (Appendix C)

Water quality monitoring during next DEP Charles River watershed survey to determine sources (e.g., golf course, agriculture) of nutrient and/or organic inputs.

Additional monitoring and evaluation of flow conditions should be conducted in Chicken Brook.

Conduct long-term monitoring (DO and temperature) to assess the *Aquatic Life Use*.

Additional bacterial sampling (minimum of five samples in a sampling season) should be conducted to assess the *Primary* and *Secondary Contact Recreation* uses.

Evaluate potential ways to reduce in-stream temperatures in Chicken Brook (e.g., removal of small dams, riparian zone protection/restoration, improving shading, etc.).

CHARLES RIVER (SEGMENT MA72-05)
Location: Outlet Populatic Pond, Norfolk/Medway to South Natick Dam, Natick.
Segment Length: 18.1 miles
Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 155.9 mi^2 subwatershed.
Forest..... 47%
Residential..... 30%
Open land 7%
The estimated percent impervious area for this subwatershed area is 10.4%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of unknown toxicity, metals, nutrients, organic enrichment/low DO, noxious aquatic plants, turbidity, pathogens and other habitat alterations(MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Millis Water Department registration/permit (22018702/9P422018703)
Tresca Brothers Sand & Gravel Inc (22018701)
Medfield Water Department (22017501/9P22017502)
Norfolk Water Department (22020802/9P22020801)
NPDES (See Appendix H, Tables H2 and H4)
Charles River Pollution Control District (CRPCD) (MA0102598)
Town of Medfield (MA0100978)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
The Charles River was sampled by DWM over the course of the summer of 2002 at three sampling locations along this segment. From upstream to downstream the sampling stations are as follows. downstream from Dean Street in Millis (Station CR51.6), upstream from Route 27 in Medfield (Station CR41.8), and off Route 16 upstream from the confluence with Davis Brook in Natick (Station CR36.3) (Appendix B). The river was approximately 60 to 70 feet wide at the most upstream station (CR51.6). Good riffle areas were present throughout the survey dates and large cobbles were the only substrate exposed. On 15 July 2002 DWM biologists conducted a habitat assessment of the Charles 120 m downstream from Dean Street, Millis (Station CR04). This site received a total habitat assessment score of 147out of a possible 200 (Appendix C). Less than optimal in-stream cover for fish, sediment deposition (bar formation), and the uniform velocity-depth regime limited habitat quality most. Both stream banks were stabilized with “rip-rap”. This sampling station was downstream from the CRPCD discharge.

Further downstream near Route 27 in Medfield (Station CR41.8) the Charles River was between 80 to 100 feet wide and was deep (> 4 feet) with open canopy (Appendix B). Both water level and velocity were relatively constant throughout the 2002 surveys. This sampling station was downstream from the Medfield WWTP discharge.

The Charles River was approximately 120 to 140 feet wide off of Route 16 in Natick (Station CR36.6) but was wadable and had an open canopy (Appendix B). Velocity was observed to decrease slightly over the sampling season and the water level dropped approximately a foot, but no substrates were exposed during the 2002 surveys.

Biology
In September 2004 a cyanobacteria bloom (primarily *Oscillatoria* sp.) was recorded by DWM staff throughout this segment of the Charles River (Connors 2004 and Beskenis 2007a).

On 25 July 2002 MA DFG biologists conducted boat electrofishing in the Charles River downstream from Populatic Pond (Richards 2006). MA DFG noted that large mats of filamentous algae were clinging to anodes and cathodes and that the water was very turbid. A total of 183 fish were collected representing 11 species. The dominant taxa were bluegill (n=79), largemouth bass, white perch (*Morone Americana*, n=26) and yellow perch (*Perca flavescens*, n=20). White sucker (n=4) and two large rainbow trout (*Oncorhynchus mykiss*, both large and likely stocked) were the only fluvial species present. All species

collected (except for the rainbow trout) are classified as being tolerant or moderately tolerant to pollution. Given the lentic nature of this reach of the Charles River and its proximity to Populatic Pond, the fish assemblage is consistent with the type of habitat present.

While only sparse amounts of milfoil (*Myriophyllum* sp.) were observed in the Charles River downstream from Dean Street in Millis (Station CR51.6) in early June, by July aquatic plant coverage was moderate. Dense coverage of green filamentous algae on substrates was observed from early June through August (Appendix B). DWM biologists also noted the dense growth of aquatic vegetation (virtually 100% cover) and filamentous green algae in riffles and pools (almost 50% of the reach) when they conducted the benthic macroinvertebrate sampling in the river near Dean Street (Station CR04) (Appendix C). Dominant algae genera collected at this site in the slow moving area were Chlorophyceae-*Ulothrix* sp. and *Mougeotia* sp., while Bacillariophyceae-*Melosira* sp. and *Fragilaria* sp. were found in the faster moving riffle area (Appendix F). Compared to the upstream reference on the Charles River (Station CR03), the RBP III analysis indicated the benthic community downstream from Dean Street in Millis (Station CR04) was moderately impacted (Appendix C).

The non-native aquatic macrophyte fanwort (*Cabomba caroliniana*) was documented in the Charles River in Medway and in the South Natick Dam impoundment during the survey conducted by CRWA in August 2005 (CRWA 2006). Water chestnut (*Trapa natans*) was also documented in the South Natick Dam impoundment.

Toxicity

Effluent

Both acute and chronic whole effluent toxicity tests have been conducted on the CRPCD treated effluent (MA0102598). With the exception of the most recent *C. dubia* test event (April 2007), acute toxicity was not detected by either *C. dubia* or *P. promelas* in the tests conducted between January 2000 and April 2007 (n=32 and 30, respectively). The LC_{50} was only 42.5% effluent for the *C. dubia* test conducted in April 2007. Results of the *C. dubia* chronic whole effluent toxicity tests (n=29 valid chronic tests) ranged from 12.5 to 100% effluent and with the exception of the April 2000 and the April 2007 test events (CNOEC = 50 and 12.5% effluent, respectively) met the CNOEC limit of $\geq$ 63% effluent (TOXTD database). The results of the *P. promelas* chronic whole effluent toxicity tests ranged from 6.25 to 100% effluent (n= 30 tests). Five chronic test events did not meet the 63% limit (July and October 2000, July 2001, and April 2002 CNOECs = 6.25% effluent, and July 2006 CNOEC = 12.5% effluent). The January 2004 and 2005 test results also indicated significant reductions in growth and survival, respectively, in the 12.5% effluent test concentration, although these tests results were both reported as CNOEC = 100% effluent.

Acute and chronic whole effluent toxicity tests have been conducted on the Medfield WWTP treated effluent. Acute toxicity was detected in two of the 29 *C. dubia* test events conducted between February 2000 and April 2007. Acute toxicity was detected in the effluent in April 2001 and April 2003 (LC_{50} = 80.40 and 32.10% effluent, respectively). Chronic toxicity test results for *C. dubia* ranged from <6.25 to 100% effluent with two tests that failed to meet the permit limit (CNOEC $\geq$ 19% effluent). These two tests were April and July 2006 with CNOECs =12.5 and <6.25% effluent, respectively. Neither acute nor chronic toxicity was detected by *P. promelas* in the three tests conducted in 2000 (February, August and November).

Water Chemistry

CRWA sampled six locations along this segment of the Charles River - behind 6 Lake Path in Norfolk (Station 201S), 58 River Road in Norfolk (Station 207S), Route 115 Baltimore Street in Millis (Station 229S), Old Bridge Street in Medfield (Station 290S), downstream from the Medfield WWTP discharge (Station 294S), and Route 27 Bridge in Medfield (Station 318S) as part of the Upper Charles River Watershed TMDL Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16, 17, and 18 October 2002 and 19, 20, and 21 October 2004 (CRWA 2004a and CRWA 2006). Two additional stations were sampled on a monthly basis --Charles River at the Dwight Street Bridge in Millis (Station 267S) and Farm Road/Bridge Street in Dover/Sherborn (Station 343S). The Charles River was also sampled at three stations by DWM between April and September 2002. From upstream to downstream these sampling stations are as follows. downstream from Dean Street in Millis (Station CR51.6), upstream from Route 27 in Medfield (Station CR41.8), and off Route 16 upstream from the confluence

with Davis Brook in Natick (Station CR36.3) (Appendix B). Water quality monitoring (*in-situ* measurements of DO and temperature) as well as total phosphorus, chlorophyll *a*, and pheophytin *a* samples were taken along this segment of the Charles River on 21 June 2005– at one location just downstream from Populatic Pond, Norfolk and at three locations above the South Natick Dam, Natick (Schlezinger and Howes 2006). These data are summarized as follows from upstream to downstream.

Water quality monitoring (*in-situ* measurements of DO and temperature) as well as total phosphorus, chlorophyll *a*, and pheophytin *a* samples were taken at the surface and bottom of one location just downstream from the Populatic Pond impoundment on 21 June 2005 (Schlezinger and Howes 2006). DO was $\geq$ 8.8 mg/L. Both total phosphorus and chlorophyll *a* concentrations were fairly low ranging from 0.045 to 0.047 mg/L and 3.77 and 4.75 µg/L, respectively.

The CRWA collected several types of water quality data at behind 6 Lake Path in Norfolk (Station 201S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, all of the DO, pH and temperature measurements met water quality criteria. Total phosphorus concentrations ranged from 0.0386 to 0.0835 mg/L (n=9 including one duplicate sample). Six measurements were slightly elevated ($\geq$ 0.05 mg/L). Chlorophyll *a* concentrations were highest during the dry weather surveys in August 2002 and August 2005 (concentrations reported as 41.6 and 22 µg/L, respectively).

The CRWA collected several types of water quality data at 58 River Road in Norfolk (Station 207S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. (This sampling location was downstream from the Charles River Pollution Control District (MA0102598) discharge.) Of the surveys conducted, all of the DO, pH and temperature measurements met water quality criteria. Total phosphorus concentrations ranged from 0.043 to 0.0717 mg/L (n=8 excluding one duplicate sample). Five measurements were slightly elevated ($\geq$ 0.05 mg/L). Chlorophyll *a* concentrations were elevated in one sample (38 µg/L during the dry weather survey in August 2002). CRWA staff also deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity in the river at this location between 23 August 2002 and 27 August 2002 at a depth of approximately 3.3 feet. DO concentrations were not less than 7.95 mg/L and were as high as 13.15 mg/L. Saturations ranged from 89 to 152% (CRWA 2004a). The maximum temperature was 24.1°C. Dissolved oxygen depletion only seems to occur near the sediment-water interface in the deepest part of the channel when depth profiles were conducted (CRWA 2004a).

MassDEP DWM conducted water quality monitoring of the Charles River at Dean Street in Millis (downstream from the Charles River Pollution Control District (MA0102598) discharge) (Station CR51.6) between April and September 2002 (Appendix B). In-stream DO concentrations were good ranging from 7.8 to 10.9 mg/L (n=10) representing both daytime and worse case (pre-dawn) conditions. The maximum temperature was 26.8°C and all pH measurements (6.8 to 7.9 SU) met criteria. The diurnal variation of DO for this site was as high as 2.0 mg/L. Saturations ranged from 82 to 119%. Total phosphorus concentrations ranged from 0.028 to 0.061 mg/L and were slightly elevated in one of the four samples. Total suspended solids were all low ($\leq$ 5.5 mg/L, n=5).

As part of the TMDL project and volunteer monitoring program the CRWA also collected water quality data from the river at Route 115 Baltimore Street in Millis (Station 229S) (CRWA 2007). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, ammonia-nitrogen, and chlorophyll a were all indicative of good water quality. One total phosphorus concentration was slightly elevated (0.054 mg/L) measured in October 2002 during a wet weather sampling event. The monthly data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between February 2000 and September 2006 (n=61) exceeded 28.3°C (maximum 26.0°C). A total of 18 pH measurements were taken at Station 229S between February 2000 and April 2002. The pH measurements ranged from 6.3 to 7.3 SU and only one measurement was <6.5 SU. Total suspended solids concentrations were all low ($\leq$ 11 mg/L, n=38).

CRWA collected monthly data for the Charles River at the Dwight Street Bridge in Millis (Station 267S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between April 2000 and October 2006 (n=55) exceeded 28.3°C (maximum 28.0°C). A total of 12 pH measurements were taken at Station 267S between February 2000 and April 2002. The pH measurements ranged from 6.1 to 7.6 SU and only one measurement was <6.5 SU. Total suspended solids concentrations were all low (≤ 9.2 mg/L, n=29).

CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity in the Charles River slightly downstream from the confluence with the Stop River between 29 August 2002 and 3 September 2002 at a depth of approximately 2.5 feet. DO concentrations were not less than 6.75 mg/L and were as high as 10.53 mg/L. Saturations ranged from 74 to 115% (CRWA 2004a). The maximum temperature was 21.31°C. Dissolved oxygen depletion did not occur near the sediment-water interface when depth profiles were conducted (CRWA 2004a).

As part of the TMDL and volunteer monitoring program the CRWA also collected monthly water quality data from the river at Old Bridge Street in Medfield (Station 290S) (CRWA 2007). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples (n=8 excluding duplicates) were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, ammonia-nitrogen, and chlorophyll a were all indicative of good water quality. Total phosphorus concentrations were also low (maximum concentration 0.047 mg/L). The monthly data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between March 2000 and October 2006 (n=62) exceeded 28.3°C (maximum 27.0°C). A total of 18 pH measurements were taken at Station 290S between February 2000 and April 2002. The pH measurements ranged from 6.1 to 7.6 SU and only two measurement was <6.5 SU. Total suspended solids concentrations were all low (≤ 12 mg/L, n=40). Total phosphorus concentrations at this sampling location ranged from 0.037 to 0.131 with 20 measurements exceeding 0.05 mg/L (n=24). The maximum ammonia-nitrogen concentration was low (0.5 mg/L, n=25). Chlorophyll *a* concentrations were all ≤16μg/L with the exception of one high measurement (29.9 μg/L in September 2000, n=14).

The CRWA collected several types of water quality data from the river downstream from the Medfield WWTP discharge (Station 294S) including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, all of the DO, pH and temperature measurements met water quality criteria. Total phosphorus concentrations ranged from 0.041 to 0.1 mg/L (n=8) with half of the samples slightly elevated (≥ 0.05 mg/L). Chlorophyll *a* concentrations were all low (≤ 15 µg/L).

MassDEP DWM conducted water quality monitoring of the Charles River at Route 27 in Medfield/Sherborn (Station CR41.8) between April and September 2002 (Appendix B). In-stream DO concentrations were good ranging from 6.7 to 10.8 mg/L (n=10) representing both daytime and worse case (pre-dawn) conditions. Saturations ranged from 72 to 131%. The maximum temperature was 27.8°C and all pH measurements (6.6 to 8.3 SU) met criteria. The diurnal variation of DO for this site was up to 1.9 mg/L. Total phosphorus concentrations ranged from 0.035 to 0.086 mg/L and were slightly elevated in two of the four samples. Total suspended solids concentrations were all low (≤ 7.7 mg/L, n=5). The CRWA also collected TMDL and monthly water quality data from the river at Route 27 Bridge in Medfield (Station 318S) (CRWA 2007). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples (n=8 excluding duplicates) were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, and ammonia concentrations were all indicative of good water quality. Total phosphorus concentrations ranged from 0.037 to 0.068 mg/L. Five of eight samples exceeded 0.05 mg/L representing both dry and wet weather sampling conditions. The maximum chlorophyll *a* concentration was 19.3 µg/L, but only one of the eight samples was >16 ug/L. The monthly data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. One of the temperature measurements taken between April 2000 and October 2006 (n=61) exceeded 28.3°C (maximum 30.0°C). A total of 18 pH measurements were taken at Station 318S between February 2000 and April 2002. The pH measurements ranged from 6.1 to 7.4 SU and only one measurement was <6.5 SU. Total suspended

solids concentrations were as high as 34 mg/L, but only two samples were ≥ 25 mg/L (n=39). CRWA staff also deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity in the Charles River at the Route 27 bridge between 28 August 2002 and 3 September 2002. DO concentrations were not less than 7.0 mg/L and were as high as 10.8 mg/L. Saturations ranged from 76 to 127%. Dissolved oxygen depletion did not occur near the sediment-water interface when depth profiles were conducted (CRWA 2004a). The pH measurements ranged from 7.3 to 8.4 SU.

CRWA collected monthly data for the Charles River at the Farm Road/Bridge Street in Dover/Sherborn (Station 343S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between April 2000 and October 2006 (n=55) exceeded 28.3°C (maximum 27.5°C). A total of 18 pH measurements were taken at Station 343S between February 2000 and April 2002. The pH measurements ranged from 6.1 to 7.4 SU and only one measurement was <6.5 SU. Total suspended solids concentrations were as high as 36.0 mg/L however only one sample was ≥ 25 mg/L (n=34).

MassDEP DWM conducted water quality monitoring of the Charles River approximately 1000 feet upstream from Davis Brook confluence in Natick at an informal boat launch off Route 16 (Station CR36.3) between April and September 2002 (Appendix B). In-stream DO concentrations ranged from 2.7 to 10.6 mg/L (n=10) and were below 5.0 mg/L on two occasions (both pre-dawn measurements). The diurnal variation of DO for this site was as high as 7.2 mg/L. The maximum temperature was 27.4°C and pH ranged from 6.6 to 8.5 SU. Total phosphorus concentrations were slightly elevated ranging from 0.037 to 0.12 mg/L. Total suspended solids concentrations were all low (≤ 24 mg/L, n=6).

The deepest area of the Charles River in the South Natick Dam impoundment (approximately 9.9 feet) is in the northernmost end slightly upstream from the dam (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity at the deep hole between 28 August 2002 and 3 September 2002. DO concentrations were not less than 5.73 mg/L and were as high as 9.91 mg/L. Saturations ranged from 63 to 118%. Dissolved oxygen depletion did not occur near the sediment-water interface in deeper portions of the impoundment when depth profiles were conducted (CRWA 2004a). The pH measurements ranged from 7.23 to 8.41 SU.

Water quality monitoring (*in-situ* measurements of DO and temperature) as well as nutrient (total phosphorus and chlorophyll *a* and pheophytin *a* samples were taken at three locations in the South Natick Dam impoundment on 21 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 6.98 to 7.31 mg/L. Total phosphorus concentrations were moderately high ranging from 0.057 to 0.068 mg/L. Chlorophyll *a* concentrations were fairly low ranging from 3.44 to 4.90 µg/L.

Sediment

Sediment cores were collected in June 2005 from this segment of the Charles River at one location just downstream from Populatic Pond, Norfolk, and at three locations above the South Natick Dam, Natick, to measure rates of sediment oxygen demand and sediment nutrient release during aerobic and anaerobic conditions (Schlezinger and Howes 2006). Sediment oxygen demand at one of the three sites was elevated (similar to those measured in Box Pond) while the other two sites were more similar to those measured in Milford Pond and other sites along the Charles River.

The *Aquatic Life Use* is assessed as impaired for this segment of the Charles River. In the upper reach the fish community was comprised primarily of macrohabitat generalists with few fluvial dependant/specialists species present. Although the two top ranking species in the Charles River Target Fish Community developed by Meixler (2006) were missing and the third and fourth ranking species were underrepresented, given the lentic nature of the fish sampling reach the absence of fluvial species is not unexpected. The RBP III analysis indicated the benthic community downstream from Dean Street in Millis (Station CR04) was moderately impacted. DWM biologists noted the hyperdominance of filter feeders "…*appear to reflect the effects of considerable organic enrichment, and is indicative of unbalanced community responding to an overabundance of a food resource (in this case, fine particulate organic material—FPOM)*" (Appendix C). Possible sources of FPOM include Populatic Pond, which is eutrophic, and the CRPCD discharge. DWM and MA DFG biologists also documented dense growths of green filamentous algae and aquatic plants in this reach of the river. While DO concentrations met the criterion at all but one of the 13 sites sampled along this segment of the river, moderately elevated concentrations of total phosphorus were frequently seen at many of sampling stations. Supersaturation and/or large diurnal

DO swings (up to 7.2 mg/L), and occasionally elevated chlorophyll *a* concentrations, are also indicative of indicative of enrichment along this segment of the Charles River. The cyanobacteria bloom (primarily *Oscillatoria* sp.) in September 2004 also affected this entire segment of the Charles River. Two non-native aquatic macrophytes in the South Natick Dam impoundment (the lower 0.6 mile reach of this segment of the Charles River) also impair the *Aquatic Life Use*.

Fish Consumption Use
A fish consumption advisory is in effect for this segment of the Charles River. Due to the presence of elevated mercury in largemouth bass, MA DPH recommends the following (MA DPH 2007).

> *"Children under 12 years of age, pregnant women, nursing mothers, and women of childbearing age who may become pregnant should not consume largemouth bass from the Charles River between the Medway Dam, Medway and the South Natick Dam, Natick and the general public should limit consumption of largemouth bass fish to two meals per month."*

It should be noted here that fish toxics monitoring was conducted in Populatic Pond in June 2007 (Maietta *et al.* 2008). Mercury concentrations not only exceeded the MA DPH trigger level in largemouth bass but also in black crappie (*Pomoxis nigromaculatus*). Although trace concentrations of PCB aroclors, PCB congeners, DDT (or it's metabolites DDD and DDE) and chlordane were found in a number of fillet samples from Populatic Pond in 2007, most concentrations appear to be low. The combination of DDE and DDD in common carp (Cyprinus carpio), however, exceeded the MA DPH trigger level. Although no advisory update has been issued as of March 2008, the 2007 survey will likely result in modification of the Charles River fish consumption advisory (Maietta *et al.* 2008).

Because of the site-specific fish consumption advisory for the Charles River between the Medway Dam, Medway and the South Natick Dam, Natick, due to elevated concentrations of mercury, the *Fish Consumption Use* is assessed as impaired for this entire segment of the Charles River.

Primary and Secondary Contact Recreation and Aesthetics Uses
In September 2004 a cyanobacteria bloom (primarily *Oscillatoria* sp.) was recorded by DWM staff throughout this segment of the Charles River (Connors 2004 and Beskenis 2007a).

CRWA sampled eight locations along this segment of the Charles River - behind 6 Lake Path in Norfolk (Station 201S), 58 River Road in Norfolk (Station 207S), Route 115 Baltimore Street in Millis (Station 229S), Dwight Street Bridge in Millis (Station 267S), Old Bridge Street in Medfield (Station 290S), downstream from the Medfield WWTP discharge (Station 294S), Route 27 Bridge in Medfield (Station 318S), and Farm Road/Bridge Street in Sherborn/Dover (Station 343S) as part of the Upper Charles River Watershed TMDL Project or as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling was conducted at six of the sampling locations on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16, 17, and 18 October 2002 and 19, 20, and 21 October 2004 (excluding stations 267S and 343S) (CRWA 2004a and CRWA 2006). *E. coli* samples were also collected from stations 229S, 267S, 290S, 318S, and 343S from 2002 through 2006. Bacteria sampling was also conducted in the river off Route 16 upstream from the confluence with Davis Brook in Natick (Station CR36.3) by DWM between April and September 2002 (Appendix B, Table 4) while observations of the river (Stations CR51.6 and CR41.8) were also made (Appendix B). These data are summarized below from upstream to downstream.

One water quality monitoring station on the Charles River behind 6 Lake Path in Norfolk (Station 201S) was sampled by CRWA staff as part of the Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16, 17, and 18 October 2002 and 19, 20 and 21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <10 to 600 cfu/100 ml (the count exceeded 235 cfu/100 ml on only one day) and the highest counts were representative of wet weather sampling conditions.

One water quality monitoring station on the Charles River at 58 River Road in Norfolk (Station 207S) was sampled as by CRWA staff part of the Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <10 to 800 cfu/100 ml

(only one count exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

MassDEP DWM personnel recorded field observations of the Charles River near Dean Street in Millis (Station CR51.6) between April and September 2002 (Appendix B). The water column was slightly turbid in stream with no odor or scum on all survey dates. However, a treated wastewater odor was noted in the air on three survey dates (in July and September). Dense coverage of green filamentous algae on substrates was observed in early June and remained through August when it began to decay. No bacteria samples were collected. DWM biologists also noted the river was slightly turbid and there was a sewage odor during their survey in July 2002 (MassDEP 2002b). No surface oils nor no trash deposits were recorded.

CRWA staff and volunteers sampled this segment of the Charles River at Route 115 Baltimore Street in Millis (Station 229S) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 at sampling station 229S (CRWA 2004a and CRWA 2006). Between these two projects, a total of 44 samples were collected, 27 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 229S	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	5	4	6	6
	Maximum cfu/100 ml	340	220	90	140	300
	Minimum cfu/100 ml	10	10	10	10	15
126 cfu/100 ml	Geometric Mean	55	54	45	66	70
Max 235 cfu/100 ml	Number of Exceedances	1	0	0	0	1
Secondary Contact	Samples Assessed	10	8	10	8	7
	Maximum cfu/100 ml	500	220	4,960	220	300
	Minimum cfu/100 ml	10	10	10	10	5
630 cfu/100 ml	Geometric Mean	118	46	105	72	48
Max 1260 cfu/100 ml	Number of Exceedances	0	0	1	0	0

Monthly bacteria sampling was conducted in the Charles River at the Dwight Street Bridge in Millis (Station 267S) by CRWA volunteers. These data can be summarized as follows.

Station 267S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	4	4	6	3
	Maximum cfu/100 ml	280	375	170	140	75
	Minimum cfu/100 ml	30	30	7.5	10	45.3
126 cfu/100 ml	Geometric Mean	103	97	40	59	55
Max 235 cfu/100 ml	Number of Exceedances	1	1	0	0	0
Secondary Contact	Samples Assessed	5	6	7	11	4
	Maximum cfu/100 ml	280	375	1,880	200	75
	Minimum cfu/100 ml	30	20	7.5	10	20.1
630 cfu/100 ml	Geometric Mean	123	61	76	51	43
Max 1260 cfu/100 ml	Number of Exceedances	0	0	1	0	0

CRWA staff and volunteers sampled this segment of the Charles River at the Old Bridge Street in Medfield (Station 290S) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 at sampling station 290S (CRWA 2004a and CRWA 2006). Between these two projects, a total of 49 samples were collected, 29 of which were during the primary contact recreation season. Both the

geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 290S	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	6	6	4	7	6
	Maximum cfu/100 ml	320	60	80	200	500
	Minimum cfu/100 ml	10	10	10	10	5
126 cfu/100 ml	Geometric Mean	51	20	37	75	41
Max 235 cfu/100 ml	Number of Exceedances	1	0	0	0	1
Secondary Contact	Samples Assessed	11	10	9	10	8
	Maximum cfu/100 ml	320	220	1,840	340	500
	Minimum cfu/100 ml	10	10	10	10	5
630 cfu/100 ml	Geometric Mean	79	24	74	75	31
Max 1260 cfu/100 ml	Number of Exceedances	0	0	1	0	0

One water quality monitoring station on the Charles River downstream from the Medfield WWTP discharge (Station 294S) was sampled by CRWA staff as part of the Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from 20 to 600 cfu/100 ml (only one count exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

MassDEP DWM personnel recorded field observations of the Charles River at Route 27 in Medfield/Sherborn (Station CR41.8) between April and September 2002 (Appendix B). In the shallow edge of the river, the water column was clear with no odor, scum or other objectionable conditions on all survey dates. Due to the river depth at this station, in-stream turbidity was difficult to determine. Sparse amounts of pickerelweed (*Pontederia cordata*), waterweed (*Elodea* sp.), duckweed (*Lemna* sp.), and green filamentous algae were observed sporadically during the May to August survey dates (Appendix B). CRWA volunteers also sampled this site (Station 318S) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 at Station 318S (CRWA 2004a and CRWA 2006). Between these two projects, a total of 49 samples were collected, 29 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 318S	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	6	6	4	7	6
	Maximum cfu/100 ml	180	110	90	100	200
	Minimum cfu/100 ml	10	10	10	10	20
126 cfu/100 ml	Geometric Mean	27	34	34	42	62
Max 235 cfu/100 ml	Number of Exceedances	0	0	0	0	0
Secondary Contact	Samples Assessed	11	8	11	11	8
	Maximum cfu/100 ml	1,600	110	740	340	200
	Minimum cfu/100 ml	10	10	10	10	5
630 cfu/100 ml	Geometric Mean	73	27	52	42	45
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	0

Monthly bacteria sampling was conducted in the Charles River at Farm Road/Bridge Street in Dover/Sherborn (Station 343S) by CRWA volunteers. These data can be summarized as follows.

Station 343S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	3	4	5	6
	Maximum cfu/100 ml	120	20	40	60	600
	Minimum cfu/100 ml	30	10	5	10	10
126 cfu/100 ml	Geometric Mean	49	16	17	27	41
Max 235 cfu/100 ml	Number of Exceedances	0	0	0	0	1
Secondary Contact	Samples Assessed	6	5	7	10	8
	Maximum cfu/100 ml	1105	240	420	280	600
	Minimum cfu/100 ml	30	10	5	10	5
630 cfu/100 ml	Geometric Mean	107	29	25	31	31
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	0

MassDEP DWM personnel recorded field observations of the Charles River approximately 1000 feet upstream from Davis Brook confluence in Natick at an informal boat launch off Route 16 (Station CR36.3) between April and September 2002 (Appendix B). The water column was slightly turbid and no odors were detected. Scum on the surface of the water ranged from pollen in the spring, to an unidentifiable sheen in early summer, to floating, green, bubbly algal mats in late summer. Aquatic plant coverage increased from April through October from sparse to dense and included waterweed (*Elodea* sp.), pondweed (*Potamogeton* sp.), and duckweed (*Lemna* sp.). In addition to the floating algal mats, dense coverage of filamentous green algae on substrates and on aquatic plants was observed in early August and remained through the September surveys. The *E. coli* bacteria counts were all low ($\leq$ 59 cfu/100 ml/100 ml/L, n=5 including one duplicate) (Appendix B, Table 4).

Secchi disk measurements were taken at three locations in the South Natick Dam impoundment on 21 June 2005 (Schlezinger and Howes 2006). Secchi disk measurements met the 1.2 m recommended guidance at one location while the other two measurements were inconclusive because of shallow depth.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* Uses are assessed as impaired based on the cyanobacteria bloom affecting this entire segment of the Charles River. Dense growth of filamentous algal was also documented in the river at two sampling stations. However it should be noted that *E. coli* bacteria counts almost always met water quality criteria. Counts were occasionally elevated during wet weather conditions.

Charles River (Segment MA72-05) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Moderately impacted benthic community, biological indicators of nutrient enrichment, elevated total phosphorus, high dissolved oxygen saturation, non-native aquatic plant infestation in lower 0.6 mile reach of river, excess algal growth Suspected causes: Occasionally low DO Sources: Municipal NPDES discharges, nonpoint sources Suspected sources: Urban stormwater, internal nutrient recycling
Fish Consumption		IMPAIRED Cause: Elevated mercury in fish tissue Source: Unknown Suspected Source: Atmospheric deposition
Primary Contact		IMPAIRED Cause: Excess algal growth Sources: Municipal NPDES discharges Suspected source: Internal nutrient recycling, nonpoint sources
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

Charles River Pollution Control District should continue to conduct whole effluent toxicity tests using both *C. dubia* and *P. promelas*. This facility should also be required to initiate a toxicity identification and toxicity reduction evaluation (TIE/TRE) to reduce/eliminate acute and chronic toxicity in their discharge. According to the 2005 WWTF inspection report, the sludge landfill at the facility still has not been covered.

The Medfield WWTP should continue to conduct whole effluent toxicity tests using *C. dubia*. If acute and/or chronic toxicity becomes more frequently detected the facility should initiate a toxicity identification evaluation/toxicity reduction evaluation (TIE/TRE).

Continue to conduct benthic macroinvertebrate sampling in the Charles River downstream from the CRPCD discharge to document conditions (e.g., facility upgrades at CRPCD, implementation of a new phosphorus limit).

Fish population sampling in lotic habitats (if any) in this segment of the river should be conducted to better evaluate whether or not the target fish community is being met.

Continue to conduct water quality monitoring (i.e., deploy *in-situ* meters to obtain long-term DO data, additional total phosphorus and chlorophyll *a* sampling) to evaluate changes in water quality in this segment of the Charles River.

Document composition/frequency/extent of cyanobacteria blooms in this segment of the Charles River. Develop monitoring program to evaluate source(s) contributing to the problem if/when blooms occur in the future.

MILL RIVER (SEGMENT MA72-15)
Location: Headwaters, outlet Bush Pond, Norfolk, to confluence with Charles River, Norfolk.
Segment Length: 3.5 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 15.9 mi^2 subwatershed.
Forest..... 47%
Residential..... 30%
Open land 7%
The estimated percent impervious area for this subwatershed area is 10.5%.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses* (*Aquatic Life* and *Aesthetics*); Others Not Assessed (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Wrentham DPW Water Division (9P42035001/42035001)
Franklin Country Club (22010103)
Norfolk Cranberry Company (42020801)
Franklin DPW Water Division (9P22010101/22010102)
NPDES (See Appendix H, Tables H2 and H4)
Buckley Mann, Inc. Norfolk (MA0031372)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
There are three dams along Mill River: Bush Pond #2 Dam, Rabbit Hill Pond Dam, and City Mills Pond Dam. On 18 July 2002 MassDEP DWM biologists conducted a habitat assessment at one location on the Mill River 500 m downstream from Main Street, Norfolk (Station MR01A). DWM biologists found this reach to be comprised primarily of shallow riffles with small cobble and pebble benthic substrate (Appendix C). Station MR01A received a total habitat assessment score of 146 out of a possible 200 (Appendix C). Epifaunal and fish habitat was limited by most by the extremely shallow conditions, which resulted in limited velocity/depth combinations and cover for fish, as well as evidence of in-stream sedimentation (Appendix C).

Streamflow estimates of Mill River at River Road in Norfolk (Station 213T1) from July 2002 through December 2005 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 0.7 to 221 cfs. The average flow for the period of record was 26.6 cfs. The lowest average monthly flows were documented between July and August 2002 (2.33 to 4.15 cfs) and August and September 2005 (2.04 to 4.7 cfs).

Biology
DWM biologists found limited algae and aquatic vegetation in the Mill River 500 m downstream from Main Street, Norfolk MA (Station MR01A), although a few small patches of green algae and water starwart (*Callitriche* sp.) were noted (Appendix C). They collected two periphyton samples from the Mill River (Station MR01A) on July 18, 2002 (Appendix C). Canopy cover at this site was reported as 75%, algal cover was <1%, and the dominant algal genera was Chlorophyceae-*Microspora* sp. *(*Appendix F).

RBP III analysis indicated that Mill River was slightly impacted compared to the reference station ST01 (Appendix C). DWM biologists found reduced taxa richness and reduced EPT index relative to the reference station and two dominant filter-feeding taxa. The filter-feeding taxa indicate an abundance of FPOM as a food source but numerous scraping taxa were also found, evidence of a periphyton feeding guild (Appendix C).

A total of 163 fish were collected by the MA Department of Fish and Game using a barge mounted elecroshocker near the mouth of the Mill River (Station 822) in August 2003. Thirteen species were identified with the most common species being redbreast sunfish (n=56), redfin pickerel (31), largemouth bass (19), golden shiner (18), and bluegill (10). These were all macrohabitat generalists. Four brown trout (fluvial specialists – all probably stocked) and eight white sucker (fluvial dependants) were also collected (Richards 2006). Given the habitat at the fish sampling site, and the site's proximity to the main

stem Charles River the dominance of macrohabitat generalists at this particular sampling location is expected.

Water Chemistry

One water quality monitoring station on Mill River at River Road in Norfolk (Station 213T1) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 (two sampling events) October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Continuous *in-situ* temperature measurements of Mill Brook at this site were also taken from July 2002 through December 2005 at 15-minute intervals as part of these projects.

The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the six surveys conducted, one DO concentration was below 5.0 mg/L (4.2 mg/L measured during dry weather in August 2005). Results of the other water quality samples indicated elevated total phosphorus during the August 2002 dry weather survey (0.1 mg/L phosphorus).

The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 31.9°C (n=121,456 measurements). The highest measurements (>28.3°C) occurred in both July and August 2002. The warm water fishery temperature criterion (28.3°C) was exceeded on 21 days for a total of 158 hours of exceedance. The average amount of time above 28.3°C was 7.5 hours per day for those days where an exceedance occurred (CRWA 2004a).

The *Aquatic Life Use* for the Mill River is assessed as impaired because of the frequency, duration, and magnitude of elevated temperatures documented in the summer of 2002 that exceeded the warm water fishery criterion of 28.3°C. While the benthic community analysis indicated only slight impairment, taxa richness was low and dominated by two filter feeding taxa. In-stream habitat at the benthic monitoring stations was limited most by extremely shallow conditions, which resulted in marginal velocity/depth combinations and cover for fish, as well as evidence of in-stream sedimentation. All fish species collected are classified as being tolerant or moderately tolerant to pollution. Low DO is also a concern.

Primary and Secondary Contact Recreation and Aesthetics Uses

DWM biologists noted isolated trash (bottle, pipes) in the Mill River 500 m downstream from Winthrop Street, Medway MA (Station MR01A) on 18 July 2002. Water clarity was clear and no other objectionable conditions were noted (e.g., oils, odors, other deposits).

One water quality monitoring station on Mill River at River Road in Norfolk (Station 213T1) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 (two sampling events) October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <10 to 300 cfu/100 ml (only one count exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

Too few bacteria data are available to effectively assess *Primary* and *Secondary Contact Recreational* uses (i.e., six samples over four years) so these uses are not assessed. The *Aesthetics Use* is assessed as support due to the lack of objectionable deposits.

Mill River (Segment MA72-15) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Elevated temperature Suspected causes: Flow regulation at impoundments Source: Unknown Suspected sources: Combination of factors including upstream impoundments, impervious surface/parking lot runoff
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

RECOMMENDATIONS

DWM biologists recommend the following (Appendix C):

implement BMPs to address sediment deposition from road runoff at Main Street, and stream clean-up to address accumulated trash.

Conduct long-term monitoring (increasing spatial coverage for both DO and temperature) and additional nutrient monitoring to assess the *Aquatic Life Use*.

Additional monitoring and evaluation of flow conditions should be conducted in the Mill River. Note that the USGS estimated base flow (the portion of streamflow originating from ground-water recharge to streams) at the mouth of the Mill River (Station MR1) under dry and average weather conditions and for three water-use scenarios (no withdrawals, average withdrawals, and maximum permitted pumping) (Eggleston 2004). This information may be helpful to better understand flow regimes in this system.

Additional bacterial sampling (minimum of five samples in a sampling season) should be conducted to assess the *Primary* and *Secondary Contact Recreation* uses.

STOP RIVER (SEGMENT MA72-09)
Location: Headwaters, near Dedham Street (Route 1A), Wrentham, to Norfolk-Walpole MCI discharge, Norfolk.
Segment Length: 5.6 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 10.6 mi^2 subwatershed.
Forest..... 47%
Residential..... 29%
Open land 8%
The estimated percent impervious area for this subwatershed area is 8.3%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, nutrients, and organic enrichment/low DO (MassDEP 2007).

Note: Highland Lake (MA72047) will not be assessed as a lake segment in this report since the estimated retention time of this 15.3 acre waterbody is approximately 4 days. It will be considered a run-of-the river impoundment (McVoy 2006). This lake is a segment on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Wrentham Developmental Center (42035002)
Norfolk Water Department (9P22020801/22020802)
MCI Norfolk/Cedar Junction (22020804)
NPDES (See Appendix H, Tables H2 and H4)
Caritas Southwood Community Hospital (MA0102288) [Note: Facility closed in 2003, EPA terminated permit on 29 December 2003.]
Wrentham Development Center (MA0102113) discharges to a tributary of the Stop River.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
On 6 July 2002 MassDEP DWM biologists conducted a habitat assessment of the Stop River downstream from Pond Street in Norfolk (Station SR01). DWM biologists found the stream to be approximately 2 m wide with a maximum depth of 0.2 m. Station SR01 received a total habitat assessment score of 147 out of a possible 200 (Appendix C). Habitat quality was compromised most by sediment deposition most likely from the former gravel pit immediately adjacent to the river just upstream from Pond Street. The gravel pit was no longer in operation and the site was being redeveloped into a sports complex.

Observations by DWM field sampling crews at Station SR02B (located just downstream from Lincoln/Campbell Street) indicated that the river channel is approximately 15 feet wide in this reach and the water level and velocity were relatively constant throughout the survey dates (Appendix B).

Biology
RBP III analysis indicated that the benthic community of the river near Pond Street (Station SR01) was slightly impacted compared to the reference station at the Stony Brook station (Appendix C). Total taxa richness and EPT taxa richness was highest at this station compared to all other biomonitoring stations in the Charles River watershed in 2002 (Appendix C). Percent abundance of individual taxa was balanced indicating good community structure. The lack of filter feeders and scrapers at this station may be a result of natural conditions (Appendix C).

Toxicity
Ambient
The Norfolk-Walpole MCI staff collected water from the Stop River upstream from the outfall pipe for use as dilution water in the facility's whole effluent toxicity tests. Between March 2000 and April 2007, survival of *C. dubia* exposed (approximately 7 days) to the Stop River water ranged from 90 to 100% (n=27). Between March 2000 and April 2007 survival of *P. promelas* exposed (approximately 7 days) to the Stop River water ranged from 33 to 100% (n=27). The survival of *P. promelas* was <75% in seven of

the tests. Five of these results were from April testing events. In-stream hardness ranged from 24 to 80 mg/L (n=28).

Effluent
Whole effluent toxicity tests have been conducted on the Wrentham Development Center's treated effluent (MA0102113), which discharges to an unnamed tributary to this segment of the Stop River. Between January 2005 and April 2007, 10 tests were conducted using *C. dubia* and *P. promelas*. No acute whole effluent toxicity has been detected (LC_{50}s were all >100% effluent n=10 for both species). The CNOECs (chronic no observed effect concentration) were 100% effluent for six of the nine tests valid tests using *C. dubia* and nine of the ten tests using *P. promelas*. The three most recent valid test events (July and October 2006 and January 2007) exhibited chronic toxicity to *C.dubia* with CNOEC's of <6.25, 6.25 and 12.5% effluent, respectively. The October 2006 test exhibited some chronic toxicity (poor growth) in a single test concentration (6.25% effluent) although the test result was reported as 100%.

Water Chemistry
The Stop River near Campbell Street/Lincoln Road (Station SR02B) was sampled by DWM eleven times between April and September 2002. Monitoring included *in-situ* measurements using a multiprobe and nutrient sampling. These data can be found in Appendix B, Tables 3 and 4. Of the surveys conducted, two DO measurements (both in August) were below 5.0 mg/L (4.3 and 4.7 mg/L.). The diurnal variation of DO for this site was generally limited (<0.5 mg/L). Phosphorus levels were quite high (0.11 to 0.17 mg/L, n=4).

The *Aquatic Life Use* for the upper 1.6 miles of this segment (above Dedham Street) is assessed as support because of the diverse invertebrate assemblage found at this site. This use is identified with an Alert Status due to historic problems with sedimentation most likely from the former gravel pit immediately adjacent to the river just upstream from Pond Street near Station SR01. The lower 4.0 miles are assessed as impaired because of low dissolved oxygen concentrations, high total phosphorus levels, and the somewhat frequent poor survival of test organisms (*P. promelas*) exposed to the river water collected just upstream from the Norfolk-Walpole MCI facility discharge.

Primary and Secondary Contact Recreation and Aesthetics Uses
DWM biologists noted that the water was slightly turbid at Station SR01 on July 16, 2002 and sediment deposition was observed, however no other objectionable conditions were noted (e.g., oils, odors, other deposits) (MassDEP 2002b).

A total of five bacterial samples were collected by DWM between April and September 2002 at station SR02B. Counts were very low (>6-20 cfu/100 ml) (Appendix B, Table 4). The water column at this section of the Stop River was slightly turbid in April/June, moderately turbid in July, and highly cloudy in August. Turbidity dropped to slightly turbid in September. Odor was not detected at this station until September when an odor described as "musty" and "rotting vegetation" was recorded. The odor seems to correspond with a moderate amount of decaying filamentous algae on substrates and attached to moss. There were no scums, objectionable conditions or macrophytes (other than aquatic moss and a few emergent macrophytes on the shoreline) observed on the survey dates. Organic foam that forms naturally at the outlet of Highland Lake was noted occasionally (Appendix B).

The *Primary and Secondary Contact Uses and Aesthetics* are assessed as support based on low bacteria counts and general lack of objectionable conditions (oils, odors, other deposits). However, these uses have been identified with an Alert status since the water column was described as highly cloudy during the August survey.

Stop River (Segment MA72-09) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT* Upper 1.6 miles of reach IMPAIRED Lower 4.0 miles of reach Causes: Low DO, elevated total phosphorus, and poor survival *P. promelas* Source: Unknown Suspected sources: NPDES discharge(s)
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT*
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT*

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

DWM biologists recommend the following (Appendix C):

implement BMPs to address road runoff at Pond Street and especially the adjacent industrial complex and golf course.

Continue to monitor survival of *P. promelas* exposed to Stop River water samples collected upstream from the MCI Norfolk wastewater discharge. If survival continues to be poor, an in-stream toxicity study should be developed and conducted to try to identify zone of impact as well as source(s) contributing to the problem.

Additional biomonitoring should be conducted to evaluate impacts, if any, resulting from changing land use and the closing of one of the NPDES discharges in order to document current conditions and to assess the *Aquatic Life Use*.

Conduct additional field reconnaissance to identify any areas contributing to instream sediment deposition. Develop and implement remediation plans to reduce sediment inputs to the river where necessary.

Continue to monitor in-stream turbidity. If necessary, conduct source tracking to identify problem site(s) contributing to instream turbidity that may impair aesthetics of the Stop River.

Continue to conduct bacterial sampling (minimum of five samples in a sampling season) to assess the *Primary* and *Secondary Contact Recreation* uses.

STOP RIVER (SEGMENT MA72-10)
Location: Norfolk-Walpole MCI discharge, Norfolk, to confluence with Charles River, Medfield.
Segment Length: 4.2 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 17.0 mi^2 subwatershed.
Forest..... 49%
Residential..... 30%
Open land 7%
The estimated percent impervious area for this subwatershed area is 8.0%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, nutrients, organic enrichment/low DO, and pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H2 and H4)
Massachusetts Department of Correction Norfolk-Walpole Correctional Institution (MCI) (MA0102253).
Note: The average monthly total phosphorus limit between April 1 and October 31 is 0.2 mg/L.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Observations by DWM field sampling crews of the Stop River near Noon Hill Road (Station SR03) where the river was approximately 15 feet wide upstream from the road, but widened to 20 to 30 feet downstream from the road. The water velocity was relatively constant throughout the survey dates. Although the water level dropped slightly during July and August, the channel flow status was full and there were no exposed substrates.

Streamflow estimates of the Stop River near Noon Hill Road in Medfield (Station 269T2) from July 2002 through December 2005 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 3.7 to 128 cfs. The average flow for the period of record was 28.7 cfs. The lowest average monthly flow was documented August 2002 (6.0 cfs).

On 16 July 2002 MassDEP DWM biologists conducted a habitat assessment downstream from Noon Hill Street in Medfield (Station SR03). This portion of the Stop River received a total habitat assessment score of 152 out of a possible 200 (Appendix C). The river was 5 m wide dominated by a glide/pool flow regime, and little riffle habitat was present. DWM biologists described the overall epifaunal and fish habitat as suboptimal (Appendix C). They noted established beds of burreed covering the majority of the reach and some limited in-stream deposition (Appendix C).

On 27 August 2002 DWM fisheries biologists also conducted a habitat assessment downstream from Noon Hill Road. The sampled reach was low-gradient and contained mostly sandy substrates. There was a large pool located at the upper end of the reach just downstream from the road. The riparian zone was dominated by vegetated wetland habitat. Stream margins were densely vegetated which, together with the high stream flows, made sampling difficult. Collection efficiency was rated as fair.

Biology
DWM biologists noted established beds of burreed covering the majority of the reach but limited algal abundance (Appendix C). One periphyton sample was collected at the sampling Station SR03 on 16 July 2002 (MassDEP 2002b). Canopy cover was reported as 0%, algal cover was <1%, and the dominant algal genera was Bacillariophyceae-*Melosira varians* (Appendix F). *Melosira varians* is known to be common in organically-enriched areas (Palmer 1977).

The RBP III analysis indicated that the benthic community in the Stop River (Station SR03) near Noon Hill Road was slightly impacted compared to the Stony Brook reference station (Station ST01) (Appendix C). This sample was dominated (40%) by the net-spinning caddisfly *Cheumatopsyche* sp., a tolerant taxon which was indicative of an abundance of FPOM and organic enrichment (Appendix C). However the nature and magnitude of contribution of this enrichment from upstream wetlands or upstream effluent discharges is unknown.

On 27 August 2002 DWM biologists conducted backpack electrofishing in the Stop River immediately downstream from Station SR03. A total of 32 fish were collected representing five species. The dominant taxa were yellow bullhead (n=17) and redbreast sunfish (n=9). The overall numbers of fish were low given the amount of fish habitat present but this may be attributable to the low sampling efficiencies. All fish collected were macrohabitat generalists, that are tolerant or moderately tolerant to pollution. The preponderance of wetlands (and associated low gradient habitat) both upstream and downstream from SR03 may be influencing the fish community of the Stop River.

Toxicity

Effluent

Whole effluent toxicity tests have been conducted on the Massachusetts Department of Correction Norfolk-Walpole Correctional Institution (MCI) treated effluent. Between March 2000 and April 2007, 27 tests were conducted using *C. dubia* and *P. promelas*. The LC_{50}s were all >100% effluent (n=27 for both species). For 21 of the 27 chronic whole effluent toxicity tests using *C. dubia* the CNOEC's (chronic no observed effect concentration) were 100% effluent. One test was 12.5% effluent. The remaining four were <6.25 to 12.5% effluent but these tests exhibited poor dose response. Of 27 chronic whole effluent toxicity tests using *P. promelas*, 24 were >100% effluent, one was <6.25% effluent (March 2000) and one was 12.5% effluent (but with poor dose response – in January 2005).

Water Chemistry

The Stop River near Noon Hill Road (Station SR03) was sampled by DWM on 10 days between April and September 2002. Monitoring included *in-situ* measurements using a multiprobe and nutrient sampling. In addition, a multi-probe water quality sampler was deployed for 24.5 hours from 1 July through 2 July 2002. These data can be found in Appendix B, Tables 3 and 4. Single sample dissolved oxygen concentrations fell below 5.0 mg/L during July, August, and September (n=6) and were recorded as low as 3.0 mg/L. During the multiprobe deployment DO concentrations were below 5.0 mg/L for 12.5 of the 24.5 hours sampled. During that deployment DO measurements ranged from 3.3 to 7.2 mg/L. These data were collected during one of the warmest weeks of the summer.

One water quality monitoring station was sampled on this segment of the Stop River near Noon Hill Road in Medfield (Station 269T2) as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 (two sampling events) October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the five surveys conducted, two DO concentrations were below 5.0 mg/L (4.2 and 4.54 mg/L, both measured during dry weather). Total phosphorus concentrations were elevated (0.064 to 0.131 mg/L). Chlorophyll a concentrations were high (33 µg/L) during the August 2005 dry weather sampling event.

Continuous *in-situ* temperature measurements of Stop River at this site were taken from July 2002 through December 2005 at 15-minute intervals as part of these projects. The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 29.8°C (n=117,018 measurements). The highest measurements (>28.3°C) occurred in seven of 11 months sampled (June through August 2002-2005). The warm water fishery temperature criterion (28.3°C) was exceeded on 25 days for a total of 106.5 hours of exceedance. The average amount of time above 28.3°C was 4.3 hours per day for those days where an exceedance occurred. The number of days per year with an exceedance was six for 2002, two for 2003, seven for 2004, and 10 for 2005 (CRWA 2006).

The CRWA also collected monthly water quality data from the Stop River at Causeway Street in Medfield (Station 269T) (CRWA 2007). These data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. A total of 18 pH measurements were taken Station 269T between February 2000 and April 2002. Two measurements were low (6.1 and 6.4 SU). A single temperature measurement (n=63) taken between February 2000 and September 2006 exceeded 28.3°C (28.5°C in August 2000) (CRWA 2007). Total suspended solids concentrations were all low ($\leq$ 6.5 mg/L, n=37).

The *Aquatic Life Use* for this segment of the Stop River is assessed as impaired because of low dissolved oxygen concentrations and elevated in-stream temperatures documented in June, July, and/or August in 2002 through 2005, which exceeded the warm water fishery criterion of 28.3°C. Although the benthic community RBP III analysis indicated only slight impacts the community appeared to be structured in response to organic enrichment. Elevated total phosphorus concentrations were also documented. Sedimentation is also noted as a concern.

Primary and Secondary Contact Recreation and Aesthetics Uses

DWM biologists noted that the water column in the Stop River near Noon Hill Road (Station SR03) on 16 July 2002 was clear and some limited in-stream sediment deposition was noted but no other objectionable conditions were noted (e.g., oils, odors, other deposits) (MassDEP 2002b).

One water quality monitoring station was sampled on this segment of the Stop River near Noon Hill Road in Medfield (Station 269T2) as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project as well as by DWM during the summer of 2002 (CRWA 2004a and CRWA 2006, Appendix B Table 4). CRWA sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 (two sampling events) October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Neither the geometric mean of the *E. coli* counts exceeded 126 cfu/100 ml nor did any of the samples exceed 235 cfu/100 ml at this sampling location during the primary contact season (n=4 in 2002 and n=1 in 2005). The maximum count reported for this sampling location was 300 cfu/100 ml (wet weather sampling event in September 2002).

The CRWA also collected monthly *E. coli* samples from the Stop River at Causeway Street in Medfield (Station 269T) between June 2002 and December 2006 (CRWA 2007). A total of 37 samples were collected, 26 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 269T (CRWA 2007) Year

Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed (n)	5	6	3	6	6
	Maximum cfu/100 ml	1,440	1,020	140	400	192
	Minimum cfu/100 ml	10	10	20	10	10
126 cfu/100 ml	Geometric Mean	129	49	63	81	53
Max 235 cfu/100 ml	Number of Exceedances	2	1	0	2	0
Secondary Contact	Samples Assessed (n)	7	7	6	10	7
	Maximum cfu/100 ml	1,440	1,020	140	400	192
	Minimum cfu/100 ml	10	10	10	10	5
630 cfu/100 ml	Geometric Mean	175	39	46	40	38
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	0

The *Primary Contact Recreational Use* is assessed as support for the upper 3.2 mile reach of this segment (from the MCI Norfolk discharge to the confluence with Horse Brook now identified as Nantasket Brook on the USGS topographic map). This use is assessed as impaired for the lower 1.0 miles of this segment because of elevated bacteria *(E. coli*) counts (water quality criteria were exceeded in three of five sampling years). None of the geometric means exceeded the secondary contact recreational use criterion of 630 cfu/100 ml and only one sample in 2002 exceeded 1260 cfu/100 ml (the stated maximum not to be exceeded for secondary contact recreation. The *Secondary Contact Recreational and Aesthetics* uses are assessed as support based on the bacteria data and the general lack of objectionable conditions (oils, odors, other deposits).

Stop River (Segment MA72-10) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low DO, elevated stream temperatures, biological indicators of organic enrichment, elevated total phosphorus Source: Unknown Suspected sources: NPDES discharge(s)
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT upper 3.2 miles IMPAIRED: lower 1.0 miles (downstream confluence of Nantasket Brook) Cause: Elevated E. coli Source: Unknown Suspected source: Failing on-site residential septic systems
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Bacteria source tracking along this segment of the Stop River should be conducted between Noon Hill Road and Causeway Street. There are two tributaries that discharge to this reach of the river - Horse Brook now identified as Nantasket Brook on the USGS topographic map and Saw Mill Brook which are potential sources.

Thermistors should be deployed in the Stop River subwatershed to better evaluate source(s) contributing to elevated water temperatures. Based on the results of these investigations potential ways to reduce in-stream temperatures in the Stop River (e.g., riparian zone protection/restoration, improving shading, etc.) should be developed and implemented.

Continue to monitor water quality in the Stop River (DO, temperature, nutrient concentrations) bracketing point and potential nonpoint source(s) of pollution. Evaluate whether or not naturally occurring (wetlands) or anthropogenic (e.g., upstream point sources) inputs are impairing water quality.

Continue to monitor whole effluent toxicity test results for the Norfolk-Walpole MCI discharge (MA0102253).

Conduct additional field reconnaissance to identify any areas contributing to instream sediment deposition. Develop and implement remediation plans to reduce sediment inputs to the river where necessary.

BOGASTOW BROOK (MA72-16)
Location: Headwaters, outlet Factory Pond, Holliston, to inlet South End Pond, Millis.
Segment Length: 9.5 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 25.3 mi^2 subwatershed.
Forest..... 45%
Residential..... 31%
Agriculture..... 8%
The estimated percent impervious area for this subwatershed area is 9.7%.

This segment is on the 2007 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Holliston Water Department registration/permit (22013601/9P422013602)
Millis Water Department registration/permit (22018702/9P422018703)
Medway Water Department (9P422017701, 22017701)
Glen Ellen Country Club (9P422018702)
NPDES (See Appendix H, Tables H2 and H4)
Town of Holliston Water Treatment Plant (MAG640066)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Streamflow estimates of Bogastow Brook near Ridge Street (between Middlesex Street and Sherborn border) in Millis (Station 307T3) from July 2002 through March 2006 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 1.3 to 243 cfs. The average flow for the period of record was 32.9 cfs. The lowest average monthly flows were documented between August and September 2002 (4.0 to 7.2 cfs) and August and September 2005 (6.1 to 7.4 cfs).

DWM conducted water quality monitoring of Bogastow Brook just downstream from the main outlet of Bogastow Pond at Orchard Street in Millis (Station BB08) between April and September 2002. The water level and velocity were relatively constant throughout the sampling season with only a slight decrease in water level recorded for June and July. The main channel of the brook remained relatively full during the course of the sampling season (Appendix B). There was approximately 25% coverage of moss on the bottom of the stream and in early July sparse amounts (1% coverage) of emergent grasses and arrowhead (*Sagittaria* sp.) were noted. In early September a sparse amount of filamentous algae was also recorded.

Biology
A total of 115 fish were collected from Bogastow Brook by the MA Department of Fish and Game using a backpack electroshocker near Orchard Street in Millis near the Glen Ellen Country Club (Station 825) in August 2003. Nine species were identified with the most common species being redfin pickerel (68) and bluegill (15). Seven of the nine species are considered macrohabitat generalists. Although redfin pickerel are a common stream species, their dominance, and the relative paucity of fluvial species is a concern. Four brown trout (fluvial specialists – all probably stocked) and seven white sucker (fluvial dependants) were also collected (Richards 2006). High flow conditions, tea stained water and flooded backwater areas were noted as making netting fish difficult.

Backpack electrofishing was also conducted by MA MA DFG biologists at a second station from Bogastow Brook just downstream from Bogastow Pond at Orchard Street (Station 824). A total of 76 fish were collected representing 10 species (Richards 2006). Similar to the upstream sampling location, the sample was dominated by macrohabitat generalists (20 bluegill, 19 redfin pickerel, 13 and pumpkinseed) and fluvial species were not well represented. Given the nature of the habitat (pool) and the close proximity of Bogastow Pond to the sampling reach, the dominance by macrohabitat generalists is not surprising. The only fluvial dependants were brown trout, both of which were likely stocked and two American eel were also collected.

Water Chemistry

One water quality monitoring station on Bogastow Brook near Ridge Street (between Middlesex Street and Sherborn border) in Millis (Station 307T3) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Continuous *in-situ* temperature measurements of Bogastow Brook were recorded by CRWA from July 2002 through March 2006. Measurements were taken at 15-minute intervals as part of CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Two slightly low DO measurements (4.62 mg/L in August 2002 and 4.14 mg/L in August 2005) were recorded and total phosphorus concentrations were slightly elevated (maximum of 0.0735 in August 2002). Chlorophyll *a* concentrations were all low. The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 28.0°C (n=121,203 measurements) (CRWA 2004a and CRWA 2006).

MassDEP DWM conducted water quality monitoring of Bogastow Brook just downstream from the main outlet of Bogastow Pond at Orchard Street in Millis (Station BB08) between April and September 2002. Monitoring included *in-situ* measurements using a multiprobe and nutrient sampling. These data can be found in Appendix B, Tables 3 and 4. *In-situ* measurements of DO, temperature, and pH were all indicative of good water quality conditions. The concentrations of total phosphorus were slightly elevated (maximum of 0.089 mg/L).

The *Aquatic Life Use* is assessed as support for Bogastow Brook based primarily on the water quality data. This use is identified with an Alert Status because of the relative lack of fluvial fish (both species and numbers) however sampling efficiencies were not optimal. The slight elevated concentrations of total phosphorus and the occasional slightly low DO are also of concern.

Primary and Secondary Contact Recreation and Aesthetics Uses

One water quality monitoring station on Bogastow Brook near Ridge Street (between Middlesex Street and Sherborn border) in Millis (Station 307T3) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). Three of the six bacteria samples collected exceeded 235 cfu/100 ml for *E. coli* (maximum count of 610 cfu/100 ml). The highest count represented dry weather conditions.

No odor, scum or other objectionable conditions were observed by DWM field sampling crews in Bogastow Brook just downstream from the main outlet of Bogastow Pond at Orchard Street in Millis (Station BB08). The water column was clear on all survey dates. On one occasion naturally occurring organic foam was observed. Floc was observed on the river bottom in June and July in sparse and moderate amounts, respectively. In early September a sparse amount of filamentous algae was also recorded.

Too few bacteria data are available to effectively assess *Primary* and *Secondary Contact Recreational* uses (i.e., six samples over four years) so these uses are not assessed. The *Primary Contact Recreational Use* is identified with an Alert Status because samples exceeded 235 cfu/100 mL. The *Aesthetics Use* is assessed as support due to the lack of objectionable deposits.

Bogastow Brook (Segment MA72-16) Use Summary

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Conduct long-term monitoring (DO and temperature) to assess the *Aquatic Life Use*. Additional total phosphorus sampling should also be conducted.

Additional fish population monitoring should be conducted in Bogastow Brook using more powerful equipment in an attempt to increase sampling efficiencies.

Conduct bacteria sampling (minimum of five samples in a sampling season) with increased spatial coverage (i.e., two or three sampling station locations along the brook) to assess the *Primary* and *Secondary Contact Recreation* uses

USGS estimated base flow (the portion of streamflow originating from ground-water recharge to streams) of Bogastow Brook just downstream from its confluence with Great Black Swamp (Station BB1) under dry and average weather conditions and for three water-use scenarios (no withdrawals, average withdrawals, and maximum permitted pumping) (Eggleston 2004). This information may be helpful to better understand flow regimes in this system.

CHARLES RIVER (SEGMENT MA72-06)
Location: South Natick Dam, Natick, to Chestnut Street, Needham.
Segment Length: 8.4 miles
Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 185.8 mi^2 subwatershed.
Forest..... 46%
Residential..... 32%
Open land 7%
The estimated percent impervious area for this subwatershed area is 10.5%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of priority organics, nutrients, organic enrichment/low DO, noxious aquatic plants, turbidity, and pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Natick Water Department (32019801/9P332019801)
Needham Department Of Public Works (32019901/9P332019902)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
There are two dams along this segment of the Charles River - the South Natick Dam in Natick and the Dover Dam (also known as the Cochrane Dam) in Dover/Needham.

On 17 July 2002 DWM biologists conducted a habitat assessment of the Charles downstream from Dover Dam, Dover-Needham (Station CR02A). This site received a total habitat assessment score of 169 out of a possible 200 (Appendix C). Just downstream from the dam there is a narrow island after which the two channels converge. The river was approximately 15 meters wide here and minimally shaded in this location. The benthic habitat was excellent with an abundance of cobble substrates and in-stream vegetation and mosses providing additional microhabitat. In-stream cover for fish was characterized as optimal. DWM biologists also noted dense macrophytes and algal growth, which covered almost all of the substrates in the sampling reach. DWM staff also sampled this reach of the river near Willow Street between April and September (Station CR28.9). The water level decreased approximately 1 to 2 feet over the course of the sampling season and in early August the river was not flowing over the dam, only around it. However, substrates downstream from the dam were not exposed (Appendix B).

The USGS maintains a streamflow gage on the Charles River in Dover, MA (Gage 01103500). The average annual discharge at the gage is 301.2 cfs (period of record 2000 to 2005). The maximum discharge occurred on 23 August 1955 and 22 March 1968 (3,220 cfs). The minimum discharge occurred on 24 October 1952 (0.5 cfs) and was caused by unusual regulation. The USGS remarks that flow is affected by diversions to and from the basin for municipal supplies (Socolow *et al.* 2004).

Biology
In September 2004 a cyanobacteria bloom (primarily *Oscillatoria* sp.) was recorded by DWM staff in this segment of the Charles River (counts were extremely high at Dover Dam which was most downstream station sampled) (Connors 2004 and Beskenis 2007a).

On 26 July 2002 MA DFG biologists conducted boat electrofishing in the Charles River upstream and downstream from Central Street in Dover/Needham (Richards 2006). A total of 476 fish were collected representing 13 species. The dominant taxa were bluegill (n=222), golden shiner (n=84), and largemouth bass (n=62). These species collectively comprised 77% of the sample. White sucker (n=2) were the only fluvial species present. All fish species collected are classified as being tolerant or moderately tolerant to pollution. The relative absence of fluvial fish species at the sampling location is likely the result of the Dover Dam, which alters the natural flow regime within much of this segment of the Charles River and creates habitat more conducive to macrohabitat generalists.

Four non-native aquatic macrophytes - fanwort, Euorpean water clover (*Marsilea quadrifolia*), variable milfoil (*Myriophyllum heterophyllum*), and Eurasian milfoil (*Myriophyllum spicatum*) - were documented in the river between the Elm Bank Reservation to the Dover (Cochrane) Dam during the survey conducted by CRWA in August 2005 (CRWA 2006). *Lemna*, *wolfia* sp., and filamentous algae (*Lyngbya* sp.) were also noted in the backwater areas upstream from the dam.

DWM biologists describe algal and macrophytes growth as abundant throughout the reach of the Charles River downstream from Dover Dam, Dover-Needham, MA (Station CR02A) (Appendix C). In-stream vegetation consisted of rooted submergent macrophytes (milfoil, *Myriophyllum* sp.; waterweed, *Elodea* sp.; coontail, *Ceratophyllum* sp.) and mosses, while the alga community was comprised of filamentous, matted, and globose forms (Appendix C). DWM biologists also collected periphyton samples in this area on 17 July 2002 (Appendix F). Algal cover was estimated as 95% in this open canopied stream reach. The dominant algal genera collected in the rock/riffle habitat were Chlorophyceae - *Microspora* sp., *Rhizoclonium heiroglyphicum,* and *Oedogonium* sp. (Appendix F).

Compared to the upstream reference on the Charles River (Station CR03), the RBP III analysis indicated the benthic community downstream from the Dover Dam (Station CR02A) was slightly impacted (Appendix C). The sample was hyperdominated by filter feeders "*indicating substantial suspended FPOM loads* " (Appendix C).

Water Chemistry

EPA has conducted water quality monitoring of the Charles River downstream from the South Natick Dam (Station CRBL01) as part of the Clean Charles 2005 Core Monitoring Program (Faber 2005). CRWA volunteers sampled four locations along this segment of the Charles River as part of the Upper Charles River Watershed TMDL Project and/or their monthly sampling program (CRWA 2004a CRWA 2006, and CRWA 2007). Sampling locations included Cheney Bridge in Wellesley (Station 387S), Charles River Road Bridge in Dover/Needham (Station 400S), Claybrook Road (between Main Street and Bridge at big bend in river) in Dover (Station 407S), and Dover Gage at Mill Street in Dover (Station 447S). Sampling as part of the Upper Charles River Watershed TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). Lastly, DWM conducted water quality sampling of the Charles River approximately 300 feet downstream from Dover Dam (upstream from the USGS Dover gage) in Dover (Station CR28.9) between April and September 2002 (Appendix B).

EPA conducted water quality monitoring of the Charles River downstream from the South Natick Dam (Station CRBL01) as part of the Clean Charles 2005 Core Monitoring Program (EPA 2001, Faber 2002, Faber 2003, Faber 2004, and Faber 2005). During their dry weather surveys (July, August, and September 2000 through 2004), DO was $\geq$ 6.6 mg/L (n=12), pH ranged from 6.2 to 7.9 SU (2 of 15 measurements were <6.5 SU), the maximum temperature was 28.1ºC (n=15), chlorophyll *a* concentrations ranged from 5 to 63 µg/L with 3 of 15 measurements >15 µg/L. Total phosphorus concentrations were moderately elevated ranging from 0.025 to 0.118 mg/L (half of the 14 measurements were >0.05 mg/L).

The CRWA staff and volunteers collected TMDL and monthly water quality data from the river at Cheney Bridge in Wellesley (Station 387S) (CRWA 2007). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, ammonia, and chlorophyll *a* were all indicative of good water quality. Total phosphorus concentrations ranged from 0.0307 to 0.06 mg/L (n=8 excluding duplicates). Concentrations were slightly elevated ($\geq$0.05 mg/L) in two samples. The monthly data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between February 2000 and October 2006 (n=57) exceeded 28.3°C (maximum 25.0°C). A total of 24 pH measurements were taken at Station 387S between February 2000 and April 2002. The pH measurements ranged from 6.5 to 7.7 SU. Total suspended solids concentrations were all low ($\leq$ 7.4 mg/L, n=37). Total phosphorus concentrations at this sampling location ranged from 0.028 to 0.180 with 18 measurements exceeding 0.05 mg/L (n=23). The maximum ammonia concentration was low (0.1 mg/L, n=23). Chlorophyll a concentrations were low ($\leq$ 10.4 µg/L n=12).

CRWA volunteers collected monthly data for the Charles River at Charles River Road Bridge in Dover (Station 400S) including analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. One of the temperature measurements taken between February 2000 and October 2006 (n=40) exceeded 28.3°C (maximum 28.5°C). A total of 20 pH measurements were taken at Station 400S between February 2000 and April 2002. The pH measurements ranged from 6.5 to 7.4 SU. Total suspended solids concentrations were all low (≤ 7.8 mg/L, n=31).

The CRWA staff collected TMDL water quality data from the river at Claybrook Road (between Main Street and Bridge at big bend in river) in Dover (Station 407S) (CRWA 2004a and CRWA 2006). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, and ammonia were all indicative of good water quality. Total phosphorus concentrations ranged from 0.0384 to 0.0564 mg/L (n=8 excluding duplicates). Concentrations were slightly elevated (≥0.05 mg/L) in three samples. The chlorophyll *a* concentration was elevated (30.8 μg/L) during the August 2002 survey although all other measurements were low (n=8).

The deepest area of the Charles River in the Dover Dam impoundment (approximately 10 feet) is just upstream from the dam (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, temperature and conductivity in the Charles River slightly upstream from the Dover/Cochrane Dam between 28 August 2002 and 3 September 2002 at a depth of approximately 3.3 feet. DO concentrations were not less than 6.2 mg/L and were as high as 8.8 mg/L. Saturations ranged from 79 to 102% (CRWA 2004a). The maximum temperature was 23.26°C. Dissolved oxygen depletion did not occur near the sediment-water interface in the deepest part of the channel when depth profiles were conducted (CRWA 2004a) at this site.

Water quality monitoring (*in-situ* measurements of DO and temperature) as well as nutrient (total phosphorus and chlorophyll *a* and pheophytin *a* samples were taken along this segment of the Charles River on 21 June 2005 at three locations just upstream from the Dover Dam (referred to as the Cochrane Dam in this study), Dover (Schlezinger and Howes 2006). DO was ≥ 7.8 mg/L. Total phosphorus concentrations were moderate ranging from 0.057 to 0.061 mg/L, while chlorophyll *a* concentrations were fairly low ranging from 2.79 to 6.15 µg/L.

MassDEP DWM conducted water quality monitoring of the Charles River downstream from Dover Dam (near Willow Street/South Street) in Dover/Needham (Station CR28.9) between April and September 2002 (Appendix B). This station is located 1000 feet upstream from USGS Dover Gage 01103500. In-stream DO concentrations ranged from 3.7 to 11.0 mg/L (n=10) representing both daytime and worse case (pre-dawn) conditions, however it should be noted that only one sample was less than 5.0 mg/L. The maximum temperature was 27.4°C and all pH measurements (6.8 to 7.9 cu SU) met criteria. The diurnal variation of DO for this site was somewhat high (up to 3.1 mg/L). Total phosphorus concentrations ranged from 0.023 to 0.10 mg/L and were greater than or equal to 0.05 in four out of five samples. Total suspended solids concentrations were all low (≤ 18 mg/L, n=4).

The CRWA staff and volunteers also collected TMDL and monthly water quality data from the river at Dover Gage of Mill Street in Dover (Station 447S) (CRWA 2007). *In-situ* measurements of DO, water temperature, and pH were taken and water quality samples were collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the surveys conducted, DO, pH, temperature, and ammonia were all indicative of good water quality although one pH measurement was slightly high (8.4 SU) and one temperature measurement was high (28.6°C). Total phosphorus concentrations ranged from 0.0286 to 0.0572 mg/L (n=8) but were >0.05 mg/L in only one sample. The chlorophyll *a* concentration was elevated (21 μg/L) during the August 2005 survey although all other measurements were low (n=8). The monthly data included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between April 2000 and September 2006 (n=51) exceeded 28.3°C (maximum 28.0°C). A total of 17 pH measurements were taken at Station 447S between April 2000 and April 2002. The pH measurements ranged from 6.6 to 8.1 SU. Total suspended solids concentrations were all low (≤ 6.2 mg/L, n=28).

Sediment

Sediment cores were collected in June 2005 from this segment of the Charles River at three locations just upstream the Cochrane Dam, Dover to measure rates of sediment oxygen demand and sediment nutrient release during aerobic and anaerobic conditions (Schlezinger and Howes 2006). Sediment oxygen demand was similar to the majority of other sites along the Charles River.

The *Aquatic Life Use* is assessed as impaired for this segment of the Charles River. The cyanobacteria bloom (primarily *Oscillatoria* sp.) in September 2004 affected this entire segment of the Charles River. Four non-native aquatic macrophytes were also documented and DWM biologists describe algal and macrophytes growth as abundant throughout the reach of the Charles River downstream from Dover Dam. While the RBP III analysis of the benthic community indicated only slight impairment, the sample was hyperdominated by filter feeders also indicative of the enriched conditions. DO concentrations met the criterion at all but one of sites sampled along this segment of the river, while moderately elevated concentrations of total phosphorus were detected. The current fish assemblage within this segment of the Charles River is missing the three top ranking species in the Charles River Target Fish Community developed by Meixler (2006). In addition the fourth ranking species is underrepresented. The dams along this segment alter the natural flow regime and create habitat more conducive to macrohabitat generalists. The relative absence of fluvial fish species is likely the result of the lentic nature that comprises much of this segment of the Charles River.

Fish Consumption Use

Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp, and yellow perch) were collected from the Charles River by EPA to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as composite offal samples were prepared and analyzed for PCBs and organochlorine pesticides, PAHs, metals including total mercury, % lipids, and dioxins.

Due to the presence of elevated PCB in carp and pesticides (total DDT) in largemouth bass, MA DPH recommends the following (MA DPH 2007 and Celona 2007).

> "*Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any Carp or Largemouth Bass fish from the Charles River collected between the South Natick Dam in Natick and Museum of Science Dam in Boston/Cambridge, the general public should not consume Carp from this section of the river, and the general public should limit consumption of Largemouth Bass fish to two meals per month.*"

Because of the site-specific fish consumption advisory for the Charles River between the South Natick Dam, Natick and the *Museum of Science Dam* in Cambridge/Boston due to elevated concentrations of PCBs (polychlorinated biphenyls) and pesticides (total DDT), the *Fish Consumption Use* is assessed as impaired for this segment of the Charles River.

Primary and Secondary Contact Recreation and Aesthetics Uses

In September 2004 a cyanobacteria bloom (primarily *Oscillatoria* sp.) was recorded by DWM staff throughout this segment of the Charles River (Connors 2004 and Beskenis 2007a).

EPA has conducted water quality monitoring of the Charles River downstream from the South Natick Dam (Station CRBL01) as part of the Clean Charles 2005 Core Monitoring Program (Faber 2002, Faber 2003, Faber 2004, and Faber 2005). During their dry weather surveys (July, August, and September in 2001, 2003, 2004 and September 2002), *E. coli* bacteria counts were all $\leq$ 60 cfu/100 mL.

CRWA volunteers sampled four locations along this segment of the Charles River: Cheney Bridge in Wellesley (Station 387S), Charles River Road Bridge in Dover (Station 400S), Claybrook Road (between Main Street and Bridge at big bend in river) in Dover (Station 407S), and Dover Gage of Mill Street in Dover (Station 447S) as part of the Upper Charles River Watershed TMDL Project or as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* samples were also collected from stations 387S, 400S, and 447S between March 2004 and April 2005.

CRWA staff and volunteers sampled this segment of the Charles River at Cheney Bridge in Wellesley (Station 387S) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). Between these two projects, a total of 42 samples were collected, 23 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 387S	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	2	5	5
	Maximum cfu/100 ml	440	250	190	120	100
	Minimum cfu/100 ml	30	10	19	10	7.5
126 cfu/100 ml	Geometric Mean	101	56	60	36	44
Max 235 cfu/100 ml	Number of Exceedances	1	0	0	0	0
Secondary Contact	Samples Assessed	10	8	7	10	7
	Maximum cfu/100 ml	610	250	190	290	100
	Minimum cfu/100 ml	30	10	19	10	7.5
630 cfu/100 ml	Geometric Mean	128	48	86	41	43
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Monthly bacteria sampling was conducted by CRWA volunteers in the Charles River at Charles River Road Bridge in Dover (Station 400S) by CRWA). These data can be summarized as follows.

Station 400S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	3	6	3	4	6
	Maximum cfu/100 ml	1,090	210	160	310	500
	Minimum cfu/100 ml	40	8	10	20	15
126 cfu/100 ml	Geometric Mean	130	64	36	65	67
Max 235 cfu/100 ml	Number of Exceedances	1	0	0	1	1
Secondary Contact	Samples Assessed	5	8	7	6	7
	Maximum cfu/100 ml	1,090	210	300	310	500
	Minimum cfu/100 ml	40	8	10	10	14.5
630 cfu/100 ml	Geometric Mean	194	52	42	61	54
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

The Charles River at Claybrook Road (between Main Street and Bridge at big bend in river) in Dover (Station 407S) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <100 to 900 cfu/100 ml (two counts exceeded 235 cfu/100 ml) and the highest counts were representative of wet weather sampling conditions.

During the survey conducted by CRWA in August 2005, *Lemna* sp., *Wolfia* sp., and filamentous algae (*Lyngbya* sp.) were the dominant species in the backwater areas upstream from the Dover (Cochrane) Dam (CRWA 2006).

Downstream from the Dover Dam (Station CR28.0) the river was described as slightly turbid on all survey dates between April and September 2002 by MassDEP DWM survey crews (Appendix B). Organic foam was observed in early June, most likely formed naturally from the fast water as it passed over the dam. By early August moderate amounts of green floating algal mats and green filamentous algae attached to the river substrates were observed and remained through the September survey. On 17 July 2002 DWM biologists noted that this reach of the river (Station CR02A) was highly turbid and a “raw” (i.e., untreated) sewage odor was detected (Appendix C).

CRWA volunteers sampled this segment of the Charles River at Dover Gage off Mill Street in Dover) (Station 447S) as part of the Upper Charles River Watershed TMDL Project as well as part of the CRWA monthly monitoring program (CRWA 2004a, CRWA 2006, and CRWA 2007). Sampling for the TMDL Project was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16-18 October 2002 and 19-21 October 2004 (CRWA 2004a and CRWA 2006). Between these two projects, a total of 42 samples were collected, 28 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station 447S	(CRWA 2004a, and 2006, and 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	6	5	4	7	6
	Maximum cfu/100 ml	130	260	50	100	100
	Minimum cfu/100 ml	10	10	10	10	5
126 cfu/100 ml	Geometric Mean	36	47	30	27	27
Max 235 cfu/100 ml	Number of Exceedances	0	1	0	0	0
Secondary Contact	Samples Assessed	10	7	9	9	7
	Maximum cfu/100 ml	200	260	100	320	100
	Minimum cfu/100 ml	10	10	10	10	5
630 cfu/100 ml	Geometric Mean	60	39	42	34	25
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Secchi disk measurements were taken at three locations in the Dover (Cochrane) Dam impoundment on 21 June 2005 (Schlezinger and Howes 2006). Secchi disk measurements met the 1.2 m recommended guidance at two locations while the other measurement was inconclusive because of shallow depth.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* Uses are assessed as impaired based on the cyanobacteria bloom affecting this entire segment of the Charles River. Dense growth of filamentous algal was also documented in the river downstream from the Dover (Cochrane) Dam. However it should be noted that *E. coli* bacteria counts almost always met water quality criteria though counts were occasionally elevated during wet weather conditions.

Charles River (Segment MA72-06) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Excess algal growth, non-native aquatic plant infestation, biological indicators of nutrient enrichment, fishes bioassessments, other flow regime alterations associated with dams/impoundments, other - relative absence of fluvial specialists/dependant fish species, elevated total phosphorus Sources: Habitat alteration associated with dams/impoundments, municipal NPDES discharge in upstream segment Suspected sources: Nonpoint sources, urban stormwater, internal nutrient recycling
Fish Consumption		IMPAIRED Causes: Elevated PCB in fish tissue, pesticides (total DDT) Source: Unknown Suspected source: Contaminated sediments
Primary Contact		IMPAIRED Cause: Excess algal growth Sources: Municipal NPDES discharges Suspected sources: Internal nutrient recycling, nonpoint sources
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

Continue to conduct benthic macroinvertebrate sampling in the Charles River downstream from Dover (Cochrane) Dam to document conditions (e.g., implementation of treatment upgrades/phosphorus reductions at municipal treatment plants upstream). Fish population sampling in this section of the river should also be conducted to better evaluate whether or not the target fish community is being met.

Continue to conduct water quality monitoring (i.e., deploy *in-situ* meters to obtain long-term DO data, additional total phosphorus and chlorophyll *a* sampling) to evaluate changes in water quality in this segment of the Charles River.

Document composition/frequency/extent of cyanobacteria blooms in this segment of the Charles River. Develop monitoring program to evaluate source(s) contributing to the problem.

WABAN BROOK (SEGMENT MA72-17)
Location: Headwaters, outlet Waban Lake, Wellesley, to confluence with the Charles River, Wellesley.
Segment Length: 0.7 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 15.7 mi^2 subwatershed.
Residential 52%
Forest..... 27%
Open land 10%
The estimated percent impervious area for this subwatershed area is 14.7%.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses* (*Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics*); Others Not Assessed (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Wellesley College (32031702/9P432031701)
Wellesley Water Department (32031701)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Streamflow estimates of Waban Brook at the service road to the composting site in Wellesley (Station 393TW2) from July 2002 through December 2005 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 0.4 to 90.3 cfs. The average flow for the period of record was 21.6 cfs. The lowest average monthly flows were documented between July through October 2002 (1.14 to 4.38 cfs), in June and July 2004 (2.61 to 3.13 cfs), and August and September 2005 (3.77 to 4.72 cfs).

Water Chemistry
Continuous *in-situ* temperature measurements of Waban Brook at the service road to the composting site in Wellesley (Station 393TW2) were also taken from July 2002 through December 2005 at 15-minute intervals as part of these projects. The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 32.2°C (n=113,205 measurements). The highest measurements (>28.3°C) occurred in July and August 2002, June, July, and August 2003, and July 2005. The warm water fishery temperature criterion (28.3°C) was exceeded on 18 days for a total of 134 hours of exceedance. The average amount of time above 28.3°C was 7.4 hours per day for those days where an exceedance occurred (CRWA 2004a).

One water quality monitoring station on Waban Brook near the Nehoiden Golf Club dirt road to aquaduct (downstream confluence with Fuller Brook) in Wellesley (Station 393T1) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). The CRWA collected several types of water quality data at this site including *in-situ* measurements of DO, water temperature, and pH as well as water quality samples collected and analyzed for ammonia-nitrogen, total phosphorus, and chlorophyll *a*. Of the seven surveys conducted, all of the DO, pH, temperature and chlorophyll *a* concentrations were indicative of good water quality conditions. Slightly elevated total phosphorus concentrations (maximum 0.084 mg/L on 16 October 2002) were measured during wet weather surveys.

The *Aquatic Life Use* for Waban Brook is assessed as impaired because of the frequency, duration, and magnitude of elevated stream temperatures documented in the summers of 2002, 2003, and 2005 that exceeded the warm water fishery criterion of 28.3°C. Slightly elevated total phosphorus concentrations in the brook downstream from its confluence with Fuller Brook are noted as a concern. Although the source is unknown, the large impoundments in the upper watershed area and runoff from impervious surfaces and separate storm sewer systems most likely contribute to the high stream temperatures.

Primary and Secondary Contact Recreation and Aesthetics Uses
One water quality monitoring station on Waban Brook near the Nehoiden Golf Club dirt road to aquaduct (downstream confluence with Fuller Brook) in Wellesley (Station 393T1) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <100 to 2,400 cfu/100 ml. One of two samples collected during the primary contact recreational season exceeded 235 cfu/100 ml while only one count exceeded 1,260 cfu/100 ml (criterion not to be exceeded for secondary contact recreation).

Too little data are available so the *Primary* and *Secondary Contact Recreational* and *Aesthetic* Uses are not assessed for Waban Brook. The *Primary Contact Recreational Use* is identified with an alert status, however, because of occasional high bacteria (*E. coli*) counts, the elevated bacteria *(E. coli*) counts documented in Fuller Brook, and best professional judgment.

Waban Brook (Segment MA72-17) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Elevated stream temperatures Source: Unknown Suspected sources: Combination of factors including impoundments, impervious surface/parking lot runoff, discharges from municipal separate storm sewer systems, urban runoff/stormwater
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Conduct water quality and bacteria sampling in Waban Brook to assess the *Aquatic Life* and *Primary* and *Secondary Contact Recreational* uses. Bacteria source tracking should be conducted if elevated counts are documented.

Thermistors should be deployed in the Waban Brook subwatershed to better evaluate source(s) contributing to elevated water temperatures. Based on the results of these investigations potential ways to reduce in-stream temperatures in the brook (e.g., riparian zone protection/restoration, improving shading, etc.) should be developed and implemented.

FULLER BROOK (SEGMENT MA72-18)
Location: Headwater south of Route 135, Needham, to confluence with Waban Brook, Wellesley.
Segment Length: 4.3 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 5.3 mi^2 subwatershed.
Residential 55%
Forest..... 24%
Open land 13%
The estimated percent impervious area for this subwatershed area is 15.3%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, organic enrichment/low DO, noxious aquatic plants, pathogens, and other habitat alterations (MassDEP 2007).

04-11/319: Cold Spring Brook Watershed Remediation. The goal of this project is to reduce sediment, nutrient, and fecal coliform loads to the Charles River via Cold Spring Brook and Fuller Brook through the implementation of structural and non-structural BMPs. The project was initiated in February 2006 and included the removal of sediment from the "Town Hall Duck Pond" (Fader 2007). BMPs were implemented on Linden Streeet and at the Linden Square Development Project and parking areas. The project tasks include;

1. development and implementation of an approved Quality Assurance Project Plan (QAPP),
2. final designs, permits, and installation of BMPs,
3. development and implementation of an Operation and Maintenance Plan for the BMPs, and
4. outreach and education about the project.

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H2 and H4)
F Diehl & Son, Inc. (MA0033022)
Lindwell SC, Inc. (formerly F.Diehl) (MAG910027)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
On 17 July 2002 MassDEP DWM biologists evaluated in-stream habitat in Fuller Brook 10 m upstream from Cameron Street, Wellesley (Station FB02) (Appendix C). Riffle areas with abundant cobble substrate were shallow in depth and short in length. DWM biologists noted "pools showed obvious signs of filling, sediment bars were common throughout the stream reach, and rocky substrates were approximately 40% embedded." Habitat quality was limited most by in-stream sediment, poorly vegetated banks along the right bank, poor bank stability and the lack of a vegetated riparian zone. The total habitat assessment score was 124 out of 200 (Appendix C). DWM fisheries biologists also conducted a habitat assessment of Fuller Brook on 28 August 2002. The reach sampled was comprised of a series of low gradient riffles and runs with some deep pools. Much of the substrate was sand and silt especially in the deeper areas. Most of the fish habitat present was in the form of woody snags and natural debris and deep pools. The final habitat score was 112 (of a possible 200) (Appendix G).

DWM conducted water quality monitoring of Fuller Brook just upstream from Dover Road in Wellesley (Station FB02) between April and September 2002. The riverbed was approximately 10 to 12 feet wide and channelized with stonewalls along both sides. The water level began to drop in July (from a starting depth of approximately 2 feet) and continued to drop in August when the velocity was observed to be almost stagnant, but the channel remained relatively full with no exposed substrates (Appendix B). Streamflow estimates of Fuller Brook at the Dover Road Bridge in Wellesley from July 2002 through March 2006 were reported by CRWA (CRWA 2004a and CRWA 2006). Average daily flow estimates ranged from 0.3 to 47.3 cfs. The average flow for the period of record was 7.7 cfs. The lowest average monthly flow was documented in August 2005 (1.51 cfs).

Biology
The benthic macroinvertebrate RBP III analysis indicated that Fuller Brook was moderately impacted compared to the Stony Brook reference station (Appendix C). The elevated Biotic Index and low EPT

Index were indicative of organic enrichment. The filter feeding hydropyschid caddisfly *Cheumatopysche* sp. was the single hyperdominant taxa found.

DWM biologists conducted backpack electrofishing in Fuller Brook upstream from Cameron Street in Wellesley (Station FB02) in August 2002. While fish sampling efficiency was rated as fair to poor (deep pools and the presence of a large amount course particulate organic matter (CPOM), which became suspended when disturbed), four species of fish were collected. The fish sample included mostly white sucker (15 captured, additional 20 observed), two redfin pickerel, one brown trout (stocked fish), and one yellow bullhead. White sucker, redfin pickerel, and yellow bullhead are considered either tolerant or moderately tolerant to pollution.

Water Chemistry

MassDEP DWM conducted water quality monitoring of Fuller Brook at Dover Road in Wellesley (Station FB01) between April and September 2002. Monitoring included *in-situ* measurements using a multiprobe. These data can be found in Appendix B, Table 3. *In-situ* measurements of DO, temperature, and pH were all indicative of good water quality conditions.

Continuous *in-situ* temperature measurements of Fuller Brook at the Dover Road Bridge in Wellesley (Station 393TF2) were reported by CRWA from July 2002 through March 2006. Measurements were taken at 15-minute intervals as part of CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 26.4°C (n=125,911 measurements) (CRWA 2004a and CRWA 2006).

The upper 3.3 miles of Fuller Brook are not assessed for the *Aquatic Life Use*. The *Aquatic Life Use* is assessed as impaired for the lower 1.0 miles of the brook downstream from the unnamed tributary draining the duck pond based primarily on the RBP III analysis that indicated the benthic macroinvertebrate community was moderately impacted. The community appeared to be structured in response to organic enrichment. The fish community was dominated by a fluvial dependant species. However, three of the four species collected were tolerant or moderately tolerant to pollution. Despite poor sampling efficiency, it was the opinion of DWM biologists that lack of stable fish habitat (especially under low flow conditions) threatened the fish population in Fuller Brook. Habitat quality degradation was evident in the form of erosion/sedimentation and poor riparian zone protection and streambank stability. The limited water quality data were indicative of good water quality conditions.

Primary and Secondary Contact Recreation and Aesthetics Uses

DWM biologists noted that the water column of Fuller Brook near Cameron Street, Wellesley (Station FB02) was turbid. With the exception of this condition no other objectionable conditions were noted (e.g., oils, odors, other deposits) (MassDEP 2002b).

Bacteria samples were collected from Fuller Brook at Dover Road in Wellesley (Station FB01) between April and September 2002 (Appendix B). *E. coli* counts ranged from 59 to 1,800 cfu/100 ml (Appendix B, Table 4) and three of the four counts exceeded both the primary and secondary maximum counts of 235 and 1,260, respectively. DWM field sampling crews also made observations during each survey event. The water column was described as clear to slightly turbid and no water odors were noted. However, a sulfide odor was released from the stream bottom when the muck and sediments were disturbed. No scum or other objectionable conditions (other than the sand and muck bottom deposits) were observed. Sparse coverage of aquatic plants including water starwort (*Callitriche* sp.) and duckweed (*Lemna* sp.) were observed during all of the survey dates.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed for the upper 3.3 mile reach of Fuller Brook due to a lack of data. The *Primary* and *Secondary Contact Recreational Uses* are assessed as impaired for the lower 1.0 mile reach of this segment (downstream from the unnamed tributary draining the duck pond) because of elevated bacteria *(E. coli*) counts. Historical data suggested that the tributary draining the duck pond was a significant source of bacteria pollution (Fiorentino *et al.* 2000). Other potential sources include urban runoff from the storm sewers. The *Aesthetics U*se is assessed as support based on the general lack of objectionable conditions (oils, odors, other deposits). This use is identified with an Alert Status, however, because of occasional turbidity.

Fuller Brook (Segment MA72-18) Use Summary

Designated Uses		Status
Aquatic Life		NOT ASSESSED upper 3.3 miles (to confluence with unnamed tributary draining the duck pond) IMPAIRED lower 1.0 miles (downstream from the unnamed tributary) Causes: Biological indicators of organic enrichment, sedimentation/siltation, physical habitat substrate alterations, Sources: Discharges from municipal separate storm sewer systems, loss of riparian habitat, post development erosion and sedimentation
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED upper 3.3 miles (to confluence with unnamed tributary draining the duck pond) IMPAIRED lower 1.0 miles (downstream from the unnamed tributary) Cause: Elevated *E. coli* Source: Unknown Suspected sources: Waterfowl and discharges from municipal separate storm sewer systems
Secondary Contact		
Aesthetics		NOT ASSESSED upper 3.3 miles (to confluence with unnamed tributary draining the duck pond) SUPPORT* lower 1.0 miles (downstream from the unnamed tributary)

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

DWM biologists recommend the following (Appendix C):

conduct water quality monitoring (including nutrients and bacteria source tracking) during next DEP Charles River watershed survey,
improve vegetative buffer along both banks, and
outreach to address potential impacts from upstream waterfowl population (near town hall).

Since the Cold Spring Brook Watershed Remediation Project has been implemented (the goal of this project was to reduce sediment, nutrient, and fecal coliform loads), water quality monitoring should be conducted to assess current conditions in Fuller Brook, in particular bacteria.

An additional water quality monitoring station upstream from the confluence of the unnamed tributary should be established in order to assess the status of the designated uses in the upper 3.3 miles of Fuller Brook.

Additional field reconnaissance and habitat quality assessments should be conducted along Fuller Brook to identify any anthropogenic sediment inputs to the brook. Best management practices to control these inputs should be developed and implemented.

TROUT BROOK (SEGMENT MA72-19)
Location: Headwaters, outlet Channings Pond, Dover, to confluence with Charles River, Dover.
Segment Length: 2.8 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 4.5 mi^2 subwatershed.
Forest..... 55%
Residential..... 33%
Agriculture..... 9%
The estimated percent impervious area for this subwatershed area is 7.0%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Dover Water Company, Inc. (9P432007801)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Streamflow estimates of Trout Brook at the Haven Road Bridge in Dover from July 2002 through December 2005 were reported by CRWA (CRWA 2004a and CRWA 2006). CRWA flow data collected between January 2004 and December 2005 will be reanalyzed after flow calibration data are available for the new USGS Trout Brook gaging station (installation in spring of 2007) (Pickering 2007). Average daily flow estimates for 2002 through 2003 ranged from 0.04 to 40.7 cfs. The average flow for July 2002 through December 2003 was 4.98 cfs. The lowest average monthly flows were documented in August through October 2002 (0.54 to 1.23 cfs) and August and September 2003 (0.54 to 1.31 cfs).

On 17 July 2002 DWM biologists conducted a habitat assessment of Trout Brook downstream from Haven Street in Dover (Station TB01). Both fish and invertebrate habitat were optimal in this reach and the total habitat assessment score was 182 out of a possible 200 (Appendix C). DWM biologists noted similar conditions in this same reach on 27 August 2002 with a habitat assessment score of 184 (Appendix G).

Biology
The RBP III analysis of the two samples taken from Trout Brook yielded two different results; moderately impacted and slightly impacted when compared to the Stony Brook reference station (Appendix C). The abundance of Chironomidae *Tvetenia paucunca*, often found in cool, small streams impacted by nutrient enrichment, resulted in metric scoring reductions and were specifically responsible for the one sample's moderately impacted assessment. Both samples collected though displayed high taxa richness values and had multiple families of Plecoptera, a population sensitive order (Appendix C). Considering the excellent habitat quality at this station the benthic community was likely limited by water quality.

Electrofishing was conducted by DWM in Trout Brook downstream from Haven Street in Dover (Station TB01) in August 2002. The sampling efficiency was rated as fair/poor because the riparian vegetation was so thick that it at times made electrofishing impossible. Relatively few fish were observed/collected (three species and 16 individuals), however, the fish community was dominated by multiple age classes of brook trout (*Salvelinus fontinalis*, n=10). White sucker and redfin pickerel were also present. It should be noted that in 1997 a total of 49 brook trout were collected from this sampling location (Fiorentino *et al.* 2000). It is not known whether the difference in the number of brook trout collected is due to sampling efficiency and/or population change.

Water Chemistry
One water quality monitoring station on Trout Brook near Haven Street Bridge in Dover (Station 411T2) was sampled as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). The lowest DO measurement was 5.51 mg/L

on 15 August 2002 while none of the other five measurements were less than 6.5 mg/L. All of the other water quality data (pH, ammonia-nitrogen, and chlorophyll *a* concentrations) were indicative of good water quality conditions. The total phosphorus concentrations were also generally low (only one measurement exceeded 0.05 mg/L – 0.0664 mg/L on 16 October 2002).

Continuous *in-situ* temperature measurements were also reported by CRWA for Trout Brook from July 2002 through December 2005. Measurements were taken at 15-minute intervals as part of CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). The maximum temperature recorded during CRWA continuous *in-situ* monitoring was 22.3°C (n=118,508 measurements). The highest temperatures (>20°C) occurred in June, July, and August of all sampling years. Because this brook was found to contain multiple age classes of brook trout, the temperature data were analyzed against the cold water fishery criterion (antidegradation provisions that protect existing uses 314 CMR Section 4.04(1) of the MA SWQS). The Cold Water Fishery temperature criterion (20.0°C) (calculated as the 7-day rolling average of the daily maximum temperature) was exceeded on 56 days out of 579 days for which a 7-day rolling average could be calculated during the months of June through October of all sample years. The number of days per year with a 7-day rolling average of the daily maximum temperature exceedance of 20.0°C was three times in 2002 (note no data available for June), 22 times in 2003, 25 times in 2004, and six times in 2005. On a daily basis a total of 88 days were found to exceed 20.0°C and the average amount of time an exceedance occurred on these days was 5.9 hours.

The *Aquatic Life Use* is assessed as impaired for Trout Brook based primarily on the RBP III analysis that indicated the benthic community was moderately impacted. There was evidence of benthic community recovery since 1997, however. It should be noted that while water quality might limit the biological integrity in Trout Brook given the exceptional habitat present, whether or not there are changes in the fish community (particularly fewer brook trout) is currently unknown. Although this segment is not classified as a Cold Water Fishery, the presence of multiple age classes of brook trout is indicative of a resource that merits protection. The frequency of temperatures exceeding the Cold Water Fishery criterion of 20.0°C is, therefore, also identified as a likely cause of impairment. Water withdrawals are also a concern.

Primary and Secondary Contact Recreation and Aesthetics Uses

Bacteria sampling was conducted at one water quality monitoring station on Trout Brook near Haven Street Bridge in Dover (Station 411T2) as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a and CRWA 2006). Sampling was conducted on 13 August 2002 and 24 August 2005 representing dry weather conditions (*in-situ* measurements were taken on 15 August 2002 because of equipment calibration problems) as well as during two wet weather surveys 16 and 17 October 2002 and 19 and 20 October 2004 (CRWA 2004a and CRWA 2006). *E. coli* counts ranged from <10 to 200 cfu/100 ml.

DWM biologists found the water column of Trout Brook to be clear downstream from Haven Street in Dover (Station TB01) on 17 July 2002. No objectionable conditions (e.g., oils, odors, other deposits) were noted (MassDEP 2002b).

Too few bacteria data are available to effectively assess *Primary* and *Secondary Contact Recreational* uses (i.e., six samples over four years) so these uses are not assessed. The *Aesthetics Use* is assessed as support due to the lack of objectionable deposits or odors.

Trout Brook (Segment MA72-19) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Biological indicators of organic enrichment, elevated water temperature Source: Unknown Suspected Sources: Nutrient enrichment
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

RECOMMENDATIONS

Trout Brook should be designated as a Cold Water Fishery in the next revision of the Massachusetts Surface Water Quality Standards and until that time should be protected as a cold-water fishery resource through antidegradation provisions.

A multiprobe water quality meter should be deployed in Trout Brook near Haven Street in Dover to collect long-term DO, pH, and temperature data to better assess water quality conditions particularly between the months of May through October. Consideration should also be given to establishing additional water quality monitoring station(s) in this brook.

DWM benthic macroinvertebrate biologists recommend the following (Appendix C)

Conduct biomonitoring during next MassDEP Charles River Watershed survey as well as water quality monitoring (including nutrients);

Field reconnaissance in subbasin to investigate land-uses that may contribute NPS inputs.

DWM fisheries biologists recommend the following (Appendix G).

Continued protection of the watershed and riparian zone is essential to maintaining wild brook trout in Trout Brook. Future biomonitoring should include a more thorough survey of Trout Brook to document the distribution and abundance of reproducing brook trout.

Support efforts to maximize shade (protect and/or restore riparian zone) and minimize water withdrawal pumping in summer months.

Additional bacteria sampling should be conducted to assess the status of the *Primary* and *Secondary Contact Recreational Uses*.

POWISSETT BROOK (SEGMENT MA72-20)
Location: Headwaters outlet Noannet Pond, Westwood, to confluence with Charles River, Dover.
Segment Length: 1.8 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 1.5 mi^2 subwatershed.
Residential 77%
Forest..... 12%
Open land 3%
The estimated percent impervious area for this subwatershed area is 3.7%.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses* (*Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics*); Others Not Assessed (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Powissett Brook flows through a heavily forested area in the vicinity of Wilsondale Street in Dover (Station PB01). There is an unnamed impoundment of the brook on the upstream side of the road (Appendix B). In June the water level filled the channel to the banks and there was good velocity for riffles. By early July the depth had dropped approximately 1 foot, from an initial depth of only 1.5 to 2 feet, causing some substrates to be exposed (including puddling) and the velocity to decrease to low (<1 fps). This condition continued through the September sampling date.

On 17 July 2002 DWM biologists conducted a habitat assessment of Powissett Brook downstream from Wilsondale Street in Dover (Station PB01). The stream was approximately 2 m wide with depths of up to 0.3 m in the deepest pools. The total habitat assessment score was 149 out of a possible 200 (Appendix C). Habitat limitations were largely the result of low water levels, with fish habitat availability the most negatively impacted.

Biology
The RBP III analysis of the sample collected from Powissett Brook indicated a moderately impacted benthic community compared to the Stony Brook reference station (Appendix C).

The *Aquatic Life Use* is assessed as impaired based on the RBP III analysis that indicated moderate impacts to the benthic community relative to reference station conditions. Habitat constraints related to low flow conditions appear to impact the benthic community health. These conditions are likely exacerbated by regulation of flow at upstream impoundments (e.g., Noannet Pond Dam).

Primary and Secondary Contact Recreation and Aesthetics Uses
A total of four bacteria (including one duplicate) samples were collected from Powissett Brook downstream at Wilsondale Street, Dover (Station PB01) by DWM between June and August 2002. *E. coli* bacteria counts were very low (6 – 78 cfu/100 ml) (Appendix B, Table 4). No aesthetically objectionable conditions were observed by either DWM field survey crews or biologists in Powissett Brook near Wilsondale Street in Dover (Station PB01) (Appendix B and MassDEP 2002b).

Although all of the bacteria counts were low, too little *E. coli* bacteria data are available so the *Primary and Secondary Contact Uses* are assessed not assessed. The *Aesthetics* Use is assessed as support based on the lack of objectionable conditions (oils, odors, other deposits).

Powissett Brook (Segment MA72-20) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Combined biota/habitat assessment Suspected cause: Low flow alterations Source: Unknown Suspected source: Dam/impoundments
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

RECOMMENDATIONS

Additional field reconnaissance and habitat quality assessments should be conducted along Powissett Brook particularly downstream from the impounded areas to better evaluate flow regime in the brook. Investigate outlet control practices at Noannet Pond. Develop and implement flow management plan to improve streamflows in Powissett Brook.

DWM biologists recommend the following (Appendix C):

conduct water quality and biological monitoring during next MassDEP Charles River watershed survey, and

field reconnaissance in the subwatershed area to investigate land-uses that may contribute non point source inputs.

Conduct additional bacteria sampling to assess the status of the *Primary* and *Secondary Contact Recreational Uses*.

CHARLES RIVER (SEGMENT MA72-07)
Location: Chestnut Street, Needham, to Watertown Dam, Watertown.
Segment Length: 24.8 miles
Classification: Class B, Warm Water Fishery.

Land-use estimates (top 3, excluding water) for the 271.2 mi^2 subwatershed.
Forest..... 39%
Residential 36%
Open land 8%
The estimated percent impervious area for this subwatershed area is 13.7%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of priority organics, nutrients, organic enrichment/low DO, noxious aquatic plants, turbidity, and pathogens as well as exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Dedham Westwood Water District (32007303)
Norfolk & Dedham Mutual Fire Insurance (V32007302)
Charles River Country Club (32020701)
Braeburn Country Club (9P232020701)
Woodland Golf Club (32020702/9P432020701)

NPDES (See Appendix H, Tables H2, H3, and H4)
Norfolk & Dedham Mutual Insurance Company (MAG250034)
Boston Water and Sewer Commission (MAS010001). There are four major stormwater outfalls - 7C006, 8B112, 10B015, and 9B049 - to this segment of the Charles River and one minor stormwater outfall – 8B126.
Pine Brook Country Club (MA0032212) discharge to Pine Brook tributary to this segment of the Charles River.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Brady *et al.* (2005) describes the seven dams and their fishways that exist along this segment of the Charles River. The most upstream dam is the Silk Mill Dam in Newton/Wellesley. This steel and concrete bascule dam is 14' high and 68' wide and has no fish passage. Slightly further downstream the Metropolitan Circular Dam of granite blocks is 12' high and 75' wide. No fish passage is available at this dam. The next two dams, the Cordingly (Newton Upper Falls) and the Finlay (Newton Lower Falls) dams in Wellesley/Newton, are both equipped with Denil fishways. The fishway at the Cordingly dam is currently in fair condition and is not passable. It is currently scheduled for a similar renovation as that performed at Finlay Dam. The fishway at the Finlay Dam (Newton Lower Falls) had badly deteriorated and has recently been replaced with an experimental design incorporating a recycled plastic material. It should be noted that, to date, there is no documentation of anadromous species reaching the Newton Lower Falls. The next dam on the river is the Moody Street Dam in Waltham. This dam is equipped with a combination Denil and weir-pool fishway. The incorporation of these two designs into one fishway makes proper flow regulation critical to efficient passage. Other problems such as competing spillway flow, which makes entrance to the ladder difficult, and a deteriorated baffle, makes fish passage inefficient. The next downstream dam on the river is the Bleachery Dam in Waltham. This 3.5' high, 150' wide granite block and cement dam is partially breached adjacent to the south bank of the river and breaching of dam near the north side of the river was completed on 13 September 2005 (Ferry 2006). The Watertown Dam in Watertown marks the last dam on this segment of the Charles River. The Denil fishway here functions well, although the width of the spillway and river make it difficult for river herring and shad to locate the entrance and it is likely that a large percentage of these populations fail to ascend the river beyond this point. The smelt population spawns below this dam and is not affected by the fishway's shortcomings.

The Charles River was sampled by DWM over the course of the summer of 2002 from the Mary Hunnewell footbridge in Wellesley just upstream from the Cordingly Dam (Station CR17.4) (Appendix B). Water velocities were variable -- high where the water fell a few feet over the dam and onto bedrock. By

early July velocity in the sampling area slowed to approximately 1 fps from 2 to 3 fps in the spring. By early August 2002 water was barely flowing over the dam and a large area of bedrock was exposed on the downstream side.

The USGS maintains a streamflow gage on the Charles River upstream from the Circular Dam in Wellesley, MA (Gage 01104200). The drainage area at this site is 211 mi^2. Since August 1959 the average annual discharge was 289 cfs (period of record water years 1959 to 2005) while the minimum daily mean discharge was 1.0 cfs (24 August 1965) and the maximum daily mean discharge was 2,330 cfs (22 March 1968) (USGS 2007e). The USGS remarks that flow is affected by diversion to Mother Brook (Station 01104000), and by diversions to and from the basin for municipal supplies. This gage is also affected by occasional regulation at dam 0.2 mi upstream and by other ponds.

The USGS maintains a gage on the Charles River 800 feet downstream from Moody Street Bridge in Waltham, MA (Gage 01104500). The drainage area at this site is 251 mi^2 although 24 mi^2 is probably noncontributing. Since 1931, the average annual discharge was 311 cfs (period of record water years 1931 to 2005) while the minimum daily mean discharge was 0.2 cfs (4 October 1943) and the maximum daily mean discharge was 2,940 cfs (26 January 1979) (USGS 2007f). The provisional 7Q10 of the river at this location is approximately 7.83 cfs (Zarriello 2007). The USGS remarks that flow is affected by diversion of water: from Stony Brook Reservoir (24 mi^2 for Cambridge water supply, to Mother Brook (Station 01104000), and to and from basin for municipal supplies. Before 1960 there was some regulation by mills upstream. Before 1954 low flow was entirely regulated by Boston Edison Co. powerplant.

The USGS has a gage on the Charles River above the Watertown dam in Watertown, MA (Gage 01104615). The drainage area at this site is 272 mi^2. While miscellaneous discharge measurements have been made at this site, instantaneous discharge has been estimated from the gage at Waltham (01104500) (Socolow *et al*. 2004).

Biology

Just upstream from the Cordingly Dam moderate coverage of duckweed (*Lemna* sp.), waterweed (*Elodea* sp.) and the non-native aquatic macrophyte water chestnut were observed in the Charles River near the Mary Hunnewell footbridge in Wellesley in August 2002 (Appendix B). Sparse amounts of filamentous green algae were also noted.

On 16 August 2002 MA DFG biologists and EPA personnel conducted barge electrofishing in the Charles River downstream from Route 16 in Wellesley/Newton (reach downstream from Finley Dam) (Richards 2006). Sampling notes indicate that electrofishing was conducted in a long, slow-moving pool with one good rifle and another reach of shallow glide and was terminated at a large riffle downstream from Route 16 bridge. A total of 249 fish were collected representing 10 species. The dominant taxa were bluegill (n=100), American eel (n=85), and redbreasted sunfish (n=46). These three species, all macrohabitat generalists considered to be tolerant or moderately tolerant to pollution, collectively comprised 93% of the sample. White sucker (n=2) were the only fluvial species present. The relative absence of fluvial fishes and the absence of common shiner and fallfish, the top two species in the Charles River Target Fish Community developed by Meixler (2006), is problematic.

Further downstream MA DFG biologists and EPA personnel conducted boat electrofishing in a long reach of the Charles River generally upstream from Route 128 in Newton/Weston on 30 July 2002 (Richards 2006). A total of 177 fish were collected representing 14 species. The dominant taxa were bluegill (n=61), common carp (n=30), yellow perch (n=28), largemouth bass (n=20). American eel (n=10), and redbreasted sunfish (n=3) were also present. All fish collected with the exception of two blueback herring (*Alosa aestivalis* - an anadromous fluvial dependant species) are classified as macrohabitat generalists that are tolerant or moderately tolerant to pollution. Similar to the previous station the relative absence of fluvial fishes and the absence of common shiner and fallfish, the top two species in the Charles River Target Fish Community developed by Meixler (2006), is problematic.

Mechanical harvesting of the non-native aquatic macrophyte water chestnut occurred last during the summer of 2007 in the Lakes District of this segment of the Charles River. Historical records of two other non-native aquatic macrophytes in the Lakes District (*Cabomba caroliniana* and *Myriophyllum spicatum*) are unconfirmed.

Restoration of American shad (*Alosa sapidissima*) to the Charles River is currently underway as part of the collaborative effort between the Massachusetts *Division of Marine Fisheries* and the U.S. Fish and Wildlife Service (USFWS) (Ferry 2006). The American Shad Propagation Project goals are to restore viable populations of American shad to the Charles River and to create local sport fisheries. As part of the MA DFG Shad Stocking Program 1.8 million half-inch long American shad fry were released into the Charles River at the Woerd Avenue Boat Launch in Waltham during the week of 10 July 2006.

Electrofishing was also conducted by MA DFG biologists and EPA personnel on 13 August 2002 near Bridge Street in Newton/Watertown (downstream from the breached Bemis Dam – Station 693). A total of 46 fish representing three species were collected although sample notes indicated that only 25% of the stream width was covered with the backpack shockers (the river was described as wide, shallow, flat riffle in the sampling reach (Richards 2006). The sample was dominated by American eel (n=27), redbreast sunfish (n=10) and smallmouth bass (*Micropterus dolomieu*, n=9). In light of the poor sampling efficiency it is hard to evaluate the fish population at this location. Habitat was conducive to the presence of fluvial species but none were collected or observed.

Toxicity

Effluent

Both acute and chronic whole effluent toxicity tests have been conducted on the Pine Brook Country Club effluent (MA0032212). Acute toxicity was not detected by either *C. dubia* or *P. promelas* in the 12 tests conducted between July 2000 and September 2006 - the LC_{50}s were all reported as $\geq$100% for both species. Results of the *C. dubia* and *P. promelas* chronic whole effluent toxicity tests ranged from 25 to 100% effluent and 50 to 100% effluent, respectively, all of which met the CNOEC limit (n=11 valid test events). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between July 2000 and September 2006 ranged from 0.06 to 17.0 mg/L (n=12). Total residual chlorine (TRC) concentrations reported in the whole effluent toxicity reports were all less the minimum quantification limit of 0.05 mg/L (n=12).

Water Chemistry

CRWA volunteers conducted water quality monitoring at 12 sampling stations along this segment of the Charles River as part of monthly monitoring program. These sites, from upstream to downstream, are: near Dedham Medical Center in Dedham (Station 484S), at Ames Street Bridge in Dedham (Station 521S), Route 109 Bridge in Dedham (Station 534S), Nahanton Park in Newton (Station 567S), Route 9 gaging station in Newton (Station 591S), Washington Street Hunnewell Bridge in Wellesley (Station 609S), at Leo J. Martin Golf Course/Park Road in Weston (Station 621S, at 2391 Commonwealth Ave in Newton (Station 635S), in the Lakes Region in Waltham (Station 648S), near the Moody Street Bridge in Waltham (Station 662S), near North Street in Waltham (Station 675S), at the Watertown Dam footbridge in Watertown (Station 012S). EPA conducted water quality sampling just upstream from the Watertown Dam (Station CRBL02) (EPA 2001, Faber 2002, Faber 2003, Faber 2004, and Faber 2005). MWRA also conducted water quality sampling of the river upstream from the Watertown Dam (Station 012) (Coughlin 2006). In 2002 water quality monitoring was conducted by DWM at one site, south of Route 16 at the Mary Hunnewell Bridge crossing (footbridge west of Wales Street/Walnut Street), Newton/Wellesley (Station CR17.4) between April and September 2002 (Appendix B). This sampling station was located just upstream from the CRWA Station 609S. Water quality data are also available from USGS for the Charles River at their Gage 01104615 above the Watertown Dam at Watertown (USGS 2007g).

CRWA collected monthly data for the Charles River at Near Dedham Medical Center in Dedham (Station 484S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=62) exceeded 28.3°C (maximum 24.5°C). A total of 23 pH measurements were taken at Station 484S between February 2000 and April 2002. The pH measurements ranged from 6.6 to 7.7 SU. Total suspended solids concentrations were all low ($\leq$ 9.0 mg/L, n=38).

CRWA collected monthly data for the Charles River at Ames Street Bridge in Dedham (Station 521S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. one of the temperature measurements taken between February 2000 and October 2006 (n=68) exceeded 28.3°C (maximum 27.0°C). A total of 26 pH measurements were taken at Station 521S between February 2000 and April 2002. The pH measurements ranged from 6.6 to 8.2 SU. Total suspended solids concentrations were all low ($\leq$ 13.0 mg/L, n=40).

CRWA collected monthly data for the Charles River Route 109 Bridge in Dedham (Station 534S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=64) exceeded 28.3°C (maximum 27.5°C). A total of 26 pH measurements were taken at Station 534S between February 2000 and April 2002. The pH measurements ranged from 6.5 to 8.1 SU. Total suspended solids concentrations were all low (≤ 21.0 mg/L, n=41). Ammonia concentrations were low (≤ 0.3 mg/L, n=28). Total phosphorus concentrations ranged from 0.025 to 0.133 mg/L (n=25) with 18 samples exceeding 0.05 mg/L. Chlorophyll *a* concentrations ranged from 1.41 to 46.6 μg/L (n=15) with two samples exceeding 16 μg/L.

CRWA collected monthly data for the Charles River at Nahanton Park in Newton (Station 567S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=68) exceeded 28.3°C (maximum 28.0°C). A total of 26 pH measurements were taken at Station 567S between February 2000 and April 2002. The pH measurements ranged from 6.7 to 8.4 SU. Total suspended solids concentrations were all low (≤ 13.0 mg/L, n=39).

CRWA collected monthly data for the Charles River at the Route 9 gaging station in Newton (Station 591S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between June 2000 and October 2006 (n=44) exceeded 28.3°C (maximum 26.0°C). A total of 18 pH measurements were taken at Station 591S between March 2000 and April 2002. The pH measurements ranged from 6.9 to 7.5 SU. Total suspended solids concentrations were all low (≤ 12.0 mg/L, n=28).

MassDEP DWM conducted water quality monitoring on the Charles River south of Route 16 at the Mary Hunnewell Bridge crossing (footbridge west of Wales Street/Walnut Street) in Newton/Wellesley (Station CR17.4) between April and September 2002 (Appendix B). In-stream DO ranged concentrations were good ranging from 5.6 to 11.3 mg/L (n=10) representing both daytime and worse case (pre-dawn) conditions although saturation was somewhat elevated (114%) on 11 September during the early morning sampling run. The maximum temperature was 26.8°C and all pH measurements (6.9 to 8.0 SU) met criteria. The diurnal variation of DO for this site was as high as 3.2 mg/L. Total phosphorus concentrations ranged from 0.038 to 0.077 mg/L and were elevated in three out of four samples. Total suspended solids concentrations were all low (≤ 9.2 mg/L, n=4).

CRWA collected monthly data for the Charles River at Washington Street Hunnewell Bridge in Wellesley (Station 609S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=53) exceeded 28.3°C (maximum 26.0°C). A total of 25 pH measurements were taken at Station 609S between February 2000 and April 2002. The pH measurements ranged from 6.9 to 7.6 SU. Total suspended solids concentrations were all low (≤ 11.0 mg/L, n=39). Ammonia concentrations were all ≤ 0.1 mg/L (n=22). Total phosphorus concentrations ranged from 0.034 to 0.131 mg/L (n=20) with 16 measurements that exceeded 0.05 mg/L. Chlorophyll *a* concentrations ranged from 1.91 to 33.8 μg/L (n=14) with only one sample exceeding 16 μg/L.

CRWA collected monthly data for the Charles River at Leo J. Martin Golf Course/Park Road in Weston (Station 621S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=59) exceeded 28.3°C (maximum 26.0°C). A total of 25 pH measurements were taken at Station 621S between February 2000 and April 2002. The pH measurements ranged from 6.6 to 7.4 SU. Total suspended solids concentrations were all low (≤ 12.0 mg/L, n=38).

CRWA collected monthly data for the Charles River at 2391 Commonwealth Ave in Newton (Station 635S), which included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. One of the temperature measurements taken between February 2000 and September 2006 (n=55) exceeded 28.3°C. [It should be noted that the high measurement, 37.0°C, was identified as an outlier since all other stations sampled along the river that day (20 August 2002) were around 27°C, but heated stormwater runoff from the parking area at this site may have been an influence (Kaplan 2007)]. A total of 22 pH measurements were taken at Station 635S between March 2000 and April 2002. The pH measurements ranged from 6.7 to 7.5 SU. Total suspended solids concentrations were all low (≤ 6.8 mg/L, n=34).

CRWA collected monthly data for the Charles River in the Lakes Region in Waltham (Station 648S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between April 2000 and October 2006 (n=40) exceeded 28.3°C (maximum 27.0°C). A total of 14 pH measurements were taken at Station 648S between April 2000 and April 2002. The pH measurements ranged from 6.6 to 7.5 SU. Total suspended solids concentrations were all low (≤ 9.5 mg/L, n=23).

MassDEP DWM staff deployed an unattended probe to measure DO, saturation, and temperature in the Charles River in the Lakes Region (also described as the northeastern end of the Charles River impoundment in Waltham upstream from the Moody Street Dam) between 2 and 4 August 2004 at a depth of approximately 4 feet (MassDEP 2004b). These data were collected to support the Department's ongoing nutrient criteria derivation effort. DO concentrations were not less than 8.1 mg/L and were as high as 12.7 mg/L. Saturations ranged from 103 to 158%. The maximum temperature (n=190) was 28.3°C.

CRWA collected monthly data for the Charles River near the Moody Street Bridge in Waltham (Station 662S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=70) exceeded 28.3°C (maximum 26.0°C). A total of 26 pH measurements were taken at Station 662S between February 2000 and April 2002. The pH measurements ranged from 6.7 to 7.6 SU. Total suspended solids concentrations were all low (≤ 13.0 mg/L, n=41). Ammonia concentrations were all ≤ 0.2 mg/L (n=28). Total phosphorus concentrations ranged from 0.026 to 0.103 mg/L (n=28) with 19 measurements that exceeded 0.05 mg/L. Chlorophyll *a* concentrations ranged from 1.68 to 18.4 μg/L (n=14) with two samples exceeding 16 μg/L.

CRWA collected monthly data for the Charles River near North Street in Waltham (Station 675S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between March 2000 and October 2006 (n=65) exceeded 28.3°C (maximum 26.0°C). A total of 23 pH measurements were taken at Station 675S between February 2000 and April 2002. The pH measurements ranged from 6.5 to 7.6 SU. Total suspended solids concentrations were all low (≤ 7.6 mg/L, n=37).

CRWA collected monthly data for the Charles River Watertown Dam footbridge in Watertown (Station 012S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. None of the temperature measurements taken between February 2000 and October 2006 (n=65) exceeded 28.3°C (maximum 26.0°C). A total of 26 pH measurements were taken at Station 012S between February 2000 and April 2002. The pH measurements ranged from 6.7 to 7.4 SU. Total suspended solids concentrations were all low (≤ 8.2 mg/L, n=41). Ammonia concentrations were all ≤ 0.2 mg/L (n=25). Total phosphorus concentrations ranged from 0.037 to 0.110 mg/L (n=26) with 18 measurements that exceeded 0.05 mg/L. Chlorophyll *a* concentrations ranged from 1.76 to 17 μg/L (n=15) with only one sample exceeding 16 μg/L. EPA also conducted water quality monitoring of the Charles River upstream from the Watertown Dam (Station CRBL02) as part of the Clean Charles 2005 Core Monitoring Program (EPA 2001, Faber 2002, Faber 2003, Faber 2004, and Faber 2005). During their dry and wet weather surveys conducted between July 2000 and October 2006, DO was lower than 5.0 mg/L on only two occasions (n=36), while pH and temperatures always met criteria (n=39 and 40 measurements, respectively). Chlorophyll *a* concentrations ranged from 1.7 to 52 µg/L with 4 of 36 measurements >15 µg/L. Total phosphorus concentrations were moderately elevated, as high as 0.25 mg/L, with 26 of 40 measurements > 0.05 mg/L. It should be noted that for each wet weather sampling event (pre-storm, first flush, and post storm sampling) the data were summarized above representing the worse-case condition for that event as a single sample in the data summary (i.e., the lowest DO and pH and the highest temperature, chlorophyll *a*, and total phosphorus concentration).

Water quality data reported by USGS for the Charles River above the Watertown Dam at Watertown (Gage 01104615) between January 2000 and June 2007 were reviewed (USGS 2007g). DO ranged from 3.5 to 16.7 mg/L (n=91) with six measurements that were <5.0 mg/L (these occurred in either July, August and/or September 2000, 2002, and 2005). The maximum water temperature was 26.6°C (n=92) and pH ranged from 6.6 to 7.6 SU (n=91). Total phosphorus concentrations ranged from 0.020 to 0.117 mg/L and half of the 87 measurements were >0.05 mg/L (the average concentration was 0.056 mg/L). Continuous temperature and specific conductivity measurements were taken at this gage between August

1999 and June 2000. The maximum temperature recorded during that time was 25.6°C while specific conductivity ranged from 90 to 1,204 µS/cm (USGS 2007h). Concentrations of organics and pesticides were almost always below detection limits. None of the priority pollutants analyzed exceeded current water quality criteria, though criteria were not set for all analytes tested.

MWRA collected total phosphorus and chlorophyll *a* samples upstream from the Watertown Dam (Station 012). Total phosphorus concentrations ranged from 0.029 to 0.157 mg/L (n=64) while chlorophyll *a* concentrations ranged from 1.7 to 32.2 µg/L (n= 66) in samples collected in the months of July, August, September and October 2000 through 2004 (MassDEP *et al.* 2007).

Chemistry – sediment

USGS collected sediment from the Charles River upstream from the Watertown Dam in June 1999 as part of the New England Coastal Basins (NECB) study of the USGS National Water-Quality Assessment (NAWQA) program. The sediment was analyzed for trace elements and organic compounds. Arsenic, cadmium, chromium, iron, manganese, mercury, nickel, zinc, dieldrin, and mirex concentrations all exceeded the L-EL guidelines while copper and lead were both at the S-EL guidelines and *p,p'*-DDD and total PCB exceeded the S-EL guidelines by factors of 186 and 10.7, respectively (Chalmers 2002).

Chemistry Tissue

Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp and black crappie which were substituted for yellow perch) were collected from the Route 30 Bridge in Newton to the Woerd Avenue boat ramp in Waltham (Site #1F) along this segment of the Charles River by EPA to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as composite offal samples were prepared and analyzed for PCBs and organochlorine pesticides, PAHs, metals including total mercury, % lipids, and dioxins. Weight data are not available to calculate whole body burden and compare to NAS/NAE guidelines.

The USGS collected eight white suckers from the Charles River upstream from the Watertown Dam in July 1999 (Chalmers 2001). The total PCB concentration in the "whole fish" composite sample was 2,200 ppb wet weight (Chalmers 2002). Total PCB in this "whole fish" sample exceeded the NAS/NAE guideline for total PCB (in Coles 1998) of 500 ppb wet weight for the protection of fish-eating wildlife by a factor of 4. The concentration of chlordane (including *cis*- and *trans*-chlordane, *cis*- and *trans*-nonachlor) was 275 ppb wet weight, which also exceeded the NAS/NAE guideline for chlordane (in Coles 1998) of 100 ppb wet weight for the protection of fish-eating wildlife by a factor of 2.7.

The *Aquatic Life Use* is assessed as impaired for this segment of the Charles River. This segment of the Charles River is infested with the non-native aquatic macrophyte *T. natans* (6.0 miles including the impoundment upstream from the Cordingly Dam and through the Lakes District). DO concentrations met the water quality criterion at all but one site sampled (just upstream from the Watertown Dam), while moderately elevated concentrations of total phosphorus were detected throughout. Oxygen saturation was elevated (up to 114% upstream from Cordingly Dam and up to 158% in the river upstream from the Moody Street Dam) also indicative of enriched conditions. The current fish assemblage within this segment of the Charles River is missing the two top ranking species in the Charles River Target Fish Community developed by Meixler (2006). In addition the fourth ranking species is underrepresented. Although dams along this segment alter the natural flow regime and create habitat more conducive to macrohabitat generalists, two of the three stations sampled contained habitat conducive to fluvial fishes. The relative absence of fluvial fish species at these stations is problematic and is likely influenced by the dams and their habitat effects within this segment. Anadromous fish passage continues to be a concern although there are plans to refurbish at least one additional fishway within this segment. In addition, American shad fry stocking has the potential of increasing numbers of returning shad in the near future. It should also be noted that the concentration of total PCB and chlordane in a "whole fish" sample of white sucker collected from the river are also elevated above NAS/NAE guidelines for the protection of fish-easting wildlife and are of concern. Total PCB and DDT metabolite concentrations in the sediment samples are also of concern.

Fish Consumption Use

Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp, and yellow perch) were collected from the Charles River by EPA to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as

composite offal samples were prepared and analyzed for PCBs and organochlorine pesticides, PAHs, metals including total mercury, % lipids, and dioxins.

Due to the presence of elevated PCB in common carp and pesticides (total DDT) in largemouth bass, MA DPH recommends the following (MA DPH 2007 and Celona 2007).

> "*Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any Carp or Largemouth Bass fish from the Charles River collected between the South Natick Dam in Natick and Museum of Science Dam in Boston/Cambridge, the general public should not consume Carp from this section of the river, and the general public should limit consumption of Largemouth Bass fish to two meals per month."*

Because of the site-specific fish consumption advisory for the Charles River between the South Natick Dam, Natick and the Museum of Science Dam in Cambridge/Boston due to elevated concentrations of PCBs (polychlorinated biphenyls) and pesticides (total DDT), the *Fish Consumption Use* is assessed as impaired for this segment of the Charles River. Sediment contamination (total PCB and DDT metabolites) is at least one source of the problem.

Primary and Secondary Contact Recreation and Aesthetics Uses

CRWA volunteers conducted bacteria sampling at 12 stations along this segment of the Charles River as part of their monthly monitoring program. These sites, from upstream to downstream, are: near Dedham Medical Center in Dedham (Station 484S), at Ames Street Bridge in Dedham (Station 521S), Route 109 Bridge in Dedham (Station 534S), Nahanton Park in Newton (Station 567S), Route 9 gaging station in Newton (Station 591S), Washington Street Hunnewell Bridge in Wellesley (Station 609S), at Leo J. Martin Golf Course/Park Road in Weston (Station 621S, at 2391 Commonwealth Ave in Newton (Station 635S), in the Lakes Region in Waltham (Station 648S), near the Moody Street Bridge in Waltham (Station 662S), near North Street in Waltham (Station 675S), and at the Watertown Dam footbridge in Watertown (Station 012S). EPA conducted bacteria sampling just upstream from the Watertown Dam (Station CRBL02) (Faber 2002, Faber 2003, Faber 2004, and Faber 2005). In 2002 water quality monitoring was conducted by DWM at one site - south of Route 16 at the Mary Hunnewell Bridge crossing (footbridge west of Wales Street/Walnut Street), Newton/Wellesley (Station CR17.4) between April and September 2002 (Appendix B). This sampling station was located just upstream from the CRWA Station 609S. From upstream to downstream the monthly CRWA data can be summarized as follows. Field observations and other data utilized to assess the *Recreational* and *Aesthetic* uses are also inserted where appropriate to maintain the hydrologic order (upstream to downstream).

Charles River Near Dedham Medical Center (Station 484S) in Dedham by CRWA.

Station 484S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	6	4	6	5
	Maximum cfu/100 ml	830	280	150	91	400
	Minimum cfu/100 ml	20	10	30	10	20
126 cfu/100 ml	Geometric Mean	160	49	63	41	68
Max 235 cfu/100 ml	Number of Exceedances	1	1	0	0	1
Secondary Contact	Samples Assessed	6	10	8	11	7
	Maximum cfu/100 ml	830	280	240	230	400
	Minimum cfu/100 ml	20	10	10	10	5
630 cfu/100 ml	Geometric Mean	187	40	54	41	40
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Charles River near Ames Street Bridge (Station 521S) in Dedham by CRWA.

Station 521S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	6	4	6	5
	Maximum cfu/100 ml	90	380	75	170	300
	Minimum cfu/100 ml	20	20	20	30	45
126 cfu/100 ml	Geometric Mean	41	45	45	57	121
Max 235 cfu/100 ml	Number of Exceedances	0	1	0	0	2

Secondary Contact	Samples Assessed	6	10	8	9	7
	Maximum cfu/100 ml	420	380	170	320	300
	Minimum cfu/100 ml	20	10	10	10	5
630 cfu/100 ml	Geometric Mean	74	32	38	47	65
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Charles River near Route 109 Bridge (Station 534S) in Dedham by CRWA.

Station 534S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	3	6	6
	Maximum cfu/100 ml	2,300	50	250	490	100
	Minimum cfu/100 ml	100	10	30	10	20
126 cfu/100 ml	Geometric Mean	382	27	84	54	49
Max 235 cfu/100 ml	Number of Exceedances	3	0	1	1	0
Secondary Contact	Samples Assessed	7	10	7	11	8
	Maximum cfu/100 ml	2,300	250	250	490	100
	Minimum cfu/100 ml	100	10	10	10	20
630 cfu/100 ml	Geometric Mean	345	27	60	55	42
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	0

Charles River near Nahanton Park (Station 567S) in Newton by CRWA.

Station 567S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	3	6
	Maximum cfu/100 ml	130	50	50	20	300
	Minimum cfu/100 ml	10	10	10	10	16.9
126 cfu/100 ml	Geometric Mean	38	21	15	16	41
Max 235 cfu/100 ml	Number of Exceedances	0	0	0	0	1
Secondary Contact	Samples Assessed	7	9	8	8	7
	Maximum cfu/100 ml	320	370	160	170	300
	Minimum cfu/100 ml	10	10	10	10	16.9
630 cfu/100 ml	Geometric Mean	65	26	24	21	38
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Charles River at the Route 9 gaging station (Station 591S) in Newton by CRWA.

Station 591S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	5	4	3	6
	Maximum cfu/100 ml	23,400	290	1,450	225	500
	Minimum cfu/100 ml	10	10	50	20	5
126 cfu/100 ml	Geometric Mean	933	72	176	79	57
Max 235 cfu/100 ml	Number of Exceedances	3	1	1	0	1
Secondary Contact	Samples Assessed	6	7	6	5	8
	Maximum cfu/100 ml	23,400	290	1,450	225	500
	Minimum cfu/100 ml	10	10	40	20	5
630 cfu/100 ml	Geometric Mean	703	50	140	90	45
Max 1260 cfu/100 ml	Number of Exceedances	3	0	1	0	0

MassDEP DWM personnel recorded field observations of the Charles River south of Route 16 at the Mary Hunnewell Bridge crossing (footbridge west of Wales Street/Walnut Street), Newton/Wellesley (Station CR17.4) between April and September 2002 (Appendix B). This sampling station was located just upstream from the CRWA station 609S. The water column was described as slightly turbid in-stream on all survey dates and an odor of chlorine was noted in the air in early June and July. A slight dust or pollen blanket was observed on the river's surface in August. The presence of aquatic plants and algae was not

noted until early August when the water level had dropped. At that time, moderate coverage of duckweed (*Lemna* sp.), waterweed (*Elodea* sp.) and water chestnut (*Trapa natans*) were observed along with sparse amounts of filamentous green algae attached to the plants. The plant and algae coverage persisted through September when green algae were also noted as floating and the water column was turbid.

Charles River at Washington Street Hunnewell Bridge (Station 609S) in Wellesley by CRWA.

Station 609S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	4	6
	Maximum cfu/100 ml	580	1,180	540	450	300
	Minimum cfu/100 ml	40	50	40	10	25
126 cfu/100 ml	Geometric Mean	217	148	173	148	97
Max 235 cfu/100 ml	Number of Exceedances	3	1	2	3	1
Secondary Contact	Samples Assessed	7	8	5	7	8
	Maximum cfu/100 ml	580	1,180	540	450	300
	Minimum cfu/100 ml	40	20	10	10	5
630 cfu/100 ml	Geometric Mean	223	98	98	82	59
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Charles River near the Leo J. Martin Golf Course/Park Road (Station 621S) in Weston by CRWA.

Station 621S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	5	4	6	5
	Maximum cfu/100 ml	410	360	790	1,490	900
	Minimum cfu/100 ml	130	30	100	10	147
126 cfu/100 ml	Geometric Mean	277	105	203	162	300
Max 235 cfu/100 ml	Number of Exceedances	3	1	1	3	3
Secondary Contact	Samples Assessed	7	9	7	10	7
	Maximum cfu/100 ml	410	360	790	1,490	900
	Minimum cfu/100 ml	130	10	30	10	5
630 cfu/100 ml	Geometric Mean	263	66	121	107	137
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	1	0

Charles River near 2391 Commonwealth Ave (Station 635S) in Newton by CRWA.

Station 635S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	5	3	6	5
	Maximum cfu/100 ml	150	940	2,200	3,690	640
	Minimum cfu/100 ml	40	20	90	117	27.5
126 cfu/100 ml	Geometric Mean	64	128	341	617	134
Max 235 cfu/100 ml	Number of Exceedances	0	1	1	4	2
Secondary Contact	Samples Assessed	7	7	6	8	6
	Maximum cfu/100 ml	400	940	2,200	3,690	640
	Minimum cfu/100 ml	40	10	10	40	27.5
630 cfu/100 ml	Geometric Mean	95	78	148	388	107
Max 1260 cfu/100 ml	Number of Exceedances	0	0	1	2	0

The Lakes District region along this segment of the Charles River (the 3.1 mile reach between Commonwealth Avenue in Newton and Moody Street Dam in Waltham) experiences explosive aquatic plant growth each summer including the non-native macrophyte *Trapa natans* (Fiorentino *et al*. 2000, Eleria 2008, and Davis 2008).

Charles River near the Lakes Region (Station 648S) in Waltham by CRWA.

Station 648S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	3	3	4	4
	Maximum cfu/100 ml	70	80	110	1,800	120
	Minimum cfu/100 ml	40	10	10	325	5
126 cfu/100 ml	Geometric Mean	51	34	22	701	42
Max 235 cfu/100 ml	Number of Exceedances	0	0	0	4	0
Secondary Contact	Samples Assessed	5	5	3	6	5
	Maximum cfu/100 ml	330	80	110	1,800	120
	Minimum cfu/100 ml	40	10	10	40	5
630 cfu/100 ml	Geometric Mean	75	32	22	376	44
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	1	0

The Secchi disk transparency measured in the Charles River in the Lakes Region (also described as the northeastern end of the Charles River impoundment in Waltham upstream from the Moody Street Dam) on 2 August 2004 by MassDEP DWM staff. The Secchi disk transparency was 0.55 m (MassDEP 2004b). The water column was slightly turbid and no objectionable conditions were noted.

Charles River near the Moody Street Bridge (Station 662S) in Waltham by CRWA.

Station 662S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	6	5
	Maximum cfu/100 ml	480	240	610	280	1,200
	Minimum cfu/100 ml	10	30	30	70	10
126 cfu/100 ml	Geometric Mean	39	64	76	145	82
Max 235 cfu/100 ml	Number of Exceedances	1	1	1	1	1
Secondary Contact	Samples Assessed	7	10	8	11	6
	Maximum cfu/100 ml	480	270	1,010	1,120	1,200
	Minimum cfu/100 ml	10	10	10	40	10
630 cfu/100 ml	Geometric Mean	65	57	86	155	79
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	0

Charles River near the North Street (Station 675S) in Waltham by CRWA.

Station 675S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	6	6
	Maximum cfu/100 ml	1,400	1,480	540	370	1,300
	Minimum cfu/100 ml	100	30	40	220	45
126 cfu/100 ml	Geometric Mean	325	149	135	257	239
Max 235 cfu/100 ml	Number of Exceedances	2	2	1	4	4
Secondary Contact	Samples Assessed	7	10	7	11	7
	Maximum cfu/100 ml	1,400	1,480	670	1,150	1,300
	Minimum cfu/100 ml	100	20	40	30	45
630 cfu/100 ml	Geometric Mean	326	116	159	210	254
Max 1260 cfu/100 ml	Number of Exceedances	1	1	0	0	1

Charles River near the Watertown Dam footbridge (Station 012S) in Watertown by CRWA.

Station 012S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	1	5	6
	Maximum cfu/100 ml	1,600	1,240	530	490	7,200
	Minimum cfu/100 ml	160	20	530	120	45
126 cfu/100 ml	Geometric Mean	486	219	530	249	231
Max 235 cfu/100 ml	Number of Exceedances	4	4	1	4	1
Secondary Contact	Samples Assessed	7	10	3	10	7
	Maximum cfu/100 ml	1,600	1,240	530	1,180	7,200
	Minimum cfu/100 ml	160	20	20	20	45
630 cfu/100 ml	Geometric Mean	400	162	160	196	259
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	1

MWRA reports the geometric mean of *E. coli* bacteria in the Charles River near the Watertown Dam Footbridge (Station 012) in samples collected between 1998 and 2005 (n= 127) is 181cfu/100 ml (Coughlin 2006). Counts ranged from 143 to 228 within the 95% confidence interval. According to Coughlin (2006), bacteria counts in the upper Charles River Basin fail to meet criteria in all weather conditions. *E. coli* bacteria counts reported by EPA ranged from 4 to 4,100 cfu/100 mls for samples collected from the river just upstream from the Watertown Dam (Station CRBL02) between July 2001 and October 2006 (n=41). Twelve counts during the primary contact recreation season (1 April through 15 October) exceeded 235 cfu/100 ml. Two counts exceeded 1,260 cfu/100 ml.

Sampling in the Charles River has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria.

The *Primary Contact Recreational Use* is assessed as impaired. While *E. coli* bacteria counts almost always met water quality criteria in the river upstream from Nahanton Park (Station 567S) in Newton, counts were notably higher in the river near the USGS gage in Wellesley (Station 591S). Water quality criteria for bacteria were frequently exceeded for most sites sampled in the river downstream from this gage in Wellesley. These exceedances occured in all weather conditions. It should be noted that South Meadow Brook, a tributary that flows into the Charles River upstream from the USGS gage, also had serious bacteria problems. The dense growth of *Trapa natans* in the Lakes District region of this segment of the Charles River also impairs the *Recreational* and *Aesthetics Uses*. With the exception of the Lakes District region, the *Secondary Contact Recreational* Use is assessed as support (*E. coli* bacteria counts generally met the water quality criterion although single sample exceedances were documented infrequently). The *Aesthetics Use* is not assessed (too limited data available) except for the 3.1 mile reach of the river impaired by the density of the non-native aquatic macrophyte infestation through the Lakes District. Both the *Secondary Contact Recreational* and *Aesthetics* uses are identified with an Alert Status, however, because of the cyanobacteria blooms known to occur in upstream segments of the River.

Charles River (Segment MA72-07) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Biological indicators of nutrient enrichment, elevated total phosphorus, non-native aquatic plant infestation (in 6.0 mile reach of segment), fishes bioassessments, other flow regime alterations associated with dams/impoundments, other - relative absence of fluvial specialists/dependant fish species, barriers to fish passage, Sources: Habitat alteration associated with dams/impoundments, municipal NPDES discharge(s) in upstream segments Suspected sources: Nonpoint sources, urban stormwater
Fish Consumption		IMPAIRED Causes: Elevated PCB in fish tissue, pesticides (total DDT) Sources: Contaminated sediments and unknown
Primary Contact		IMPAIRED Causes: Elevated *E. coli* bacteria throughout segment, density of non-native aquatic macrophyte infestation through 3.1 mile reach through Lakes District Sources: Discharges from municipal separate storm sewer systems, unspecified urban stormwater, urban runoff/storm sewers, introduction of non-native organism Suspected sources: Illicit connections/Hook-ups to storm sewers
Secondary Contact		IMPAIRED 3.1 mile reach through Lakes District Cause: Density of non-native aquatic macrophyte infestation Source: Introduction of non-native organism SUPPORT* (remaining 21.7 miles)
Aesthetics		IMPAIRED 3.1 mile reach through Lakes District Cause: Density of non-native aquatic macrophyte infestation Source: Introduction of non-native organism NOT ASSESSED* (remaining 21.7miles)

* Alert Status issues identified, see details in use assessment.

RECOMMENDATIONS

Continue to conduct water quality monitoring (i.e., deploy *in-situ* meters to obtain long-term DO data, additional total phosphorus and chlorophyll *a* sampling) to evaluate changes in water quality in this segment of the Charles River to document conditions (e.g., implementation of treatment upgrades/phosphorus reductions at municipal treatment plants upstream).

Document extent of cyanobacteria blooms occurring in this segment of the Charles River. Document composition/frequency/extent the blooms. Develop monitoring program to evaluate source(s) contributing to the problem.

Continue to conduct bacteria monitoring to evaluate current conditions. Review results of the recent USGS study (USGS 2007i) conducted which identify bacteria sources to this system. Bacteria source tracking should be conducted as necessary. Source(s) found should be remediated.

<u>Fish passage</u>

Beginning with the Watertown Dam (most downstream dam in this segment) investigate ways to improve attraction flows to entrance of fishway.

At Moody Street Dam a conscientious program of flow regulation and ladder maintenance for the fishway should be developed and adhered to as recommended by Brady *et al.* (2005).

At Finlay Dam where fish passage renovations have been implemented, fish passage efficiency should be evaluated/documented.

The planned renovations for the fishway at the Cordingly Dam should be implemented.

Once passage has been documented for these fishways, passage at the two remaining dams (Circular and Silk Mill dams) should be addressed.

American shad fry stocking should be continued in an attempt to reestablish this fish species to the Charles River Watershed.

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

ROCK MEADOW BROOK (SEGMENT MA72-21)
Location: Headwaters in Fisher Meadow, Westwood, thru Stevens Pond and Lee Pond, Westwood, to confluence with Charles River, Dedham.
Segment Length: 3.8 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 2.7 mi^2 subwatershed.
Residential 41%
Forest..... 34%
Open land 11%
The estimated percent impervious area for this subwatershed area is 10.4%.

This segment is on the 2006Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Dedham Westwood Water District (32007303)
Dedham Country Club (32007301)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
On 18 July 2002 DWM biologists conducted a habitat assessment of Rock Meadow Brook upstream from Summer Street in Westwood (Station RM01). The brook was approximately 2 m wide and was comprised primarily of cobble and boulder substrate. Water depth was uniform throughout the reach (0.1 m). The habitat assessment score was 165 out of a possible 200 and was limited most by lack of velocity/depth combinations and the uniformly shallow conditions (Appendix C).

The brook was also sampled between April and September 2002 upstream from the impoundment at Hole Number 8 of the Dedham Country Club in Dedham (Station RM01A). The river channel was approximately 20 feet wide in this reach. Water velocities were described as low (approximately 1 fps), from April to July, to stagnant, by the August survey dates (Appendix B). Dense coverage of aquatic plants were noted to be present from June through September and moderate amounts of green filamentous algae, periphyton, and floating green algal mats were also noted on occasion (Appendix B).

Biology
The RBP III analysis of the sample collected from Rock Meadow Brook upstream from Summer Street in Westwood (Station RM01) indicated a moderately impacted benthic community compared to the Stony Brook reference station (Appendix C). Although community structure was characterized as optimal due to good taxa richness, filter feeders compromised 65% of the total sample, evidence of an unbalanced trophic structure (Appendix C). The benthic community appeared to be structured in response to organic enrichment and increased levels of fine particulate organic matter.

Water Chemistry
Rock Meadow Brook was sampled by DWM at two locations; upstream from Summer Street in Westwood and upstream from the impoundment at Hole Number 8 of the Dedham Country Club in Dedham (Stations RM01 and RM01A, respectively) during the 2002 field season. A multi-probe water quality sampler was deployed in the brook at Station RM01 for 24 hours from 5 June through 6 June 2002. All DO, pH, and temperature measurements at this location were indicative of good water quality (Appendix B, Table 3). Monitoring further downstream in the brook near Hole Number 8 (Station RM01A) included *in-situ* measurements using a multiprobe and nutrient sampling. These data can be found in Appendix B, Tables 3 and 4. Of the surveys conducted, five of the nine DO measurements (June, July, August and September) were below 5.0 mg/L (four of these five measurements were extremely low (0.5 to 1.9 mg/L). The diurnal variation of DO for this site was also extremely high (up to 6.3 mg/L). pH measurements were slightly low (<6.5 SU) on six of nine occasions (as low as 6.2 SU). Phosphorus levels ranged from 0.034 to 0.17 mg/L (n=5) and were quite high ($\geq$0.13 mg/L) on three occasions.

The *Aquatic Life Use* is assessed as impaired for Rock Meadow Brook based on the RBP III analysis that indicated moderate impacts to the benthic community relative to reference station conditions. Additionally, poor water quality conditions (low DO, elevated total phosphorus, evidence of productivity including dense aquatic macrophytes, filamentous algae) were also documented in the lower reach of the brook (near the Dedham Country Club). The velocities in this lower reach were very low to stagnant. Water withdrawals likely exacerbate these conditions.

Primary and Secondary Contact Recreation and Aesthetics Uses
DWM field sampling crews did not note any objectionable conditions (e.g., oils, odors, other deposits) in Rock Meadow Brook upstream from Summer Street in Westwood (Station RM01) (MassDEP 2002a and 2002b).

A total of five bacteria samples were collected by DWM from Rock Meadow Brook upstream from the impoundment at Hole Number 8 of the Dedham Country Club in Dedham (Station RM01A) between April and September 2002. *E. coli* counts were low ranging from 20 to 140 cfu/100 ml (Appendix B, Table 4). The water column at Station RM01A was slightly turbid during the April survey. Waterfowl droppings were on the shore. By early June the water column in stream was highly cloudy with a pollen scum on the surface. A sulfide odor was released from the mucky bottom when it was disturbed. Between July and September aesthetically objectionable conditions were noted at this sampling station including moderate to dense coverage of floating and submerged aquatic plants, green filamentous algae and floating green algal mats.

The *Primary and Secondary Contact Uses and Aesthetics* are assessed as support for the upper 2.6 mile reach of Rock Meadow Brook based on low bacteria counts and general lack of objectionable conditions (oils, odors, other deposits). Downstream from the Dedham Country Club property (the lower 1.2 mile reach), the *Recreational* and *Aesthetics Uses* are assessed as impaired because of objectionable growths of aquatic macrophytes and filamentous algae.

Rock Meadow Brook (Segment MA72-21) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Organic enrichment indicated by biological assessment, benthic macroinvertebrate bioassessment, low DO, elevated total phosphorus Sources: Unknown, golf course and water withdrawals lower 1.2 miles of reach Suspected sources: Urban runoff/stormwater, impoundments
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT upper 2.6 miles IMPAIRED lower 1.2 miles Causes: Excess algal growth, noxious growth of aquatic plants Sources: Unknown, golf course and water withdrawals lower 1.2 miles of reach Suspected sources: Urban runoff/stormwater
Secondary Contact		
Aesthetics		

RECOMMENDATIONS
Sampling should be conducted to identify sources contributing nutrient loadings (particularly total phosphorus) to Rock Meadow Brook.

DWM biologists recommend the following (Appendix C):
conduct water quality and biomonitoring during next DEP Charles River watershed survey, and field reconnaissance to investigate land-uses that may contribute non point source inputs.

Westwood should continue to implement requirements of their stormwater general permit (MAR041069).

Dedham Country Club should:

- establish a riparian zone along the brook,
- optimize course irrigation practices to minimize any impact(s) on flows in Rock Meadow Brook, and
- utilize best management practices to reduce nutrient loading to the brook.

ALDER BROOK (SEGMENT MA72-22)
Location: Headwaters northwest of the Route 135 and South Street intersection, Needham, to confluence with Charles River, Needham.
Segment Length: 0.3 miles
Classification: Class B.

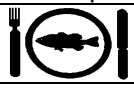
Land-use estimates (top 3, excluding water) for the 1.6 mi^2 subwatershed.
Residential 77%
Open land 14%
Forest..... 4%
The estimated percent impervious area for this subwatershed area is 26.7%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, nutrients, and organic enrichment/low DO (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Alder Brook. No designated uses are assessed.

Alder Brook (Segment MA72-22) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct water quality and biological monitoring to evaluate designated uses.

SAWMILL BROOK (SEGMENT MA72-23)
Location: Headwaters, Newton, to confluence with Charles River, Boston.
Segment Length: 2.4 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 2.8 mi^2 subwatershed.
Residential 57%
Forest..... 16%
Open land 14%
The estimated percent impervious area for this subwatershed area is 25.8%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of other inorganics, organic enrichment/low DO, noxious aquatic plants, pathogens, taste, odor and color, and other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H3 and H4)
Boston Water and Sewer Commission (MAS010001). There are three major stormwater outfalls in this subwatershed area -14C009, 12B124 and 11B123 - and five minor stormwater outfalls – 13B011, 12B031, 12B033, 12B010, and 12B014.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Sawmill Brook was sampled by DWM upstream from the first driveway into St. Joseph's Cemetery, approximately 140 feet upstream from Baker Street (Station SB01). The velocity at this station on all survey dates was low (0 to 1 fps), and the water level began to drop in July. Although the brook neared no flow, the channel remained relatively full (Appendix B).

Biology
There was no aquatic plant coverage in Sawmill Brook upstream from Baker Street (Station SB01), but in early June sparse coverage of green filamentous and thin film algae attached to the substrates was observed and remained through September. In August moderate coverage of grey periphyton was observed on the substrates. Microscopic identification of this periphyton revealed the sample was composed primarily of the stalked ciliate *Vorticella* sp. and contained some nematodes, sewage fungus as well as free-swimming ciliates (Connors 2007). The protozoan assemblage is similar to that found in activated sludge and is indicative of organic enrichment.

Water Chemistry
In-situ water quality monitoring and sampling was conducted by DWM in Sawmill Brook in Saint Joseph's Cemetery in West Roxbury (Station SB01) between April and September 2002. DO measurements were very low (<5.0 mg/L) on five of the 10 surveys. None of the measurements taken between 11 July and 11 September were above 3.6 mg/L (Appendix B, Table 3). The maximum temperature recorded was 19.6°C and all pH measurements met criteria. It should be noted that conductivities were elevated (ranging from 307 to 1,170 μS/cm and six of the 10 measurements were qualified for being outside of the upper calibration range). Phosphorus levels ranged from 0.066 to 0.19 mg/L (n=5 excluding duplicate samples) and were quite high (≥0.11 mg/L) on four occasions.

The *Aquatic Life Use* is not assessed in the upper 1.0 mile reach (to the Boston Water and Sewer Commission outfall #12B124) due to the lack of water quality data. The *Aquatic Life Use* is assessed as impaired in the lower 1.4 mile reach based on the poor water quality conditions documented (low DO, high total phosphorus, evidence of organic enrichment, high conductivities).

Primary and Secondary Contact Recreation and Aesthetics Uses
Four bacteria results were reported by DWM for Sawmill Brook upstream from the Boston Water and Sewer Commission's (BWSC) outfall #12B124 in Saint Joseph's Cemetery (Station SB02) between April and September 2002. *E. coli* counts were elevated ranging from 320 to 960 cfu/100 ml (Appendix B, Table 4). The geometric mean was 499 cfu/100 ml. The water column of Sawmill Brook upstream from the Boston Water and Sewer Commission's (BWSC) Outfall #12B124 in Saint Joseph's Cemetery (Station SB02) was clear for the April, June and July surveys, but was turbid during the August and

September surveys. No odor, scum, or other objectionable conditions were observed at this station, except for the occasional piece of trash. A sparse amount of duckweed (*Lemna* sp.) was present in July, August and September 2002.

A total of four bacteria results (plus two duplicate samples) were reported by DWM for Sawmill Brook in Saint Joseph's Cemetery upstream from Baker Street (Station SB01). This sampling location was downstream from the BSWC outfall. The *E. coli* counts were elevated ranging from 485 to 2,100 cfu/100 ml (Appendix B, Table 4). The geometric mean was 1,147 cfu/100 ml. The water column of Sawmill Brook in Saint Joseph's Cemetery upstream from Baker Street (Station SB01) was slightly turbid on the survey dates. No odor, scum, or other objectionable conditions were observed, but occasionally some trash was found in the stream. Sparse coverage of green filamentous and thin film algae attached to the substrates was observed and remained through September. In August moderate coverage of grey periphyton was observed on the substrates.

The *Primary* and *Secondary Contact Recreational* uses are assessed as impaired for Sawmill Brook because of elevated bacteria *(E. coli*) counts. Sources include urban runoff from the storm sewers. The *Aesthetics U*se is assessed as support based on the general lack of objectionable conditions (oils, odors, other deposits). This use is identified with an Alert Status, however, because of the periphyton growth noted in the brook in August.

Sawmilll Brook (Segment MA72-23) Use Summary

Designated Uses		Status
Aquatic Life		NOT ASSESSED upper 1.0 miles IMPAIRED lower 1.4 miles Causes: Low DO, elevated total phosphorus, biological indicators of organic (sewage) enrichment Source: Unknown Suspected sources: Urban/stormwater runoff
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Elevated *E. coli* Sources: Discharges from municipal separate storm sewer systems, illicit connections/hook-ups to storm sewers, unspecified urban stormwater
Secondary Contact		IMPAIRED Cause: Elevated *E. coli* Sources: Discharges from municipal separate storm sewer systems, illicit connections/hook-ups to storm sewers, unspecified urban stormwater
Aesthetics		SUPPORT*

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Additional bacteria sampling should be conducted to assess the status of the *Primary* and *Secondary Contact Recreational Uses* and to evaluate cleanup progress.

SOUTH MEADOW BROOK (SEGMENT MA72-24)
Location: From emergence west of Parker Street, Newton, to confluence with the Charles River, Newton (sections culverted).
Segment Length: 1.7 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 2.9 mi^2 subwatershed.
Residential 68%
Forest..... 13%
Open land 8%
The estimated percent impervious area for this subwatershed area is 30.1%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients, siltation, organic enrichment/low DO, turbidity, pathogens, taste, odor and color as well as other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
South Meadow Brook behind 29 Tower Road in Newton (Station SM01) was approximately 10 feet wide at this station with a depth of 1 to 2 feet in April 2002. By July the water level had dropped approximately 1 foot and the velocity slowed, but some small riffles remained through September. Substrates were exposed from July through September in the shallower areas of the brook (i.e., a sand and gravel bar in the middle of the brook). Habitat quality degradation (channelization, reduction of riparian zone) and significant deposition of sand and silt was also problematic.

Water Chemistry
In-situ water quality monitoring and sampling was conducted by DWM in South Meadow Brook behind 29 Tower Road in Newton (Stations SM01B and SM01) between April and September 2002. DO was low (<5.0 mg/L) on four of the 10 surveys ranging from 3.5 to 10.4 mg/L. Low DO occurrences were measured during the July sampling event as well as predawn sampling in August and September (Appendix B, Table 3). The maximum temperature recorded was 20.5°C and all pH measurements met criteria. It should be noted that conductivities were elevated (ranging from 611 to 1,070 μS/cm and seven of the 10 measurements were qualified for being outside of the upper calibration range). Phosphorus levels ranged from 0.04 to 0.11 mg/L (n=5 excluding duplicate samples) and were high (≥0.075 mg/L) on four occasions. Ammonia-nitrogen concentrations were as high as 0.81 mg/L.

The *Aquatic Life Use* is assessed as impaired for South Meadow Brook based on the poor water quality conditions documented -- low DO, high total phosphorus, evidence of organic enrichment, high conductivities, and habitat quality degradation (from sand and silt deposits).

Primary and Secondary Contact Recreation and Aesthetics Uses
Bacteria sampling took place South Meadow Brook behind 29 Tower Road in Newton (Station SM01) (downstream from a stormwater outfall) with the exception of the first survey (29 April 2002), which mistakenly took place upstream from the storm drain (Station SM01B). The *E. coli* bacteria count upstream from the storm drain was 120 cfu/100 ml while the counts ranged from 830 to 5,000 cfu/100 ml downstream from the storm drain. The geometric mean of all of five samples is 1,098 cfu/100 ml. The water column was clear to slightly turbid between April and September 2002. A pool area just downstream from the stormwater outfall at the sampling site was observed to be highly cloudy in August and September. Turbidity appeared to originate from the outfall since the brook was relatively clear upstream from the drain. No odor, scum or other objectionable conditions were observed except for trash on the banks and sand deposition in stream. Sparse coverage (approximately 25%) of thin film periphyton on the stream bottom was observed early June through the September survey dates.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for South Meadow Brook because of elevated bacteria *(E. coli*) counts, turbidity, and trash and debris. Sources include urban runoff from the storm sewers.

South Meadow Brook (Segment MA72-24) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low DO, elevated total phosphorus, physical habitat degradation, bottom deposits of sediment and silt Sources: Loss of riparian habitat, municipal high density area, habitat modification in the form of channelization/culverting, discharges from municipal separate storm sewer systems, unspecified urban stormwater
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Causes: Elevated *E. coli*, turbidity, trash and debris Sources: Discharges from municipal separate storm sewer systems, illicit connections/hook-ups to storm sewers, unspecified urban stormwater
Secondary Contact		IMPAIRED Causes: Elevated *E. coli*, turbidity, trash and debris Sources: Discharges from municipal separate storm sewer systems, illicit connections/hook-ups to storm sewers, unspecified urban stormwater
Aesthetics		IMPAIRED Causes: Objectionable turbidity, trash and debris Sources: Discharges from municipal separate storm sewer systems, unspecified urban stormwater

RECOMMENDATIONS

Additional bacteria sampling should be conducted to assess the status of the *Primary* and *Secondary Contact Recreational Uses* and to evaluate cleanup progress.

Stream cleanups to remove trash and debris.

Conduct stream surveys to identify source(s) of sand and silt.

ROSEMARY BROOK (SEGMENT MA72-25)
Location: Headwaters, outlet Rosemary Lake, Needham, to confluence with the Charles River, Wellesley.
Segment Length: 3.3 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 3.8 mi^2 subwatershed.
Residential 54%
Open land 19%
Forest..... 15%
The estimated percent impervious area for this subwatershed area is 19.0%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients, organic enrichment/low DO, turbidity, pathogens, suspended solids, taste, odor and color (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Wellesley Water Department (32031701). [Note: A non-consumptive use status was also accepted for the Wellesley DPW in January 1989 for a water treatment system to withdraw and oxygenate water, then inject it into the groundwater to treat for iron and manganese. The withdrawal points for the non-consumptive use are 02G – Wellesley Ave and 06G – TF Coughlin Wellfields with a withdrawal volume of 117 million gallons per year (McCann 2007).]
Wellesley Country Club (32031703)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
There are three dams along Rosemary Brook - Rosemary Lake Dam, Wellesley Avenue Dam, and Longfellow Pond Dam. Downstream from these dams, Rosemary Book was approximately 20 feet wide near Barton Road in Wellesley (Station RB02) between April and September 2002 (Appendix B). By early June the water level had dropped approximately 1 foot and the velocity was low. Low flows continued into July and by the August and September surveys the brook was almost stagnant. The stream bottom was described as mucky and silt covered with no aquatic plants at this sampling location.

Water Chemistry
Rosemary Brook was sampled by DWM near Barton Road in Wellesley (Station RB02) between April and September 2002. DO was very low (<5.0 mg/L) on six of the 10 surveys. None of the measurements taken between 10 July and 11 September were above 4.3 mg/L (Appendix B, Table 3). The maximum temperature recorded was 21.6°C and all pH measurements met criteria. Conductivities were somewhat elevated (ranging from 455 to 965 μS/cm and two of the 10 measurements were qualified for being outside of the upper calibration range). Phosphorus levels were moderately high ranging from 0.041 to 0.12 mg/L (n=5 excluding duplicate samples).

The *Aquatic Life Use* is assessed as impaired for Rosemary Brook based primarily on the low DO documented between July and September 2002 and the elevated concentrations of total phosphorus. The dams and water withdrawals in this subwatershed likely exacerbate low flow conditions in the brook. Sources contributing to these conditions are unknown, although the country club and nonpoint source(s) from urban/residential areas likely contribute to these conditions.

Primary and Secondary Contact Recreation and Aesthetics Uses
Bacteria sampling took place in Rosemary Brook near Barton Road in Wellesley (Station RB02) between April and September 2002 (Appendix B). The *E. coli* bacteria counts ranged from <20 to 540 cfu/100 ml. The geometric mean of all of five samples is 96 cfu/100 ml and only one of the five counts exceeded 235 cfu/100 ml. The water column was slightly turbid in-stream with no odor during the April and June surveys, but in July there was an odor described as “rotting vegetables” and “swampy”. Trash was noted near the sampling site on all survey dates.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as support for Rosemary Brook because of the low bacteria counts and the general lack of objectionable conditions. The *Aesthetics Use* is identified with an Alert Status because of deposits of trash and debris.

Rosemary Brook (Segment MA72-25) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low DO, elevated total phosphorus Suspected causes: Flow regulation at impoundments, water withdrawals Source: Unknown Suspected sources: Golf course, habitat modification associated with dams, baseflow depletion from groundwater withdrawals, nonpoint source from urban/residential areas
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT*

*Alert Status issues identified, see details in use assessment.

RECOMMENDATIONS

Additional bacteria sampling should be conducted to assess the status of the *Primary* and *Secondary Contact Recreational Uses* and to evaluate cleanup progress.

Wellesley Country Club should:

- establish a riparian zone along the brook,
- optimize course irrigation practices to minimize any impact(s) on flows in Rosemary Brook, and
- utilize best management practices to reduce nutrient loading to the brook.

Additional field reconnaissance should be conducted along Rosemary Brook to better evaluate habitat quality conditions as well as flow conditions. Efforts should be made to better understand streamflow regimes (particularly during low flow months) and what effect water withdrawals and/or outlet control practices of the impoundments along the brook are having on aquatic life habitat.

Stream cleanup to remove trash/debris.

STONY BROOK (**SEGMENT MA72-26**)
Location: Headwaters, outlet Beaver Pond, Lincoln, to inlet Stony Brook Reservoir, Waltham/Weston.
Segment Length: 5.1 miles
Classification: Class A.

Land-use estimates (top 3, excluding water) for the 22.0 mi^2 subwatershed.
Forest..... 41%
Residential..... 33%
Industrial 5%
The estimated percent impervious area for this subwatershed area is 13.3%.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses* (*Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics*); Other Designated uses Not Assessed (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
(The Cambridge Water Department and Lincoln Water Department are registered to withdraw from sources in this subwatershed area – see Cambridge Reservoir (also referred to as Hobbs Brook Reservoir) - MA72014, and Sandy Pond - MA72105.
NPDES (See Appendix H, Tables H2 and H4)
Weston Sanitary Landfill (MA0033031)
Massachusetts Broken Stone Company/BP Weston Quarry, LLC (MAR05A069)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
On 16 July 2002 MassDEP DWM biologists conducted a habitat assessment on Stony Brook downstream from Church Street in Weston (Station ST01). In-stream habitat quality was excellent (total habitat assessment score was 182 out of a possible 200) (Appendix C).

The USGS maintains a gage on Stony Brook at Route 20 in Waltham (Gage 01104460). The drainage area at the gage is 22.0 mi^2 and the average annual discharge is 40.6 cfs (period of record 1 October 1997 to September 1998, August 2002 through 30 September 2005) (USGS 2007a). The USGS remarks that flow at this station is affected by regulation of a dam that is 2.6 miles upstream on Hobbs Brook at outflow of Cambridge Reservoir. The instantaneous minimum discharge over the period of record occurred on 11 September 2002 (3.4 cfs) (USGS 2007a).

Stony Brook was sampled by DWM off of Sibley Road downstream from the railroad tracks in Weston (Station ST00). The river channel was approximately 20 feet wide in this reach. Although there was a slight drop in depth in August and September water levels and velocities were relatively constant throughout the summer. The channel remained full with no exposed substrates and fast riffles (Appendix B).

Biology
MassDEP DWM biologists conducted benthic macroinvertebrate sampling of Stony Brook downstream from Church Street in Weston (Station ST01) in July 2002. This site was used as a reference station. The brook was found to have a macroinvertebrate assemblage indicative of a healthy aquatic community and was considered to be representative of least impacted conditions (Appendix C).

DWM biologists conducted electrofishing in Stony Brook downstream from Church Street in Weston in August 2002 (Appendix G). Fish species captured included only three American eel, although two others were observed but not collected, and two bluegill (Appendix G). Flows were low and may have been impacting the fish community in this reach. It should be noted that in 1997 young of the year brook trout and one wild brown trout were collected from this same reach of Stony Brook (Fiorentino 1999 and Fiorentino *et al.* 2000). Whether the absence of trout during the 2002 fish survey is a result of water quality/habitat changes or natural variability such as low flow conditions is not known at this time.

MA DFG biologists conducted backpack shocking in Stony Brook on 7 August 2001 downstream from the dump road crossing in Weston (Richards 2006). The stream reach sampled was wide and fast and

sampling efficiency was noted as being poor. A total of four species (n=7 fish) were collected including four largemouth bass, and an individual each of brown trout, white sucker, and yellow perch.

Water Chemistry

The maximum temperature recorded by USGS at their gage (01104460) from 14 August 2002 through 25 June 2005 was 26.7°C on 17 August 2002 (n=100,421 measurements) (USGS 2007h). Although this segment is not classified as a Cold Water Fishery, since there was some historical evidence of a cold water fish population (Fiorentino 1999 and Fiorentino *et al.* 2000), the temperature data were compared to the cold water fishery criterion of 20°C (antidegradation provisions that protect existing uses 314 CMR Section 4.04(1) of the MA SWQS). The Cold Water Fishery temperature criterion (20.0°C) (calculated as the 7-day rolling average of the daily maximum temperature) was exceeded on 245 days out of 401 days for which a 7-day rolling average could be calculated during the months of May through September of all sample years. The number of days per year with a 7-day rolling average of the daily maximum temperature exceedance of 20.0°C was 34 times in 2002 (note no data available until August 14th), 93 times in 2003, 106 times in 2004, and 12 times in 2005 (note no data after June 25th). On a daily basis a total of 234 days were found to exceed 20.0°C and the average amount of time an exceedance occurred on these days was 21.4 hours.

Stony Brook was sampled by DWM off of Sibley Road downstream from the railroad tracks in Weston (Station ST00) between April and September 2002 (Appendix B). DO concentrations were all $\geq$5.5 mg/L and only one of the nine measurements was <6.0 mg/L. The highest temperature was 23.4°C although six of the nine measurements were >20.0°C. The pH measurements met water quality criteria. Conductivities were somewhat elevated (ranging from 356 to 827 μS/cm and six of the nine measurements were qualified for being outside of the upper calibration range). Phosphorus levels were low ranging from 0.022 to 0.036 mg/L (n=5).

The *Aquatic Life Use* is assessed as support for Stony Brook based primarily on the RBP III analysis, which indicated a healthy benthic community. Whether or not there are changes in the fish community from 1997 to 2002 is currently unknown. The absence of trout during the 2002 fish survey may be the result of water quality/habitat changes or natural variability such as low flow conditions so this use is identified with an Alert Status.

Primary and Secondary Contact Recreation and Aesthetics Uses

DWM biologists noted that Stony Brook was slightly turbid downstream from Church Street in Weston (Station ST01) on 16 July 2002 and no objectionable conditions were noted (e.g., oils, odors, other deposits) (MassDEP 2002b).

Bacteria sampling took place in Stony Brook off of Sibley Road downstream from the railroad tracks in Weston (Station ST00) between April and September 2002 (Appendix B). The *E. coli* bacteria counts were low ranging from 39 to 210 cfu/100 ml (geometric mean = 99 cfu/100 ml). The water column was clear and there were no other objectionable conditions noted (e.g., odors, oils). Except for a sparse amount of moss, no other aquatic plants were observed.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as support for Stony Brook because of the low bacteria counts and the lack of objectionable conditions.

Stony Brook (MA72-26) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Drinking Water**		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* Alert Status issues identified, see details in use assessment
** The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS

Continue to monitor (both water quality and biological) Stony Brook. Future biomonitoring should include a more thorough survey of Stony Brook to document the presence and abundance of reproducing brook and/or brown trout.

Protection of trout in Stony Brook at a minimum would require reducing summer time in-stream temperatures. Investigate potential reservoir and other management strategies to reduce in-stream temperatures in Stony Brook.

UNNAMED TRIBUTARY (SEGMENT MA72-27)
Location: Headwaters, outlet Stony Brook Reservoir, Waltham/Weston, to confluence with the Charles River, Waltham/Weston.
Segment Length: 0.2 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 23.7 mi^2 subwatershed.
Forest..... 40%
Residential..... 34%
Open land 5%
The estimated percent impervious area for this subwatershed area is 13.3%.

This segment is on the 2006 Integrated List of Waters in "Category 2"- *Attaining Some Uses* (*Aquatic Life, Primary Contact Recreation, Secondary Contact Recreation* and *Aesthetics*); Others Not Assessed (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
(The Cambridge Water Department, Lincoln Water Department, and Weston Golf Club are registered to withdraw from sources in this subwatershed area – see Stony Brook Reservoir - MA72114, Cambridge Reservoir (also referred to as Hobbs Brook Reservoir) - MA72014, and Sandy Pond - MA72105.
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life
Habitat and Flow
The USGS maintains a gage 10 feet upstream from the bridge on River Road (downstream from Stony Brook Reservoir gatehouse) on this unnamed tributary to the Charles River. The USGS gage name is Stony Brook Reservoir Dam near Waltham, MA (Gage 01104480). The average annual discharge at the gage is 22.3 cfs (period of record October1999 through September 2005) (USGS 2007h). USGS reports that this gage experienced no flow on many days throughout the period of record due to controlled shutdowns. The USGS remarks that flow is affected by regulation of the dam 300 ft. upstream at outflow of Stony Brook Reservoir.

Water Chemistry
USGS does report water quality data for their Stony Brook Reservoir Dam gage (01104480). However their water quality monitor is equipped with a flow-through system that receives reservoir water from a submersible pump, so the data are not summarized here.

The *Aquatic Life Use* for this unnamed tributary is assessed as impaired because of flow alterations caused by reservoir management practices (i.e., controlled shutdowns with no minimum releases).

Unnamed Tributary (Segment MA72-27) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low flow alterations, other flow regime alterations Sources: Flow alterations from water diversions impacts from flow regime alterations, dams/impoundments
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS

A reservoir flow management plan should be established to protect aquatic habitat in this segment.

Conduct bacteria sampling to evaluate status of the recreational uses.

BEAVER BROOK (SEGMENT MA72-28)
Location: Headwaters north of Route 2, Lexington, through culverting to the Charles River, Waltham.
Segment Length: 5.5 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 11.4 mi^2 subwatershed.
Residential 47%
Forest..... 22%
Open land 17%
The estimated percent impervious area for this subwatershed area is 22.4%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, nutrients, siltation, organic enrichment/low DO, turbidity, pathogens, taste, odor and color, flow alteration, and other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Belmont Country Club (32002601)
NPDES (See Appendix H, Tables H2 and H4)
Old Colony Petroleum Co (MA0031933)
Waverly Oaks Park/Duffy Brothers Construction (MAG910153)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Beaver Brook was sampled by DWM at two sites. The first site was located at the inlet to Mill Pond in Waltham/Belmont (Station BE03). The second site was located upstream from Beaver Street in Waltham (Station BE02). Sites were sampled between April and September 2002 (Appendix B). The brook is low gradient upstream from the Mill Pond impoundment and in the spring this reach was slightly flooded with a velocity of approximately 1 fps. In June the water level began to drop, exposing the sandy banks and by August the brook was almost stagnant. Depth continued to drop into September (Appendix B). Further downstream near Station BE02 (approximately 1.4 miles) the stream channel was approximately 15 feet wide. The water level and velocity in the brook began dropping in July, exposing sandy substrates on the banks. These same conditions remained through September.

The lower 0.6-mile reach of Beaver Brook is culverted underground.

Biology
In July the non-native aquatic macrophyte water chestnut was observed to cover approximately 50% of the Mill Pond impoundment (Appendix B). Dense coverage of green filamentous algae was observed attached to substrates in the brook at both sampling locations (BE03 and BE02). This density is indicative of enrichment associated with elevated nutrients.

Water Chemistry
Beaver Brook was sampled by DWM at the inlet to Mill Pond in Waltham/Belmont (Station BE03) between April and September 2002 (Appendix B). With the exception of two pre-dawn measurements taken in August and September (4.4 and 4.7 mg/L, respectively) DO concentrations were all $\geq$5.6 mg/L. The highest temperature was 20.0°C and only one pH measurement (6.4 SU) was slightly below standards (n=10). Conductivities were somewhat elevated (ranging from 639 to 1,1330 μS/cm and nine of the 10 measurements were qualified for being outside of the upper calibration range). Phosphorus levels were somewhat elevated ranging from 0.046 to 0.098 mg/L with three of the five measurements $\geq$0.074 mg/L (n=5).

The *Aquatic Life Use* is assessed as impaired for Beaver Brook based primarily on the water quality data which indicated slightly low DO, slightly elevated total phosphorus, as well as the dense growths of filamentous green algae attached to substrates and best professional judgment. The infestation of *Trapa natans* (a non-native aquatic macrophyte) is also a problem in the Mill Pond impoundment. Habitat quality is completely degraded in the lower 0.6-mile reach of Beaver Brook where it is culverted underground.

Primary and Secondary Contact Recreation and Aesthetics Uses
Beaver Brook was sampled by DWM at two sites: the inlet to Mill Pond in Waltham/Belmont (Station BE03) and upstream from Beaver Street in Waltham (Station BE02) between April and September 2002 (Appendix B). *E. coli* bacteria counts were elevated at both sampling locations. The geometric mean was 441 cfu/100 ml (range 130 to 1,200 cfu/100 ml n=5) at the upstream sampling location while the geometric mean for the river near Beaver Street was 431 cfu/100 ml and the range was 78 to 1,900 cfu/100 ml). It should be noted that one of five measurements (excluding duplicate) exceeded the single sample maximum standard of 1,260 cfu/100 ml for secondary contact recreation.

The water column of Beaver Brook near the inlet to Mill Pond in Waltham/Belmont (Station BE03) was slightly turbid with no odor on the survey dates. By July moderate amounts of green filamentous algae attached to rocks on the bottom of the brook were observed and remained through September. Emergent aquatic plant life began to appear in June. In July production immediately downstream from the footbridge, in the pond, resulted in dense coverage of emergent, floating and submerged macrophytes including waterweed (*Elodea* sp.), duckweed (*Lemna* sp.), and water chestnut (*Trapa natans*). Approximately 50% of Mill Pond was covered with water chestnut. In August a natural oily sheen was observed on the surface of the water at the sampling station. Further downstream near Beaver Street in Waltham (Station BE02), the water column was slightly turbid on the survey dates. A petroleum odor was noted in July and a musty odor was noted in August. There were no scums observed, but there was some trash on the banks. There were no aquatic plants, but dense coverage of green filamentous algae attached to substrates was observed in July, August and September.

Sampling in Beaver Brook has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria in this brook.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as impaired for Beaver Brook because of elevated *E. coli* counts and the objectionable growths of green filamentous algae.

Beaver Brook (Segment MA72-28) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low DO, biological indicators of organic enrichment, excess algal growth, elevated total phosphorus, infestation of non-native aquatic macrophyte though Mill Pond impoundment (0.1 mile reach), other anthropogenic substrate alteration (culverting) for lower 0.6 mile reach because of habitat alteration Sources: Introduction of non-native organism 0.1-mile reach through Mill Pond impoundment, channelization for the lower 0.6 mile reach of this segment, loss of riparian habitat, unspecified urban stormwater
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Causes: Elevated *E. coli*, excess algal growth Sources: Unknown, unspecified urban stormwater, waterfowl Suspected source: Illicit connections
Secondary Contact		IMPAIRED Cause: Excess algal growth Sources: Unknown, unspecified urban stormwater Suspected source: Illicit connections
Aesthetics		

RECOMMENDATIONS

Continue to conduct water quality monitoring (i.e., DO, temperature, total phosphorus sampling) in Beaver Brook to evaluate potential sources contributing to the enriched conditions (low DO, presence of filamentous algal growth, elevated nutrients).

Conduct biological monitoring (fish population sampling) in Beaver Brook to assess the *Aquatic Life Use.*

Bacteria source tracking should be conducted during the next MassDEP Charles River Watershed survey to find potential bacterial sources (e.g., illicit connections, wildlife). Review results of recent studies (e.g., USGS studies such as *Pharmaceuticals and Personal Care Products as indicators of Sewage Contamination in Urban Streams* (USGS 2007i), which may identify bacteria sources to this system. If necessary implement outreach to the Massachusetts Department of Conservation and Recreation (MA DCR) to address potential impacts from feeding waterfowl populations in the MA DCR managed park.

Protect/restore vegetative buffers along the streambanks.

Conduct habitat assessment evaluations along Beaver Brook to determine if flow regimes have been restored in the brook downstream from MA DCR's Beaver Brook Reservation impoundments. If still problematic a flow management plan should be developed by MA DCR to protect aquatic habitat in Beaver Brook.

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

CHEESE CAKE BROOK (SEGMENT MA72-29)
Location: Emerges south of Route 16, Newton, to the confluence with the Charles River, Newton.
Segment Length: 1.4 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 2.7 mi^2 subwatershed.
Residential 71%
Open land 16%
Transport 4%
The estimated percent impervious area for this subwatershed area is 32.2%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients, siltation, organic enrichment/low DO, oil and grease, pathogens, taste, odor and color, noxious aquatic plants, and other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H2 and H4)
Radiant Fuel Company, Inc. (MA0001236)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Cheesecake Brook was sampled by DWM at two sites - upstream from Watertown Street in Newton (Station CB03) and off of Albemarle Road near the confluence with the Charles River in Newton (Station CB01) between April and September 2002 (Appendix B). The stream channel was approximately 15 feet wide at both sampling locations and water levels and velocities were relatively constant throughout the summer. Depths dropped approximately one half foot in August. Cheesecake Brook is completely channelized within stonewalls and lacks canopy cover throughout most of its length. In the reach near the confluence with the Charles River, the brook can be described as a slow run.

Biology
Sparse amounts of moss and duckweed (*Lemna* sp.) were observed in Cheesecake Brook near Watertown Street (Station CB03) (Appendix B). Some filamentous green algae were observed in this reach later in the summer. Further downstream near the confluence with the Charles River (Station CB01), green and brown filamentous algae covered approximately 25% of the sparse plant coverage (*Callitriche* sp. and *Elodea* sp.) and substrates in the brook (Appendix B).

Water Chemistry
Cheesecake Brook was sampled by DWM off of Albemarle Road near the confluence with the Charles River in Newton (Station CB01) between April and September 2002 (Appendix B). With the exception of one pre-dawn measurement taken in September (4.5 mg/L) DO concentrations were all $\geq$5.2 mg/L (n=10). However, it should be noted that diurnal variations were high (ranging up to 7 mg/L). Supersaturated conditions (as high as 142%) were documented over 110% during three of the five daytime surveys. The highest temperature was 21.5°C and only one pH measurement (6.4 SU) was slightly below the water quality criterion (n=10). Conductivities were somewhat elevated (ranging from 564 to 997μS/cm and eight of the 10 measurements were qualified for being outside of the upper calibration range). Phosphorus levels were slightly elevated ranging from 0.02 to 0.068 mg/L with two of the five measurements $\geq$0.061 mg/L (n=5).

The *Aquatic Life Use* for Cheesecake Brook is assessed as impaired based on habitat alteration (channelization), loss of riparian vegetative cover, and the evidence of productivity (extreme diurnal oxygen fluctuations and extremely high saturation of DO).

Primary and Secondary Contact Recreation and Aesthetics Uses
Cheesecake Brook was sampled by DWM at two primary sites - upstream from Watertown Street (Route 16) in Newton (Station CB03) and off of Albemarle Road near the confluence with the Charles River in Newton (Station CB01) between April and September 2002 (Appendix B). The *E.coli* sample collected from the brook slightly downstream from a storm drain pipe near Watertown Street (Station CB03A) in April 2002 was low (20 cfu/100 ml). *E. coli* bacteria counts were elevated at both sampling locations. The geometric mean was 399 cfu/100 ml (range 160 to 720 cfu/100 ml n=4) at the upstream sampling

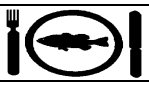
location while the geometric mean for the river near the confluence with the Charles was 265 cfu/100 ml and the range was 160 to 520 cfu/100 ml).

With the exception of occasional trash and the growth of some filamentous green algae later in the summer, no other objectionable conditions (no odors, scums, or turbidity) was observed in Cheesecake Brook upstream from Watertown Street in Newtown (Station CB03). Further downstream, near the confluence with the Charles River (Station CB01), green and brown filamentous algae covered approximately 25% of the sparse plant coverage and substrates by early August. Although no objectionable odors or scums were noted, a considerable amount of fecal matter from waterfowl was observed on the river bottom (Appendix B).

Sampling in Cheesecake Brook has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria in this brook.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as impaired for Cheesecake Brook because of elevated *E. coli* counts, growths of green filamentous algae, and the waterfowl droppings (objectionable deposits).

Cheesecake Brook (Segment MA72-29) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Other anthropogenic substrate alteration (channelization), alteration in stream-side or littoral vegetative cover, DO saturation Sources: Channelization, loss of riparian habitat, unspecified urban stormwater
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Causes: Elevated *E. coli*, excess algal growth Sources: Unknown, unspecified urban stormwater, waterfowl Suspected source: Illicit connections
Secondary Contact		IMPAIRED Cause: Excess algal growth Sources: Unknown, unspecified urban stormwater, waterfowl Suspected source: Illicit connections
Aesthetics		

RECOMMENDATIONS

Continue to conduct water quality monitoring (i.e., DO, temperature, total phosphorus sampling) in Cheesecake Brook to evaluate potential sources contributing to the enriched conditions (large diurnal fluctuations in DO, supersaturation, presence of filamentous algal growth) and to assess the *Aquatic Life Use*.

Conduct *E. coli* bacteria sampling to assess *Primary* and *Secondary Contact Recreational Uses*. Review results of the recent USGS study (USGS 2007i) conducted which identify bacteria sources to this system. Bacteria source tracking should be conducted to verify high densities and identify sources. Sources should be remediated as necessary.

Habitat evaluations should be conducted along the brook. Where needed develop and implement plans to improve habitat (e.g., restore vegetative buffers, increase shading along brook, reduce sediment inputs, etc.).

CHARLES RIVER (SEGMENT MA72-36)
Location: Watertown Dam, Watertown, to Boston University Bridge, Boston/Cambridge.
Segment Length: 6.1 miles
Classification: Class B, Warm Water Fishery
Combined Sewer Overflows discharge to this waterbody.

[Note: This segment is formerly part of Charles River - Segment MA72-08.]

Land-use estimates (top 3, excluding water) for the 281.3 mi^2 subwatershed.
Forest..... 38%
Residential..... 37%
Open land 9%
The estimated percent impervious area for this subwatershed area is 14.6%.

This segment (formerly part of a segment reported as MA72-08) is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, unknown toxicity, metals, nutrients, priority organics, organic enrichment/low DO, pathogens, oil and grease, noxious aquatic plants, turbidity, taste, odor and color (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Mount Auburn Cemetery (9P432004901)

NPDES (See Appendix H, Tables H2, H3, and H4)
Boston Water and Sewer Commission (MAS010001). There are 10 major stormwater outfalls to this segment of the Charles River – 24C031, 24D032, 24D150, 25D040, 25E037, 26F038, 26G001, 24G034, 24G035, and 23G132 as well as three minor stormwater outfalls – 24C174, 25G041, and 25G005.
Genzyme Corp. (MAG450001)
Harvard University (MA0004901)
CSX Transportation, Inc. (CSXT) (MA0025704)
Boston Water and Sewer Commission (MA0101192)
BOS032: Charles River-Upper CSO volume (mg) 1.92 –eliminated
BOS033: Charles River-Upper CSO volume (mg) 0.07 –eliminated
Cambridge Department of Public Works (MA0101974)
CAM005: (Lowell Street at Mount Auburn) - will activate twice per year, annual volume of 0.78 MG
CAM007: (Memorial Drive at Hawthorne Street) - will activate once per year, annual volume of 0.03 MG
CAM009: (Memorial Drive at Old Murray Road) - closed
CAM011: (Plympton Street) - will not activate
Massachusetts Water Resources Authority (MA0103284)
MWR201: Cottage Farm Chlorination and Detention Station Facility.

Superfund Site: Materials Technology Laboratory (MA0213820939) – Final Baseline Ecological Risk Assessment completed by ENSR in 2005. This report included fish tissue, sediment, and surface water quality data from this segment of the Charles River (dates of study 2001-2005). The Army Materials Technology Laboratory was de-listed from the NPL in 2007 (http://www.nae.usace.army.mil/news/2006-082.htm). Additional information about the project is available at: http://www.nae.usace.army.mil/news/ma.pdf.

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
The Denil fishway at the Watertown Dam in Watertown is operational though the width of the spillway and river make it difficult for river herring and American shad to locate the entrance and it is likely that a large percentage of these populations fail to ascend the river beyond this point (Brady *et al.* 2005). The rainbow smelt (*Osmerus mordax*) population spawns below this dam and is not affected by the fishway's shortcomings.

On 16 July 2002 DWM biologists conducted a habitat assessment of the Charles downstream from the Watertown Dam, Watertown (Station CR00). This site received a total habitat assessment score of 152 out of a possible 200 (Appendix C). The channel at this station was wide (60 m) with a completely open

canopy. This reach provided excellent epifaunal and fish habitat in the form of varying riffle depths, cobble-dominated substrates, deep pools and a variety of stable cover (boulder, submerged logs, and snags) (Appendix C). Channel flow status was also optimal. While in-stream habitat quality was optimal, riparian and bank habitat was noted as being compromised (limited riparian buffer, vegetative protection. and bank stability).

Water depths range from 6 to 12 feet in the Charles River upstream from the BU Bridge (MassDEP *et al.* 2007). Low flows, at or near the estimated 7Q10 flow of 18 cfs, were observed in the Lower Charles River during the summers of 1997, 1999, 2001, and 2002 (MassDEP *et al.* 2007).

There is a cooling water intake structure (CWIS) along the granite block sidewall of the Charles River directly in front of Harvard University's Blackstone Steam Plant facility in Cambridge where the river is flowing in a southerly direction. The intake is approximately 8 feet wide and 12 feet deep and designed to withdraw water from the surface of the river. The opening is equipped with bar racks to keep large debris from entering the four-foot diameter intake tunnel. The estimated intake approach velocity is 0.005 foot per second (fps) and the through bar intake velocity is estimated at 0.007 fps for the projected use of 0.3 MGD (EPA 2007a). Use of this CWIS is expected to be terminated by December 2008.

Biology

DWM biologists noted that half of the available substrates in the river downstream from the Watertown Dam (Station CR00) were covered with aquatic vegetation, mostly mosses with some milfoil, while dense growth of filamentous green and thin film algae were even more extensive. Algal cover was estimated as 100% in this open canopied stream reach. The dominant algal genera collected in the rock/riffle habitat were Cyanophyceae-*Lyngbya* sp. (Appendix F).

Compared to the upstream reference on the Charles River (Station CR03) the RBP III analysis indicated the benthic community downstream from the Watertown Dam (Station CR00) was slightly impacted (Appendix C). Filter feeders were well represented (indicative of the abundance of FPOM as a food resource) at this location but not hyperdominant as was the case in 1997. In addition, the presence of scrapers in 2002 (absent in 1997 sample) was also indicative of an improved trophic structure. However, whether or not this resulted from improved water quality or higher flows is unclear.

On 13 August 2002 MA DFG and EPA biologists conducted backpack electrofishing in the Charles River in an 80 m reach of the river downstream from the Watertown Dam (Station 694) (Richards 2006). A total of 190 fish were collected representing eight species. Fish sampling efficiency was noted as being poor in the deeper pools and only 10% of the eels seen were reportedly captured. That being said the dominant taxa were American eel (n=138), while pumpkinseed (n=17), bluegill (n=12), and redbreasted sunfish (n=11) comprised an estimated 21% of the sample. With the exception of white sucker (n=4), all fish species collected are classified as being macrohabitat generalists, which are tolerant or moderately tolerant to pollution. The relative absence of fluvial fishes and the absence of common shiner and fallfish, the top two species in the Charles River Target Fish Community developed by Meixler (2006), where habitat is appropriate, is problematic.

Boat electrofishing was also conducted by MA DFG and EPA biologists in the Charles River near the Watertown Yacht Club on 31 July 2002 (Richards 2006). The boat was noted to have broken down during the survey. All sampling was conducted in an impounded area. A total of 142 fish were collected representing 11 species. Yellow perch (n=81) dominated the sample. American eel (n=7) and blueback herring (n=3) were collected as was one white sucker (a fluvial dependant species). With the exception of the blueback herring and white sucker, all fish were macrohabitat generalists, which are classified as being tolerant or moderately tolerant to pollution.

As part of the *Final Baseline Ecological Risk Assessment* for the Charles River Operable Unit Army Materials Testing Laboratory in Watertown, benthic macroinvertebrate sampling was conducted at 16 stations in four reaches along this segment of the Charles River in June 2003 (ENSR 2005). The conditions were similar to those documented in the 1995 study including low diversity and dominance of pollution tolerant taxa (oligochaetes). Substrates in this area are comprised of a silt/muck bottom. It should also be noted that the non-native Asiatic clam, *Corbicula* spp., were found in the samples (ENSR 2005).

Toxicity

Sediment

As part of the *Final Baseline Ecological Risk Assessment* for the Charles River Operable Unit Army Materials Testing Laboratory in Watertown, whole sediment toxicity testing studies were conducted on samples collected from the river in June/July 2003 (ENSR 2005). Survival data for organisms exposed to sediment collected from 16 sites within four reaches along this segment of the Charles River (with static and/or continous renewal of overlying water) are summarized below.

- Upstream: just upstream from the Newton Yacht Club to just upstream from the Watertown Yacht Club. Four sites sampled were tested for toxicity. Survival of midge (*Chironomus tentans*) exposed (10-day) from this reach of the river was $\geq$ 73%. Survival of the amphipod (*Hyallela azteca*) exposed (28-day) was $\geq$ 74% and the pooled mean was 84%. Survival of fathead minnows (*Pimephalas promelas*) exposed (7-day) ranged from 50 to 93% (average was 70%).

- Adjacent: located in the main channel of the river just upstream Watertown Yacht Club to just downstream from North Beacon Street Bridge. Three sites sampled were tested for toxicity. Survival of *C. tentans* exposed (10-day) ranged from 46 to 69% (average 58%). Survival of *H. azteca* exposed (28-day) to sediment was also low ranging from 15 to 58% (average survival 30%). Survival of *P. promelas* exposed (7-day) ranged from 50 to 78% (pooled mean 68% survival).

- Back Channel: river between Sunrise Island and the northern bank including the Watertown Yacht Club. Three sites sampled were tested for toxicity. Survival of *C. tentans* exposed (10-day) ranged from 70 to 89% (average 79%). Survival of *H. azteca* exposed (28-day) ranged from 65 to 91% (average survival was 81%). Survival of *P. promelas* exposed (7-day) ranged from 40 to 91% (average survival was 78%).

- Downstream: downstream from North Beacon Street Bridge to Arsenal Street Bridge. Three sites sampled were tested for toxicity. Survival of *C. tentans* exposed (10-day) to sediment from this reach of the river ranged from 59 to 70% (average 64%). Survival of *H. azteca* exposed (28-day) ranged from 31 to 58% (average was 40%). Survival of *P. promelas* exposed (7-day) was good ranging from 88 to 95%.

Effluent

Between October 2000 and February 2008, acute toxicity tests (24-hour screening tests) were conducted on the MWRA Cottage Farm Chlorination and Detention Station discharge. Acute toxicity was detected in one of four tests conducted with *Daphnia pulex* (LC_{50} =93.4% effluent in October 2000). Acute toxicity was detected in two of nine 24-hour screening tests using *C. dubia* (LC_{50} =18.3 and 48.7% effluent in the April 2004 and October 2005 test events, respectively). Of the 11 tests conducted using *P. promelas*, 24-hour acute toxicity was detected in four test events (LC_{50} =51.6, 60.5, 34, and 69.6% effluent in the April 2002, October 2002, April 2004, and October 2005 test events, respectively). The ammonia concentrations ranged from 1.39 to 8.8 mg/L (n=14) while the TRC concentrations (n=14) were all reported as <0.05 mg/L with the exception of one measurement (0.28 mg/L in November 2000).

Water Chemistry

Water quality monitoring data for this segment of the Charles River (the upper Basin) was compiled/analyzed for the *Nutrient TMDL Development for the Lower Charles River Basin, Massachusetts* (MassDEP *et al.* 2007). Sources of data for the TMDL included EPA, CRWA, MWRA, USGS, and Mirant (owner/operator of the Kendall Square Station power generation facility). [Note: data generated by Mirant were collected from the river downstream from the BU bridge (see Segment MA72-38).]

CRWA volunteers conducted water quality monitoring at four sampling stations along this segment of the Charles River as part of their monthly monitoring program. These sites, from upstream to downstream, are: North Beacon Street in Watertown/Boston/Brighton (Station 700S), Arsenal Street in Watertown/Boston/Brighton (Station 715S), Eliot Street Bridge (Station 729S), and at Western Avenue in Cambridge (Station 743S). EPA conducted water quality sampling at three sampling station locations in this segment of the Charles River (CRBL03 near Daly Field, Newton/Boston, CRBL04 near Herter East Park, Boston, CRBL05 near Magazine Beach, Cambridge). MWRA also conducted water quality sampling at two sampling stations in this segment of the river (Station 001 near Nonantum Road behind the MA DCR skating rink in Newton and Station 005 near Magazine Beach in Cambridge) (Coughlin 2006).

Dissolved oxygen concentrations reported by MWRA in 2005 at two of their sampling stations along this segment of the Charles River (Stations 001 and 005) were all > 5.0 mg/L, but these data do not represent worse case (pre-dawn) sampling conditions. It should also be noted that the DO data at these sites show no depletion in bottom waters (Coughlin 2006). The maximum temperature reported by MWRA at these sites was 28.1ºC. Evidence of high primary productivity (i.e., supersaturation of dissolved oxygen, high pH, high chlorophyll *a* concentrations, and low Secchi disk transparencies) was documented at sampling locations within this segment of the Charles River (MassDEP *et al.* 2007).

Total phosphorus concentrations reported by EPA (three stations described above as well as their Watertown Dam station) ranged from 0.025 to 0.1 mg/L in dry weather samples collected from July through October between 2001 and 2004 (n=74) (MassDEP *et al.* 2007). MWRA reported similar seasonal concentrations (includes both dry and wet weather sampling conditions) (0.029 to 0.157 mg/L, n=47 in this same timeframe) at their Watertown Dam sampling station. The reported range of annual means from this dataset was 0.059 to 0.079 mg/L.

Chlorophyll *a* concentrations reported by EPA (three stations described above as well as their Watertown Dam station) ranged from 1.1 to 53.0 µg/L in dry weather samples collected from July through October between 2001 and 2004 (n=71) (MassDEP *et al.* 2007). It should be noted that higher concentrations were always measured at the downstream sampling locations (mean concentrations were >20 µg/L at the two downstream sampling locations (Herter East Park and Magazine Beach). MWRA reported similar seasonal concentrations (includes both dry and wet weather sampling conditions) (1.7 to 32.2 µg/L, n=49 in this same timeframe) at their Watertown Dam sampling station. The reported range of annual means from this dataset was 5.1 to 12.8 µg/L.

Secchi disk transparency reported by EPA (three sampling station locations in this segment of the Charles River) ranged from 0.6 to 1.5 m in dry weather samples collected from July through October between 2000 and 2004 (n=61) (MassDEP *et al.* 2007). It should be noted that mean Secchi disk depths were always lower ($\leq$1.0 m) at the downstream sampling locations (Herter East Park and Magazine Beach). Secchi disk transparency reported by MWRA in 2005 at their two sampling stations along this segment of the Charles River (Stations 001 and 005) were also ($\leq$1.0 m) (Coughlin 2006).

CRWA collected monthly data for the Charles River at North Beacon Street in Watertown/Boston/Brighton (Station 700S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between February 2000 and October 2006 (n=67) exceeded 28.3°C (maximum 28.0°C). A total of 24 pH measurements were taken at Station 700S between February 2000 and April 2002. The pH measurements ranged from 6.8 to 7.5 SU. Total suspended solids concentrations were all low (< 12.0 mg/L, n=37).

CRWA collected monthly data for the Charles River at Arsenal Street in Watertown/Boston/Brighton (Station 715S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between February 2000 and October 2006 (n=57) exceeded 28.3°C. A total of 24 pH measurements were taken at Station 715S between March 2000 and April 2002. The pH measurements ranged from 6.9 to 7.6 SU. Total suspended solids concentrations were all low (< 10.0 mg/L, n=36).

CRWA collected monthly data for the Charles River at Eliot Street Bridge (Station 729S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed as part of this assessment. None of the temperature measurements taken between February 2000 and October 2006 (n=61) exceeded 28.3°C (maximum 26.0°C). A total of 24 pH measurements were taken at Station 729S between March 2000 and April 2002. The pH measurements ranged from 6.6 to 7.7 SU. Total suspended solids concentrations were all low (< 13.0 mg/L, n=36).

CRWA collected monthly data for the Charles River at Western Avenue in Cambridge (Station 743S) included analytes such as pH, temperature, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 were reviewed

as part of this assessment. Five of the temperature measurements taken between February 2000 and October 2006 (n=66) exceeded 28.3°C (maximum 36.0°C in June and July 2001. Actual dates of exceedance include: 17 September 2000, 15 May 2001, 19 June 2001, 17 July 2001, and 21 June 2005). A total of 22 pH measurements were taken at Station 743S between March 2000 and April 2002. The pH measurements ranged from 6.6 to 7.5 SU. Total suspended solids concentrations were all low (< 12.0 mg/L, n=38). Ammonia concentrations were low (< 0.1 mg/L, n=24). Total phosphorus concentrations ranged from 0.031 to 0.161 mg/L (n=25) with 20 of 25 samples exceeding 0.05 mg/L. Chlorophyll *a* concentrations ranged from 1.93 to 27.2 μg/L (n=14) with three samples exceeding 16 μg/L.

Sediment Chemistry

Surficial sediment sampling was conducted at 44 sites throughout this segment of the Charles River by USGS in July and August 1998 (Breault *et al.* 2000). The report states that, "…*inorganic and organic compounds were detected at sufficiently high concentrations to cause potentially severe biological effects to benthic organisms living in and on the bottom sediment*." The distribution of the inorganic elements appeared to be controlled primarily by in-stream processes associated with sediment transport, while, in contrast, the distribution of organic compounds appeared to reflect local point and non-point sources (Breault *et al.* 2000). Water depths and the thickness of post-1908 bottom sediments (after construction of the Charles River Dam in 1908 which created the "Basin") were also measured. In this segment of the Charles River the thickness of sediment deposited ranges from less than 0.5 feet near the Watertown Dam to ≤ 2.0 feet (Plate 1 in Brealt *et al.* 2000). Surficial sediments collected at 47 sites in the river (as part of the *Final Baseline Ecological Risk Assessment* for the Charles River Operable Unit Army Materials Testing Laboratory in Watertown, in June/July 2003 (ENSR 2005) resulted in similar findings.

Chemistry Tissue

Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp, and yellow perch) were collected by EPA from three reaches (3F, 4F, and 5F) of the Charles River to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as composite offal samples were prepared and analyzed for PCBs and organochlorine pesticides, PAHs, metals including total mercury, % lipids, and dioxins. Weight data are not available to calculate whole body burden and compare to NAS/NAE guidelines.

The *Aquatic Life Use* is assessed as impaired for this segment of the Charles River. Nutrient enrichment (moderately elevated concentrations of total phosphorus) is manifested by several biological and chemical indicators of high productivity (i.e., supersaturation of dissolved oxygen, high pH, high chlorophyll *a* concentrations, dense growth of filamentous green algae, and low Secchi disk transparencies). The infestation of the non-native Asiatic clam, *Corbicula* spp. is also problematic. In habitat that is appropriate (lotic), the current fish assemblage within this segment of the Charles River is missing the two top ranking species in the Charles River Target Fish Community developed by Meixler (2006). In addition, the fourth ranking species (white sucker) is underrepresented. Within the slower moving reaches the fish assemblage is comprised primarily by macrohabitat generalists, which is expected. The Watertown Dam alters the natural flow regime and appears to be affecting the migration of diadromous fishes. Additionally, sediment contamination (both inorganic and organic compounds) as well as the poor survival of test organisms exposed to sediments collected from the river in the vicinity of the Watertown Arsenal is also problematic. The sheer numbers of American eels observed in the river at the base of the Watertown Dam suggests that passage for this catadromous species through the Denil fishway is inefficient.

FISH CONSUMPTION USE

Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp, and yellow perch) were collected by EPA from three reaches (3F, 4F, and 5F) in the Charles River to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as composite offal samples were prepared and analyzed for PCBs and organochlorine pesticides, PAHs, metals including total mercury, % lipids, and dioxins.

Due to the presence of elevated PCB in carp and pesticides (total DDT) in largemouth bass, MA DPH recommends the following (MA DPH 2007 and Celona 2007).

> "*Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any Carp or Largemouth Bass fish from the Charles River collected between the South Natick Dam in Natick and Museum of Science Dam in*

Boston/ Cambridge, the general public should not consume Carp from this section of the river, and the general public should limit consumption of Largemouth Bass fish to two meals per month."

Because of the site-specific fish consumption advisory for the Charles River between the South Natick Dam, Natick and the Museum of Science Dam in Cambridge/Boston due to elevated concentrations of PCBs (polychlorinated biphenyls) and pesticides (total DDT), the *Fish Consumption Use* is assessed as impaired for this segment of the Charles River.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

On 16 July 2002 DWM biologists noted that the water in the Charles River downstream from the Watertown Dam (Station CR00) was slightly turbid with a slight slick/sheen of surface oil. However, no other objectionable conditions were noted (e.g., oils, odors, other deposits) (MassDEP 2002b).

CSO abatement has nearly eliminated these discharges to this segment of the Charles River (see details for Cambridge MA0101974, Boston Water and Sewer Commission MA0101192, and MWRA MA0103284 estimated frequencies and volumes in Appendix H).

E. coli samples were collected by CRWA volunteers as part of the CRWA monthly monitoring program at four locations along this segment of the Charles River. From upstream to downstream, these sites are: North Beacon Street, Watertown/Boston/Brighton (Station 700S), Arsenal Street, Watertown/Boston/Brighton (Station 715S), Eliot Street Bridge, Cambridge (Station 729S), and Western Avenue, Cambridge (Station 743S). MWRA typically conducts monitoring at two stations in this segment of the river (Station 001 near Nonantum Road behind the MA DCR skating park in Newton and Station 005 near Magazine Beach in Cambridge) (Coughlin 2006). EPA conducted bacteria sampling at three sampling station locations in this segment of the Charles River (CRBL03 near Daly Field, Newton/Boston, CRBL04 near Herter East Park, Boston, CRBL05 near Magazine Beach, Cambridge) (Faber 2002, Faber 2003, Faber 2004, and Faber 2005). Data for these sites are summarized below (CRWA 2007 and Coughlin 2006).

The geometric mean of *E. coli* bacteria in the Charles River near Nonantum Road behind the MA DCR skating park in Newton (Station 001) in samples collected between 1998 and 2005 (n= 21) is 534 cfu/100 ml (Coughlin 2006). Counts ranged from 272 to 1,047 cfu/100 ml within the 95% confidence interval.

E. coli bacteria counts reported by EPA ranged from 4 to 468 cfu/100 mls for samples collected from the river near Daly Field, Newton/Boston (Station CRBL03) between July 2001 and September 2004 (n=14). Six counts exceeded 235 cfu/100 ml.

Charles River at North Beacon Street in Watertown/Boston/Brighton town (Station 700S)

Station 700S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	5	4	6	6
	Maximum cfu/100 ml	1,300	790	320	990	600
	Minimum cfu/100 ml	50	40	110	220	70
126 cfu/100 ml	Geometric Mean	239	232	227	410	166
Max 235 cfu/100 ml	Number of Exceedances	3	3	3	5	2
Secondary Contact	Samples Assessed	7	8	7	11	8
	Maximum cfu/100 ml	1,300	790	660	990	600
	Minimum cfu/100 ml	50	40	80	50	70
630 cfu/100 ml	Geometric Mean	273	212	248	277	170
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	0

Charles River at Arsenal Street in Watertown/Boston/Brighton (Station 715S)

Station 715S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	4	4	6	3
	Maximum cfu/100 ml	250	3170	210	4,600	1,600
	Minimum cfu/100 ml	170	80	140	130	90
126 cfu/100 ml	Geometric Mean	206	466	168	640	343
Max 235 cfu/100 ml	Number of Exceedances	2	3	0	4	2
Secondary Contact	Samples Assessed	6	7	6	9	5
	Maximum cfu/100 ml	470	3,170	230	4,600	1,600
	Minimum cfu/100 ml	170	20	40	130	75
630 cfu/100 ml	Geometric Mean	267	325	139	482	238
Max 1260 cfu/100 ml	Number of Exceedances	0	2	0	2	1

E. coli bacteria counts reported by EPA ranged from 4 to 1,100 cfu/100 mls for samples collected from the river near Herter East Park, Boston (Station CRBL04) between July 2001 and September 2004 (n=14 including one duplicate sample). Three counts exceeded 235 cfu/100 ml.

Charles River at Eliot Street Bridge in Cambridge (Station 729S).

Station 729S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	6	3	6	6
	Maximum cfu/100 ml	2,100	240	270	590	1,900
	Minimum cfu/100 ml	30	20	90	110	1
126 cfu/100 ml	Geometric Mean	244	98	147	255	94
Max 235 cfu/100 ml	Number of Exceedances	2	1	1	2	2
Secondary Contact	Samples Assessed	6	9	4	11	8
	Maximum cfu/100 ml	2,100	510	300	680	1,900
	Minimum cfu/100 ml	30	20	90	60	1
630 cfu/100 ml	Geometric Mean	284	135	175	251	93
Max 1260 cfu/100 ml	Number of Exceedances	1	0	0	0	1

Charles River at Western Avenue in Cambridge (Station 743S)

Station 743S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	6	6
	Maximum cfu/100 ml	330	210	190	640	2,100
	Minimum cfu/100 ml	20	20	10	10	10
126 cfu/100 ml	Geometric Mean	88	71	30	141	95
Max 235 cfu/100 ml	Number of Exceedances	1	0	0	3	1
Secondary Contact	Samples Assessed	7	10	7	11	8
	Maximum cfu/100 ml	800	650	190	640	2,100
	Minimum cfu/100 ml	20	20	10	10	5
630 cfu/100 ml	Geometric Mean	144	105	48	158	64
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	1

E. coli bacteria counts reported by EPA ranged from 4 to 4,100 cfu/100 mls for samples collected from the river near Magazine Beach, Cambridge (Station CRBL05) between July 2001 and October 2006 (n=42 including two duplicate samples). Fifteen counts exceeded 235 cfu/100 ml and two of these exceeded 1,260 cfu/100 ml.

According to MWRA, the geometric mean of *E. coli* bacteria in the Charles River near Magazine Beach in Cambridge (Station 005) in samples collected between 1998 and 2005 (n= 102) was 226 cfu/100 ml (Coughlin 2006). Counts ranged from 169 to 302 cfu/100 ml within the 95% confidence interval.

Secchi disk transparency reported by EPA (four sampling station locations in this segment of the Charles River) ranged from 0.6 to 1.5 m in dry weather samples collected from July through October between 2000 and 2004 (n=61) (MassDEP *et al.* 2007). It should be noted that mean Secchi disk depths were always lower (≤1.0 m) at the downstream sampling locations (Herter East Park and Magazine Beach). Secchi disk transparency reported by MWRA in 2005 at their two sampling stations along this segment of the Charles River (Stations 001 and 005) were also (≤1.0 m) (Coughlin 2006).

Sampling in the Charles River has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria.

The *Primary Contact Recreational Use* is assessed as impaired for this segment of the Charles River because of elevated *E. coli* bacteria, which frequently exceeds the water quality criteria. According to Coughlin (2006), bacteria counts in this segment of the Charles River (referred to as the upper Basin) fail to meet criteria in all weather conditions. While *E. coli* bacteria counts met criteria for secondary contact recreation, the *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as impaired because of the poor Secchi disk transparencies.

Charles River (Segment MA72-36) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Biological indicators of nutrient enrichment, elevated total phosphorus, elevated chlorophyll *a*, elevated saturation of dissolved oxygen, high pH, poor Secchi disk transparency, non-native aquatic species, fishes bioassessment, other flow regime alterations associated with dams/impoundments, other - relative absence of fluvial specialists/dependant fish species, barriers to fish passage, sediment toxicity Sources: Habitat alteration associated with dams/impoundments, municipal NPDES discharge(s) in upstream segments, contaminated sediments, introduction of non-native aquatic organism Suspected sources: Nonpoint sources, urban stormwater
Fish Consumption		IMPAIRED Causes: Elevated PCB in fish tissue, pesticides (total DDT) Source: Unknown Suspected sources: Contaminated sediments
Primary Contact		IMPAIRED Causes: Elevated *E. coli*, poor Secchi disk transparency Sources: Upstream sources, discharges from municipal separate storm sewer systems, unspecified urban stormwater, urban runoff/storm sewers Suspected sources: Illicit Connections/Hook-ups to Storm Sewers
Secondary Contact		IMPAIRED Cause: Poor Secchi disk transparency Sources: Upstream sources, discharges from municipal separate storm sewer systems, unspecified urban stormwater, urban runoff/storm sewers
Aesthetics		IMPAIRED Cause: Poor Secchi disk transparency Sources: Upstream sources, discharges from municipal separate storm sewer systems, unspecified urban stormwater, urban runoff/storm sewers

RECOMMENDATIONS

Continue to conduct water quality monitoring (i.e., deploy *in-situ* meters to obtain long-term DO and temperature data, additional total phosphorus and chlorophyll *a* sampling) to evaluate changes in water quality in this segment of the Charles River to document conditions (e.g., implementation of treatment upgrades/phosphorus reductions at municipal treatment plants upstream).

Document composition/frequency/extent of cyanobacteria blooms in this segment of the Charles River. Develop monitoring program to evaluate source(s) contributing to the problem.

DWM biologists recommend improving vegetative buffer along the river and conducting biological and water quality monitoring during the next Charles River Watershed survey (Appendix C).

Fish passage

Improve passage for fish at the Watertown Dam including American eel.

Continue to monitor *E. coli* bacteria in the Charles River to evaluate the status of the *Primary* and *Secondary Contact Recreational Uses* as well as progress made through cleanup/restoration efforts. Review results of the recent USGS study (USGS 2007i) conducted which identify bacteria sources to this system. Continue to conduct bacterial source tracking to identify illicit connections and other sources when deemed necessary.

UNNAMED TRIBUTARY (SEGMENT MA72-30)
Location: locally known as "Laundry Brook" – emerges north of California Street, Watertown, to the confluence with the Charles River, Watertown.
Segment Length: 0.02 miles
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, nutrients, organic enrichment/low DO, turbidity, pathogens, taste, odor and color and other habitat alterations (MassDEP 2007).

Sampling has been completed for the grant project, *01-01/104: Pilot Study to Quantify Human vs. Non-Human Bacteria Sources to the Lower Charles River Basin, Massachusetts*, but a final report is not yet available. The objectives of the study included the following:

- demonstrate the feasibility of using rep-PCR DNA fingerprinting of *E. coli* isolates to distinguish potential human, domestic-animal, and wildlife bacterial sources to the lower Charles River watershed;
- correlate the densities of fecal bacterial indicators (*E. coli*, fecal coliform, and enterococcus) with each other and with the fecal sources as delineated by rep-PCR fingerprinting of the *E. coli* isolates;
- quantify bacterial sources to dry-weather flows in the Laundry Brook sub-basin over a one-month period; and
- assess the timing of human, domestic, and wildlife host contributions to non-CSO stormwater over the course of two storm events in the Laundry Brook sub-basin.

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
USGS reported that streamflow at the Laundry Brook station (01104640) ranged from 0.36 to 194 cfs between October 1999 and September 2000 (Breault *et al.* 2002). The mean dry-weather discharge for this period was 1.07 cfs, while the mean stormwater discharge was 7.81 cfs. Discharge in Laundry Brook is affected (increased) when the City of Newton lowers the water level in Bulloughs Pond just prior to large storms for flood control purposes (Breault *et al.* 2002).

Water Chemistry
EPA and USGS personnel conducted water quality monitoring of Laundry Brook. The DO measurements for Laundry Brook taken in July, August, September and October 1999 ranged from 8.8 to 10.6 mg/L (n=4), pH measurements ranged from 6.4 to 7.6 SU (n=5), and the maximum temperature was 19.6°C (EPA 2000). Dry weather total phosphorus concentrations ranged from <0.05 to 0.1 mg/L (n=10 plus one split field sample) for samples collected from September 1999 through July 2000 (Breault *et al.* 2002). Event mean wet weather total phosphorus concentrations ranged from 0.1 to 0.6 mg/L (n=9) for samples collected from January through September 2000 (Breault *et al.* 2002).

The *Aquatic Life Use* for Laundry Brook is assessed as impaired based on the elevated concentrations of total phosphorus and best professional judgment.

Primary and Secondary Contact Recreation and Aesthetics Uses
E.coli sampling of Laundry Brook was most recently conducted by EPA personnel. *E. coli* counts ranged from 755 to 1,800 cfu/100 ml for samples collected in July, August, and September 2001 (n=3) and was 875 cfu/100 ml in the sample collected in September 2005 mg/L (Faber 2002 and EPA 2006, respectively).

Dry weather bacteria sampling data for Laundry Brook reported by USGS can be summarized as follows. *Enterococcus* counts ranged from 40 to 2,600 cfu/100 ml (n=15 samples including two splits collected between July 1999 and July 2000) (Breault *et al.* 2002). *Enterococcus* bacteria counts for discrete samples collected during storm events ranged from 1,300 to 460,000 cfu/100 ml (n=35 samples including one replicate collected between December 1999 and September 2000) (Breault *et al.* 2002).] Event mean *Enterococcus* bacteria results for the storm events sampled were reported to range from 1,700 to 46,000 cfu/100 ml (n=8 events between January 2000 and July 2000) (Breault *et al.* 2002).

[Note: Although Massachusetts Surface Water Quality Standards have recently adopted the use of *E. coli* bacteria, fecal coliform bacteria data were used as the former bacterial criteria. Dry weather bacteria sampling data for Laundry Brook reported by USGS can be summarized as follows. fecal coliform counts ranged from 50 to 5,500 cfu/100 ml (n=15 samples including two splits collected between July 1999 and July 2000) (Breault *et al.* 2002). Fecal coliform bacteria counts for discrete samples collected during storm events ranged from 620 to 110,000 cfu/100 ml (n=37 samples collected between December 1999 and September 2000) (Breault *et al.* 2002).]

Total suspended solids concentrations during dry weather sampling conditions were all $\leq$ 4 mg/L (n=13, including one splits collected between July 1999 and July 2000) (Breault *et al.* 2002). Similarly, turbidity measurements were also low ($\leq$ 11 NTU n=11 measurements). Event mean concentrations of total suspended solids and turbidity for the storm events sampled were reported to range from 16 to 142 mg/L (n=9) and 11.0 to 86.0 NTU (n=8), respectively (storm events sampled occurred between January 2000 and September 2000) (Breault *et al.* 2002).

Sampling in Laundry Brook has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria in this brook.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for Laundry Brook based on the elevated *E. coli* and *Enterococcus* bacteria counts documented during both dry and wet weather conditions as well as elevated total suspended solids and turbidity associated with stormwater.

Unnamed Tributary "Laundry Brook" (Segment MA72-30) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Elevated total phosphorus concentrations Sources: Unknown, unspecified urban stormwater
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Causes: Elevated *E. coli* and *Enterococcus* bacteria, total suspended solids, turbidity Sources: Unknown, unspecified urban stormwater, discharges from municipal separate storm sewer systems Suspected sources: Illicit connections
Secondary Contact		
Aesthetics		IMPAIRED Causes: Total suspended solids, turbidity Sources: Unknown, unspecified urban stormwater, discharges from municipal separate storm sewer systems

RECOMMENDATIONS

Review results of the project *01-01/104: Pilot Study to Quantify Human vs. Non-Human Bacteria Sources to the Lower Charles River Basin, Massachusetts* as well as any more recent studies (e.g., USGS studies utilizing microbial toolkit - Eleria 2008) conducted which identify bacteria sources to this system.

Continue to monitor *E. coli* bacteria in Laundry Brook to evaluate the status of the *Primary* and *Secondary Contact Recreational Uses* as well as progress made through cleanup/restoration efforts. Conduct bacterial source tracking to identify illicit connections when deemed necessary.

UNNAMED TRIBUTARY (SEGMENT MA72-32)
Location: locally known as "Sawins Brook" – emerges east of Elm Street, Watertown, to the confluence with the Charles River, Watertown (sections culverted).
Segment Length: 0.5 miles
Classification: Class B.

Land-use estimates (top 3, excluding water) for the 0.5 mi^2 subwatershed.
- Residential 39%
- Commercial..... 22%
- Industrial 20%

The estimated percent impervious area for this subwatershed area is 48.6%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of pathogens (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Primary and Secondary Contact Recreation and Aesthetics Uses
E.coli sampling of Sawins Brook was most recently conducted by EPA personnel. *E. coli* counts ranged from 360 to 818 cfu/100 ml for samples collected in July, August, and September 2001 (n=3) (Faber 2002). Sewage smells were noted as being present during storms (Bering and Hammett 2002).

Sampling in Sawins Brook has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria in this brook.

The *Primary Contact Recreational Use* is assessed as impaired because of elevated *E. coli* bacteria. Too limited data are available to assess the *Secondary Contact Recreational* and *Aesthetics* uses. These uses are both identified with an Alert Status, however, based on comments received (notes of sewage odors) by the Department from the Watertown Conservation Commission members (Bering and Hammett 2002).

Unnamed Tributary locally known as Sawins Brook (Segment MA72-32) Use Summary

Designated Uses		Status
Aquatic Life		NOT ASSESSED
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Elevated *E. coli* Sources: Unspecified urban stormwater, discharges from municipal separate storm sewer systems Suspected sources: Illicit connections
Secondary Contact		NOT ASSESSED*
Aesthetics		NOT ASSESSED*

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Continue to monitor *E. coli* bacteria in Sawins Brook to evaluate the status of the *Primary* and *Secondary Contact Recreational Uses* as well as progress made through cleanup/restoration efforts. Review results of the recent USGS study (USGS 2007i) conducted which identify bacteria sources to this system.

Conduct water quality monitoring to evaluate designated uses.

CHARLES RIVER (SEGMENT MA72-38)
Location: Boston University Bridge, Boston/Cambridge, to the New Charles River Dam, Boston.
Segment Length: 3.1 miles
Classification: Class B, Warm Water Fishery
Combined Sewer Overflows discharge to this waterbody.

[Note: This segment is formerly part of Charles River - Segment MA72-08.]

Land-use estimates (top 3, excluding water) for the 310.6 mi^2 watershed:
Residential…….38%
Forest……..35%
Open land……..10%
The estimated percent impervious area for the 310.6 mi^2 watershed is 16.4%.

This segment (formerly part of segment reported as MA72-08) is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of cause unknown, unknown toxicity, metals, nutrients, priority organics, organic enrichment/low DO, pathogens, oil and grease, noxious aquatic plants, turbidity, as well as taste, odor and color (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Ames Safety Envelope Company (32027401/9P232027401)
Mirant Kendall (9P432004901). Additionally, a non-consumptive use status was accepted by the MassDEP for this facility (originally Cambridge Light) in October 1992.
A non-consumptive use status was accepted for the Massachusetts Institute of Technology Magnet Lab in December 1988 for two withdrawals: 002 for the Magnet Lab at Endicott and Memorial Drive for 3.4 MGD and 003 for the Combustion Lab at 222 Memorial Drive for 0.17 MGD (McCann 2007).
NPDES (See Appendix H, Tables H2, H3, and H4)
Boston Water and Sewer Commission (MAS010001). There is one major stormwater outfall to this segment of the Charles River- 23H042 and one minor stormwater outfall – 23H040.
Massachusetts Institute of Technology (MA0000795)
Mirant Kendall, L.L.C. (MA0004898) (see EPA 2007b)
MWRA Hyde Park Pump Station (MAG250008)
Biopure Corporation (MA0036366)
MBTA North Station Railroad Terminal (MA0028941)
Riverside Galleria Associates Trust (MA0031879)
Massachusetts Water Resources Authority (MA0103284) five CSO outfalls
City of Cambridge Department of Public Works (MA0101974) one CSO outfall
Boston Water and Sewer Commission (MA0101192) one CSO outfall

From upstream to downstream the CSOs discharges to this segment of the Charles River include:
MWR010: Brookline Street Overflow
BOS042: Charles River-Lower CSO volume (mg) 0.0 -eliminated
MWR023: Fens Gatehouse Overflow
MWR018: Gloucester Street Overflow
MWR019: Exeter Street Overflow
MWR020: Berkely Street Overflow
MWR021: Mt. Vernon Street Overflow -closed
MWR022: Cambridge Street Overflow -closed
CAM017: (Binny Street at Edwin Land Boulevard) will active twice per year, annual volume 1.23 MG.
BOS049: Lower Charles River although both frequency and volume are indicated as 0.
BOS050: closed as of March 2006

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Water depths range from 9 to 36 feet in the Basin (MassDEP *et al.* 2007). Salt-water intrusion into the Basin through the New Charles River Dam results in a portion of the Basin becoming vertically stratified with two distinct layers; a fresh-water layer overlying a more dense salt-water layer. The average observed pycnocline – top of salt-water layer – occurs at a depth of approximately 15 feet in the

summertime (MassDEP *et al.* 2007). The impounded Basin tends to have relatively long water residence times (typically 4 to 10 weeks) during the summer months when river flow rates decline. Residence times of the salt layer may be many times longer than those of the overlying freshwater layer. Water flow through the New Charles River Dam is manipulated to prevent flooding and to keep the water level in the basin from fluctuating excessively (Szal 2007).

Massachusetts Institute of Technology has a 30" intake for non-contact cooling water along the northern shore of the Charles River just downstream from the Route 2A bridge in Cambridge. The facility utilizes 0.08 MGD of non-contact cooling water on an intermittent basis. Run times are typically 12 hours/day when in use (Davidovitz 2007).

Mirant Kendall has three intake bays that are each equipped with two single speed pumps in the Lower Charles River Basin at the 'Broad Canal', a dead-end body of water located downstream from the Longfellow Bridge that extends about 800 ft. into Cambridge and lies perpendicular to the Charles basin. The facility utilizes 70 MGD annual rolling average (80 MGD daily maximum) of water from the Charles Basin for its non-contact cooling water.

Although equipped with a fishway in 1978, the new Charles River Dam and Locks, operated by the Department of Conservation and Recreation, has never operated this fishway effectively due to mechanical failures and insufficient attraction flow and, as a result, migrating fish must rely on opening of the locks for access to the river (Brady *et al.*, 2005). A locking protocol has been developed to maximize usage by rainbow smelt, river herring and American shad during their spawning runs.

The presence of the new Charles River Dam deprives the Lower Charles River Basin of a naturally mixed estuary and acts as a barrier to fish movement upstream and downstream in the system. The presence of the new Charles River dam and added heat from Mirant Kendall also act to create the potential for heat-shock to in-migrating herring and Atlantic shad adults and out-migrating juveniles of these species (Szal 2007).

Biology

During the summer/fall of 2006 (from the beginning of August through mid-October) a very severe toxic cyanobacteria (blue-green) algal bloom occurred in the Lower Charles Basin causing the Massachusetts Department of Public Health to post warnings for the public and their pets to avoid contact with the Lower Charles River. The bloom consisted of extremely high cell counts, over one million cells/milliliter, of the cyanobacteria (blue-green) *Microcystis* sp. *Microcystis* sp. is potentially toxic since it may contain the hepatotoxin microcystin. Besides the threat to public health, the bloom caused the water of the Lower Charles to turn a bright green color. More recently (summer of 2007), a *Microcystis* sp. bloom occurred in July. During the month of September 2007 a bloom of *Anabaena* sp., and other filamentous cyanobacteria occurred in the Lower Charles River Basin (extending up to Herter Park) (Beskenis 2007c).

Anadromous/catadromous fish species that utilize the Lower Charles River Basin include, but may not be limited to, alewife (*Alosa pseudoharengus*), blueback herring, American eel, white perch, rainbow smelt, Altantic tomcod (*Microgadus tomcod*), American shad, and striped bass (*Morone saxatilis*).

Impingement and Entrainment

Impingement losses associated with the operation of Mirant Kendall over the years for which evaluations were conducted (1999-2000) were determined to be negligible. The facility also conducted estimates of larval fish losses due to entrainment of these larvae through the facility. All larvae entrained into the plant were assumed to die. The losses of all larvae generated in the Charles Basin over 1999 through 2000, when these estimates were calculated, were primarily associated with two species, as follows (page 213 in EPA 2004a).

White Perch:
- 1999: 29% loss
- 2000: 8% loss

River Herring (blueback herring and alewives)
- 1999: 14.3% loss
- 2000: 24.4% loss

The larval losses are equivalent to losses to the adult population that would have been produced from these larvae. It should be noted, however, that these estimates for impingement and entrainment were conducted prior to the Mirant Kendall expansion in 2003 (changes at the facility included generating

capacity increase from 113 MW to 283 MW, peak load to a base load power plant, oil to gas-fired combustion turbine generator).

It should also be noted that river herring were filmed attempting to breed in Mirant Kendall's discharge pipe. Biologists postulate that these fish are attracted to the water velocity in the discharge pipe, which is higher than ambient river water velocities. This type of behavior (i.e., attraction to a discharge) has also been known to occur at other power plants (Pilgrim Nuclear and Brayton Point) (Szal 2007). This is problematic for two reasons: 1) any eggs fertilized in this manner are not expected to survive due to thermal effects of the discharge, which is often approximately 20ºF higher than ambient river temperatures and 2) adults spawning in this area will be less likely to spawn again in upstream areas where habitat is more suitable.

The numbers of juvenile alewives and blueback herring caught in nighttime sampling at the surface of the Lower Basin in both 2004 and 2005, over the July-September period, showed statistically-significant declines with increasing proximity to the Mirant Kendall thermal discharge. Declines were seen over about 1.4 miles of the Lower Basin and were shown to be significantly correlated with increasing water temperatures that were due to Mirant Kendall's thermal discharge. (EPA 2006, see also graphics C3-1 through C3-9 at the following web-link: http://www.epa.gov/region1/npdes/mirantkendall/.] According to the response to comments on the draft NPDES permit for the Mirant Kendall Station, the thermal discharge from Kendall Station has caused appreciable harm to the alewife and blueback herring populations in the Lower Charles River Basin in 2004-2005 (EPA 2006).

Water Chemistry

Water chemistry for this segment was assessed using data and/or analyses from the following sources, which are summarized below:

a) The Nutrient TMDL - Lower Charles River Basin (MassDEP *et al.* 2007). Data sources reviewed for the nutrient TMDL included those compiled by EPA, CRWA, MWRA, USGS, and Mirant (owner/operator of the Kendall Square Station power generation facility);

b) CRWA. CRWA volunteers conducted water quality monitoring at three sampling stations along this segment of the Charles River as part of their monthly monitoring program. These sites, from upstream to downstream, are: Massachusetts Avenue at Harvard Bridge, Boston (Station 763S), Longfellow Bridge, Cambridge (Station 773S), and New Charles River Dam (Station 784S).

c) EPA Regional Lab in Chelmsford. EPA staff conducted sampling primarily at seven sites along this segment of the Charles River as part of their Clean Charles 2005 water quality monitoring project although additional sampling sites were added on occasion. These sites from upstream to downstream are: downstream from BU Bridge center channel (Station CRBL06), Downstream from Stony Brook & Mass Ave, 10 m off south shore (Station CRBL07), off the Esplanade (Station CRBLA8), Upstream from the Longfellow Bridge on the Cambridge side (Station CRBL09), the Community boating area (Station CRBL10), between the Longfellow Bridge and the old dam – center channel (Station CRBL11), and upstream from the Railroad Bridge – center channel (Station CRBL12).

d) MWRA data and analytical reports. MWRA conducted water quality sampling at seven sampling stations in this segment of the river (Station 006 - midstream downstream from the BU bridge (also downstream from the Cottage Farm CSO) in Cambridge/Boston, Station 007- near Memorial Drive/MIT Boathouse in Cambridge, Station 008 – midstream downstream from the Harvard Bridge in Cambridge/Boston, Station 009 – midstream upstream from the Longfellow Bridge in Cambridge/Boston, Station 010 – downstream from the Longfellow Bridge in Boston, Station 166 – near Science Museum (Old Charles River Dam) in Boston, and Station 011 – upstream from the river locks at the New Charles River Dam and I-93 in Boston) (Coughlin 2006).

e) Permittee. Dissolved oxygen, temperature and salinity data collected by Marine Research, Inc. for Mirant Kendall.

Dissolved oxygen concentrations reported by MWRA in 2005 at their sampling stations along this segment of the Charles River (stations 006 through 011) were all > 5.0 mg/L at the surface but showed substantial depletion in the bottom waters at each site with the exception of Station 166, which is a shallow site (Coughlin 2006). It should also be noted that these data do not represent worse case (pre-

dawn) sampling conditions. Based on data generated by MRI from 2005, during the July-September period, dissolved oxygen levels fell below the 5.0 mg/L criterion over more than half the area of the segment downstream from the BU Bridge, primarily at depths of 12-15 feet and deeper (Mirant Kendall 2006). Depth profile sampling (n=6) conducted by EPA in June, July, August, and September 2002 between the BU bridge and the Museum of Science corroborated these results (Faber 2003).

During the growing season there were periods of high chlorophyll *a* concentrations, high pH, and low Secchi disk readings that corresponded with algal blooms (particularly cyanobactera) throughout this segment of the Charles River. Also, dissolved oxygen concentrations, measured by EPA at the surface during the day showed supersaturation as high as 168%, which is also indicative of a nutrient-rich system and enhanced photosynthesis (MassDEP *et al.* 2007).

Surface water temperature data collected from this segment of the Charles River have been analyzed to evaluate compliance with the Massachusetts Surface Water Quality Standards and to characterize the magnitude, frequency, temporal duration, and areal extent of temperature exceedances when information to conduct such an analysis was available (Appendix I). The following points were excerpted from this analysis.

Multiple exceedances of both the delta temperature criterion and the maximum temperature criterion for Class B Warm Water occurred at the surface of the water column over the summer and early fall of 2005 in this segment of the Charles River.

The maximum temperature criterion was exceeded throughout the portion of the Lower Basin that extended from a point slightly downstream of the Harvard Bridge, and at a number of monitoring locations downstream, to a point about halfway between the Museum of Science and the new Charles River Dam -- a distance of approximately 1.5 miles.

At some stations, especially those downstream of the Longfellow Bridge, exceedances of the maximum criterion occurred on most of the sampling events over about a six-week period from mid-July through August 2005.

It appears reasonable to assume that exceedances of both the maximum and delta temperature criteria seen in 2005 were primarily due to the influence of the heated discharge from Mirant Kendall. Of further concern, high temperatures and/or high delta temperatures probably stretched from the Cambridge shoreline (where Kendall's thermal discharge is located) completely across the surface of the Lower Charles River Basin to the Boston shoreline indicating the lack of a zone of passage for fish and other organisms.

EPA also measured temperature exceedences in August 2006 (Faber 2006).

Total phosphorus concentrations reported by EPA (as many as 13 sampling station locations in this segment of the Charles River) ranged from 0.017 to 0.12 mg/L in dry weather samples collected from July through October between 2001 and 2004 (n=154) (MassDEP *et al.* 2007). The reported range of annual means from this dataset was 0.046 to 0.070 mg/L. MWRA reported similar seasonal concentrations (includes both dry and wet weather sampling conditions) (0.028 to 0.149 mg/L, n=44 in this same timeframe) at their Museum of Science sampling site (Station 166) (MassDEP *et al.* 2007). The reported range of annual means from this dataset was 0.064 to 0.078 mg/L. CRWA reported total phosphorus concentrations ranging from 0.041 to 0.134 mg/L (n=44) in samples collected from two stations (743S and 784S) between February 2000 and October 2006. Thirty-six of the samples were >0.05 mg/L (CRWA 2007). In June, July, August, and September 2002 EPA measured elevated total phosphorus concentrations in the water below the pycnocline sometimes in excess of 1.0 mg/L (Faber 2003).

Chlorophyll *a* concentrations reported by EPA (as many as 13 sampling station locations in this segment of the Charles River) ranged from 1.5 to 55.4 µg/L in dry weather samples collected from July through October between 2001 and 2004 (n=146) (MassDEP *et al.* 2007). The reported range of annual means from this dataset was 18.4 to 24.6 µg/L. MWRA reported similar seasonal concentrations (includes both dry and wet weather sampling conditions) (2.6 to 45.7 µg/L, n=51 in this same timeframe) at their Museum of Science sampling site (Station 166) (MassDEP *et al.* 2007). The reported range of annual means from this dataset was 20 to 25.3 µg/L. CRWA reported chlorophyll *a* concentrations ranging from 1.29 to 50.2 µg/L (n=28) in samples collected from two stations (743S and 784S) between February 2000 and October 2006. Nine of the samples were >16 µg/L (CRWA 2007).

From July-September 2005 salinity levels over more than 50% of the Lower Basin downstream from the BU Bridge exceeded the Untied States Fish and Wildlife Service (USFWS) guidance figure of 0.5 ppt for

freshwater habitats. The guidance figure was used by USFWS to delineate between "freshwater" (salinities <0.5 ppt) and "brackish" water (salinities between 0.5 and 30 ppt). Exceedances occurred primarily at depths of six feet and greater.

Secchi disk transparency reported by EPA (as many as 13 sampling station locations in this segment of the Charles River) ranged from 0.7 to 2.2 m in dry weather samples collected from July through October between 2000 and 2004 (n=166) (MassDEP *et al.* 2007). The reported range of annual means from this dataset was 1.2 to 1.5 m. Secchi disk transparency reported by MWRA in 2005 at their seven sampling stations along this segment of the Charles River (stations 006, 007, 008, 009, 010, 166, and 011) were frequently ≤1.2 m although they showed improvement from upstream to downstream and from the segment above (Coughlin 2006).

Sediment Chemistry

Surficial sediment sampling was conducted at 91 sites throughout this segment of the Charles River by USGS in July and August 1998 (Breault *et al.* 2000). The report states that "…*inorganic and organic compounds were detected at sufficiently high concentrations to cause potentially severe biological effects to benthic organisms living in and on the bottom sediment … and the distribution of the inorganic elements appeared to be controlled primarily by instream processes associated with sediment transport and the presence of an anoxic zone within a non-tidal salt wedge in the basin while in contrast the distribution of organic compounds appeared to reflect local point and nonpoint sources"* (Breault *et al.* 2000). Water depths as well as the thickness of post-1908 bottom sediments (after construction of the Charles River Dam in 1908, which created the "Basin") were also measured. In this segment of the Charles River, the thickness of sediment deposited since 1908 ranged from ≤ 2.0 feet near the BU bridge to >5 feet near the Museum of Science (Plate 1 in Breault *et al.* 2000).

Chemistry Tissue

Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp, and yellow perch) were collected by EPA from two reaches (7F and 9F) of the Charles River to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as composite offal samples were prepared and analyzed for PCBs and organochlorine pesticides, PAHs, metals including total mercury, % lipids, and dioxins. Weight data are not available to calculate whole body burden and compare to NAS/NAE guidelines.

The *Aquatic Life Use* is assessed as impaired for this segment of the Charles River (the Lower Charles River Basin). Based on estimated entrainment losses, populations of white perch and river herring (alewives and blueback herring) were impacted by the Mirant Kendall's cooling water intake. Additionally, EPA documented that habitat modification, due to Kendall's thermal discharge, resulted in decreased abundances of juvenile alewives and blueback herring in areas of the Lower Basin. The presence of the new Charles River Dam and added heat from Mirant Kendall also act to create the potential for heat-shock to in-migrating herring and Atlantic shad adults and out-migrating juveniles of these species. Additionally, salt water intrusion into the Lower Charles River Basin, resulting in part from the operation of the locks and associated structures, as well as the original creation of the Lower Charles River Basin from a tidal estuary, result in salinity levels that exceed the USFWS guidance of 0.5 ppt for freshwater habitats. Low dissolved oxygen (hypoxia/anoxia) has been documented in bottom waters over more than half the area of the segment downstream from the BU Bridge, primarily at depths of 12-15 feet and deeper when the Lower Basin becomes vertically stratified with a fresh-water layer overlying a more dense salt-water layer. Nutrient enrichment (moderately elevated concentrations of total phosphorus), coupled with flow alteration in the Lower Basin, is manifested by several biological and chemical indicators of high productivity (i.e., cyanobacteria blooms, supersaturation of dissolved oxygen, high chlorophyll *a* concentrations, and low Secchi disk transparencies). Sediment contamination (both inorganic and organic compounds) is also problematic (Breault *et al.* 2000). Lastly, the presence of the new Charles River Dam deprives the Lower Charles River Basin of a naturally-mixed estuary and acts as a barrier to fish movement upstream and downstream in the system.

Fish Consumption Use
Between 1 and 18 November 1999 target species of fish (largemouth bass, common carp, and yellow perch) were collected from two reaches (7F and 9F) of this segment of the Charles River by EPA to evaluate human health risks and to determine if ecological health risks might be present (Snook 2001). Composite samples of skin-off fillets as well as composite offal samples were prepared and analyzed for PCBs, organochlorine pesticides, PAHs, metals (including total mercury), % lipids, and dioxins.

Due to the presence of elevated PCB in carp and pesticides (total DDT) in largemouth bass, MA DPH recommends the following (MA DPH 2007 and Celona 2007).

> "*Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any Carp or Largemouth Bass fish from the Charles River collected between the South Natick Dam in Natick and Museum of Science Dam in Boston/ Cambridge, the general public should not consume Carp from this section of the river, and the general public should limit consumption of Largemouth Bass fish to two meals per month."*

Because of the site-specific fish consumption advisory for the Charles River between the South Natick Dam, Natick and the Museum of Science Dam in Cambridge/Boston resulting from elevated concentrations of PCBs (polychlorinated biphenyls) and pesticides (total DDT) the *Fish Consumption Use* is assessed as impaired for this segment of the Charles River. It should be noted that although the current advisory has not been modified by MA DPH to end at the Charles River Dam, it is best professional judgment that the advisory should apply to the entire segment.

Primary and Secondary Contact Recreation and Aesthetics Uses
During the summer of 2006 a very severe toxic cyanobacteria (blue-green) algal bloom occurred in the Lower Charles causing the Massachusetts Department of Public Health to post warnings for the public and their pets to avoid contact with the Lower Charles River. The bloom consisted of extremely high cell counts, over one-million cells/milliliter, of the cyanobacteria (blue-green) *Microcystis* sp. *Microcystis* sp. is potentially toxic since it may contain the hepatotoxin microcystin. Besides the threat to public health, the bloom caused the water of the Lower Charles to turn a bright green color.

Secchi disk transparency reported by EPA (as many as 13 sampling station locations in this segment of the Charles River) ranged from 0.7 to 2.2 m in dry weather samples collected from July through October between 2000 and 2004 (n=166) (MassDEP *et al.* 2007). The reported range of annual means from this dataset was 1.2 to 1.5 m. Secchi disk transparency reported by MWRA in 2005 at their seven sampling stations along this segment of the Charles River (Stations 006, 007, 008, 009, 010, 166, and 011) were frequently $\leq$1.2 m, although they showed improvement from upstream to downstream and from the segment above (Coughlin 2006).

Implementation of CSO/stormwater remediation projects has eliminated/reduced many discharges --see Appendix H, Boston Water and Sewer Commission (MA0101192), City of Cambridge Department of Public Works (MA0101974**),** Massachusetts Water Resources Authority (MA0103284), City of Somerville **(**MA0101982), and Boston Water and Sewer Commission (MAS010001). Prior to implementation of these CSO/stormwater remediation project, annual bacterial loads to the lower river were found to be dominated by wet-weather inputs from Stony Brook and Muddy River, with substantial additional bacterial inputs from areas of the watershed upstream from the Watertown Dam (Weiskel 2007).

E. coli samples were collected by CRWA volunteers as part of the CRWA monthly monitoring program at three locations along this segment of the Charles River. These sites, from upstream to downstream, are: Massachusetts Avenue at Harvard Bridge, Boston (Station 763S), Longfellow Bridge, Cambridge (Station 773S), and New Charles River Dam (Station 784S) (CRWA 2007). MWRA has conducted extensive water quality monitoring at numerous locations in the Lower Charles River related to the CSO program. These stations from upstream to downstream are: midstream downstream from the BU bridge (Station 006), near Memorial Drive/MIT boathouse (Station 007), midstream downstream from Harvard Bridge (Station 008), midstream upstream from Longfellow Bridge near Community Sailing (Station 009), downstream from Longfellow Bridge (Station 010), near the Science Museum/Old Charles River Dam (Station 166), and upstream from the river locks/I-93 (Station 011) (Coughlin 2006). Lastly EPA has also conducted bacteria monitoring at seven stations in the lower Charles River Basin as part of the Clean Charles 2005 Project: (center channel downstream from BU Bridge in Boston (Station CRBL06), downstream from Stony Brook & Mass Ave (10 m off south shore, Boston (Station CRBL07), off the Esplanade, Boston (Station CRBL08A), upstream from the Longfellow Bridge, Cambridge side(Station

CRBL09), near the community boating area (Station CRBL10), center of the channel between Longfellow Bridge and the old dam (Station CRBL11), and center channel upstream from the Railroad Bridge (Station CRBL12) (Faber 2002, Faber 2003, Faber 2004, and Faber 2005). Data for each site, organized from upstream to downstream, are summarized below.

BU Bridge
MWRA reports for Station 006 that the geometric mean of *E. coli* bacteria samples collected between 1998 and 2005 is 311 cfu/100 ml (n= 80) (Coughlin 2006). Counts ranged from 236 to 409 cfu/100 ml within the 95% confidence interval. *E. coli* bacteria counts reported by EPA (Station CRBL06) ranged from 4 to 2,400 cfu/100 mls for samples collected between July 2001 and October 2006 (n=47 including seven duplicate samples, with sixteen counts exceeding 235 cfu/100 ml (three just after the primary contact season, which ends October 15th) and one exceeding 1,260 cfu/100 ml.

Memorial Drive/MIT boathouse
MWRA reports for Station 007 that the geometric mean of *E. coli* bacteria in surface samples collected between 1998 and 2005 (n= 78) is 111 cfu/100 ml (Coughlin 2006). Counts ranged from 77 to 161 cfu/100 ml within the 95% confidence interval.

Charles River at Massachusetts Avenue/Harvard Bridge in Boston
CRWA (2007) data summary (Station 763S)

Station 763S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	5	5
	Maximum cfu/100 ml	675	180	300	260	2,400
	Minimum cfu/100 ml	10	10	10	10	9.8
126 cfu/100 ml	Geometric Mean	80	51	73	87	156
Max 235 cfu/100 ml	Number of Exceedances	1	0	1	1	2
Secondary Contact	Samples Assessed	7	9	6	8	7
	Maximum cfu/100 ml	870	400	490	1,020	2,400
	Minimum cfu/100 ml	10	10	10	10	5
630 cfu/100 ml	Geometric Mean	152	86	97	180	92
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	1

E. coli bacteria counts reported by EPA ranged from 4 to 1,900 cfu/100 mls for samples collected downstream from Stony Brook & Mass Ave, 10 m off south shore (Station CRBL07) between July 2001 and October 2006 (n=52 including eleven duplicate samples). Six counts exceeded 235 cfu/100 ml and one of these exceeded 1,260 cfu/100 ml. Two of the exceedances occurred just after the primary contact season, which ends October 15th. The geometric mean of *E. coli* bacteria in surface samples collected from the Charles River midstream and downstream from Harvard Bridge (Station 008) in samples collected between 1998 and 2005 (n= 78) is 59 cfu/100 ml (Coughlin 2006). Counts ranged from 39 to 88 cfu/100 ml within the 95% confidence interval.

Esplanade
EPA reports *E. coli* bacteria counts (Station CRBL08) ranging from 9 to 120 cfu/100 mls for samples collected between July 2001 and September 2001 (n=3).

Longfellow Bridge
MWRA reports that the geometric mean of *E. coli* bacteria near Community Sailing (Station 009) in samples collected between 1998 and 2005 (n= 80) is 43 cfu/100 ml (Coughlin 2006). Counts ranged from 30 to 61 cfu/100 ml within the 95% confidence interval. *E. coli* bacteria counts reported by EPA (Station CRBL09) ranged from 4 to 420 cfu/100 mls for samples collected between July 2001 and September 2004 (n=39 including eight duplicate samples). Two counts exceeded 235 cfu/100 ml, but both exceedances occurred just after the primary contact season.

CRWA (2007) data summary (Station 773S).

Station 773S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	4	6	4	6	6

	Maximum cfu/100 ml	105	170	90	150	6,400
	Minimum cfu/100 ml	10	10	5.3	10	10
126 cfu/100 ml	Geometric Mean	32	48	29	43	140
Max 235 cfu/100 ml	Number of Exceedances	0	0	0	0	1
Secondary Contact	Samples Assessed	6	10	8	10	8
	Maximum cfu/100 ml	1,100	970	380	820	6,400
	Minimum cfu/100 ml	10	10	5.3	10	10
630 cfu/100 ml	Geometric Mean	97	92	53	97	96
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	1

Community Boating Area
E. coli bacteria counts reported by EPA (Station CRBL10) ranged from 3 to 28 cfu/100 mls for samples collected between July 2001 and September 2004 (n=15). No counts exceeded 235 cfu/100 ml.

Downstream Longfellow Bridge
MWRA reports that the geometric mean of *E. coli* bacteria (Station 010) in samples collected between 1998 and 2005 (n= 80) is 35 cfu/100 ml (Coughlin 2006). Counts ranged from 24 to 50 cfu/100 ml within the 95% confidence interval. *E. coli* bacteria counts reported by EPA (Station CRBL11) ranged from 4 to 410 cfu/100 mls for samples collected between July 2001 and October 2006 (n=45 including five duplicate samples). A single count exceeded 235 cfu/100 ml.

Science Museum/Old Charles River Dam
MWRA reports that the geometric mean of *E. coli* bacteria (Station 166) in samples collected between 1998 and 2005 (n= 131) is 40 cfu/100 ml (Coughlin 2006). Counts ranged from 29 to 55 cfu/100 ml within the 95% confidence interval.

Railroad Bridge
E. coli bacteria counts reported by EPA (Station CRBL12) ranged from 3 to 360 cfu/100 mls for samples collected between July 2001 and October 2006 (n=25 including two duplicate samples). A single count exceeded 235 cfu/100 ml.

New Charles River Dam and Locks
MWRA reports that the geometric mean of *E. coli* bacteria (Station 011) in samples collected between 1998 and 2005 (n= 81) is 34 cfu/100 ml (Coughlin 2006). Counts ranged from 25 to 47 cfu/100 ml within the 95% confidence interval.

CRWA (2007) data summary (Station 784S).

Station 784S	(CRWA 2007)	Year				
Period	Summary Statistic	2002	2003	2004	2005	2006
Primary Contact	Samples Assessed	5	6	4	6	6
	Maximum cfu/100 ml	650	140	30	40	5,800
	Minimum cfu/100 ml	20	10	10	10	10
126 cfu/100 ml	Geometric Mean	156	34	15	22	70
Max 235 cfu/100 ml	Number of Exceedances	3	0	0	0	1
Secondary Contact	Samples Assessed	7	9	7	10	8
	Maximum cfu/100 ml	930	140	160	960	5,800
	Minimum cfu/100 ml	20	10	10	10	10
630 cfu/100 ml	Geometric Mean	230	42	27	59	58
Max 1260 cfu/100 ml	Number of Exceedances	0	0	0	0	1

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses for the Lower Charles Basin are assessed as impaired primarily as a result of a cyanobacteria bloom affecting this entire segment of the Charles River and the low Secchi disk transparencies. However, it should be noted that with the exception of the sampling conducted in the river just downstream from the BU bridge, *E. coli* bacteria counts almost always met water quality criteria throughout the rest of the basin. Counts were occasionally elevated during wet weather conditions.

Charles River (Segment MA72-38) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Elevated water temperatures, combined biota/habitat bioassessment, salinity, biological indicators of nutrient enrichment, blue-green algal bloom, low dissolved oxygen, elevated saturation of dissolved oxygen, elevated chlorophyll *a*, poor Secchi disk transparency, elevated total phosphorus, other flow regime alterations associated with dams/impoundments, sediment contamination (sediment screening values exceeded) Sources: Thermal discharge, habitat modification from thermal discharge, entrainment from cooling water intake structure, habitat alteration associated with dams/impoundments, changes in ordinary stratification and bottom water hypoxia/anoxia, contaminated sediments, upstream sources, discharges from municipal separate storm sewer systems, unspecified urban stormwater, urban runoff/storm sewers
Fish Consumption		IMPAIRED Causes: Elevated PCB in fish tissue, pesticides (total DDT) Source: Unknown Suspected source: Contaminated sediments
Primary Contact		IMPAIRED Causes: Blue-green algal bloom, poor Secchi disk transparency Sources: Upstream sources, discharges from municipal separate storm sewer systems, unspecified urban stormwater, urban runoff/storm sewers
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

Water quality in the Lower Charles River Basin is heavily influenced by the Mirant Kendall Station operations. In order to limit the effects of the facility's intake and discharge on aquatic life in the Lower Basin, the following issues should be addressed by permitting agencies:

a) entrainment and impingement of eggs and larvae of river herring and white perch;
b) high instream temperatures caused by Mirant Kendall's discharge;
c) high instream delta temperatures caused by Mirant Kendall's discharge; and
d) maintenance of a thermal "zone of passage and habitat" that would allow fish to move upstream and downstream past the Mirant Kendall discharge without exposure to adverse temperatures and/or delta temperatures.

Continue to conduct water quality monitoring (i.e., deploy *in-situ* meters to obtain long-term DO and temperature data, additional total phosphorus and chlorophyll *a* sampling) to evaluate changes in water quality in this segment of the Charles River to document conditions (e.g., implementation of treatment upgrades/phosphorus reductions at municipal treatment plants upstream).

Document composition/frequency/extent of cyanobacteria blooms in this segment of the Charles River. Develop monitoring program to evaluate source(s) contributing to the problem.

Fish passage

The locking protocol that has been developed for the Charles River Dam and Locks should be evaluated for effectiveness and adjustments made if required for optimal fish passage. Lock operators should strictly adhere to the accepted protocol (Brady *et al.* 2005).

Although a protocol has been developed to optimize fish passage, it is unclear whether or not this protocol is minimizing saltwater intrusion into the Charles River Basin. A comprehensive plan needs to be developed which addresses the problem of fish passage and saltwater intrusion. This plan should also take into account other uses such as boating, boat passage, and other recreational activities.

MUDDY RIVER (SEGMENT MA72-11)
Location: Headwaters, outlet Ward Pond in Olmstead Park, Boston, to confluence with the Charles River, Boston.
Segment Length: 3.6 miles
Classification: Class B, Warm Water Fishery, Combined Sewer Overflow.

Land-use estimates (top 3, excluding water) for the 6.5 mi^2 subwatershed.
Residential 55%
Open land 22%
Commercial..... 9%
The estimated percent impervious area for this subwatershed area is 29.5%.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of priority organics, metals, nutrients, siltation, organic enrichment/low DO, oil and grease, pathogens, taste, odor and color, and other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
The Country Club (32004601)
NPDES (See Appendix H, Tables H2 and H3):
Boston Water and Sewer Commission (MA0101192). This combined sewer overflow (CSO) discharge is through outfall BOS 046 to the Back Bay Fens area of the Muddy River.
[Note: The BWSC completed the Stony Brook Sewer Separation Project (at a cost of $45 million) in September 2006 (MWRA 2007), which will alleviate some of the discharges to the Muddy River at Outfall BOS 046. MWRA (2007) also states that "*The project was intended to reduce CSO discharge at seven CSO regulators along the Stony Brook Conduit from 22 activations and 44.5 million gallons in a typical year (a discharge level that had been attained in 2000 with completion of pumping and treatment improvements at Deer Island) to 2 activations and 0.13 million gallons. While this represents a 99.7 % reduction in annual CSO volume, the CSO regulators must remain open to provide flood control in large storm events. In 2007, BWSC will continue work to repave streets and remove downspouts from the sewer system. Downspout connections in this area are 85% complete.*"]

Boston Water and Sewer Commission (MAS010001). There are two major stormwater outfalls - 20G161 and 21H201, and seven minor stormwater outfalls - 18G233, 19G199, 19G043, 19G194, 20G163, 21H047, and 21H048 - that discharge to this segment of the Muddy River (BWSC 2007). There are also four major stormwater outfalls that discharge into the Stony Brook subwatershed area – 13D077, 13D078, 13E175, and 15F288 and three minor stormwater outfalls (13E174, 13E176, and 13F095).

[Note: EPA terminated the former Boston Latin Academy NPDES permit (MA0039934) in October 2005 because the facility was dismantled. There were also four NPDES permittees that were identified as discharging to Muddy River as of the last water quality assessment report (Fiorentino *et al.* 2000). EPA has since terminated these permits (MA0034410 and MA0034401 remediation ended, MA0036102 discharge ceased, and MA0030783 EPA determined a permit was not required).]

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
The USGS maintains a real time water stage recorder and precipitation gage (01104683) on the Muddy River just downstream from Netherlands Road Bridge (near the Brookline Water Department building), Brookline, MA. The period of record for this gage is November 1999 to October 2000 and August 2001 to current year. The USGS remarks that there are daily or more frequent fluctuations related to pool stage fluctuations in the lower Charles River Basin and operation of flood-control gates and pumps at Charles River Dam (Socolow *et al.* 2005). The annual average gage height is approximately 7.8 feet (October 2003 through September 2005) and flood stage at this gage is 15 feet (established by the MBTA) (USGS 2007b and USGS 2007c).

Breault *et al.* (1998) describes the channel morphology and bathymetry of the Muddy River as well as sediment quality conditions. Accumulation of sediment and poor sediment quality, channelization, altered hydrology, and the infestation of *Phragmites australis* degrades habitat quality of the Muddy River. The

U.S. Army Corps of Engineers has developed a plan to increase flood control, improve water quality and enhance aquatic/riparian habitat within the Muddy River by dredging accumulated sediment, providing flood damage reduction through improvements to restrictive drainage culverts, removing nuisance vegetation, improving fisheries/wildlife habitat and water quality, bank stabilization and promoting and enhancing recreational use of Emerald Necklace parklands (ACOE 2003). The design effort for Phase 1 of the project (flood damage reduction component) was initiated in September 2005 and was expected to be complete in October 2007 (Keegan 2007). Work in Phase I includes the installation of two culverts and daylighting of the river (ACOE 2007).

Water Chemistry

USGS personnel conducted water quality monitoring in the upper portion of this segment of the Muddy River just downstream from Netherlands Road Bridge (near the Brookline Water Department building), Brookline, MA. Dry weather total phosphorus concentrations ranged from ≤0.1 to 0.20 mg/L (n=13 including one split sample) for samples collected from July 1999 through July 2000 (Breault *et al.* 2002). Event mean wet weather total phosphorus concentrations ranged from 0.1 to 0.40 mg/L (n=10 including one split sample) for samples collected from January through September 2000 (Breault *et al.* 2002).

The CRWA volunteers sampled the Muddy River at Commonwealth Avenue in Boston (Station 760T and/or 760S) as part of their monthly monitoring program (CRWA 2007 and Kaplan 2007). These data included temperature, pH, and total suspended solids. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 are summarized below. None of the temperature measurements (n=54) taken between February 2000 and October 2006 exceeded 28.3°C (maximum measurement was 27°C in July 2006). A total of 23 pH measurements were taken between February 2000 and December 2001. One measurement was slightly low (6.4 SU). Between February 2000 and December 2003, total suspended solids concentrations ranged from <2 to 51 mg/L (n=37) and only two samples were >25 mg/L.

EPA deployed a meter near the mouth of the Muddy River from 17 to 21 July 2000 (EPA 2001). The minimum DO measurement recorded was 3.5 mg/L, while the maximum DO recorded was 7.1 mg/L. Over the 72 hour deployment period DO was less than 5.0 mg/L for an estimated total of 8.5 hours. The maximum temperature was 25.5°C (EPA 2001).

Sediment Chemistry

Breault *et al.* (1998) describes the poor sediment quality conditions of sites sampled along the Muddy River. Elevated concentrations of trace metals and organic compounds exceeded S-EL guidelines (Fiorentino *et al.* 2000). These conditions are still considered to be problematic since remediation (e.g. dredging) has not yet occurred.

The *Aquatic Life Use* for the Muddy River is assessed as impaired. Causes of impairment include habitat quality degradation in the form of culverting and channelization, bottom deposits of sediment and silt, sediment contamination, the infestation of *P. australis*, and high concentrations of total phosphorus. Sources of impairment include urban stormwater runoff, channelization, sediment contamination, the loss of riparian habitat, as well as discharges from both municipal separate storm sewer systems and combined sewer systems.

Fish Consumption Use

DWM conducted fish toxics monitoring in July 1990 (Fiorentino *et al.* 2000). The MA DPH issued the following fish consumption advisory for the Muddy River.

> "*Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this water body, the general public should not consume brown bullhead, carp or American eel from this water body, and the general public should limit consumption of non-affected fish from this waterbody to two meals per month."*

Elevated concentrations of PCBs in brown bullhead, carp, and American eel resulted in the issuance of a site-specific DPH advisory so the *Fish Consumption Use* for the Muddy River is assessed as impaired. Sediment contamination (Breault *et al.* 1998) is one source of the problem.

Primary and Secondary Contact Recreation and Aesthetics Uses

Dry weather bacteria sampling data for the upper portion of this segment of the Muddy River just downstream from Netherlands Road Bridge (near the Brookline Water Department building), Brookline, MA reported by USGS can be summarized as follows. *Enterococcus* counts ranged from <10 to 1,100 cfu/100 ml (n=12 samples collected between July 1999 and July 2000) (Breault *et al.* 2002). *Enterococcus* bacteria counts for discrete samples collected during storm events ranged from <10 to 44,000 cfu/100 ml (n=29 samples including two replicates collected between December 1999 and September 2000) (Breault *et al.* 2002).] Event mean *Enterococcus* bacteria results for the storm events sampled were reported to range from 1,300 to 20,000 cfu/100 ml (n=8 events between January 2000 and July 2000) (Breault *et al.* 2002).

[Note: Although Massachusetts Surface Water Quality Standards have recently adopted the use of *E. coli* bacteria, fecal coliform bacteria data was the former bacterial criteria. Dry weather bacteria sampling data for the Muddy River reported by USGS can be summarized as follows. fecal coliform counts ranged from ≤10 to 4,200 cfu/100 ml (n=12 samples collected between July 1999 and July 2000) (Breault *et al.* 2002). Fecal coliform bacteria counts for discrete samples collected during storm events ranged from <10 to 64,000 cfu/100 ml (n=31 samples including two replicates collected between December 1999 and September 2000) (Breault *et al.* 2002).]

Total suspended solids concentrations during dry weather dry sampling conditions were all ≤ 11 mg/L (n=14 including one split collected between June 1999 and July 2000) (Breault *et al.* 2002). Similarly, turbidity measurements were also low (≤ 23 NTU n=10 measurements). Event mean concentrations of total suspended solids and turbidity for the storm events sampled were reported to range from 24 to 65 mg/L (n=10 measurements including one split) and 16.0 to 39.0 NTU (n=7), respectively (storm events sampled between January 2000 and September 2000) (Breault *et al.* 2002).

As part of the CRWA monthly monitoring program *E. coli* samples were also collected from one station in the Muddy River at Commonwealth Avenue in Boston (Station 760T and/or 760S) between June 2002 and October 2006 (CRWA 2007 and Kaplan 2007). A total of 36 samples were collected, 23 of which were during the primary contact recreation season. Both the geometric means and number of samples exceeding maximum counts were analyzed for each of the five years and these data are summarized below.

Station Station 760S	(CRWA 2007)	Year					Total
Period	Summary Statistic	2002	2003	2004	2005	2006	
Primary Contact	Samples Assessed	5	6	3	3	6	23
	Maximum cfu/100 ml	430	5,200	520	1,130	13,700	13,700
	Minimum cfu/100 ml	90	100	80	120	15	
126 cfu/100 ml	Geometric Mean	258	354	224	372	260	
Max 235 cfu/100 ml	Number of Exceedances	4	2	2	2	4	
Secondary Contact	Samples Assessed	7	10	5	6	8	36
	Maximum cfu/100 ml	2,000	5,200	520	1,130	13,700	13,700
	Minimum cfu/100 ml	90	100	60	110	15	
630 cfu/100 ml	Geometric Mean	383	445	163	328	190	
Max 1260 cfu/100 ml	Number of Exceedances	1	3	0	0	1	

The Brookline Open Space 2005 Plan (Town of Brookline 2006) states the following.

> "…*As mandated by the federal stormwater discharge permit for urbanized communities, the Town's stormwater control and management work includes minimizing polluted stormwater runoff or treating it before it drains to the Charles and Muddy Rivers, identifying and removing illicit connections to the storm drain system, and repairing or replacing faulty, broken sewer pipes…In late 2004, Brookline DPW began a formal illicit discharge detection and elimination program to remove sanitary sewer connections to the storm drain system. This program should be a major focus of the DPW in the upcoming years and will contribute to cleaner water in both the Muddy and the Charles Rivers."*

Sampling in the Muddy River has recently been conducted by USGS as part of a study evaluating *Pharmaceuticals and Personal Care Products as Indicators of Sewage Contamination in Urban Streams* (USGS 2007i and Eleria 2008). The results of this study have not yet been published but should be used to help identify sources contributing to elevated bacteria in this river.

Finally, both CRWA and DWM staff describe the Muddy River as very turbid with frequently less than one foot of visibility into the water column (Eleria 2008 and Davis 2008).

The *Primary Contact Recreational Use* is assessed as impaired for the Muddy River because of elevated bacteria *(E. coli*) counts and turbidity. The *Secondary Contact Recreational and Aesthetic Uses* are assessed as impaired because of objectionable turbidity. Occasionally highly elevated *E. coli* counts (notably higher during storm events) are also of concern for the *Secondary Contact Recreational Use*. Urban stormwater runoff, illicit connections/hookups to storm sewers, and discharges from both municipal separate storm sewer systems and combined sewer systems all contribute to elevated bacteria and turbidity in the Muddy River. These sources as well as the loss of riparian habitat, channelization, and altered hydrology also likely contribute to the turbidity problems.

Muddy River (Segment MA72-11) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Bottom deposits of sediment and silt, physical substrate habitat alteration, flow regime alterations, elevated total phosphorus, and the dense infestation of *Phragmites australis*, and other contamination including elevated concentrations of trace metals and organic compounds in sediment Sources: Wet weather discharges (point source and combination of stormwater, sanitary sewer overflow (SSO) or combined sewer overflow (CSO), channelization, sediment contamination, the loss of riparian habitat
Fish Consumption		IMPAIRED Causes: Elevated levels of polychlorinated biphenyls in fish tissue (carp, bullhead, and American eel) Sources: Unknown and contaminated sediments
Primary Contact		IMPAIRED Causes: Elevated *E. coli*, turbidity Sources: Wet weather discharges (point source and combination of stormwater, sanitary sewer overflow (SSO) or combined sewer overflow (CSO), illicit connections/hookups to storm sewers Suspected sources: Channelization, loss of riparian habitat
Secondary Contact		IMPAIRED Cause: Turbidity Sources: Wet weather discharges (point source and combination of stormwater, sanitary sewer overflow (SSO) or combined sewer overflow (CSO), illicit connections/hookups to storm sewers Suspected sources: Channelization, loss of riparian habitat
Aesthetics		

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Continue to monitor *E. coli* bacteria in the Muddy River to evaluate the status of the *Primary* and *Secondary Contact Recreational Uses* as well as progress made through cleanup/restoration efforts. Review results of recent studies (e.g., USGS 2007i) conducted which may identify bacteria sources to this system.

Support the U.S. Army Corps of Engineers' plan to increase flood control, improve water quality and enhance aquatic/riparian habitat within the Muddy River by dredging accumulated sediment, providing flood damage reduction through improvements to restrictive drainage culverts, removing nuisance vegetation, improving fisheries/wildlife habitat and water quality, bank stabilization and promoting and enhancing recreational use of Emerald Necklace parklands (ACOE 2003).

Brookline and Boston should continue to identify and remediate illicit hookups/connections to storm drains.

STONY BROOK (SEGMENT MA72-37)
Location: Outlet Turtle Pond, Boston, to culvert entrance, Boston.
Segment Length: 1.6 miles
Classification: Class B.

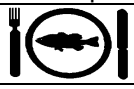
Note: This segment comprises the portion of Stony Brook that has not been channelized underground.

Land-use estimates (top 3, excluding water) for the 2.3 mi^2 subwatershed.
Residential 43%
Forest..... 38%
Open land 13%
The estimated percent impervious area for this subwatershed area is 20.5%.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

USE ASSESSMENT
No quality-assured data are available for this segment of Stony Brook. No designated uses are assessed.

Stony Brook (Segment MA72-37) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct biological monitoring to assess the *Aquatic Life Use*.

Conduct bacteria and water quality monitoring to evaluate designated uses.

UNNAMED TRIBUTARY (SEGMENT MA72-31)
Location: locally known as "Millers River" – From emergence near Route 93, Cambridge/Boston, to the confluence with the Charles River, Cambridge.
Segment Length: 0.2 miles
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of priority organics, metals, oil and grease, taste, odor and color as well as other habitat alterations (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H2, H3, and H4)
MBTA Boston Engine Terminal (MA0003590)
Boston Sand and Gravel Company (MA0000531)
Boston Water and Sewer Commission (MAS010001). There are three major stormwater outfalls (27J001, 27J044, and 27J096) that discharge to this segment of the Millers River (BWSC 2007).

[Note: MBTA Rail Maintenance Facility (MA0035297) stormwater basin drain discharge was terminated in 2001 so EPA terminated the permit. One CSO discharge to the Millers River (Outfall SOM010) was closed in January 1998 and a second CSO discharge (Outfall BOS028), an emergency overflow for Prison Point, has reportedly been silted in since 1992).]

USE ASSESSMENT
The use assessments for the Millers River have been based primarily on the information from the last water quality assessment report (Fiorentino *et al.* 2000) since these conditions have not changed (CRWA and CLF 2007). The following is an excerpt from Fiorentino *et al.* (2000).

> *"This watercourse (akin to a drainage ditch) conveys stormwater runoff and some base flow to the Charles River just upstream from the MDC Gridley Dam/Locks. The river has been culverted and filled over time and what remains is very degraded. In the development of the 1998 303(d) List of Impaired Waters in Massachusetts, information was provided to the DEP DWM supporting the inclusion of the "Millers River" on the List. Sediment sampling in the Millers River, documented elevated levels of heavy metals, PCB, Total Petroleum Hydrocarbons and, PAHs (CDM 1995). A preliminary assessment and risk characterization of the Millers River conducted by GeoEnvironmental, Inc. (GZA) for the Massachusetts Bay Transportation Authority (MBTA) Commuter Rail Maintenance Facility also provided data indicative of contamination in the Millers River (GZA GeoEnvironmental, Inc 1998). Furthermore their report stated that no fish were observed during an electroshock fishing effort."*

The *Aquatic Life* and *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses for the Millers River are assessed as impaired because of the degraded habitat and sediment quality and aesthetic conditions. Stormwater runoff from both permitted facilities and general urban runoff contribute to these conditions.

Millers River (Segment MA72-31) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Habitat quality degradation in the form of sedimentation, sediment contamination including polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons, and total PCB and heavy metals (use code 476) Sources: Urban stormwater runoff, channelization, sediment contamination, the loss of riparian habitat, discharges from municipal separate storm sewer systems, NPDES discharge(s)
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Causes: Scum/oil slicks, oil and grease, objectionable bottom deposits Sources: Urban stormwater runoff, NPDES discharge(s), discharges from municipal separate storm sewer systems
Secondary Contact		
Aesthetics		

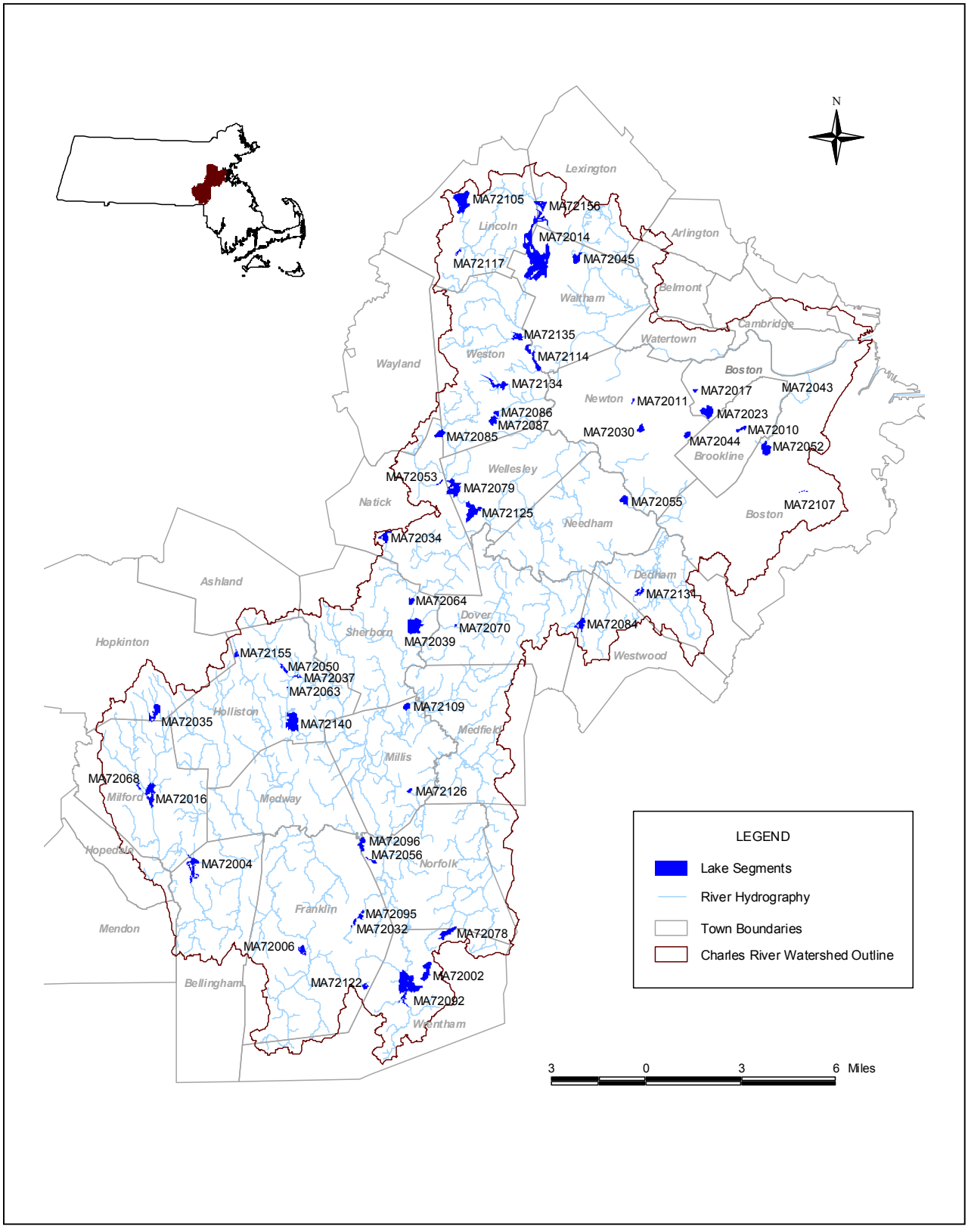
RECOMMENDATIONS

Develop a monitoring plan for the Millers River to evaluate the status of the designated uses. Habitat quality assessments, visual observations of water quality and aesthetics during both dry and wet weather conditions, monitoring for *E. coli* bacteria should all be conducted to better evaluate the status of the *Primary* and *Secondary Contact Recreational Uses* as well as progress made through cleanup/restoration efforts. Other issues of concern for this waterbody include low DO, elevated temperature as well as concentrations of phosphorus and metals

Carefully review the monitoring information submitted by the NPDES permitted facilities that discharge to the Millers River to determine whether or not appropriate stormwater pollution prevention plans are being developed and implemented.

CHARLES RIVER WATERSHED LAKE SEGMENT ASSESSMENTS

Figure 8 illustrates the lake segments in the Charles River Watershed that are included in this report.



LAKE ARCHER (SEGMENT MA72002)
Location: Wrentham
Length/area: 77 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses* (*Secondary Contact Recreation* and *Aesthetics*); Others Not Assessed (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Tables H2 and H4)
Tyco Valves and Controls (TVC Wrentham) (MAG250431)
One whole effluent toxicity test was conducted on Tyco Valves and Controls non-contact cooling water (NCCW) in July 2002. The effluent exhibited both acute and chronic toxicity to *C. dubia*. The LC_{50} was 35% effluent and the CNOEC was 25% effluent.

USE ASSESSMENT
Aquatic Life Use
Biology
Lake Archer is infested with a non-native aquatic plant – South American waterweed (*Egregia densa*) (Robinson 2006).

Water Chemistry
Although not enough quality assurance data were available, ESS (2001) reported low hypolimnetic DO below 5-7 meter depths. This represents a high percentage of the lake area, which is of concern.

The *Aquatic Life Use* for Lake Archer is assessed as impaired because of the infestation of a non-native aquatic macrophyte. The low hypolimnetic DO conditions are also of concern.

Primary and Secondary Contact Recreation and Aesthetics Uses
There is one beach along the shoreline of Lake Archer (Lake Archer Beach). Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody. Issues of concern reported by ESS (2001) include high fecal coliform levels in samples collected from storm drains that discharge to the lake and a Secchi disk transparency that was also less than 1.2 meters in one of three measurements (range 1.1 to 4.4 meters).

The *Recreational* and *Aesthetics* uses are not assessed but are identified with an Alert Status because of high fecal coliform bacteria in storm drain discharges to the lake and a low Secchi disk transparency measurement.

Lake Archer (Segment MA72002) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED*
Aesthetics		NOT ASSESSED*

*Alert Status issues identified, see details in use assessment

RECOMMENDATIONS

TVC Wrentham should consider close looping their NCCW. When the new general permit for non-contact cooling water discharges is issued by EPA, TVC Wrentham's total residual chlorine (TRC) and whole effluent toxicity testing results should be evaluated to see if they are eligible for coverage under the new permit. An individual NPDES permit with water quality based limits may need to be developed for this facility.

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

BEAVER POND (SEGMENT MA72004)
Location: Bellingham/Milford
Length/area: 87 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
One aquatic macrophyte, *Myriophyllum* sp., was identified in Beaver Pond in 1997 (MassDEP 1997). This macrophyte may be a non-native, so it will require further identification when flowering heads are present.

The *Aquatic Life Use* is not assessed for Beaver Pond. However, this use is identified with an Alert Status because of the potential infestation of non-native form of *Myriophyllum*.

Fish Consumption Use
Fish toxics monitoring was conducted in Beaver Pond in 1997(Maietta *et al.* 2008). Mercury concentrations exceeded the MA DPH trigger level of 0.5 ppm in edible fillets of chain pickerel (0.56 ppm) and largemouth bass (0.98 ppm), both of which are considered predatory species. Although no advisory update has been issued as of March 2008, the 2007 survey will likely result in a fish consumption advisory because of elevated mercury (Maietta *et al.* 2008).

The *Fish Consumption Use* is not assessed for Beaver Pond but this use is identified with an Alert Status because of elevated mercury in edible fillets of chain pickerel and largemouth bass.

Beaver Pond (Segment MA72004) Use Summary Table

Aquatic Life*	Fish Consumption*	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Conduct aquatic macrophyte survey in late July/August to confirm species of *Myriophyllum*.

Continue to monitor for the presence of invasive non-native aquatic vegetation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

Conduct monitoring to evaluate designated uses.

BEAVER POND (SEGMENT MA72006)
Location: Franklin
Length/area: 32 acres
Classification: Class B

This is a new segment not on the 2006 Integrated List of Waters.

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Two non-native aquatic macrophyte species, variable watermilfoil (*Myriophyllum heterophyllum*) and fanwort (*Cabomba caroliniana*), were identified in Beaver Pond in 2002 (MA DCR 2005).

The *Aquatic Life Use* for Beaver Pond is assessed as impaired because of the infestation of two non-native aquatic macrophytes.

Primary and Secondary Contact Recreation and Aesthetics Uses
There is one beach along the shoreline of Beaver Pond (Chilson Beach). Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed.

Beaver Pond (Segment MA72006) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

Support improvement of freshwater Beaches Bill data quality and reporting.

Conduct monitoring to evaluate designated uses.

BROOKLINE RESERVOIR (SEGMENT MA72010)
Location: Brookline
Length/area: 21 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Brookline Reservoir. No designated uses are assessed.

Brookline Reservoir (Segment MA72010) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

BULLOUGHS POND (SEGMENT MA72011)
Location: Newton
Length/area: 7 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients and noxious aquatic plants (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No recent quality-assured data are available for Bulloughs Pond. No designated uses are assessed.

Bulloughs Pond (Segment MA72011) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

CAMBRIDGE RESERVOIR (SEGMENT MA72014)
Location: Waltham/Lincoln/Lexington
Length/area: 532 acres
Classification: Class A.

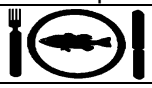
This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Cambridge Water Department registration/permit (32004901/9P32004901)
NPDES (See Appendix H, Tables H2 and H4)
US Postal Service Facility (MA0033774)
Hewlett-Packard Groundwater TS (MA0039993)
SRI Two Realty Trust (MA0028495)

The USGS maintains a gage on Hobbs brook below Cambridge Reservoir near Kendal Green, MA (Gage 01104430). The average annual discharge at the gage is 10.5 cfs (period of July 1997 to Sept. 2005). In the period of record the highest discharge was 62 cfs. Days of no flow occurred on many days throughout the period of record. The USGS remarks that the flow is affected by regulation of a dam 300 ft upstream at the outflow of the Cambridge Reservoir (USGS Annual Water-Data Reports available on-line. http://pubs.usgs.gov/wdr/).

USE ASSESSMENT
No quality-assured data are available for Cambridge Reservoir. No designated uses are assessed.

Cambridge Reservoir (Segment MA72014) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct water quality monitoring to evaluate designated uses.

CAMBRIDGE RESERVOIR, UPPER BASIN (SEGMENT MA72156)
Location: Lincoln/Lexington
Length/area: 44 acres
Classification: Class A.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and turbidity (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Cambridge Reservoir Upper Basin. No designated uses are assessed.

Cambridge Reservoir Upper Basin (Segment MA72156) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

CEDAR SWAMP POND (SEGMENT MA72016)
Location: Milford
Length/area: 99 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of metals, noxious aquatic plants and flow alterations (MassDEP 2007). This waterbody is also commonly referred to as Milford Pond.

The Northeast Regional Mercury Total Maximum Daily Load (TMDL) was prepared by the New England Interstate Water Pollution Control Commission (NEIWPCC) in cooperation with the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The TMDL covers waterbodies that are impaired primarily due to atmospheric deposition of mercury (Northeast States 2007). The TMDL target for Massachusetts is 0.3 ppm or less of mercury in fish tissue. The plan calls for a 75% reduction of in-region and out of region atmospheric sources by 2010 and a 90% or greater reduction in the future (NEIWPCC 2007).

Milford Pond Restoration, Milford
MA DCR (then DEM) on behalf of the Town of Milford requested that the US Army Corps of Engineers conduct a study of Milford Pond to investigate alternatives to restore the ecology and health of this 120-acre degraded freshwater pond. This study was conducted under the Corps' Aquatic Ecosystem Restoration Program, Section 206 of the Water Resources Development Act of 1996. The National Ecosystem Restoration plan identified in the final report is to dredge 45 + acres of Milford Pond to achieve an open water body depth of 12 feet. The Engineering/Planning Division granted Project Approval on June 29, 2005. The Plans & Specifications phase was initiated in July 2005. Condition surveys were completed in December 2005. Plans & Specifications are scheduled to be complete in fiscal year 2008, depending on funding appropriations. Current efforts are focusing on obtaining permits. Future efforts will consist of finalizing the plans and specifications and signing a project cooperation agreement (PCA) in preparation for construction (ACOE 2008).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Milford Water Department registration/permit (22018501/9P22018501).
NPDES (See Appendix H, Table H4):
Mobil Station 06-PLH (MA0033936) Storm drain to Milford Pond. EPA list indicates facility terminated permanently in October 2005.

USE ASSESSMENT
Aquatic Life Use
Biology
The non-native aquatic macrophyte, variable milfoil, was documented in the pond during the survey conducted by CRWA in August 2005 (CRWA 2006).

The deepest area in Cedar Swamp Pond impoundment (also referred to as the Milford Pond) is approximately eight feet (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, temperature and conductivity between 4 September 2002 and 9 September 2002. DO concentrations ranged from 1.16 to 4.82 mg/L during the probe deployment and all of the profiled stations showed oxygen depletion with depth. Water quality monitoring (*in-situ* measurements of DO and temperature) as well as nutrient (total phosphorus and chlorophyll *a* and pheophytin *a* samples were taken at three locations in Cedar Swamp Pond on 23 June 2005 (Schlezinger and Howes 2006). Sediments have an oxygen demand that leads to anoxia (in lab tests) and likely nutrient release from the sediments. DO concentrations at these stations ranged from 4.5 to 6.6 mg/L. Reliable total phosphorus and chlorophyll *a* data were not available.

Sediment
Sediment cores were collected in June 2005 at three locations in Cedar Swamp Pond to measure rates of sediment oxygen demand and sediment nutrient release during aerobic and anaerobic conditions (Schlezinger and Howes 2006).

The *Aquatic Life Use* is assessed as impaired for Cedar Swamp Pond because of the infestation of the non-native aquatic macrophyte *M. heterophyllum* and low dissolved oxygen.

Fish Consumption Use
Fish toxics monitoring in Cedar Swamp Pond, Milford was last conducted in 1989. The following advisory was issued by MA DPH (2007).

> *"Children under 12 years of age, pregnant women, and nursing mothers not consume any fish species from that waterbody because of mercury hazard. All other people should limit consumption of any fish species to two (2) meals per month".*

Because of the site-specific fish consumption advisory due to mercury contamination the *Fish Consumption Use* is assessed as impaired.

Primary and Secondary Contact Recreation and Aesthetics Uses
Secchi disk depth measurements were taken at three locations in Cedar Swamp Pond on 23 June 2005 (Schlezinger and Howes 2006). Measurements ranged from 0.65 to 1 m, all below the swimming guidance of 1.2 m.

Although Secchi disk measurements were low no other data are available for Cedar Swamp Pond. Data collected on one date is insufficient to assess the *Primary* and *Secondary Contact Recreational* or *Aesthetics* uses and therefore they are not assessed but are identified with an Alert Status because of the low Secchi disk readings.

Cedar Swamp Pond (Segment MA72016) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low dissolved oxygen, non-native aquatic macrophyte infestation Sources: Introduction of non-native macrophyte, unknown
Fish Consumption		IMPAIRED Cause: Elevated mercury in fish tissue Source: Unknown Suspected Source: Atmospheric Deposition
Primary Contact		NOT ASSESSED*
Secondary Contact		NOT ASSESSED*
Aesthetics		NOT ASSESSED*

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Water quality monitoring in Cedar Swamp Pond should be conducted after the ACOE dredging project is complete (Scheduled October 2006 but not started as of Dec, 2006). The ACOE provided funding for a Milford Pond Project in 2007 (http://www.usace.army.mil/cw/cecwb/fy07/fy07_capplan_final_19mar07.pdf).

Continue to monitor for the presence of invasive non-native aquatic vegetation after dredging has been completed. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

Conduct monitoring to evaluate designated uses.

Continue to conduct fish toxics monitoring for Hg to evaluate changes. Evaluate whether or not this waterbody can be addressed by the Mercury TMDL.

CHANDLER POND (SEGMENT MA72017)
Location: Boston
Length/area: 11 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5* - *Waters Requiring a TMDL* because of nutrients, organic enrichment/low DO, noxious aquatic plants (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H3)
Boston Water and Sewer Commission (MAS010001). There is one major stormwater outfall to Chandler Pond – 22C384 and one minor stormwater outfall- 21C212.

USE ASSESSMENT
Aquatic Life Use
Biology
Chandler Pond is infested with water chestnut (*Trapa natans*), a non-native aquatic plant (MassDEP 2002a). Floating clumps of green and blue-green algae were also noted as common.

Water Chemistry
Sampling was conducted by DWM staff at the deep hole (W0978) in Chandler Pond as part of the 2002 Baseline Lake TMDL Project (Appendix D, Tables D1 and D3). High concentrations of total phosphorus ($\geq$ 0.15 mg/L) and chlorophyll *a* ($\geq$ 37.3 mg/m^3), as well as poor Secchi disk transparency ($\leq$ 0.6 m) and supersaturation of dissolved oxygen (as high as 133%) are all indicative of a highly productive system.

The *Aquatic Life Use* for Chandler Pond is assessed as impaired because of the infestation of a non-native aquatic macrophyte, elevated concentrations of total phosphorus, and biological indicators of enrichment (including high chlorophyll a and supersaturation of dissolved oxygen) as well as excessive algal growth.

Primary and Secondary Contact Recreation and Aesthetics Uses
Sampling was conducted by DWM staff at the deep hole (W0978) in Chandler Pond as part of the 2002 Baseline Lake TMDL Project (Appendix D, Tables D1 and D3). Secchi disk transparency was poor on all three surveys conducted between July and September 2002 (0.3 to 0.6 m) (Appendix D, Table D1). The pond was highly turbidity (brown) with poor water clarity during the macrophyte mapping survey of the pond on 14 August 2002.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are assessed as impaired for Chandler Pond based on the poor Secchi disk transparency, as well as the poor aesthetics (high turbidity/poor water clarity) documented during the summer of 2002.

Chandler Pond (Segment MA72017) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Non-native aquatic macrophyte infestation; biological indicators of nutrient enrichment, elevated total phosphorus; excessive algal growth Sources: Introduction of non-native macrophyte, unknown Suspected sources: Stormwater/urban runoff
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Causes: Poor Secchi disk transparency, excessive algal growth Source: Unknown Suspected sources: Stormwater/urban runoff
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Develop a management plan to mitigate water quality degradation including monitoring to determine sources of nutrients to the pond.

CHESTNUT HILL RESERVOIR (SEGMENT MA72023)
Location: Boston
Length/area: 82 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

USE ASSESSMENT
No quality-assured data are available for Chestnut Hill Reservoir. No designated uses are assessed.

Chestnut Hill Reservoir (Segment MA72023) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

CRYSTAL LAKE (SEGMENT MA72030)
Location: Newton
Length/area: 27 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
In July 2006 two samples from Crystal Lake (one from a beach and one from "deep" water) were analyzed at the MassDEP DWM laboratory (Beskenis 2007b). The cyanobacterium *Anabaena* sp. was dominant in both samples and was considered in bloom condition. The counts, however, were below the World Health Organization (WHO) guidance of 100,000 cells/ml (for lake closure). No other quality-assured data are available for Crystal Lake so all designated uses are not assessed. Because of the cyanobacteria bloom, the *Aquatic Life*, *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are all identified with an Alert Status.

Crystal Lake (Segment MA72030) Use Summary

Aquatic Life*	Fish Consumption	Primary Contact*	Secondary Contact*	Aesthetics*
				
NOT ASSESSED				

* Alert Status issues identified, see details in use assessment

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses and determine magnitude and frequency of cyanobacteria blooms.

DUG POND (SEGMENT MA72034)
Location: Natick
Length/area: 50 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
The non-native aquatic macrophyte, curly-leaved pondweed (*Potamogeton crispus*), was reported in Dug Pond (MassDEP 2004a and MassDEP 2005a). Boat shocking was conducted by DFW in August 2000. Seven species of fish were collected (Richards 2006). The presence of American eel, a catadromous species, indicates that eel passage is possible up to this point in the watershed. Macrohabitat generalists dominated the fish community.

The *Aquatic Life Use* is assessed as impaired for Dug Pond because of the infestation of the non-native aquatic macrophyte *P. crispus*.

Primary and Secondary Contact Recreation and Aesthetics Uses
There is one beach along the shoreline of Dug Pond. Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Recreational* and *Aesthetics* uses are not assessed.

Dug Pond (Segment MA72034) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking)

should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

ECHO LAKE (**SEGMENT MA72035**)
Location: Milford/Hopkinton
Length/area: 72 acres
Classification: Class A.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of metals (MassDEP 2007).

The Northeast Regional Mercury Total Maximum Daily Load (TMDL) was prepared by the New England Interstate Water Pollution Control Commission (NEIWPCC) in cooperation with the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The TMDL covers waterbodies including Echo Lake that are impaired primarily due to atmospheric deposition of mercury (Northeast States 2007). The TMDL target for Massachusetts is 0.3 ppm or less of mercury in fish tissue. The plan calls for a 75% reduction of in-region and out of region atmospheric sources by 2010 and a 90% or greater reduction in the future (NEIWPCC 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Milford Water Company registration/permit (22018501/9P22018501)

USE ASSESSMENT
Aquatic Life Use
Water Chemistry
CRWA conducted water quality monitoring in Echo Lake. Although unattended probes were deployed between 4 through 9 September 2002 near the outlet of the lake review of these data indicate that the data may not be reliable and so they were not used to make assessment decisions. Profiles were also taken at five locations, the deepest of which was 22 feet, on 9 September 2002 (CRWA 2004a). Dissolved oxygen depletion occurred at a depth of approximately 14 feet at four of the five stations.

Too limited data are available so the *Aquatic Life Use* for Echo Lake is not assessed. This use is identified with an Alert Status, however, because of evidence of oxygen depletion at depths greater than 14 feet. No bathymetric map is available to calculate area of the lake affected by oxygen depletion.

Fish Consumption Use
In July of 2004 Normandeau Associates conducted electrofishing in Echo Lake as part of the BRP Office of Research and Standards Mercury Study. Mercury concentrations in yellow perch fish tissue ranged from 0.13 to 0.58 ppm wet weight (n=18) with two fish exceeding the 0.5 ppm standard. Fish lengths ranged from 120 mm to 312 total length. Mercury concentrations in largemouth bass ranged from 0.27 to 0.70 ppm (n=13). A total of eight largemouth bass exceeded the 0.5 ppm trigger level. Fish sizes ranged from 146 mm to 450 mm total length. As expected, the largest fish of both species had the highest mercury concentrations. The MA DPH reviewed these data and issued the following fish consumption advisory (MA DPH 2007).

> *"Mercury Warning: Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any Largemouth Bass fish from this water body. The general public should limit consumption of Largemouth Bass fish to two meals per month."*

The *Fish Consumption Use* is assessed as impaired for Echo Lake because of the issuance of a fish consumption warning by the MA DPH.

Echo Lake (Segment MA72035) Use Summary Table

Designated Uses		Status
Aquatic Life		NOT ASSESSED*
Fish Consumption		IMPAIRED Cause: Elevated mercury in fish tissue Source: Unknown Suspected Source: Atmospheric Deposition
Drinking Water**		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

*Alert Status issue identified, see details in use assessment section

** The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS

A bathymetric map should be obtained/developed for Echo Lake.

Conduct monitoring to evaluate designated uses.

Continue to conduct fish toxics monitoring for Hg to evaluate changes and success of TMDL.

FACTORY POND (SEGMENT MA72037)
Location: Holliston
Length/area: 10 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants as well as exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
The non-native aquatic macrophyte variable watermilfoil was observed in Factory Pond during the 1998 synoptic surveys (MassDEP 1997).

The *Aquatic Life Use* is assessed as impaired for Factory Pond because of the infestation of the non-native aquatic macrophyte *M. heterophyllum*.

Factory Pond (Segment MA72037) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Conduct monitoring to evaluate designated uses.

FARM POND (SEGMENT MA72039)
Location: Sherborn
Length/area: 125 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

USE ASSESSMENT
Aquatic Life Use
Water Chemistry
Farm Pond was sampled by DWM on 13 September 2005 as part of a nutrient criteria development project for lakes. Monitoring included *in-situ* water quality profile measurements (i.e., temperature, dissolved oxygen, pH, specific conductance), water quality sampling for phosphorus analysis, chlorophyll *a* determinations and the analysis of apparent color. These data are not yet available and so the *Aquatic Life Use* is not assessed.

Primary and Secondary Contact Recreational and Aesthetics Uses
There is one beach along the shoreline of Farm Pond (Farm Pond Beach). There were no reported exceedances in 2001, 2004 or 2005 while no data were reported for 2002 or 2003. Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The Secchi disk depth measured by DWM personnel on 13 September 2005 was 7.7 m. No objectionable conditions (i.e., odors, color, turbidity, algal blooms) were reported and plant cover was sparse (MassDEP 2005b). It is expected that plant cover would be less in mid-September.

Although no objectionable conditions were recorded (MassDEP 2005b), because of the lack of bacteria data and enough Secchi disk depth measurements the *Primary* and *Secondary Contact Recreational Uses* are not assessed. The *Aesthetics Uses* is assessed as support.

Farm Pond (Segment MA72039) Use Summary

Designated Uses		Status
Aquatic Life		NOT ASSESSED
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

RECOMMENDATIONS
Support improvement of freshwater Beaches Bill data quality and reporting.

Conduct monitoring to evaluate designated uses.

FRANKLIN RESERVOIR NORTHEAST (SEGMENT MA72095)
Location: Franklin
Length/area: 21 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and turbidity (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Franklin Reservoir Northeast. No designated uses are assessed.

Franklin Reservoir Northeast (Segment MA72095) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

FRANKLIN RESERVOIR SOUTHWEST (SEGMENT MA72032)
Location: Franklin
Length/area: 13 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and turbidity (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Franklin Reservoir Southwest. No designated uses are assessed.

Franklin Reservoir Southwest (Segment MA72032) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

HALLS POND (SEGMENT MA72043)
Location: Brookline
Length/area: 0.6 acres
Classification: Class B.

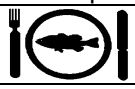
This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

The Halls Pond Restoration Project (97-08/319) has been completed. Reports on the project did not include data usable in this assessment.

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Halls Pond. No designated uses are assessed.

Halls Pond (Segment MA72043) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

HAMMOND POND (SEGMENT MA72044)
Location: Newton
Length/area: 22 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)
Hammond Park Condominiums (MA0035726) discharge was terminated by EPA in September 2003.

USE ASSESSMENT
Aquatic Life Use
Biology
A macrophyte survey of the pond was conducted by DWM in August 2002. Although a dense to very dense biovolume of aquatic macrophytes was present, no non-native species were found (Mattson 2007).

Water chemistry
Sampling was conducted by DWM staff at the deep hole (W0977) in Hammond Pond as part of the 2002 Baseline Lake TMDL Project (Appendix D, Tables D1 and D3). Total phosphorus and chlorophyll *a* concentrations were both low and DO concentrations were good throughout the water column. Secchi disk transparency measurements were all good ($\geq$ 1.4 m).

The *Aquatic Life Use* for Hammond Pond is assessed as support based on the water quality data. This use is identified with an Alert Status, however, because of the potential that the dense macrophyte biovolumes result from anthropogenic sources (e.g., runoff from adjacent parking lots/roads). It should be noted that the Hammond Pond Stormwater Management Plan (Project #02-08/319) was completed in July 2007 (City of Newton 2007). The project included the design, permitting, and installation of Phase I BMPs (bioretention facilities, sand filter, Vortechs unit, buffers, forebay, paving modification), the development of a long-term operation and maintenance plan, and outreach and education to discourage waterfowl feeding and inform about project function.

Primary and Secondary Contact Recreation and Aesthetics Uses
Sampling was conducted by DWM staff at the deep hole (W0978) in Hammond Pond as part of the 2002 Baseline Lake TMDL Project (Appendix D, Tables D1 and D3). Secchi disk transparency measurements were all greater than 1.2 m (Appendix D, Table D1) and no objectionable conditions were noted.

Although no objectionable conditions were recorded (MassDEP 2002a), because of the lack of bacteria data the *Primary Contact Recreational Use* is not assessed. The *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as support based on good transparency and lack of objectionable conditions.

Hammond Pond (Segment MA72044) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

An aquatic macrophyte survey should be conducted again as well as estimates of biovolume.

Follow-up monitoring should be conducted to evaluate the need for additional stormwater management controls.

HARDYS POND (SEGMENT MA72045)
Location: Waltham
Length/area: 43 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants, nutrients and turbidity as well as exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Water chestnut, a non-native aquatic macrophyte, was observed in Hardys Pond during the 1997 synoptic surveys (MassDEP 1997). The same species was noted in the 2004 herbicide application file (MassDEP 2004a)

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a *T. natans*.

Hardys Pond (Segment MA72045) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Conduct monitoring to evaluate designated uses.

HOUGHTON POND (SEGMENT MA72050)
Location: Holliston
Length/area: 18 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants, turbidity, as well as exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Holliston Water Department (22013601/9P422013602) has one groundwater well (02g) source upstream from the pond.
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
A suspected non-native species (*Myriophyllum* sp., possibly *M. heterophyllum*) was observed in Houghton Pond during the 1997 synoptic surveys (MassDEP 1997).

The *Aquatic Life Use* for this segment is not assessed but is identified with an Alert Status based on the potential presence of a non-native species.

Houghton Pond (Segment MA72050) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

*Alert Status issue identified, see detail in use assessment section

RECOMMENDATIONS
Conduct monitoring to determine it the *Myriophyllum* sp. is in fact *M. heterophyllum*. If this invasive non-native aquatic species is present conduct monitoring to determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Conduct monitoring to evaluate designated uses.

JAMAICA POND (SEGMENT MA72052)
Location: Boston
Length/area: 67 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients and organic enrichment/low DO (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H3)
Boston Water and Sewer Commission (MAS010001). There is one minor stormwater outfall to Jamaica Pond –17F012.

USE ASSESSMENT
Aquatic Life Use
Biology
A macrophyte survey of the pond was conducted by DWM in August 2002. The biovolume of aquatic macrophytes was sparse and no non-native species were found (Mattson 2007). A non-native aquatic macrophyte, Eurasian milfoil (*Myriophyllum spicatum*), was found in the pond south of the Jamaica Pond Sailing Club. This was hand pulled and properly disposed of by DWM staff.

Water Chemistry
Sampling was conducted by DWM staff at the deep hole (W0973) in Jamaica Pond as part of the 2002 Baseline Lake TMDL Project (Appendix D, Tables D1 and D3). This pond was also sampled in 2003 and 2005 as part of the Nutrient Criteria Development Project (data collected in 2003 are in Appendix D, Tables D2 and D4, but data from 2005 are not yet available). Chlorophyll *a* concentrations ranged from 5.5 to 23 mg/m^3 while Secchi disk transparency measurements were all $\geq$ 1.8 m. Oxygen depletion occurred at depths below 6.5 m, which affects more than 50% of the lake area. Total phosphorus concentrations near the bottom ranged from 0.29 to 0.36 mg/L. This is strong evidence of internal cycling of phosphorus from anoxic sediments.

The *Aquatic Life Use* is assessed as impaired for Jamaica Pond based on low dissolved oxygen in the hypolimnion, which affects more than 50% of the lake area. Additionally, total phosphorus release from the sediments during anoxic conditions also occurs. While chlorophyll *a* concentrations are generally low, occasional high values have been documented. This may be a harbinger of future problems. Although the non-native aquatic macrophyte *M. spicatum* was found in the pond in 2002, the infestation was isolated to one location and the plant was removed so it is not listed as a cause of impairment at this time.

Primary and Secondary Contact Recreation and Aesthetics Uses
Sampling was conducted by DWM staff at the deep hole (W0973) in Jamaica Pond as part of the 2002 Baseline Lake TMDL Project (Appendix D, Tables D1 and D2). Secchi disk transparency measurements were all good (Appendix D, Table D1) and no objectionable conditions were noted.

Although no objectionable conditions were recorded (MassDEP 2002a), because of the lack of bacteria data the *Primary Contact Recreational Use* is not assessed. The *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as support based on good transparency and lack of objectionable conditions.
.

Jamaica Pond (Segment MA72052) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low dissolved oxygen, elevated total phosphorus Source: Internal nutrient (phosphorus) recycling Suspected source: Unknown
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

To prevent additional water quality degradation in Jamaica Pond, a management plan/TMDL should be developed to control nutrient inputs and internal recycling of nutrients from the sediments (a nutrient budget should be developed for internal and external sources of total phosphorus.

A macrophyte survey of the pond should be conducted again to determine whether or not *M. spicatum* is in the pond. If the pond is infested, determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Continue to conduct water quality monitoring in Jamaica Pond as well as bacteria sampling to better evaluate the designated uses.

JENNINGS POND (SEGMENT MA72053)
Location: Natick
Length/area: 7 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and flow alteration (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Habitat and Flow
Based on the MassGIS aerial photographic layer (MassGIS 2005) the pond has been reflooded since the 1997 synoptic survey by DWM. Therefore, flow alteration can be removed as a cause of impairment. The maximum depth of Jennings Pond is 2.7 m (Whitman & Howard, Inc. 1986).

Biology
Aquatic plant cover was observed to be moderate to dense (MassDEP 2004b and Zimmerman 2007).

Water Chemistry
MassDEP DWM staff deployed an unattended probe to measure DO, saturation, and temperature in Jennings Pond between 2 and 4 August 2004 at a depth of approximately one foot (MassDEP 2004b). The probe was deployed approximately 490 feet from the Oak Street culvert. These data were collected to support the Department's ongoing Nutrient Criteria Development Project. DO concentrations were not less than 7.8 mg/L and were as high as 9.8 mg/L. Saturations ranged from 98 to 128%. The maximum temperature (n=190) was 28.2°C. USGS personnel also sampled the deep hole in Jennings Pond on 11 August 2004 as part of the Nutrient Criteria Development Project. Monitoring included *in-situ* water quality profile measurements (i.e., temperature, dissolved oxygen, pH, specific conductance), water quality sampling for phosphorus analysis, chlorophyll *a* determinations and the analysis of apparent color (Zimmerman 2004). Dissolved oxygen profiles of uncertain quality assurance indicate that depletion occurred below a depth of approximately 5 feet in the pond (Zimmerman 2007). If these conditions were confirmed it would mean that approximately 30% of the pond area is affected. The concentration of total phosphorus was 0.038 mg/L and the chlorophyll *a* concentration was low (3.77 µg/L) (Zimmerman 2007).

The *Aquatic Life Use* is not assessed for Jennings Pond. There is unconfirmed evidence of a substantial area of the lake that may be affected by oxygen depletion (depths below 5 feet), as well as supersaturation (evidence of high productivity) potentially from anthropogenic sources. Because of these factors the *Aquatic Life Use* is listed with an "Alert Status."

Primary and Secondary Contact Recreation and Aesthetics Uses
Secchi disk transparency was measured in Jennings Pond (Station W0973) on 2 August 2004 by DWM staff as part of the Nutrient Criteria Development Project. The Secchi disk transparency was 0.65 m, which was the maximum depth at this sampling location (MassDEP 2004b). The water column was clear and no objectionable conditions were noted. USGS staff sampled also measured Secchi disk transparency at the deep hole in Jennings Pond on 11 August 2004 as part of the Nutrient Criteria Development Project. The Secchi disk transparency recorded was 2.3 m (Zimmerman 2007).

Although no objectionable conditions were recorded (MassDEP 2005b), because of the lack of bacteria data and enough Secchi disk depth measurements the *Primary* and *Secondary Contact Recreational Uses* are not assessed. The *Aesthetics Uses* is assessed as support.

Jennings Pond (Segment MA72053) Use Summary

Designated Uses		Status
Aquatic Life		NOT ASSESSED*
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Conduct monitoring (including *in-situ* DO profiles at the deep hole) to evaluate designated uses.

An aquatic macrophyte survey should be conducted again as well as estimates of biovolume.

KENDRICK STREET POND (SEGMENT MA72055)
Location: Needham
Length/area: 39 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of turbidity (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Kendrick Street Pond. No designated uses are assessed.

Kendrick Street Pond (Segment MA72055) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

KINGSBURY POND (SEGMENT MA72056)
Location: Norfolk
Length/area: 15 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 4c - Impairment Not Caused by a Pollutant due to flow alteration* (MassDEP 2007).

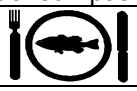
WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
No non-native aquatic macrophytes were observed by MA DCR staff in Kingsbury Pond in 2003 (MA DCR 2005).

Boat shocking was conducted by MA DFG biologists in August 2005. Three species of fish were collected (Richards 2006). Macrohabitat generalists dominated the fish community.

Too limited data are available for Kingsbury Pond so no designated uses are assessed.

Kingsbury Pond (Segment MA72056) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

LINDEN POND (SEGMENT MA72063)
Location: Holliston
Length/area: 1 acre
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and turbidity (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Linden Pond. No designated uses are assessed.

Linden Pond (Segment MA72063) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

LITTLE FARM POND (SEGMENT MA72064)
Location: Sherborn
Length/area: 24 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

USE ASSESSMENT
No quality-assured data are available for Little Farm Pond. No designated uses are assessed.

Little Farm Pond (Segment MA72064) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

LOUISA LAKE (SEGMENT MA72068)
Location: Milford
Length/area: 8 acres
Classification: Class A.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

This waterbody is an emergency drinking water source for the Milford Water Company.

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Louisa Lake. No designated uses are assessed.

Louisa Lake (Segment MA72068) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

LYMANS POND (SEGMENT MA72070)
Location: Dover
Length/area: 4 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of noxious aquatic plants and turbidity (MassDEP 2007).

USE ASSESSMENT
Aquatic Life Use
Biology
The non-native species yellow floating heart (*Nymphoides peltata*) was reported to be in Lymans Pond (MassDEP 2003, MassDEP 2004a).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

Lymans Pond (Segment MA72070) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

MIRROR LAKE (SEGMENT MA72078)
Location: Wrentham/Norfolk
Length/area: 62 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of nutrients, noxious aquatic plants, turbidity, and exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
The non-native aquatic macrophyte curly-leaved pondweed was observed in Mirror Lake during the 1997 synoptic surveys (MassDEP 1997) and was also identified by ESS personnel (2001).

Water Chemistry
Water quality sampling was conducted by DWM sampling staff at the deep hole station (Station W0871) in Mirror Lake in July, August, and September 2002 (Appendix D, Tables D1 and D3). DO concentrations were good. Chlorophyll *a* concentrations ranged from 11.8 – 24.8 mg/m^3 (n=5 including two duplicate samples), which indicates moderately high levels of algal productivity. In addition, total phosphorus concentrations ranged from 0.045 – 0.064 mg/L, which represents moderate levels for that nutrient.

The *Aquatic Life Use* for Mirror Lake is assessed as impaired based on biological indicators of nutrient enrichment (evidence of high algal productivity), elevated concentrations of total phosphorus, and the presence of a non-native aquatic macrophyte.

Primary and Secondary Contact Recreation and Aesthetics Uses
There is one beach along the shoreline of Mirror Lake. Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Secchi disk transparencies were less than bathing beach guidance (1.2 m) in three out of three measurements in 2002 (Appendix D, Table D1). The pond was described as turbid and/or highly turbid during the surveys in July, August and September 2002 (MassDEP 2002a). Poor Secchi disk transparency was also reported by ESS (2001) in one of three measurements (range 0.8 to 1.4 meters). It should also be noted that ESS (2001) reported high fecal coliform levels in samples collected from storm drains that discharge to Mirror Lake.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as impaired for Mirror Lake based on the low Secchi disk measurements and the aesthetic degradation (high turbidity).

Mirror Lake (Segment MA72078) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Non-native aquatic macrophyte, biological indicators of nutrient enrichment, elevated total phosphorus Sources: Introduction of non-native organism, unknown Suspected source: Residential development along shoreline
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Poor Secchi disk transparency Source: Unknown Suspected source: Residential development along shoreline
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

MORSES POND (SEGMENT MA72079)
Location: Wellesley/Natick
Length/area: 112 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 4c - Impairment Not Caused by a Pollutant due to the presence of exotic (non-native) species* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA
Natick Water Department (32019801/9P332019801) has three groundwater wells (Oak Wells # 1, 2, and 3) upstream from the pond.
NPDES (See Appendix H, Table H4)
Lilja Elementary School, Natick (MA0039977) EPA indicated no permit was required as of January 2005.

USE ASSESSMENT
Aquatic Life Use
Biology
Three non-native aquatic macrophyte species (fanwort, variable watermilfoil, and Eurasian watermilfoil) were observed in Morses Pond during the 1997 synoptic surveys (MassDEP 1997).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of non-native aquatic macrophytes.

Primary and Secondary Contact Recreation and Aesthetics Uses
There is one beach along the shoreline of Morses Pond. Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Recreational* and *Aesthetics* uses are not assessed.

Morses Pond (Segment MA72079) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophytes Source: Introduction of non-native organisms
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the

specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

NOANNET POND (SEGMENT MA72084)
Location: Dover/Westwood
Length/area: 50 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 4c - Impairment Not Caused by a Pollutant due to the presence of exotic (non-native) species* (MassDEP 2007).

USE ASSESSMENT
Aquatic Life Use
Biology
Variable watermilfoil, a non-native aquatic macrophyte, was observed in Noannet Pond during the 1997 synoptic survey (MassDEP 1997) and also reported in 2005 (MassDEP 2005a).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native aquatic macrophyte.

Primary and Secondary Contact Recreation and Aesthetics Uses
There are two beaches along the shoreline of Noannet Pond (Membership Beach and North Beach). Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Recreational* and *Aesthetics* uses are not assessed.

Noannet Pond (Segment MA72084) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

NONESUCH POND (SEGMENT MA72085)
Location: Weston/Natick
Length/area: 39 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Curly-leaved pondweed, a non-native aquatic macrophyte, was reported in Noannet Pond in 2004 and 2005 (MassDEP 2004a, MassDEP 2005a).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native aquatic macrophyte (*P. crispus*).

Primary and Secondary Contact Recreation and Aesthetics Uses
There is one beach along the shoreline of Nonesuch Pond (River Day Camp Beach). Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Recreational* and *Aesthetics* uses are not assessed.

Nonesuch Pond (Segment MA72085) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

NORUMBEGA RESERVOIR (NORTH BASIN) (SEGMENT MA72086)
Location: Weston
Length/area: 14 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Norumbega Reservoir (North basin). No designated uses are assessed.

Norumbega Reservoir (North basin) (Segment MA72086) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

NORUMBEGA RESERVOIR (SOUTH BASIN) (SEGMENT MA72087)
Location: Weston
Length/area: 38 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Norumbega Reservoir (South basin). No designated uses are assessed.

Norumbega Reservoir (South basin) (Segment MA72087) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

LAKE PEARL (SEGMENT MA72092)
Location: Wrentham
Length/area: 237 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 4c - Impairment Not Caused by a Pollutant due to the presence of exotic (non-native) species* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Wrentham DPW Water Division registration/permit (42035001/9P42035001)
Franklin DPW Water Division 3 registration/permit (42010102/9P42010101)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Eurasian watermilfoil, a non-native aquatic macrophyte, was observed in Lake Pearl in 2002 (MassDEP 2002a). An additional non-native species variable watermilfoil, was reported in Lake Pearl in 2004 and 2005 (MassDEP 2004a, MassDEP 2005a). ESS (2001) also reports the presence of these two aquatic macrophytes in the Wrentham Lakes Report.

Boat electrofishing was conducted by DFW in June 2002. Eleven species of fish were collected (Richards 2006). The presence of American eel, a catadromous species, indicates that eel passage is possible up to this point in the watershed. Macrohabitat generalists dominated the fish community.

Water Chemistry
Sampling was conducted by DWM staff at the deep hole (W0970) in Lake Pearl as part of the 2002 Baseline Lake Project in July, August, and September 2002 as well as part of the Nutrient Criteria Development Project in July 2003 (Appendix D, Tables D1, D2, D3 and D4). Oxygen depletion occurred at depths below 5.0 m, which represents a high percentage of the lake area. Supersaturation (up to 106%) was measured in the epilimnion in July 2003. These data corroborate data reported by ESS (2001). Chlorophyll *a* concentrations ranged from 8.4 to 19 mg/m^3. Three out of four measurements were moderately high which is indicative of increased primary productivity. Secchi disk transparency measurements, however, were all $\geq$ 2.4 m. Total phosphorus concentrations near the bottom were slightly elevated (0.058 and 0.066 mg/L), an indication of phosphorus release from anoxic sediments.

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of non-native aquatic macrophytes (*M. spicatum* and *M. heterophyllum*), and low dissolved oxygen in the hypolimnion which affects a high percentage of the lake area. While chlorophyll *a* concentrations are occasionally high (indicative of algal productivity) Secchi disk transparencies were good. The indication of phosphorus release from anoxic sediments and algal productivity may be a harbinger of future problems.

Fish Consumption Use
In May 2002 Lake Pearl in Wrentham was sampled in the Charles River Watershed (Appendix E, Table E1). Composite samples of largemouth bass, brown bullhead, and yellow perch were analyzed. No DPH site-specific advisory has been issued for Lake Pearl.

Since no site-specific fish consumption advisory was issued by the MA DPH, the *Fish Consumption Use* is not assessed.

Primary and Secondary Contact Recreation and Aesthetics Uses
There are three beaches along the shoreline of Lake Pearl (Sweatt Beach, Lake Pearl Boat Launch, and Lake Pearl Park). Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

Sampling was conducted by DWM staff at the deep hole (W0970) in Lake Pearl as part of the 2002 Baseline Lake TMDL Project and the Nutrient Criteria Development Project in 2003 (Appendix D, Tables

D1 and D2). Secchi disk transparency measurements were all ≥2.4 m and no objectionable conditions (e.g., scums, deposits, odors) were noted (MassDEP 2002a and MassDEP 2003). High fecal coliform levels in one tributary (Uncas Brook) and storm drains, however, identified by ESS (2001), are of concern.

Although no objectionable conditions were recorded (MassDEP 2002a), because of the lack of lake bacteria data, the *Primary Contact Recreational Use* is not assessed. This use is identified with an Alert Status because of high bacteria counts in a tributary and storm drains that discharge to the lake. The *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as support.

Lake Pearl (Segment MA72092) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Non-native aquatic macrophyte; low DO Sources: Introduction of non-native macrophyte, unknown
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED*
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

*Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Support improvement of freshwater Beaches Bill data quality and reporting.

Conduct additional water quality monitoring (chlorophyll a, DO profiles, nutrient sampling at depth) in the pond and the watershed particularly during the summer months in order to develop a TMDL.

POPULATIC POND (SEGMENT MA72096)
Location: Norfolk
Length/area: 42 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of metals, noxious aquatic plants, and turbidity (MassDEP 2007).

The Northeast Regional Mercury Total Maximum Daily Load (TMDL) was prepared by the New England Interstate Water Pollution Control Commission (NEIWPCC) in cooperation with the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The TMDL covers waterbodies including Populatic Pond that are impaired primarily due to atmospheric deposition of mercury (Northeast States 2007). The TMDL target for Massachusetts is 0.3 ppm or less of mercury in fish tissue. The plan calls for a 75% reduction of in-region and out of region atmospheric sources by 2010 and a 90% or greater reduction in the future (NEIWPCC 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
In September 2004 a cyanobacteria bloom was recorded by DWM staff in Populatic Pond (Connors 2004 and Beskenis 2007a).

Water Chemistry
CRWA conducted water quality monitoring in Populatic Pond at the boat launch in Norfolk (Station 199S) (CRWA 2007). These data included analytes such as pH, temperature, nutrients, and chlorophyll *a*. The total number of samples collected varied by analyte. Data collected as part of this monitoring program since 2000 are summarized below. A total of 14 phosphorus and 13 ammonia samples were collected between March 2000 and December 2004. Of these 11 total phosphorus samples were above 0.05 mg/L (maximum concentration 0.102 mg/L) while the maximum ammonia-nitrogen concentration was 0.1 mg/L (CRWA 2007). Chlorophyll *a* concentrations between March 2000 and December 2003 (n= 10) ranged from 1.93 to 63.6 μg/ml with the highest measurements in September (10.1 to 63.6 μg/ml) indicative of high productivity. None of the temperature measurements (n=39) taken between April 2000 and October 2006 exceeded 28.3°C (maximum measurement was 28°C in August 2002). A total of 15 pH measurements were taken between February 2000 and December 2001. All pH measurements met water quality criteria (6.6 to 7.7 SU).

CRWA also conducted water quality monitoring in Populatic Pond as part of the CRWA Upper Charles River Watershed Total Maximum Daily Load Project (CRWA 2004a). Profiles were also taken at five locations in the pond on 27 August 2002. The deepest area in Populatic Pond (approximately 12 feet) is in the southeastern corner (CRWA 2004a). CRWA staff deployed an unattended probe to measure DO, saturation, pH, and conductivity in the northern end of the pond between 23 and 27 August 2002. DO concentrations were not less than 8.03 mg/L and were as high as 14.4 mg/L. Saturations ranged from 98 to 171%. The pH ranged from 8.37 to 9.55SU also indicative of high productivity. Dissolved oxygen depletion occurred below a depth of approximately 7 feet in the pond. Approximately a third of the lake area is deeper than 7 feet.

Water quality monitoring (*in-situ* measurements of DO and temperature) and nutrient (total phosphorus and chlorophyll *a* and pheophytin *a* samples were also taken at four locations in Populatic Pond on 21 June 2005 (Schlezinger and Howes 2006). DO concentrations at these stations ranged from 4.8 (measurements taken near the bottom) to 10.6 mg/L and all but one measurement indicated supersaturation (saturations ranged from 100.5 to 153.3%). Total phosphorus concentration ranged from 0.040 to 0.066 mg/L. It should be noted that the sample with the highest total phosphorus concentration was taken near the bottom. Chlorophyll *a* concentrations were fairly low ranging from 3.73 to 9.22 µg/L.

Sediment
Sediment cores were collected in June 2005 at four locations in Populatic Pond to measure rates of sediment oxygen demand and sediment nutrient release during aerobic and anaerobic conditions

(Schlezinger and Howes 2006). Sediments were found to have an oxygen demand that lead to anoxia (in lab tests) and nutrient release from the sediments.

The *Aquatic Life Use* is assessed as impaired for Populatic Pond based primarily on the evidence of a substantial area of the lake that affected by oxygen depletion (depths below 7 feet), high DO saturation, as well as the cyanobacteria bloom (also indicative of enrichment).

Fish Consumption Use

Fish toxics monitoring was conducted in the Charles River upstream from the South Natick Dam in 1997. The DPH reviewed these data and issued a fish consumption advisory (MA DPH 2007).

> *"Children under 12 years of age, pregnant women, and nursing mothers not consume largemouth bass from the Charles River between the Medway and South Natick Dams because of mercury hazard. All other people should limit consumption of this species to two (2) meals per month".*

Although Populatic Pond is not specifically mentioned in the current fish consumption advisory it is within the portion of the Charles River covered by the advisory (see river segments MA72-04 and MA72-05). In addition, fish toxics monitoring was conducted in Populatic Pond in June 2007 (Maietta *et al.* 2008). Mercury concentrations not only exceeded the MA DPH trigger level in largemouth bass but also in black crappie. Although trace concentrations of PCB aroclors, PCB congeners, DDT (or it's metabolites DDD and DDE) and chlordane were found in a number of fillet samples from Populatic Pond in 2007, most concentrations appear to be low. The combination of DDE and DDD in carp, however, exceeded the MA DPH trigger level. Although no advisory update has been issued as of March 2008, the 2007 survey will likely result in modification of the Charles River fish consumption advisory (Maietta *et al.* 2008).

Because of the site-specific fish consumption advisory due to mercury contamination, the *Fish Consumption Use* is assessed as impaired.

Primary and Secondary Contact Recreation and Aesthetics Uses

As part of the CRWA monthly monitoring program *E. coli* samples were collected from the Populatic Pond boat launch in Norfolk (Station 199S) between April and June 2004 (CRWA 2007). Counts ranged from <10 to 60 *E. coli*/100 mls (n=3).

In September 2004 a cyanobacteria bloom was recorded by DWM staff in Populatic Pond (Connors 2004 and Beskenis 2007a).

The *Primary and Secondary* Contact Recreational and *Aesthetic Uses* are assessed as impaired because of the objectionable conditions associated with the cyanobacteria bloom.

Populatic Pond (Segment MA72096) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Low dissolved oxygen, biological indicators of nutrient/eutrophication, excess algal growth, and high DO saturation Suspected cause: Sediment oxygen demand Source: Internal nutrient recycling Suspected source: Municipal NPDES discharge in upstream segment
Fish Consumption		IMPAIRED Cause: Elevated mercury in fish tissue Source: Unknown Suspected Source: Atmospheric Deposition
Primary Contact		IMPAIRED Cause: Excess algal growth Source: Internal nutrient recycling Suspected source: Municipal NPDES discharge in upstream segment
Secondary Contact		
Aesthetics		

RECOMMENDATIONS

Document composition/frequency/extent of cyanobacteria blooms in Populatic Pond. Develop monitoring program to evaluate source(s) contributing to the problem.

Conduct additional monitoring to better evaluate designated uses.

Continue to conduct fish toxics monitoring for Hg to evaluate changes and success of TMDL.

SANDY POND (SEGMENT MA72105)
Location: Lincoln
Length/area: 157 acres
Classification: Class A.

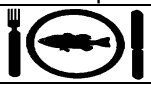
This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

This pond is also known as Gould Pond and Flint Pond.

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Lincoln Water Department registration (32015701)
NPDES (See Appendix H, Table H2)
Lincoln Water Treatment Plant (MAG640051)

USE ASSESSMENT
No quality-assured data are available for Sandy Pond. No designated uses are assessed.

Sandy Pond (Segment MA72105) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

SCARBORO GOLF COURSE POND (SEGMENT MA72107)
Location: Boston
Length/area: 6 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 4c - Impairment Not Caused by a Pollutant due to the presence of exotic (non-native) species* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Yellow floating heart, a non-native aquatic macrophyte, was reported to be in Scarboro Golf Course Pond during the 1997 synoptic surveys (MassDEP 1997). The presence of this plant actually dates back to a survey conducted by DWPC in 1986. No known control measures have been implemented to eradicate it, so it has remained as a cause of impairment.

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native aquatic macrophyte (*N. peltata*).

Scarboro Golf Course Pond (Segment MA72107) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophyte Source: Introduction of non-native organism
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

SOUTH END POND (SEGMENT MA72109)
Location: Millis
Length/area: 30 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Millis Water Department registration/permit (22018702/9P422018703)

USE ASSESSMENT
No quality-assured data are available for South End Pond. No designated uses are assessed.

South End Pond (Segment MA72109) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

STONY BROOK RESERVOIR (SEGMENT MA72114)
Location: Waltham/Weston
Length/area: 64 acres
Classification: Class A.

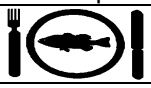
This segment is on the 2006 Integrated List of Waters in *Category 2- Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

Stony Brook Reservoir is also known as Turtle Pond.

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Cambridge Water Department registration/permit (32004901/9P32004901)
Weston Golf Club registration (32033301) (tributary that discharges to the reservoir)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Stony Brook Reservoir. No designated uses are assessed.

Stony Brook Reservoir (Segment MA72114) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

TODD POND (SEGMENT MA72117)
Location: Lincoln
Length/area: 9 acres
Classification: Class A.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Lincoln Water Department registration (32015701)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Todd Pond. No designated uses are assessed.

Todd Pond (Segment MA72117) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

* The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

UNCAS POND (SEGMENT MA72122)
Location: Franklin
Length/area: 17 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Uncas Pond is infested with the non-native aquatic plant variable milfoil (*M. heterophyllum*) (MA DCR 2005).

Water Chemistry
Sampling was conducted by DWM staff at the deep hole (W0969) in Uncas Pond as part of the 2002 Baseline Lake TMDL Project and in 2003 as part of the Nutrient Criteria Development Project (Appendix D, Tables D1, D2, D3 and D4). Chlorophyll *a* concentrations ranged from 7.2 to 18 mg/m^3 while Secchi disk transparency measurements were all $\geq$ 3.0 m. Oxygen depletion occurred at depths below 4.0 m, which affects approximately 40% of the lake area. Supersaturation (up to 117%) was measured in around the top of the thermocline in July 2003. Total phosphorus concentrations near the bottom ranged from 0.027 to 0.19 mg/L. There is some evidence of internal loading of phosphorus during anoxic conditions even though levels of total phosphorus in the pond seem to be fairly low. All of these factors are indicative of a fairly productive system.

The *Aquatic Life Use* is assessed as impaired for Uncas Pond based on low dissolved oxygen in the hypolimnion, which affects about 40% of the lake area. Additionally total phosphorus release from the sediments during anoxic conditions also occurs. While chlorophyll *a* concentrations are generally low, one marginally high value was documented. The infestation of the non-native aquatic macrophyte *M. heterophyllum* is also problematic.

Primary and Secondary Contact Recreation and Aesthetics Uses
Sampling was conducted by DWM staff at the deep hole (W0969) in Uncas Pond as part of the 2002 Baseline Lake TMDL Project and in 2003 as part of the Nutrient Criteria Development Project (Appendix D, Tables D1 and D2). Secchi disk transparency measurements were all good (Appendix D, Table D1) and no objectionable conditions were noted.

Although no objectionable conditions were recorded (MassDEP 2002a), because of the lack of bacteria data, the *Primary Contact Recreational Use* is not assessed. The *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as support.

Uncas Pond (Segment MA72122) Use Summary

Designated Uses		Status
Aquatic Life		IMPAIRED Causes: Non-native aquatic macrophyte, low dissolved oxygen Sources: Introduction of non-native organism, unknown
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

Conduct additional water quality monitoring (chlorophyll *a*, DO profiles, nutrient sampling at depth) in the pond and the watershed particularly during the summer months in order to develop a TMDL.

LAKE WABAN (SEGMENT MA72125)
Location: Wellesley
Length/area: 109 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 4c - Impairment Not Caused by a Pollutant due to the presence of exotic (non-native) species* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA (See Appendix H, Table H1)
Wellesley College (32031702/9P432031701) has two groundwater wells near the pond. A non-consumptive use status was also accepted for Wellesley College in May 2000 for 0.72MGD from Lake Waban from June to September.
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Two non-native species, fanwort and Eurasian watermilfoil, were observed in Lake Waban during the 1997 synoptic survey (MassDEP 1997). ACT, Inc. (consultants) also observed water shamrock (*Marsilea quadrifolia*) in the lake in 2005 (MA DCR 2005). One additional species, variable watermilfoil, was identified in Morses Pond located just upstream from Lake Waban. The proximity of this other non-native is a potential threat to this waterbody.

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of non-native aquatic macrophytes.

Lake Waban (Segment MA72125) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophytes Source: Introduction of non-native organisms
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS
Continue to monitor for the presence of invasive non-native aquatic vegetation and determine the extent of the infestation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas, including downstream from the site, and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and their responsibility to prevent spreading these species. The Final GEIR for Eutrophication and Aquatic Plant Management in Massachusetts (Mattson *et al.* 2004) should also be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should not be used for many species because of the propensity for these invasive species to reproduce and spread vegetatively (from cuttings).

WALKER POND (SEGMENT MA72126)
Location: Millis
Length/area: 9 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

USE ASSESSMENT
No quality-assured data are available for Walker Pond. No designated uses are assessed.

Walker Pond (Segment MA72126) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

WASEEKA SANCTUARY POND (SEGMENT MA72155)
Location: Holliston
Length/area: 17 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Waseeka Sanctuary Pond. No designated uses are assessed.

Waseeka Sanctuary Pond (Segment MA72155) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

WELD POND (SEGMENT MA72131)
Location: Dedham
Length/area: 27 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
A suspected non-native species (*Myriophyllum* sp., possibly *M. heterophyllum*) was observed in Weld Pond during a macrophyte survey conducted by DWM in August 2002 (MassDEP 2002a).

Water Chemistry
Sampling was conducted by DWM staff at the deep hole in the northeast lobe (W0972) in Weld Pond as part of the 2002 Baseline Lake Project (Appendix D, Tables D1 and D3). Chlorophyll *a* and total phosphorus concentrations were both low ($\leq$2.6 mg/m^3 and <0.015 mg/L, respectively). DO concentrations ($\geq$ 5.5 mg/L) and Secchi disk transparency measurements (> 1.9 m) were good.

The *Aquatic Life Use* is assessed as support for Weld Pond based on the good water quality conditions. However, this use is identified with an Alert Status based on the potential presence of a non-native species.

Primary and Secondary Contact Recreation and Aesthetics Uses
Sampling was conducted by DWM staff at the deep hole (W0972) in Weld Pond as part of the 2002 Baseline Lake Project (Appendix D, Tables D1 and D2). Secchi disk transparency measurements were all good (Appendix D, Table D1) and no objectionable conditions were noted.

Although no objectionable conditions were recorded (MassDEP 2002a), because of the lack of bacteria data, the *Primary Contact Recreational Use* is not assessed. The *Secondary Contact Recreational* and *Aesthetics Uses* are assessed as support.

Weld Pond (Segment MA72131) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* Alert Status issues identified, see details in use assessment section

RECOMMENDATIONS
Conduct aquatic macrophyte survey in late July/August to confirm species of *Myriophyllum*.

Continue to monitor for the presence of invasive non-native aquatic vegetation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

Conduct monitoring to evaluate designated uses.

WESTON RESERVOIR (SEGMENT MA72134)
Location: Weston
Length/area: 59 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 2 - Attaining Some Uses (Secondary Contact Recreation and Aesthetics); Others Not Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Weston Reservoir. No designated uses are assessed.

Weston Reservoir (Segment MA72134) Use Summary

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

WESTON STATION POND (SEGMENT MA72135)
Location: Weston
Length/area: 38 acres
Classification: Class A.

This segment is on the 2006 Integrated List of Waters in *Category 3 - No Uses Assessed* (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
No quality-assured data are available for Weston Station Pond. No designated uses are assessed.

Weston Station Pond (Segment MA72135) Use Summary

Aquatic Life	Fish Consumption	Drinking Water*	Primary Contact	Secondary Contact	Aesthetics
					
NOT ASSESSED					

*The MassDEP Drinking Water Program maintains current drinking water supply data.

RECOMMENDATIONS
Conduct monitoring to evaluate designated uses.

LAKE WINTHROP (SEGMENT MA72140)
Location: Holliston
Length/area: 131 acres
Classification: Class B.

This segment is on the 2006 Integrated List of Waters in *Category 5 - Waters Requiring a TMDL* because of pesticides as well as exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES
WMA
Holliston Water Department (22013601/9P422013602) has one groundwater well (01g) source upstream from the pond.
Holliston Lake Winthrop (9P222013601) surface water withdrawal (01S)
Ben Generazio Nursery & Fish (22017702)
NPDES (See Appendix H, Table H4)

USE ASSESSMENT
Aquatic Life Use
Biology
Two non-native species, fanwort and variable watermilfoil, were observed in Lake Winthrop during the 1997 synoptic surveys (MassDEP 1997).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of non-native aquatic macrophytes.

Fish Consumption Use
As a result of fish toxics sampling at Lake Winthrop in 1983/84 the MA DPH issued the following fish consumption advisory because of elevated dioxin levels (MA DPH 2007).

"The general public should not consume any fish from this water body."

Subsequent sampling was conducted in by MassDEP DWM in 1996 and1997. The results of all of these surveys are summarized in Appendix E.

Because of the site-specific fish consumption advisory for Lake Winthrop due to dioxin contamination, the *Fish Consumption Use* is assessed as impaired

Primary and Secondary Contact Recreation and Aesthetics Uses
There are two beaches along the shoreline of Lake Winthrop (Pleasure Point Beach and Stoddard Beach). Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to the MA DPH which is required as part of the Beaches Bill. Therefore, no *Primary Contact Recreational Use* assessments (either support or impairment) decisions are being made using Beaches Bill data for this waterbody.

The *Recreational* and *Aesthetics* uses are not assessed.

Lake Winthrop (Segment MA72140) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native aquatic macrophytes Source: Introduction of non-native organism
Fish Consumption		IMPAIRED Cause: Dioxin (2,3,7,8-TCDD) Source: Unknown Suspected Source: Historic herbicide treatments
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

RECOMMENDATIONS

Support improvement of freshwater Beaches Bill data quality and reporting.

Continue to monitor for the presence of invasive non-native aquatic vegetation. Prevent spreading of invasive aquatic plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

Conduct additional monitoring to evaluate designated uses.

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