

CONNECTICUT RIVER WATERSHED

2003 WATER QUALITY ASSESSMENT REPORT



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CONNECTICUT RIVER BASIN
2003 WATER QUALITY ASSESSMENT REPORT

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Division of Watershed Management

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Cover photo: View of the Connecticut River Valley from Sugarloaf Mountain in Deerfield, taken by Jamie Carr.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACOE Army Corps of Engineers (United States)	MassDEP Massachusetts Department of Environmental Protection
BMP best management practice	MA DFG Massachusetts Department of Fish and Game
BPJ best professional judgment	MA DPH Massachusetts Department of Public Health
CMR Code of Massachusetts Regulations	MassGIS Massachusetts Geographic Information System
CNOEC chronic no observed effect concentration	NPDES National Pollutant Discharge Elimination System
CRWC Connecticut River Watershed Coalition	PAH polycyclic aromatic hydrocarbons
CSO combined sewer overflow	PCB polychlorinated biphenyls
CWA Clean Water Act	QAPP quality assurance project plan
DDE dichlorodiphenyldichloroethylene	SOP standard operating procedure
DDT dichlorodiphenyltrichloroethane	SWQS Surface Water Quality Standards
DO dissolved oxygen	TMDL total maximum daily load
DPW Department of Public Works	TRC total residual chlorine
DWM Division of Watershed Management	TSS total suspended solids
EPA United States Environmental Protection Agency	USGS United States Geological Survey
GIS geographic information system	WBS Waterbody System database
LC ₅₀ lethal concentration to 50% of the test organisms	WMA Water Management Act
MA DCR Massachusetts Department of Conservation and Recreation	WPCF Water Pollution Control Facility
	WWTP wastewater treatment plant

LIST OF UNITS

cfs cubic feet per second
cfu colony forming unit
gpm gallons per minute
MG million gallons
MGD million gallons per day
M meter
ml milliliters
mg/L milligram per liter
MG/yr million gallons per year
MPN most probably number
NTU nephelometric turbidity units
psi pounds per square inch
µeq/L microequivalents per liter
µg/kg microgram per kilogram
µS/cm micro seimens per centimeter

LIST OF FISH SPECIES

Common Name	Scientific Name
American eel	<i>Anguilla rostrata</i>
Atlantic Salmon	<i>Salmo salar</i>
Blacknose dace	<i>Rhinichthys atratulus</i>
Bluegill	<i>Lepomis macrochirus</i>
Bowfin	<i>Amia calva</i>
Brook trout	<i>Salvelinus fontinalis</i>
Brown bullhead	<i>Ameiurus nebulosus</i>
Brown trout	<i>Salmo trutta</i>
Chain pickerel	<i>Esox niger</i>
Common shiner	<i>Notropis cornutus</i>
Creek chub	<i>Semotilus atromaculatus</i>
Creek chubsucker	<i>Erimyzon oblongus</i>
Fallfish	<i>Semotilus corporalis</i>
Golden shiner	<i>Notemigonus crysoleucas</i>
Hybrid bluegill/ pumpkinseed	<i>Lepomis macrochirus X Lepomis gibbosus</i>
Largemouth bass	<i>Micropterus salmoides</i>
Longnose dace	<i>Rhinichthys cataractae</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Rainbow trout	<i>Oncorhynchus mykiss</i>
Redbreast sunfish	<i>Lepomis auritus</i>
Redfin pickerel	<i>Esox americanus americanus</i>
Rock bass	<i>Ambloplites rupestris</i>
Sea lamprey	<i>Petromyzon marinus</i>
Slimy sculpin	<i>Cottus cognatus</i>
Smallmouth bass	<i>Micropterus dolomieu</i>
Tessellated darter	<i>Etheostoma olmstedii</i>
White sucker	<i>Catostomus commersoni</i>
Yellow bullhead	<i>Ameiurus natalis</i>
Yellow perch	<i>Perca flavescens</i>

LIST OF INVASIVE PLANT SPECIES

Latin Name	Common Name
<i>Cabomba caroliniana</i>	Fanwort
<i>Myriophyllum heterophyllum</i>	Variable Watermilfoil
<i>Myriophyllum sp.</i>	Watermilfoil
<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil
<i>Najas minor</i>	European Naiad
<i>Nelumbo lutea</i>	American Lotus
<i>Potamogeton crispus</i>	Curly-leaved Pondweed
<i>Trapa natans</i>	Water Chestnut

EXECUTIVE SUMMARY

CONNECTICUT RIVER BASIN 2001 -2007 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 Connecticut 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). Summaries of the assessments for the *Aquatic Life*, *Fish Consumption*, *Primary* and *Secondary Contact Recreation*, and *Aesthetics* uses in the Connecticut River Watershed segments are illustrated in Figures 1 through 5, respectively.

The term *Drinking Water Use* is used to indicate sources of public drinking water. While this use is not assessed in this report, the state provides general guidance on drinking water source protection of both surface water and groundwater sources (available at <http://www.mass.gov/dep/water/drinking.htm>). These waters are subject to stringent regulation in accordance with the Massachusetts Drinking Water Regulations. MassDEP’s Drinking Water Program has responsibility for implementing the provisions of the federal Safe Drinking Water Act. The Drinking Water Program also continues to work on its Source Water Assessment Program, which requires that the Commonwealth delineate protection areas for all public ground and surface water sources, inventory land uses in these areas that may present potential threats to drinking water quality, determine the susceptibility of water supplies to contamination from these sources, and publicize the results.

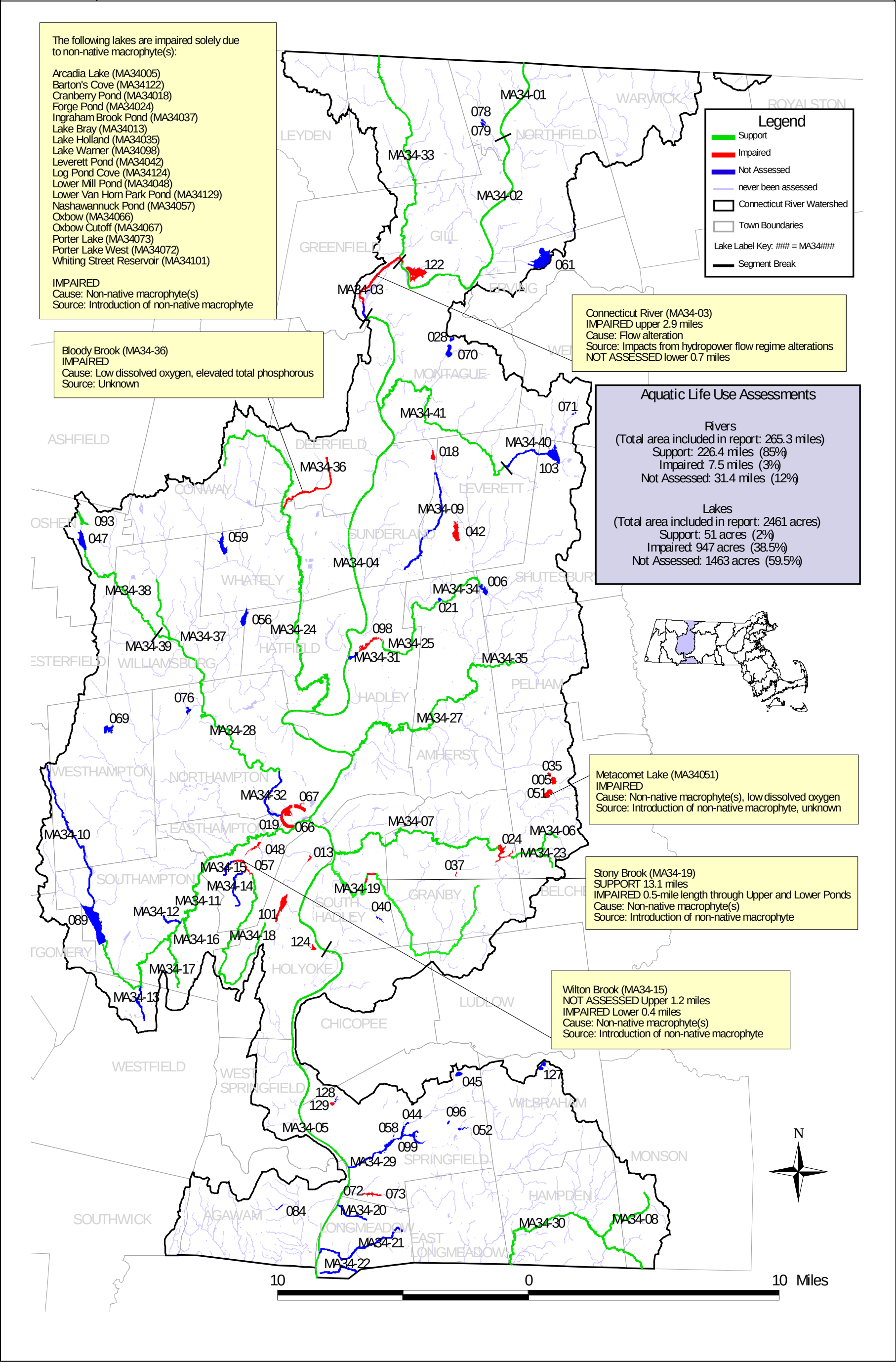
Public water suppliers monitor their finished water (tap water) for major categories of both naturally occurring and man-made contaminants such as: microbiological, inorganic, organic, pesticides, herbicides, and radioactive contaminants. Specific information on community drinking water sources, including Source Water Assessment Program activities and drinking water quality information, are updated and distributed annually by the public water system to its customers in a “Consumer Confidence Report”. These reports are available from the public water system, the local boards of health, MA DPH and MassDEP.

On December 20, 2007, the U.S. EPA approved the Northeast Regional Mercury Total Maximum Daily Load (TMDL). This TMDL is a Federal Clean Water Act mandated document that identifies pollutant load reductions necessary for regional waterbodies to meet and maintain compliance with state and federal water quality standards. It 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). Currently, the MA DPH statewide fish advisory regarding fish consumption and mercury contamination encompasses all freshwaters in Massachusetts (MA DPH 2001), thus the Fish Consumption Use for all waterbodies in this report cannot be assessed as support (see Fig. 2, page xiii).



Figure 1. 2003 Aquatic Life Use assessment summary for river and lake segments in the Connecticut 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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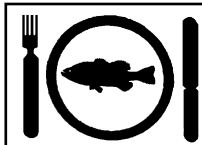


Figure 2. 2003 Fish Consumption Use assessment summary for river and lake segments in the Connecticut Watershed.

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.

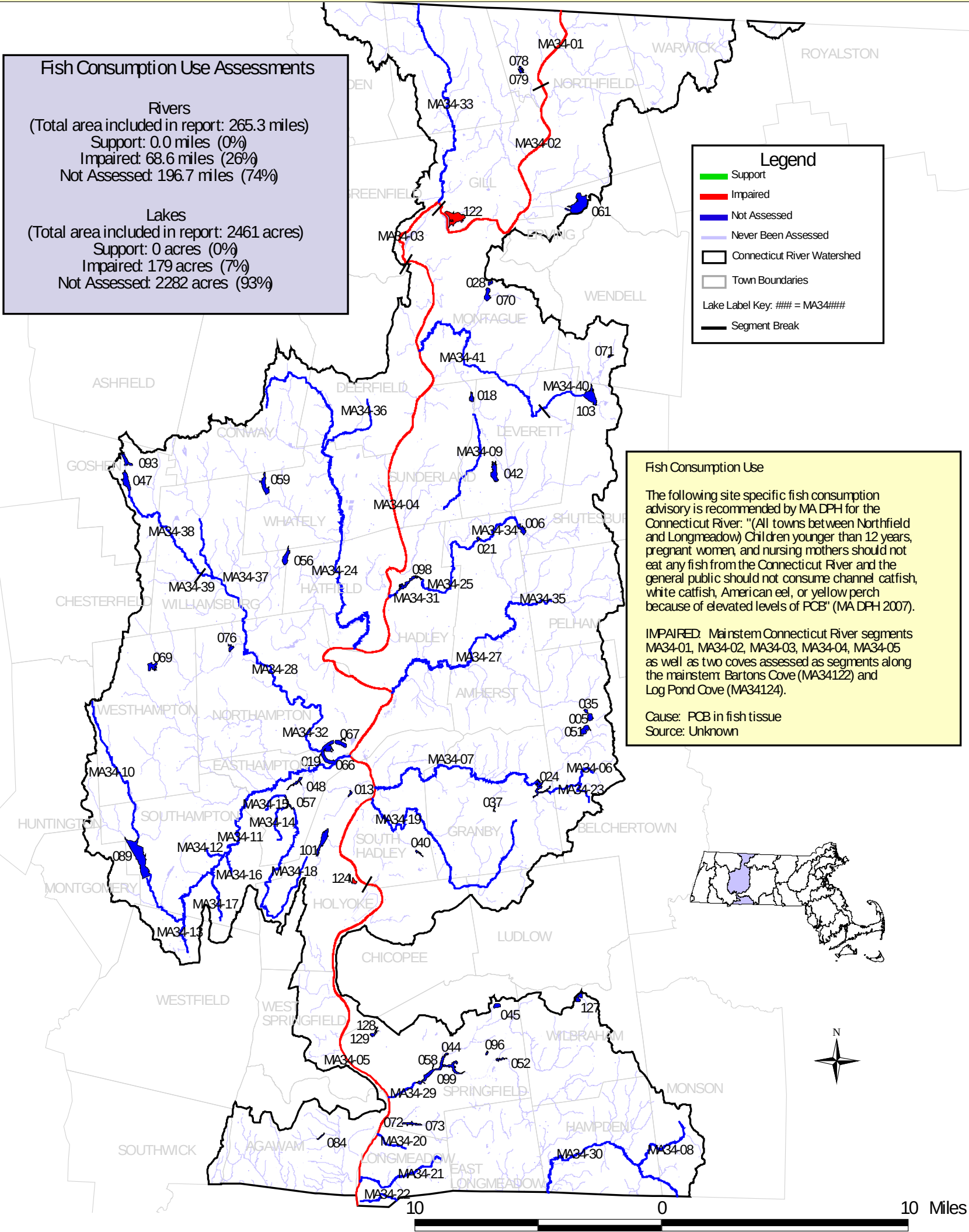
The current MA DPH statewide advisory (MA DPH 2001):

In July 2001 MA DPH issued new consumer advisories on fish consumption and mercury contamination. The MA DPH "...is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers, and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age. Finally, MA DPH is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers, and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to two (2) cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury."

MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

Since the statewide advisory encompasses all freshwaters in Massachusetts, the Fish Consumption Use for waterbodies cannot be assessed as support.

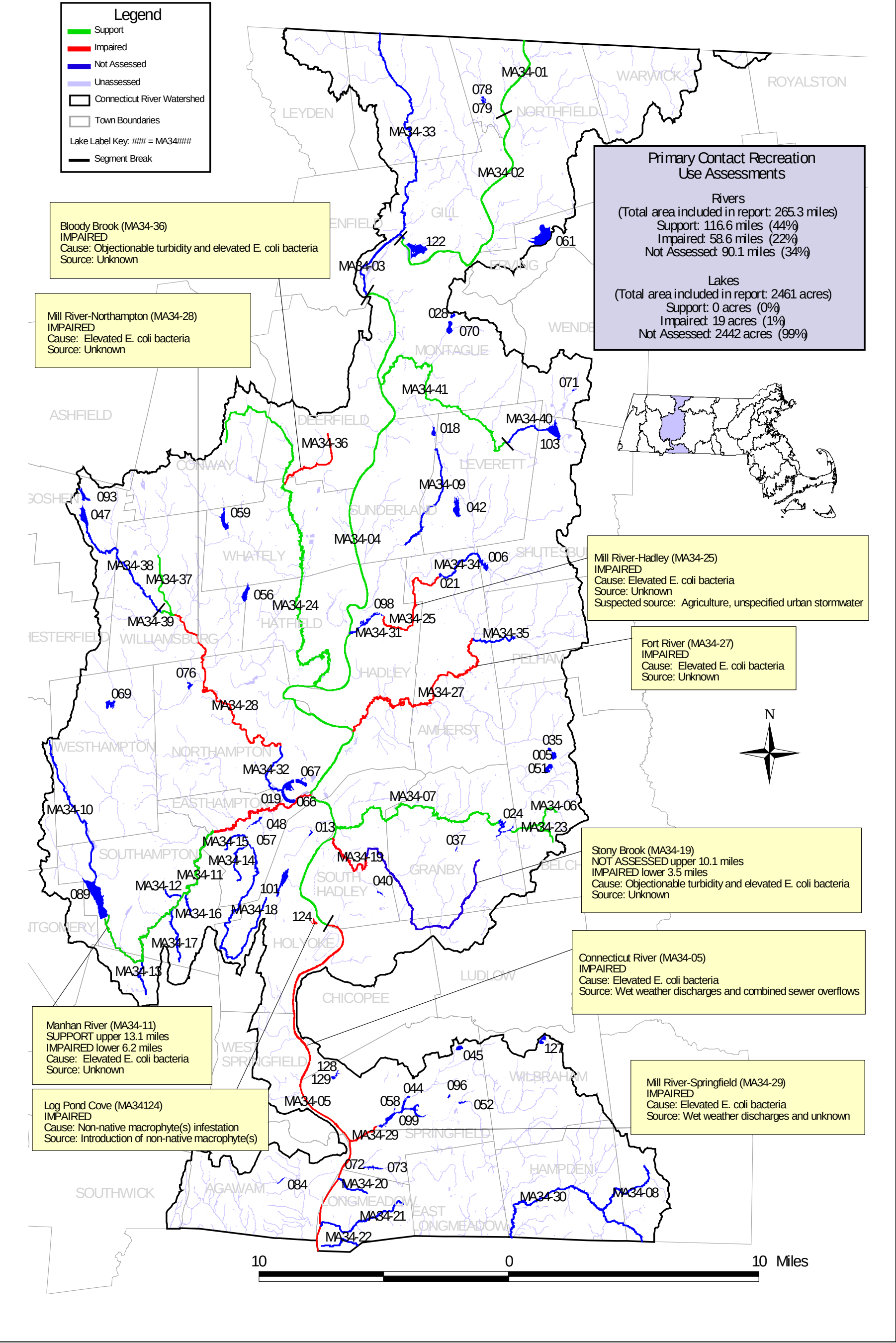
Northeast Regional Mercury TMDL: On 20 December 2007 the U.S. EPA approved the Northeast Regional Mercury Total Maximum Daily Load (TMDL). This TMDL is a Federal Clean Water Act mandated document that identifies pollutant load reductions necessary for regional waterbodies to meet and maintain compliance with state and federal water quality standards. It 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 inland 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). The TMDL will be reassessed in 2010 based on an evaluation of new on-going monitoring and air deposition data. Final targets will be determined at that time.



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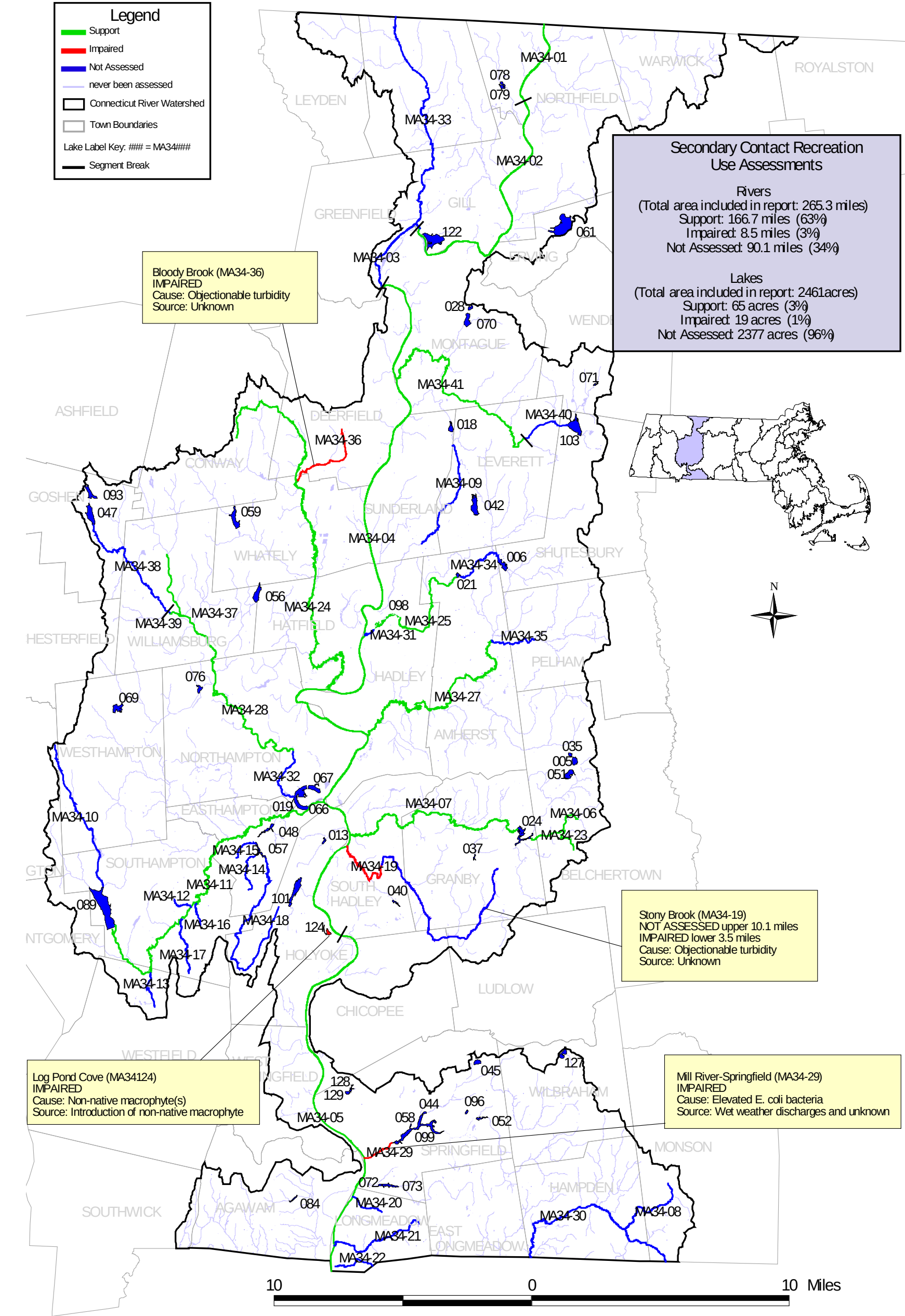
Figure 3. 2003 Primary Contact Recreational Use assessment summary for river and lake segments in the Connecticut Watershed
Note: The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, turbidity and aesthetics meet the SWQS and/or the MA DPH 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. 2003 Secondary Contact Recreational Use assessment summary for river and lake segments in the Connecticut 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.

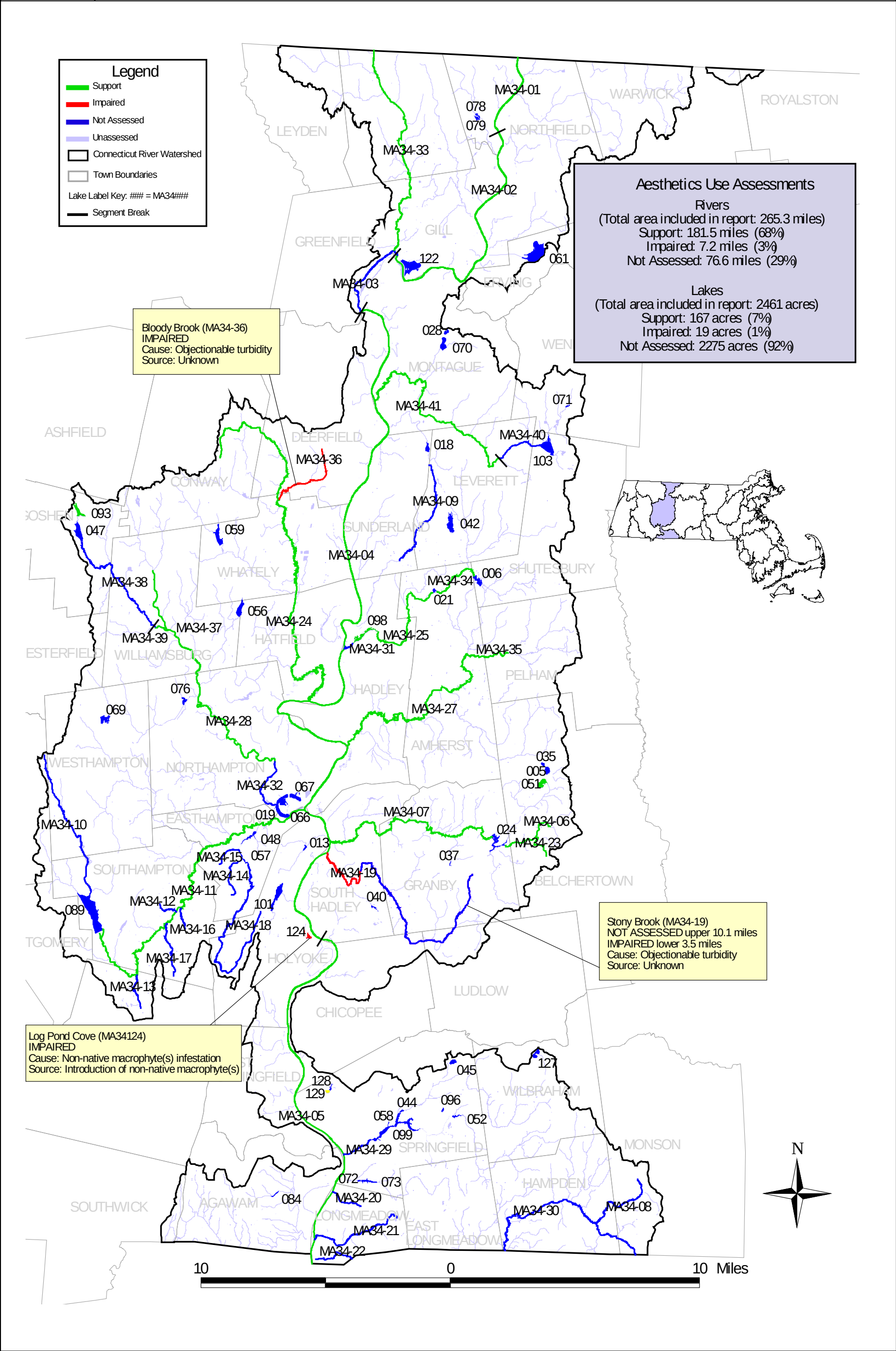


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Figure 5. 2003 Aesthetics Use assessment summary for river and lake segments in the Connecticut Watershed

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, MassDEP must submit a statewide report every two years to the EPA, which describes the status of water quality in the Commonwealth. 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.

This report presents the current assessment of water quality conditions in the Connecticut River Watershed. The assessments are based on information that has been 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) 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 in and since 2003 were utilized to make assessment decisions. All of these data are provided as Appendices to this report. Other sources of water quality data used to make use assessment attainment decisions are also utilized and cited in this report.

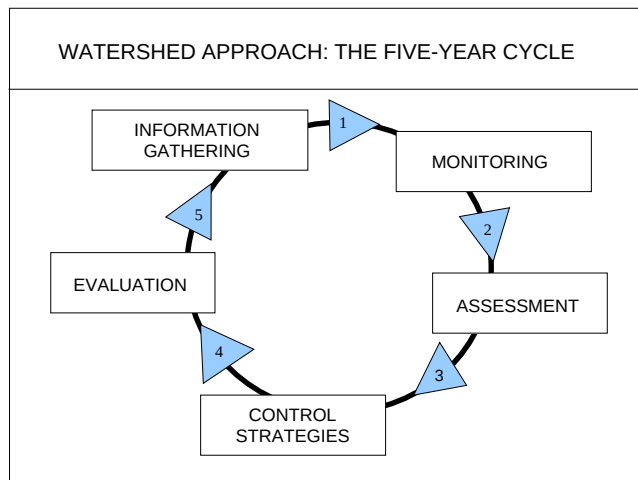


Figure 6. Five-year cycle of the Watershed Approach

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 report) 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.

CONNECTICUT RIVER WATERSHED DESCRIPTION

The Connecticut River and its tributaries constitute the largest river basin in New England. From its origin in the Connecticut Lakes Region near the Canadian border, the 410-mile Connecticut River flows southward to form the boundary between New Hampshire and Vermont. It then flows through Massachusetts and Connecticut to the Long Island Sound. The Connecticut River traverses approximately 67 river miles and drains approximately 2,726 square miles within Massachusetts. In Massachusetts it is bordered by the Deerfield River Basin to the northwest, the Westfield River Basin to the southwest, the Millers River Basin to the northeast and by the Chicopee River Basin to the southeast.

Based upon the Massachusetts Water Resources Commission's delineation, the Connecticut River Basin drains approximately 670 square miles (exclusive of the Deerfield, Millers, Westfield and Chicopee subbasins). The communities of Agawam, Amherst, Ashfield, Belchertown, Bernardston, Chesterfield, Chicopee, Conway, Deerfield, East Longmeadow, Easthampton, Erving, Gill, Goshen, Granby, Greenfield, Hadley, Hampden, Hatfield, Holyoke, Huntington, Leverett, Leydon, Longmeadow, Ludlow, Monson, Montague, Montgomery, Northampton, Northfield, Pelham, Royalston, Shutesbury, South Hadley, Southampton, Southwick, Springfield, Sunderland, Warwick, Wendell, West Springfield, Westfield, Westhampton, Whately, Wilbraham, and Williamsburg lie wholly or partly within the watershed boundary. Major tributaries discharging to the Connecticut River within Massachusetts include the Millers, Deerfield, Chicopee and Westfield rivers.

OBJECTIVES

This report summarizes information generated in the Connecticut River Watersheds since the last water quality assessment report that was published in November 2000 (Kennedy and Weinstein 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 2003 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 Connecticut River Watershed.

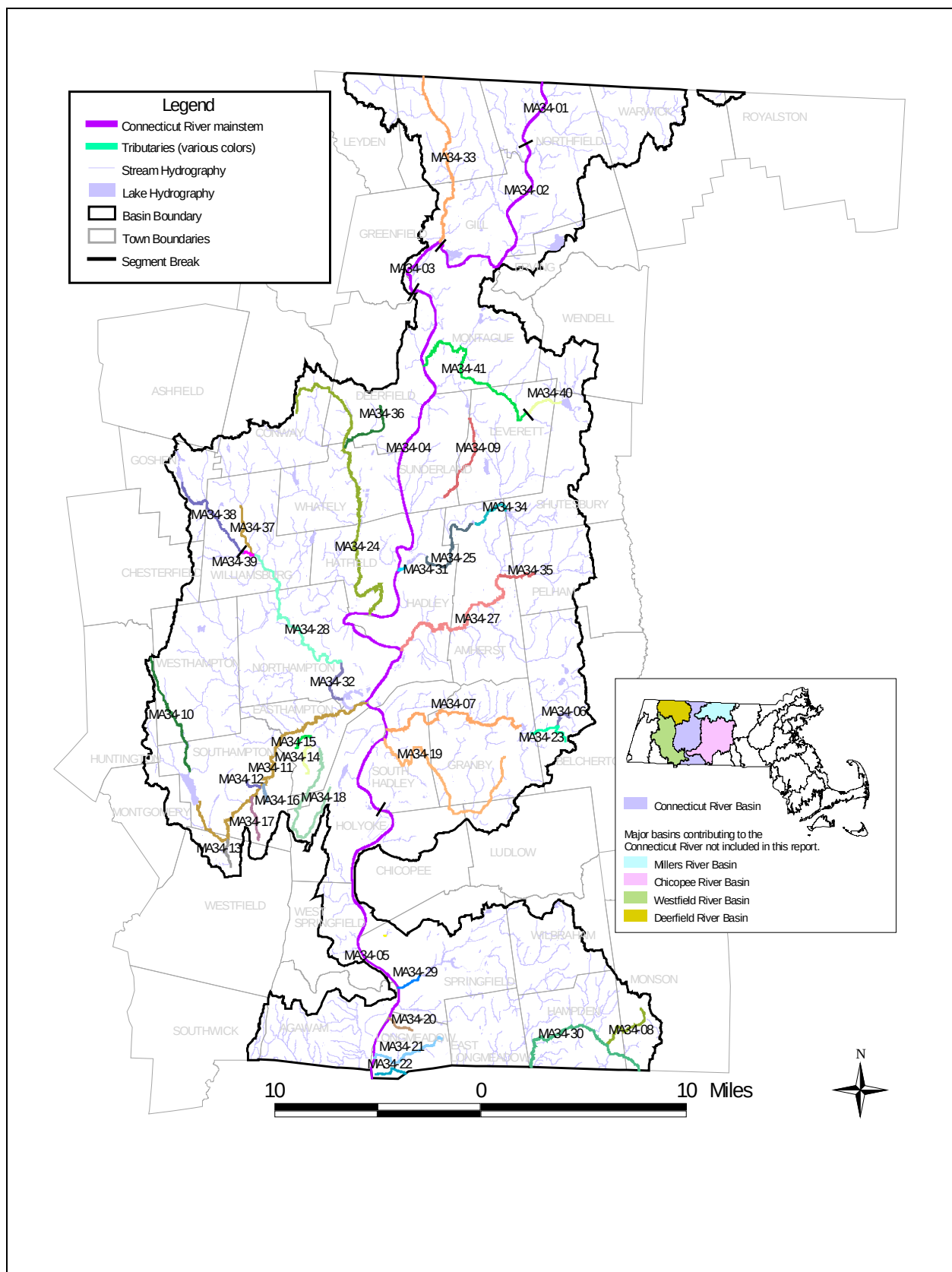
Not all waters in the Connecticut River Watershed are included in the MassDEP/EPA databases (either the waterbody system database -- WBS, or the newer assessment database -- ADB) or this report.

The objectives of this water quality assessment report are to:

1. evaluate whether or not surface waters in the Connecticut 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 (wastewater discharges) and non-point (land-use practices, stormwater discharges, 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.

CONNECTICUT RIVER WATERSHED – RIVER SEGMENTS ASSESSED

Figure 7. River segments in the Connecticut River Watershed included in this report.



CONNECTICUT RIVER (SEGMENT MA34-01)

Location: New Hampshire/Vermont/Massachusetts state line to Route 10 bridge, Northfield.

Segment Length: 3.5 miles.

Classification: Class B, Warm Water Fishery.

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

The State of New Hampshire identifies aluminum, copper, and pH as pollutants impairing the *Aquatic Life Use* of the mainstem Connecticut River segment immediately upstream from Massachusetts (Edwardson 2007). The *Fish Consumption Use* was impaired due to mercury (likely source atmospheric deposition) and PCB contamination (source unknown). The *Primary and Secondary Contact Recreation Uses* were assessed as support.

The Connecticut River from Vernon, Vermont, to Turners Falls, Massachusetts, is commonly known as the Turner Falls Power Pool. This segment (MA34-01) is entirely contained within the 22-mile Turners Falls Power Pool. Bank erosion caused by a complex interaction of multiple factors is a significant problem in this reach of the Connecticut River. Flood flows, boat wakes, overland flow, groundwater seeps, and pool fluctuation resulting from operation of multiple hydroelectric generating facilities directly impact the day-to-day hydrodynamics of the Turners Falls Power Pool.

The 1979 "Report on Connecticut River Streambank Erosion Study" Report by the Army Corps of Engineers (ACOE) attempted to identify the causes of erosion and rate the importance of each. In addition to natural causes such as shear stress and stage variation, the report identified pool fluctuations and boat waves as contributing erosional factors. Pool fluctuations were named as causing an increase in bank instability on the order of 18% of the shear stress exerted in the bank merely by flowing water. The report also identifies the difference in the nature of the erosion caused by wave action, which only works at the level of the water and the various shear stress forces that work on the full height of the submerged bank, where the maximum shear stress is exerted on the bank below water at about 2/3 of the water's depth (Franklin Regional Council of Governments and Connecticut River Streambank Erosion Committee 1999).

In July of 1991, the ACOE completed a follow-up report on the erosion in the Turners Falls Pool, "General Investigation Study, Connecticut River Streambank Erosion: Connecticut River, Turners Falls Dam to State Line, MA." This study concluded that the riverbank erosion had increased almost threefold since 1979, with approximately one-third of the shoreline undergoing active erosion (Franklin Regional Council of Governments and Connecticut River Streambank Erosion Committee 1999). A follow up study conducted in 2007 found that bank recession rates are on the order of 1.0 ft/yr, but that as much as 9.0 ft of erosion has occurred in a single year (Field 2007).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

East Northfield Water Company (9P210621702)

NPDES (Appendix H, Table H2)

Town of Northfield Wastewater Treatment Facility (MA0100200)

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

Three hydroelectric generating facilities directly impact the day-to-day hydrodynamics of the Turners Falls Power Pool: Vernon, VT, Northfield Mountain, and Turners Falls. In the Turners Falls Pool section of the Connecticut the banks of the river, which are often twenty or more feet above the water level, are characterized by slumping and mass wasting of huge sections of bank, with trees and other riparian vegetation frequently falling and sliding into the water (Franklin Regional Council of Governments and Connecticut River Streambank Erosion Committee 1999). Evidence of extreme erosion prompted the Franklin Regional Council of Governments to carry out a series of 319-funded bank stabilization projects implemented between 1996 and 2007. These Connecticut River Watershed Restoration Projects

included: Phase I (96-03/319); Phase II (00-04/319); and Phase III (03-07/319). Eroding sites in this segment of the Connecticut River were inventoried and prioritized according to factors including severity of the problem and feasibility of stabilization, and selected for restoration via design and installation of bioengineered bank. Over 1,500 linear feet of eroded bank have been stabilized by these three projects using a variety of bioengineering techniques.

Toxicity

Ambient

The Northfield Wastewater Treatment Facility staff collected water from the Connecticut River at the boat ramp, north of Schell Bridge, for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and August 2007, survival of *C. dubia* exposed (48-hours) to the Connecticut River water ranged from 90 to 100% (n=15). Hardness ranged from 23 to 52 mg/L (n=15).

Effluent

Acute whole effluent toxicity tests have been conducted on the Northfield Wastewater Treatment Facility treated effluent. No acute toxicity was detected in the 15 *C. dubia* test events conducted between August 2000 and August 2007 (LC₅₀ ≥ 100% effluent).

Chemistry - water

DWM conducted water quality sampling at the Route 10 Bridge in Northfield, Station CT06, on this segment of the Connecticut River between April and October 2003 (Appendix B). All measurements were indicative of good water quality conditions.

Chemistry- fish tissue

The Connecticut River Fish Tissue Contaminant Study (2000) was a collaborative federal and multi-state project designed to provide a baseline of tissue contaminant data from several fish species and learn what threat eating these fish poses to other mammals, birds, and fish (Hellyer 2006). This study reached the following conclusions: mercury poses a risk to fish-eating wildlife, DDT homologs (chemical physical, and biological breakdown products of the parent compound) pose a risk to fish-eating birds, coplanar PCBs pose a risk to fish-eating mammals and fish-eating birds, and dioxin constituted a risk to fish-eating wildlife.

This segment of the Connecticut River is assessed as support with Alert Status for the *Aquatic Life Use*. This decision is based upon the good survival of test organism in toxicity tests and the good water quality conditions. However, this use is identified with an Alert Status due to the regulated flow regime, the severe bank erosion issues, and the risk that fish tissue contaminants pose to fish-eating wildlife. At this time there is insufficient evidence of a negative impact to in-stream biota to result in the impairment of this use.

FISH CONSUMPTION

The following site specific fish consumption advisory is recommended by MA DPH for the mainstem Connecticut River:

"(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB" (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected *E. coli* samples from the Connecticut River at the Route 10 Bridge in Northfield (Station CT06) between April and November 2003 (Appendix B). The geometric mean of these samples was 12 cfu/100ml.

DWM personnel made field observations at Station CT06 during the surveys conducted between April and October 2003. This station was free from odors and objectionable deposits during all visits, although the water clarity was recorded as highly turbid on three occasions (MassDEP 2003).

The *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based upon the low bacteria counts and the lack of objectionable deposits, odors, or oils. However these uses are identified with an Alert Status due to the highly turbid conditions, regulated flow regime and severe bank erosion issues.

Connecticut River (Segment MA34-01) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		SUPPORT*
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT*

* Alert Status, see details in use assessment

RECOMMENDATIONS

Didymosphenia geminata, otherwise known as Didymo or “rock snot”, is considered an invasive algae and has been found in the Connecticut River in Vermont and New Hampshire. Infestation and nuisance blooms of Didymo can produce thick mats that blanket stream and river substrates, causing a loss of habitat for fish and other aquatic organisms. Didymo blooms can make fishing, swimming, or boating undesirable or impossible (MA DCR 2008). Although it is currently not known if Didymo will colonize and/or bloom in the Massachusetts section of the Connecticut River, every effort should be made to prevent the spread of this nuisance algae in the mainstem Connecticut River and its tributaries. MA DCR recommends the Check-Clean-Dry protocol be followed when exiting waters that may be infested with Didymo. For more information visit: http://www.mass.gov/dcr/waterSupply/lakepond/hot_topic.htm.

The Town of Northfield Wastewater Treatment Facility NPDES Permit MA0100200 should be reissued. Based on the lack of any evidence of acute whole effluent toxicity, the whole effluent toxicity testing requirements should be reduced to annually (testing required in August of each year).

Field determined that 20 percent of the bank length has been protected by rock armor. Field recommends using new approaches for subsequent bank stabilization work, as continued reliance on armoring could lead to increased erosion elsewhere (Field 2007).

Water quality testing, especially TSS and turbidity, should continue to be monitored to assess the impact of the severe bank erosion upon the *Aquatic Life Use*.

CONNECTICUT RIVER (SEGMENT MA34-02)

Location: Route 10 bridge, Northfield, to Turners Falls Dam, Gill/Montague.

Segment Length: 11.2 miles.

Classification: Class B, Warm Water Fishery.

This segment is on the 2006 Integrated List of Waters in "Category 5"- *Waters Requiring a TMDL* because of priority organics, flow alteration, and other habitat alterations (MassDEP 2007).

This segment of the Connecticut River (MA34-02) is entirely contained within the 22-mile Turners Falls Power Pool. Bank erosion caused by a complex interaction of multiple factors is a significant problem in this reach of the Connecticut River. In addition to flood flows, boat wakes, overland flow, and groundwater seeps, pool fluctuation resulting from operation of one of three hydroelectric generating facilities directly impact the day-to-day hydrodynamics of the Turners Falls Power Pool. The Northfield Mountain Pumped Storage Project is located within this segment. The joint operation of the Turners Falls and the Northfield projects has affected the daily flow regime of the river in this pool, resulting in larger and quicker pool fluctuations than would naturally occur (Franklin Regional Council of Governments and Connecticut River Streambank Erosion Committee 1999).

The Northfield Mountain Pumped Storage Project is located about five miles upstream from the Turners Falls dam. It consists of an upper reservoir and an underground pumping and generating plant, which uses reversible pump turbine units. The Project also relies on the Turners Falls Pool to serve as a lower reservoir. During periods of low electrical demand, the Northfield Mountain Pumped Storage Facility pumps water from the lower reservoir to the upper reservoir using the pump turbine generators. The water is then released during periods of high electrical demand, again through the pump turbine generators. In this way, the project is able to generate a maximum of 1,080 megawatts of electricity. The increase in dam height over time, from 163.9 feet in 1867 to 185.5 feet in 1970 (21.6 feet in 103 years), has significantly altered the hydrodynamics of the reach. The joint operation of the Turners Falls and the Northfield projects has also significantly changed the daily flow regime of the river in the Turners Falls Pool, resulting in larger and quicker pool fluctuations. Typically, pool fluctuations may average as much as 3.5 feet per day, and much higher fluctuations (9-10.5 feet) may occur over the weekly cycle (Franklin Regional Council of Governments and Connecticut River Streambank Erosion Committee 1999).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Four Star Farms, Inc., Northfield (9P210621703)

NPDES (Appendix H, Table H2)

Northfield Mount Hermon School, Gill Facility (MA0032573)

First Light Hydro Generating Company (MA0035530)

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

Project Name	Owner	Project #	Issue Date	Expiration Date	River	Kilowatts
Northfield Mountain Power Station	FirstLight Hydro Generating Company	2485	14 May 1968	30 April 2018	Connecticut River	1,080,000

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

Three hydroelectric generating facilities directly impact the day-to-day hydrodynamics of the Turners Falls Power Pool: Vernon, VT, Turners Falls, and Northfield Mountain. The banks of the Connecticut River in the Turners Falls Pool section are often twenty or more feet above the water level, and are characterized by slumping and mass wasting of huge sections of streambank. Trees and other riparian vegetation frequently fall and slide into the water (Franklin Regional Council of Governments and Connecticut River Streambank Erosion Committee 1999). Evidence of extreme erosion prompted the Franklin Regional Council of Governments to carry out a series of 319-funded bank stabilization projects implemented

between 1996 and 2007. These Connecticut River Watershed Restoration Projects included: Phase I (96-03/319); Phase II (00-04/319); and Phase III (03-07/319). Eroding sites in this segment of the Connecticut River were inventoried and prioritized according to factors including severity of the problem and feasibility of stabilization, and selected for restoration via design and installation of bioengineered bank. Over 2,500 linear feet of eroded bank have been stabilized by these three projects using a variety of bioengineering techniques.

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported isolated patches of this non-native aquatic macrophyte in this segment of the Connecticut River along the shoreline upstream from Barton Cove near the end of Barton Cove Road and near the Turners Falls Rod and Gun club (Boettner 2007).

Note: Three non-native species (*Myriophyllum spicatum*, *Cabomba caroliniana*, and *Potamogeton crispus*) have been observed on surveys and are known to occur in Barton Cove (MA DCR 2005). Impairments due to the presence of these non-native plant species are reported under segment MA34122 Barton Cove.

Toxicity

Ambient

Water was collected from the Connecticut River, approximately 400 yards upstream from the Northfield Mount Hermon School WWTP discharge, for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48-hours) to the Connecticut River water has been $\geq 95\%$ (n=14). River water hardness ranged from 28 to 52mg/L (n=14).

Effluent

Whole effluent toxicity tests have been conducted on the Northfield Mount Hermon School treated effluent. Between August 2000 and September 2006, 13 valid tests were conducted using *C. dubia*. The LC₅₀s were all $\geq 100\%$ effluent (n=13).

Chemistry - water

DWM conducted water quality sampling downstream from Fourmile Brook in Gill (Station 02A) on this segment of the Connecticut River between July and September 2003 (Appendix B and E). All measurements were indicative of good water quality conditions.

Chemistry- fish tissue

The Connecticut River Fish Tissue Contaminant Study (2000) was a collaborative federal and multi-state project designed to provide a baseline of tissue contaminant data from several fish species and learn what threat eating these fish poses to other mammals, birds, and fish (Hellyer 2006). This study reached the following conclusions: mercury poses a risk to fish-eating wildlife, DDT homologs (chemical physical, and biological breakdown products of the parent compound) pose a risk to fish-eating birds, coplanar PCBs pose a risk to fish-eating mammals and fish-eating birds, and dioxin constituted a risk to fish-eating wildlife.

This segment of the Connecticut River is assessed as support with an Alert Status for the *Aquatic Life Use*. This decision is based upon the good survival of test organisms in toxicity tests and the good water quality conditions. However, this use is identified with an Alert Status due to the regulated flow regime, severe bank erosion issues, the isolated presence of non-native plant species, and the risk that fish tissue contaminants pose to fish-eating wildlife. At this time there is insufficient evidence of a negative impact to in-stream biota to result in the impairment of this use.

FISH CONSUMPTION

The following site specific fish consumption advisory is recommended by MA DPH for the mainstem Connecticut River:

"(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB" (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

DWM collected *E. coli* samples from left bank, right bank, and center stream of the Connecticut River downstream from Fourmile Brook in Gill (Station 02A) between April and November 2003 (Appendix B). The geometric mean of these samples was 20 cfu/100ml.

DWM personnel made field observations at Station 02A during the surveys conducted between July and September 2003. No objectionable deposits or water odors were recorded, but pollen or dust blankets were noted as being present on the water surface on three occasions. Water clarity was noted as clear or slightly turbid at this station (MassDEP 2003).

The *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based upon the low bacteria counts and the lack of objectionable deposits, odors, or oils. However, these uses are identified with an Alert Status due to the turbid conditions, regulated flow regime and severe bank erosion issues identified in the upstream segment.

Connecticut River (Segment MA34-02) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		SUPPORT*
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT*

* Alert Status, see details in use assessment

RECOMMENDATIONS

Didymosphenia geminata, otherwise known as Didymo or “rock snot”, is considered an invasive algae and has been found in the Connecticut River in Vermont and New Hampshire. Infestation and nuisance blooms of Didymo can produce thick mats that blanket stream and river substrates, causing a loss of habitat for fish and other aquatic organisms. Didymo blooms can make fishing, swimming, or boating undesirable or impossible (MA DCR 2008). Although it is currently not known if Didymo will colonize and/or bloom in the Massachusetts section of the Connecticut River, every effort should be made to prevent the spread of this nuisance algae in the mainstem Connecticut River and its tributaries. MA DCR recommends the Check-Clean-Dry protocol be followed when exiting waters that may be infested with Didymo. For more information visit: http://www.mass.gov/dcr/waterSupply/lakepond/hot_topic.htm.

Field determined that 20 percent of the bank length has been protected by rock armor. Field recommends using new approaches for subsequent bank stabilization work, as continued reliance on armoring could lead to increased erosion elsewhere (Field 2007).

Water quality testing, especially TSS and turbidity, should continue to be monitored to assess the impact of the severe bank erosion upon the *Aquatic Life Use*.

The First Light Hydro Generating Company NPDES permit should be reissued with appropriate limits and monitoring requirements. Special consideration should be given to best available cooling water intake structure technologies that minimize fish impingement and entrainment.

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 users to the problem and their responsibility to prevent spreading these species.

CONNECTICUT RIVER (SEGMENT MA34-03)

Location: Turners Falls Dam, Gill/Montague, to confluence with Deerfield River, Greenfield/Montague/Deerfield.

Segment Length: 3.6 miles.

Classification: Class B, Warm Water Fishery, combined sewer overflow.

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

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Australis Aquaculture LLC (9P10619202)

Southworth Company (Registration 10619203)

NPDES (Appendix H, Table H2)

Australis Aquaculture LLC (MA0110264)

Southworth Company Turners Falls Mills Canal Street Facility (MA0005011)

Esleek Manufacturing Company (MA0003964) listed as inactive by EPA as of June 2001

First Light Hydro Generating Company (MA0035521)

Town of Montague Pollution Control Facility (MA0100137)

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

Project Name	Owner	Project #	Issue Date	Expiration Date	River	Kilowatts
Turners Falls	Turners Falls Hydro LLC	2622	29 June 1990	28 February 2021	Connecticut Canal	937
Turners Falls	FirstLight Hydro Generating Co.	1889	05 May 1980	30 April 2018	Connecticut River	56,573

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

The Connecticut River is diverted at Turners Falls Dam into the Northeast Utility's power canal (7000 feet long by 120 feet wide) where it is used to generate hydroelectric power. Despite a minimum flow release of 120 cfs during most of the year and slightly higher (400 cfs) releases during fish migration periods (Grader undated), approximately two miles of the mainstem Connecticut River are bypassed. Water is returned to the Connecticut River after passing through the Turners Falls power Canal. On average less than 25 percent of shad reaching the Turners Falls Dam are successful in passing the fishways and the dam, indicating significant passage problems within the complex of three fishways (Schrock 2005).

Toxicity

Ambient

The Southworth Company Turners Falls Mill staff collected water from the Power Canal, which flows into the Connecticut River, at the Loomis Road and Turner Falls Road Bridge for use as dilution water in the facility's whole effluent toxicity tests. Between July 2000 and October 2007, survival of *C. dubia* exposed (approximately 7-days) to the Connecticut River water was $\geq 80\%$ (n=26). River water hardness ranged from 23 to 84 mg/L (n=26).

Effluent

Whole effluent toxicity tests have been conducted on the Southworth Company Turner Falls Mill treated effluent. Between July 2000 and October 2007, 26 valid acute tests were conducted using *C. dubia*. The LC₅₀s ranged from 23.3 to >100% effluent and were below the LC₅₀ limit of 50% in 7 of the 26 tests (October 2000, September 2002, March and June 2003, June 2004, June 2006, and September 2007). Results of the *C. dubia* chronic whole effluent toxicity tests ranged from <6.25 to 100% effluent. Chronic toxicity was detected in all but four test events (CNOEC < 100% effluent). Results of the *C. dubia* chronic whole effluent toxicity tests ranged from <6.25 to 100% effluent. Chronic toxicity was detected in all but four test events (CNOEC < 100% effluent).

Chemistry- fish tissue

The Connecticut River Fish Tissue Contaminant Study (2000) was a collaborative federal and multi-state project designed to provide a baseline of tissue contaminant data from several fish species and learn what threat eating these fish poses to other mammals, birds, and fish (Hellyer 2006). This study reached the following conclusions: mercury poses a risk to fish-eating wildlife, DDT homologs (chemical physical, and biological breakdown products of the parent compound) pose a risk to fish-eating birds, coplanar PCBs pose a risk to fish-eating mammals and fish-eating birds, and dioxin constituted a risk to fish-eating wildlife.

Although Fall River discharges into this segment of the Connecticut River just below the Turner's Falls Dam, the majority of the Connecticut River is diverted through the power canal. This renders a reach of the Connecticut River into a virtually dry streambed for part of the year, and therefore the *Aquatic Life Use* is assessed as impaired for the upper 2.9 miles of this segment. The flow of the river is returned to the channel at this point, however there are no water quality data available for this section. The lower 0.7 miles of this segment (downstream from the power canal) are not assessed. The *Aquatic Life Use* is identified with an Alert Status due to the risk that fish tissue contaminants pose to fish-eating wildlife.

FISH CONSUMPTION

The following site specific fish consumption advisory is recommended by MA DPH for the Connecticut River:

"(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB" (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

Connecticut River (Segment MA34-03) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED upper 2.9 miles Cause: Flow alteration Source: Impacts from hydropower flow regime alterations NOT ASSESSED* lower 0.7 miles
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
Aesthetics		NOT ASSESSED

* Alert Status, see details in use assessment

RECOMMENDATIONS

Didymosphenia geminata, otherwise known as Didymo or "rock snot", is considered an invasive algae and has been found in the Connecticut River in Vermont and New Hampshire. Infestation and nuisance blooms of Didymo can produce thick mats that blanket stream and river substrates, causing a loss of habitat for fish and other aquatic organisms. Didymo blooms can make fishing, swimming, or boating undesirable or impossible (MA DCR 2008). Although it is currently not known if Didymo will colonize and/or bloom in the Massachusetts section of the Connecticut River, every effort should be made to prevent the spread of this nuisance algae in the mainstem Connecticut River and its tributaries. MA DCR

recommends the Check-Clean-Dry protocol be followed when exiting waters that may be infested with Didymo. For more information visit: http://www.mass.gov/dcr/waterSupply/lakepond/hot_topic.htm. Review the information submitted by the Southworth facility (MA0005011) as part of their cooling water intake structure monitoring program annual reports.

The Southworth facility needs to reduce the acute whole effluent toxicity present in their treated process wastewater discharge.

Implement planned fish passage improvements at the Turners Falls Dam.

Collect appropriate data to assess the *Primary* and *Secondary Contact Recreation* uses.

FALL RIVER (SEGMENT MA34-33)

Location: Vermont/Massachusetts border, Bernardston, to the confluence with the Connecticut River, Greenfield/Gill

Segment Length: 10.2 miles.

Classification: Class B, Cold Water Fishery.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

Fall River is stocked with salmon fry by the Massachusetts Division of Fisheries and Wildlife as part of the ongoing Atlantic Salmon Restoration Program (Slater 2000).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Crumpin Fox Golf Club (9P2010602902)

Bernardston Fire & Water District (Sugarhouse Well) (9P010602901)

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

DWM performed a habitat assessment of Fall River upstream from Bascom Road in Gill on 17 September 2003 as part of the fish population survey. The habitat was scored as optimal (175 / 200). This was the best habitat score out of six stations sampled in the Connecticut River Watershed in 2003 (Appendix D).

Biology

On 17 September 2003, DWM biologists sampled the fish community on the Fall River upstream from Bascom Road in Gill (Appendix D). Seven fish species were collected during this survey, including 122 blacknose dace, 11 slimy sculpin, 9 longnose dace, 5 Atlantic salmon, 5 brook trout, 4 creek chub, and one pumpkinseed. The community was dominated by a pollution tolerant fluvial specialist species, but three pollution intolerant cold water species were also present.

This segment of Fall River is assessed as support for the *Aquatic Life Use* based on the fish community and habitat data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

No objectionable conditions were noted by the DWM biologists during the fish population surveys conducted in 2003 (Mitchell 2007).

Fall River (Segment MA34-33) Use Summary Table

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

RECOMMENDATIONS

Conduct bacteria and water quality monitoring in order to assess the *Aquatic Life Use* and the *Primary* and *Secondary Contact Recreation* uses.

CONNECTICUT RIVER (SEGMENT MA34-04)

Location: Confluence with Deerfield River, Greenfield/Montague/Deerfield, to Holyoke Dam, Holyoke/South Hadley.

Segment Length: 34.4 miles.

Classification: Class B, Warm Water Fishery, combined sewer overflow.

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

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

South Deerfield Water Supply District (10607402)

Chang Farms, Inc. (9P210633701)

Delta Sand And Gravel, Inc. (10628904)

Nourse Farm (10607401)

Sunderland Water District (10628905)

Mohawk Trout Hatchery (10628903)

Sunderland State Fish Hatchery (9P210628902, 10628907)

Mckinstry Market Garden (10606102)

Hadley Water Department (9P210611701, 10611702)

Earle M. Parsons & Sons, Inc. (10611705)

Mt Tom Generating Company, LLC. (10613712)

South Hadley Fire District 2 Water Dept. (10627502)

Ledges Golf Club (9P210627502)

NPDES (Appendix H, Table H2)

Town of Montague Pollution Control Facility (MA0100137)

Montague State Fish Hatchery, MA Division of Fisheries and Wildlife (MA0110051)

Boston and Maine Corporation (B&M) East Deerfield Rail Yard (MA0000272)

Town of Deerfield South Deerfield Wastewater Treatment Plant (MA0101648)

Chang Farms, Inc. Whately (MA0040207)

Town of Sunderland Wastewater Treatment Plant (MA0101079)

Town of Amherst Wastewater Treatment Plant (MA0100218)

Sunderland State Fish Hatchery, MA Division of Fisheries and Wildlife (MA0110035)

Town of Hatfield Wastewater Treatment Plant (MA0101290)

Town of Hadley Wastewater Treatment Plant (MA0100099)

Northampton Wastewater Treatment Plant (MA0101818)

Town of Easthampton Wastewater Treatment Plant (MA0101478)

Mt. Tom Generating Company (MA0005339)

Holyoke Department of Public Works (MA0101630): Five CSO outfalls discharge to the Connecticut River upstream from the Holyoke Dam (021, 020, 023, 019, and 018)

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

Project Name	Owner	Project #	Issue Date	Expiration Date	River	Kilowatts
Holyoke	City of Holyoke (HG&E)	2004	20 August 1999	31 August 2039	Connecticut River	45,675

The Holyoke Dam Hydroelectric Project is an operating FERC licensed facility located on the Connecticut River in the City of Holyoke and the town of South Hadley. A complete description of the facility is presented in Segment MA34-05.

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

The USGS maintains a gage on the Connecticut River in Montague City, MA (Gage 01170500). The average annual discharge at this gage is 11,742 cfs (period of record 2000 to 2005). The maximum

discharge at this gage occurred on 19 March, 1936 (236,000 cfs). The minimum discharge occurred on 31 August and 1 September 1958 (215 cfs) (period of record March 1904 to 2004) (Socolow et al. 2004).

The Mt. Tom Generating Station is a 147 MW “base-load” generating facility that utilizes coal as its fuel source. Cooling water is withdrawn from the western shore of the Connecticut River and is oriented parallel to flow for use as once through cooling water at the Mt. Tom Generating Station. The following information on the intake was taken from the Proposal for Information Collection (PIC) for the facility required by Section 316(b) Phase II rule of the Clean Water Act (Kleinschmidt 2006b).

The intake is through an 8' diameter, 345' long concrete intake pipe at the Mt. Tom Generating Station. Directly in front of the intake pipe there is a series of seven, evenly spaced 4" diameter brass vertical bars installed in concrete sleeves, directly in front of the inlet of the pipe to preclude large debris from entering the cooling water system. An electric fish screen was installed immediately behind the brass bars to deter fish from entering the pipe. In addition, a five-foot tall sheet pile curtain wall was located approximately 20' in front of the intake pipe to direct fish and debris away from the entrance. The intake pipe terminates at a screenwell structure with two bays, each of which has a trash rack and a 10' wide traveling screen with 3/8" square mesh. The traveling screen rotation is activated on a signal from a differential pressure switch. The traveling screens are cleaned by a screen wash system consisting of two, 250 gpm, 70 psi rated screen wash pumps. The high-pressure spray washes impinged debris and fish into a debris trough and ultimately discharged back into the river downstream from the intake pipe. The design intake flow is 133.2 MGD and the design intake velocity at mean low water level is approximately 1.7 feet per second.

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Cove Island Cove at the mouth of White Brook in South Hadley and at the mouth of the Mill River in Northampton (Boettner 2007).

The Shortnose sturgeon (*Acipenser brevirostrum*), a federally endangered freshwater fish, is present in this section of the Connecticut River. This fish utilizes discrete habitats within this system for feeding and spawning. Historically, adult Shortnose sturgeon would spawn in the late spring near the confluence of the Deerfield and Connecticut Rivers and then migrate downstream to foraging areas as far downstream as Long Island Sound. At present, it is believed that the Holyoke Dam divides the Connecticut River Sturgeon into two separate populations (UMass 2007).

Toxicity

Ambient

The Montague Water Pollution Control Facility staff collected water from the Connecticut River, at the end of Poplar Street (near the sandbar) in Montague, for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48 hours) to the Connecticut River water was $\geq 85\%$ (n=15). River water hardness ranged from 26 to 44.6 mg/L (n=15).

The South Deerfield Wastewater Treatment Facility staff collected water from the Connecticut River approximately 250 feet above the Sunderland Bridge in Deerfield for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48 hours) to the Connecticut River water was $\geq 90\%$ (n=16). River water hardness ranged from 26.9 to 51 mg/L (n=16).

The Sunderland Wastewater Treatment Plant staff collected water from the Connecticut River at the Riverside Cemetery in Sunderland for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and September 2007, survival of *P. promelas* exposed (48-hour) to the Connecticut River water was $\geq 95\%$ (n=15). River water hardness ranged from 23 to 52 mg/L (n=15).

Water from the Connecticut River was collected from the boat launch in Hatfield just downstream from the Hatfield Wastewater Treatment Plant (WWTP) for use as dilution water in the facility's whole effluent toxicity tests. The sampling location will be properly located upstream from the discharge for tests conducted in June 2007 and thereafter. For the purposes of this report, however, survival of *C. dubia*

exposed (48 hours) to the Connecticut River water collected downstream from the Hatfield WWTP discharge between May 2001 and October 2006 ranged from 90 to 100% (n=12). Survival of *P. promelas* exposed (48 hours) to the Connecticut River water ranged from 98 to 100% (n=2). River water hardness ranged from 20 to 44 mg/L (n=12).

The Amherst Public Works staff collected water from the Connecticut River upstream from the Amherst WWTP discharge off Route 47 in Hadley for use as dilution water in the facility's whole effluent toxicity tests. (This sampling location is upstream from the confluence with Russellville Brook.) Between August 2000 and October 2007, survival of *C. dubia* exposed (48-hours) to the Connecticut River water was 100% (n=12). River water hardness ranged from 26 to 44 mg/L (n=12).

Water from the Connecticut River was collected from the boat dock at 29 Honey Pot Road (upstream from the Route 9 Calvin Coolidge Bridge) in Hadley for use as dilution water in the Hadley Wastewater Treatment Plant (WWTP) whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48 hours) to the Connecticut River water was $\geq 90\%$ (n=15). River water hardness ranged from 25 to 51mg/L (n=15).

Water from the Connecticut River was collected approximately 300 yards upstream from the Northampton Wastewater Treatment Facility outfall diffuser off of Hockanum Road for use as dilution water in the facility's whole effluent toxicity tests. Between November 2000 and September 2007, survival of *C. dubia* exposed (48-hours) to the Connecticut River water was $\geq 95\%$ (n=15). River water hardness ranged from 20 to 47mg/L (n=15).

The Easthampton Wastewater Treatment Plant (WWTP) staff collected water from the Connecticut River, across the railroad from East Street, approximately 15 feet upstream from the outfall, for use as dilution water in the facility's whole effluent toxicity tests. Between June 2000 and June 2007, survival of *C. dubia* exposed (48 hours) to the Connecticut River water ranged from 95 to 100% (n=15). River water hardness ranged from 26 to 38mg/L (n=15).

Water from the Connecticut River was collected near the Dinosaur Tracks (mile marker #17 on Route 5) in Holyoke for use as dilution water in the Holyoke WPCF facility's acute whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48- hours) to the Connecticut River water was $\geq 90\%$ (n=30). River water hardness ranged from 26.2 to 52.5mg/L (n=29).

Effluent

Acute whole effluent toxicity tests have been conducted on the Montague Water Pollution Control Facility treated effluent. Between August 2000 and September 2007, 15 tests were conducted using *C. dubia*. No acute toxicity has been detected in the effluent (LC₅₀s were all $\geq 100\%$ effluent in the 14 valid tests conducted).

Acute whole effluent toxicity tests have been conducted on the South Deerfield Wastewater Treatment Plant treated effluent. Between August 2000 and September 2007, 16 tests were conducted using *C. dubia*. With the exception of one test event (September 2005 LC₅₀=18.4%effluent), no acute whole effluent toxicity has been detected.

Acute whole effluent toxicity tests have been conducted on the Sunderland Wastewater Treatment Plant treated effluent. Between August 2000 and September 2007, 15 tests were conducted using *P. promelas*. With the exception of one test event (May 2001 LC₅₀=72.2%effluent), no acute whole effluent toxicity has been detected. The facility has consistently passed its whole effluent toxicity testing limits.

Acute whole effluent toxicity tests have been conducted on the Hatfield WWTP treated effluent. Between May 2001 and October 2006, 12 tests were conducted using *C. dubia* and two were conducted using *P. promelas*. The effluent exhibited some acute toxicity to *C. dubia* in the May and August 2001, May 2002, October 2005, and May 2006 test events although the LC₅₀ was $\leq 50\%$ effluent (the permit limit) in only the October 2005 test event (LC₅₀=39.2% effluent). Some acute whole effluent toxicity was detected in the August 2001 *P. promelas* test (LC₅₀=73.3% effluent) but not the May 2001 test (LC₅₀>100% effluent).

Acute whole effluent toxicity tests have been conducted on the Amherst WWTP effluent. Between August 2000 and October 2007, 12 tests were conducted using *C. dubia*. With the exception of the most recent test event (October 2007, LC₅₀=70.7% effluent) no acute whole effluent toxicity has been detected (LC₅₀s were all >100% effluent).

Whole effluent toxicity tests have been conducted on the Hadley WWTP treated effluent. Between August 2000 and September 2007, no acute toxicity to *C. dubia* has been detected (LC₅₀s all ≥100% effluent (n=15).

Acute whole effluent toxicity tests have been conducted on the Northampton WWTF treated effluent. Between November 2000 and September 2007, 15 valid tests were conducted using *C. dubia*. The LC₅₀s were all ≥100% effluent.

Acute whole effluent toxicity tests have been conducted on the Easthampton WWTP treated effluent discharged via Outfall 001. Between June 2000 and June 2007, 15 valid tests were conducted using *C. dubia*. The LC₅₀s were all ≥100% effluent with the exception of three test events (December 2003, December 2005, and June 2006 with LC₅₀= 88.5, 70.7, and 69.8%, respectively).

Chemistry - water

DWM conducted water quality sampling at two stations along this segment in 2003. Station 04A was located at Route 116 in Deerfield/Sunderland. All measurements were indicative of good water quality conditions. Station 04C was located upstream from the confluence of the Mill River-Northampton, near the Oxbow, in Northampton/Hadley. All measurements were indicative of good water quality conditions. (Appendix B and E).

Chemistry- fish tissue

The Connecticut River Fish Tissue Contaminant Study (2000) was a collaborative federal and multi-state project designed to provide a baseline of tissue contaminant data from several fish species and learn what threat eating these fish poses to other mammals, birds, and fish (Hellyer 2006). This study reached the following conclusions: mercury poses a risk to fish-eating wildlife, DDT homologs (chemical physical, and biological breakdown products of the parent compound) pose a risk to fish-eating birds, coplanar PCBs pose a risk to fish-eating mammals and fish-eating birds, and dioxin constituted a risk to fish-eating wildlife.

This segment of the Connecticut River is assessed as support for the *Aquatic Life Use*. This is based on the good water quality data, the excellent survival of test organisms exposed to water collected from the Connecticut River in this segment, and the general lack of acute toxicity in the effluents of facilities discharging to this segment. This use is identified with an Alert Status due to the isolated occurrences of *Trapa natans* found in Cove Island Cove and at the mouth of the Mill River in Northampton and the risk that fish tissue contaminants pose to fish-eating wildlife.

FISH CONSUMPTION

The following site specific fish consumption advisory is recommended by MA DPH for the mainstem Connecticut River:

"(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB" (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the Connecticut River at Station 04A between April and November in 2003. The last three samples were collected as a transect across the river in order to determine if there was any variability in water quality conditions as a result of incomplete mixing. The geometric mean of all samples collected at Station 04A was 8 cfu/100ml. No significant differences in results were observed between the left, middle, and right transect locations. Bacteria samples were also collected at Station

04C, but it was only sampled three times and thus no geometric mean was calculated (Appendix B).

Metcalfe & Eddy collected *E. coli* bacteria samples as part of the Connecticut River Bacteria Monitoring Project at Station RIV-1 (Connecticut River upstream boundary) in Holyoke/South Hadley within this segment (Metcalfe & Eddy 2006). This project was funded to obtain river bacteria results upstream and downstream of combined sewer overflows during dry and wet weather conditions. Five samples were collected across a transect perpendicular to the river flow at this location. Up to six rounds of sampling were collected at each transect location within a one to three day period in order to capture both dry and wet weather bacteria levels. Samples were collected at this station during one dry weather (8 August 2001) and three wet weather periods (25-27 September 2001, 15-16 September 2002, and 16-18 October 2002). All valid samples collected at this location have been pooled to calculate a single geometric mean. The geometric mean of all samples collected during the primary contact recreation season (which excludes the 16-18 October sampling event) at Station RIV-1 was 25 cfu/100mL. The geometric mean of all samples collected was 25 cfu/100mL.

DWM personnel made field observations at Stations 04A and 04C during surveys conducted between April and October 2003. Station 04A was free from odors. Garbage was noted on shore during only one visit; pollen or dust blankets were noted as being present on the water surface on three occasions. Water clarity was recorded as highly turbid on two occasions, and often was noted as slightly turbid (MassDEP 2003). At Station 04C no objectionable deposits or water odors were recorded, but pollen or dust blankets were noted as being present on the water surface on three occasions. Water clarity was noted as clear or slightly turbid at this station (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

Connecticut River (Segment MA34-04) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* Alert Status, see details in use assessment

RECOMMENDATIONS

Didymosphenia geminata, otherwise known as Didymo or “rock snot”, is considered an invasive algae and has been found in the Connecticut River in Vermont and New Hampshire. Infestation and nuisance blooms of Didymo can produce thick mats that blanket stream and river substrates, causing a loss of habitat for fish and other aquatic organisms. Didymo blooms can make fishing, swimming, or boating undesirable or impossible (MA DCR 2008). Although it is currently not known if Didymo will colonize and/or bloom in the Massachusetts section of the Connecticut River, every effort should be made to prevent the spread of this nuisance algae in the mainstem Connecticut River and its tributaries. MA DCR recommends the Check-Clean-Dry protocol be followed when exiting waters that may be infested with Didymo. For more information visit: http://www.mass.gov/dcr/waterSupply/lakepond/hot_topic.htm.

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 users to the problem and their responsibility to prevent spreading these species.

The Montague Water Pollution Control Facility NPDES permit should be reissued. Based on the general lack of any acute whole effluent toxicity, the whole effluent toxicity testing requirements should be reduced to annually (testing required in August of each year).

With the exception of one test event (September 2005 $LC_{50}=18.4\%$ effluent), no acute whole effluent toxicity has been detected in the South Deerfield Wastewater Treatment Plant treated effluent. The whole effluent toxicity testing requirements could be reduced to annually if no further evidence of acute toxicity is detected.

Acute whole effluent toxicity tests have been conducted using *P. promelas* on the Sunderland Wastewater Treatment Plant treated effluent. With the exception of one test event there has been no evidence of acute whole effluent toxicity and the facility has consistently passed its LC_{50} limit. The whole effluent toxicity testing requirements should be reduced to annually (testing required in August of each year).

If the Amherst WWTP does not exhibit acute whole effluent toxicity, the requirements should be reduced to annually (testing required in September of each year).

Based on the lack of any evidence of acute whole effluent toxicity, the whole effluent toxicity testing requirements for the Hadley WWTP should be reduced to annually (testing required in August of each year).

The Northampton WWTP acute whole effluent toxicity testing requirements should be reduced to annually (testing required in August of each year) since the facility has consistently been in compliance with their LC_{50} permit limit.

A Toxicity Identification/Toxicity Reduction Evaluation (TIE/TRE) may be warranted for the Easthampton WWTP facility if acute whole effluent toxicity continues to be present in the effluent.

Review and evaluate submissions of data and reports required by 316a and 316b for the Mt. Tom Generating Company.

SAWMILL RIVER (SEGMENT MA34-40)

Location: Outlet of Lake Wyola, Shutesbury, to Dudleyville Road, Leverett

Segment Length: 2.0 miles.

Classification: Class B.

This segment is formerly part of MA34-26, which is on the 2006 Integrated List of Waters in "Category 3"-*No Uses Assessed* (MassDEP 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG conducted electrofishing at one location in this segment of the Sawmill River slightly upstream from Dudleyville Road at North Leverett Road on 9 September 2003 (Site 939). A total of 93 fish were collected, representing four species. Blacknose dace and Atlantic salmon dominated the sample while longnose dace and a brown trout were also collected.

Too limited data are available so this segment of the Sawmill River is not assessed for the *Aquatic Life Use*.

Sawmill River (Segment MA34-40) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

SAWMILL RIVER (SEGMENT MA34-41)

Location: Dudleyville Road, Leverett, to the confluence with the Connecticut River, Montague.

Segment Length: 11.0 miles.

Classification: Class B, Cold Water Fishery.

This segment is formerly part of MA34-26, which is on the 2006 Integrated List of Waters in "Category 3"-*No Uses Assessed* (MassDEP 2007).

2003-02/604: An Ecosystem Approach to the Sawmill River Watershed Restoration. This project will provide a three-phase geomorphic approach for the lower portion of the Sawmill River Watershed. The assessments will use a state-of-the-art model to inventory and analyze river ecosystem health indicators.

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Turners Falls Fire District (9P10619201, 10619201)

NPDES (Appendix H, Table H2)

Red Wing Meadow Trout Hatchery (MA0027880) terminated by EPA in January 2005.

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

DWM biologists performed a habitat assessment of the Sawmill River upstream from South Ferry Road in Montague on 22 July 2003. This site received a total habitat score of 137 out of a possible 200 (Appendix D). Reductions in the habitat score were primarily due to abutting agricultural practices. The removal of trees to create pastureland, and the impact that livestock has had on the native vegetation contributed to low scores for Riparian Vegetative Zone Width and Bank Vegetative Protection.

Vanase Hangen Brustlin, Inc. outlined areas of excessive sediment deposition, bank erosion, and inadequate riparian buffer in the lower portion of this Sawmill River segment in a report prepared for the Franklin County Conservation District (VHB 2006). Priority reaches for restoration efforts were identified and prioritized, though restoration efforts have not yet been implemented.

Biology

DWM conducted benthic macroinvertebrate sampling in the Sawmill River at Station B0515, upstream from South Ferry Road in Montague on 22 July 2003. The benthic community collected did not reflect the habitat perturbation observed within the sample reach and appeared to be in good health. The total metric score is 90% comparable to the reference station, Amethyst Brook, resulting in an assessment score of "non-impacted" (Appendix C). Taxa Richness was the highest of all Connecticut watershed biomonitoring stations assessed, indicating a diverse community with good health and function.

MA DFG collected fish community data at seven different locations on the Sawmill River during sampling conducted during 2002, 2003, and 2005 (Richards 2006). Sampling was conducted at the following locations: slightly upstream from Dudleyville Road at North Leverett Road (Site 939), Rattlesnake Gutter Road (Site 938), at the North Leverett Road pullout off Route 63 (Site 1346), Route 47/63 junction (Site 937), North Street (Site 943), upstream from Meadow Street (Site 944), and Willis Ferry Road (Site 942). Blacknose dace, a pollution tolerant fluvial specialist species, was the most numerous fish collected at all but one station. However, most stations displayed a varied fish community with pollution intolerant cold water species present. Evidence of reproducing brown trout, a pollution intolerant cold water species, was found at 5 of the 7 stations. Anadromous sea lamprey were collected at 3 stations. Evidence of the Anadromous Fish Restoration Project's efforts can be found in the fact that Atlantic salmon were present at 6 of the 7 stations.

Chemistry - water

DWM conducted water quality sampling at South Ferry Road in Montague, Station 26A, on this segment of the Sawmill River between April and October 2003 (Appendix B). All measurements were indicative of good water quality conditions.

This segment of the Sawmill River is assessed as support for the *Aquatic Life Use*. This assessment is based primarily upon the non-impacted benthic macroinvertebrate community, the healthy and diverse fish communities, and the good water quality, though the low habitat score and problems in the lower reach outlined by Vanase Hangen Brustlin, Inc. are of concern.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the Sawmill River at South Ferry Road in Montague (Station 26A) between April and October 2003 (Appendix B). The geometric mean of these samples was 61 cfu/100ml.

Bacteria samples were collected at 15 locations in the Sawmill river subwatershed during bacteria source tracking investigations conducted by DWM personnel in 2006 (Kurpaska and Poach 2006). Samples were collected at each station once in July during a wet weather event, and again in September during dry weather. Samples collected during wet weather conditions exhibited *E. coli* counts from 14.8 to 435.2 MPN per 100mL of sample. All counts were below the source tracking trigger of 2000 MPN/100mL for follow up investigation for wet weather conditions. Samples collected during dry weather conditions had *E. coli* counts that ranged from 0 to 275.1 MPN per 100mL of sample. All counts were below the source tracking trigger of 500 MPN/100mL for dry weather conditions. Due to the fact that each site was only sampled on two occasions, no geometric means have been calculated and these data are not used for assessment purposes.

MassDEP biologists observed the water quality in the Sawmill River upstream of South Ferry Road in Montague on July 22, 2003. The water was clear with no turbidity, odors, or surface oils. Cow manure was observed in the river and on its banks, and barbed wire stretching across the stream was noted (Appendix C).

DWM personnel made field observations at Station 26A during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was generally noted as clear or slightly turbid (MassDEP 2003).

The *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for primary and secondary contact and the lack of objectionable conditions.

Sawmill River (Segment MA34-41) Use Summary Table

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

RECOMMENDATIONS

Investigate and address the cattle access to the stream in the area upstream from South Ferry Road. Determine if fencing or other cattle exclusion methods might be feasible to remedy this issue.

LONG PLAIN BROOK (SEGMENT MA34-09)

Location: Headwaters, Leverett/Sunderland town line, to confluence with Russellville Brook at Rt. 116, Sunderland.

Segment Length: 5.0 miles.

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 (Appendix H, Table H1)

Sunderland Water District (10628905)

Delta Sand And Gravel, Inc. (10628904)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data at Long Plain Brook at Site 999 (Station described by MA DFG as Russellville Brook) upstream from Bull Hill Road in 2004. Only two fish were collected, one golden shiner and one tessellated darter. Sampling comments also noted the presence of several juvenile bridge shiners. Comments described the area as "low gradient with occasional riffle...shocked a long way for almost no fish" (Richards 2006).

This segment of Long Plain Brook is not assessed for the *Aquatic Life Use* due to a general lack of data. The single fish sampling event by MA DFG in 2004 does not provide conclusive evidence for either support or impairment of the *Aquatic Life Use*.

Long Plain Brook (Segment MA34-09) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

CUSHMAN BROOK (SEGMENT MA34-34)

Location: Headwaters, outlet Atkins Reservoir, Shutesbury, to the inlet of Factory Hollow Pond, Amherst
Segment Length: 2.5 miles.

Classification: Class B.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 17 September 2003 DWM biologists conducted a habitat assessment of Cushman Brook at the south side of State Street in Amherst. Most of the habitat measures were found to be within the “optimal” range. The total habitat score arrived at for this fish population survey was 167/200 (Appendix D). DWM biologists also conducted a habitat assessment on Cushman Brook in conjunction with benthic macroinvertebrate sampling upstream from Factory Hollow Pond in Amherst in 2003. The total habitat score for Cushman Brook at that location was 154 / 200 (Appendix C).

Biology

DWM conducted benthic macroinvertebrate sampling in Cushman Brook at Station B0508, upstream from Factory Hollow Pond in Amherst on 22 July 2003. The total metric score for Cushman Brook is 86% comparable to the reference station (Amethyst Brook) in terms of community structure, resulting in an assessment of “non-impacted” (Appendix C).

DWM conducted fish population sampling in Cushman Brook, south side of State Street in Amherst on 17 September 2003 (Appendix D). Five fish species were collected from this station, including: 26 brown trout (multiple age classes), 13 blacknose dace, 1 brook trout, 1 white sucker, and 1 longnose dace. Pollution intolerant fluvial specialist/dependant species dominated the fish community.

This segment of Cushman Brook is assessed as support for the *Aquatic Life Use* based on the non-impacted benthic macroinvertebrate community and the fish community data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

No objectionable conditions were noted by the DWM biologists during the fish population or benthic macroinvertebrate surveys (Appendix C and Mitchell 2007).

Cushman Brook (Segment MA34-34) Use Summary Table

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

RECOMMENDATIONS

Conduct bacteria sampling to evaluate the Primary and Secondary Contact Recreation uses.

MILL RIVER-HADLEY (SEGMENT MA34-25)

Location: Outlet of Factory Hollow Pond, Amherst, to the inlet of Lake Warner, Hadley.

Segment Length: 5.2 miles.

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 (Appendix H, Table H1)

Sunderland National Salmon Station (10628901)

NPDES (Appendix H, Table H2)

Note: Although the Amherst WWTP is located along this segment, the actual discharge point is to the mainstem Connecticut River (Segment MA34-04).

Bioshelters, Inc. (MA0110281)

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

The total habitat score recorded by DWM fisheries biologists for the Mill River – Hadley site in 2003 was 112 out of a possible 200. This is the poorest score of all stations examined in the Connecticut watershed in 2003 (Appendix D). Habitat was most limited by the poor epifaunal substrate score (no riffles were present). Scores were also suboptimal for embeddedness, sediment deposition, and velocity-depth combinations. These conditions were considered to be naturally occurring; the reach is within the Connecticut River Valley floor, is of relatively low gradient, and has a sandy bottom.

Biology

DWM conducted fish population sampling in the Mill River - Hadley, East of Route 116 in Amherst on 17 September 2003. Only 15 fish were captured during the survey, representing eight species. However, electro-fishing efficiency was rated as "poor," and due to the depth and width of the stream some fish were not captured (Appendix D). The fish community was dominated by moderately pollution tolerant fluvial specialist/dependant species.

Chemistry - water

DWM conducted water quality sampling at Mill River Lane in Hadley, Station 25C, on this segment of the Mill River - Hadley between April and October 2003 (Appendix B and E). All measurements were indicative of good water quality conditions.

This segment of Mill River - Hadley is assessed as support for the *Aquatic Life Use* based on the good water quality data. The poor collection efficiency noted with the fish community data makes it difficult to determine if the low numbers of fish collected are truly representative of the fish community present at that location. The low habitat score is a concern but is naturally occurring and does not overrule the good water quality data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the Mill River – Hadley at Mill River Lane in Hadley (Station 25C) between April and November 2003 (Appendix B). The geometric mean of these samples was 148 cfu/100ml.

DWM personnel made field observations at Station 25C during surveys conducted between April and October 2003. A methane odor was reported at this station on one occasion. No objectionable deposits were noted, and the water clarity was recorded as highly turbid on two occasions (MassDEP 2003).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated *E. coli* bacteria counts, noted particularly during wet weather. The *Secondary Contact Recreation and Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the general lack of objectionable conditions.

Mill River-Hadley (Segment MA34-25) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: <i>E. coli</i> bacteria Source: Unknown Suspected source: Agriculture, unspecified urban stormwater
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Fish population surveys should be revisited during lower flows, at a more suitable location, or with different methods in order to sample the fish community more accurately than in 2003.

UNNAMED TRIBUTARY (SEGMENT MA34-31)

Location: Headwaters, outlet Lake Warner, Hadley, to the confluence with the Connecticut River, Hadley.

Segment Length: 0.5 miles.

Classification: Class B.

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

USE ASSESSMENT

No recent quality-assured data are available for this unnamed tributary.

Unnamed Tributary (Segment MA34-31) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

BLOODY BROOK (SEGMENT MA34-36)

Location: From the railroad tracks north of North Main Street, Deerfield, to the confluence with Mill River - Hatfield, Whately
Segment Length: 3.7 miles.
Classification: Class B.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

USE ASSESSMENT

AQUATIC LIFE

Chemistry - water

DWM conducted water quality sampling at Whately Road in Deerfield, Station BB01, on this segment of Bloody Brook between April and October 2003 (Appendix B and E). Pre-dawn and early morning dissolved oxygen concentrations were generally low, ranging from 1.6 to 7.9 mg/L. Three of the six measurements were less than 4 mg/L. Total phosphorus concentrations were very high, ranging from 0.058 to 0.16 mg/L. Conductivity measurements also were elevated.

Bloody Brook is assessed as impaired for the *Aquatic Life Use* based on the low dissolved oxygen concentrations and the elevated total phosphorus.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from Bloody Brook at Whately Road in Deerfield (Station BB01) between April and November 2003 (Appendix B). The geometric mean of these samples was 251 cfu/100ml.

DWM personnel made field observations at Station BB01 on Bloody Brook during surveys conducted between April and October 2003. Aquatic weeds such as duckweed were recorded as objectionable deposits on one occasion. An oily sheen on the water surface was reported during one visit, and pollen blankets were visible on the water surface on two visits. A musty basement water odor was reported on one occasion. Water clarity was noted as highly turbid at this station on six occasions, with the water being slightly turbid during the other two visits (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as impaired based upon the chronic highly turbid conditions documented during water quality surveys. The *Primary Contact Recreational Use* is also impaired because of elevated *E. coli* bacteria counts.

Bloody Brook (Segment MA34-36) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Low dissolved oxygen, elevated total phosphorus Source: Unknown
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Objectionable turbidity and elevated <i>E. coli</i> bacteria Source: Unknown
Secondary Contact		IMPAIRED Cause: Objectionable turbidity Source: Unknown
Aesthetics		IMPAIRED Cause: Objectionable turbidity Source: Unknown

RECOMMENDATIONS

Investigate the causes of chronic turbidity, low dissolved oxygen, and elevated total phosphorus concentrations observed in Bloody Brook in 2003, and confirm that these issues are still problematic

within this segment. Field reconnaissance is recommended to begin to identify sources of the above-mentioned pollutants that have impaired Bloody Brook.

Evaluate whether this segment is a candidate for bacteria source tracking efforts to identify sources of bacteria contamination in this subwatershed.

MILL RIVER-HATFIELD (SEGMENT MA34-24)

Location: Headwaters, north of Route 116, Conway, to the confluence with the Connecticut River, Hatfield.

Segment Length: 24.6 miles.

Classification: Class B.

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).

The Town of Whatley was awarded \$3,000 for Riparian Planting along the Mill River. This buffer planting project was completed following the bioengineering work covered under a 319 grant. Local citizens were recruited and educated about the importance of buffer zones, and the volunteers assisted in the actual plantings in the fall (Riverways Program 2000).

A feasibility study for removing the Hatfield Dam was completed in 2007 (Donlon 2008). This dam is located in Hatfield on the Mill River – Hatfield.

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

South Deerfield Water Supply District (10607402)

Hatfield Water Department (10612702)

Northampton Department Of Public Works (9P210621401, 10621401)

NPDES (Appendix H, Table H2)

South Deerfield Water Supply District (MAG640005) discharges to an unnamed tributary to Mill River – Hatfield. It should be noted that one modified acute and chronic whole effluent toxicity test was conducted on the South Deerfield Water Supply effluent in November 2002. The discharge was acutely toxic to both *C. dubia* and *P. promelas* ($LC_{50}=70\%$ effluent for both species) and the CNOEC results were 50% effluent. Survival in river water used for diluent was $\geq 90\%$.

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 23 July 2003 MassDEP DWM biologists conducted a habitat assessment of Mill River approximately 20 meters upstream from Omasta Well at Mountain Rd. in Hatfield, below the confluence with West Brook (Station B0510). The overall habitat score for Mill River - Hatfield was 158 out of a possible 200, with all but four parameters scoring optimally (Appendix C).

The Instream Habitat Program, Department of Natural Resources, Cornell University and the Massachusetts Cooperative Extension, University of Massachusetts prepared a report in 2003 entitled "Measuring River Ecosystem Health in Western Massachusetts- The Mill River, Hatfield, MA" (Parasiewicz et al 2003). The analysis of benthic macroinvertebrates in this report indicated the presence of slight water quality impairments of some areas, especially within the lower portion of the river. The principal problems identified within the Mill River –Hatfield system were low flows that affect fish habitat and alter fish community structure, increased temperature, and sporadically impaired water quality that suppressed the abundance of fish and benthic invertebrates. Also, a temperature logger placed in the Mill River – Hatfield between May and August 2001 at Christian Lane in Whatley revealed water temperatures that often approached and even exceeded the warm water temperature criteria. Raw data, QAPP, and SOP information were not acquired for this data source, so the elevated temperatures reported will only result in Alert Status of the *Aquatic Life Use*. It should be noted that data in this report generally corroborates data collected by MassDEP and MA DFG.

Biology

MA DFG collected fish community data at Mill River - Hadley at Site 1148 along Route 116 in Deerfield in 2005 (Richards 2006). Fish included: 49 blacknose dace, 23 Atlantic salmon, 6 brook trout, and 4 pumpkinseed. The sample was dominated by fluvial specialist species; two pollution intolerant species were present.

DWM conducted benthic macroinvertebrate sampling in the Mill River- Hatfield at Station B0510,

upstream from Mountain Drive in Hatfield on 23 July 2003. The Total Metric Score is 71% when compared to Amethyst Brook, the reference station. This results in an assessment of “slightly impacted” (Appendix C).

Chemistry - water

DWM conducted water quality sampling at Maple Street in Hatfield, Station 24B, on this segment of the Mill River - Hatfield between April and October 2003 (Appendix B and E). Most measurements were indicative of good water quality conditions. Total phosphorus was slightly elevated and ranged from 0.019 to 0.057 mg/L.

The Mill River - Hatfield is assessed as support for the *Aquatic Life Use* based on the macroinvertebrate and fish communities and the good water quality. An Alert Status is attached to this use based on the elevated water temperatures reported by Parasiewicz et al. at one location in 2003.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the Mill River - Hatfield at Maple Street in Hatfield (Station 24B) between April and November 2003 (Appendix B). The geometric mean of these samples was 63 cfu/100ml.

Bacteria samples were collected at 31 locations in the Mill River – Hatfield watershed during Bacteria Source Tracking investigations conducted by DWM personnel in 2006 (Kurpaska and Poach 2006). Wet weather conditions exhibited *E. coli* counts from 0 to 261.3 MPN per 100mL of sample. All counts were well below the source tracking trigger of 2000 MPN/100 mL for wet weather conditions, and no further sampling of this watershed was conducted. Due to the fact that each site was only sampled on one occasion, no geometric means have been calculated and these data are not used for assessment purposes.

MassDEP personnel observed the water quality at the Mill River – Hatfield Station B0510 on July 23, 2003. The water was clear to grey, slightly turbid, odorless, and without any surface oils.

DWM personnel made field observations at Station 24B on the Mill River during surveys conducted between April and October 2003. No objectionable deposits or scums were recorded. A septic odor was noted on one occasion and the water generally appeared slightly turbid. The water was highly turbid during one visit (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

Mill River-Hatfield (Segment MA34-24) Use Summary Table

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

*Alert Status, see details in use assessment

RECOMMENDATIONS

Temperature patterns should be monitored in the Mill River - Hatfield to study possible impairment due to thermal issues.

Poor survival of test organisms in the South Deerfield Water Supply effluent is of concern, due to the fact that drinking water effluent did fail toxicity testing conducted in 2002. However, the young age of the plant at the time of that test and sampling inconsistencies over what is required by 40 CFR 136 (Code of Federal Regulations) lend credible doubt about any negative impact the effluent may have on Roaring Brook. The Town is conducting additional tests in 2008. These tests should provide a better assessment of the potential impact the effluent will have on Roaring Brook.

AMETHYST BROOK (SEGMENT MA34-35)

Location: Headwaters, confluence of Buffum and Harris brooks, Pelham, to the confluence with Adams River (forming the headwaters of Fort River), Amherst

Segment Length: 2.1 miles.

Classification: Class B.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Amherst DPW Water Div., Amherst (9P10600801, 10600802)

NPDES (Appendix H, Table H2)

Amherst Centennial Water Treatment Plant (MAG640046) [Note: discharge to Harris Brook just upstream of this segment.]

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 22 July 2003 DWM biologists conducted a habitat assessment of Amethyst Brook at Station B0514, near Allen Mill Road in Amherst. The within-reach habitat conditions observed at Amethyst Brook were quite good, scoring a 157 out of a possible 200 (Appendix C).

Biology

DWM conducted benthic macroinvertebrate sampling in Amethyst Brook at Station B0514, near Allen Mill Road in Amherst on 22 July 2003. The dominant taxon collected was *Leuctra* sp., a highly sensitive stonefly. Amethyst Brook was chosen to represent the reference condition for wadeable streams within the Connecticut River Basin.

MA DFG collected fish community data in Amethyst Brook at Site 951 in the Allen Mill Road conservation area in Amherst in 2003 (Richards 2006). A total of 86 fish were collected, representing 8 species, including: 62 blacknose dace, 7 white sucker, 6 common shiner, 4 slimy sculpin, 3 longnose dace, 2 brown trout, one brook trout, and one chain pickerel.

Amethyst Brook is assessed as support for the *Aquatic Life Use* based on the macroinvertebrate community, fish community, and habitat data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

MassDEP personnel observed the water quality at Amethyst Brook in South Hadley on July 22, 2003. The water was clear with no turbidity, odorless, and had no surface oils. No obvious sources of non-point source pollution were noted, although it was noted that many dogs are walked along the trails that parallel the brook.

The *Aesthetics Use* is assessed as support based on the lack of objectionable conditions. The *Primary* and *Secondary Contact Recreational* uses are not assessed due to the lack of recent bacteria data.

Amethyst Brook (Segment MA34-35) Use Summary Table

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

RECOMMENDATIONS

A high total residual chlorine limit listed in the Amherst Centennial Water Treatment NPDES permit warrants that monitoring should be conducted to investigate any negative impacts to biota in Amethyst Brook.

Conduct bacteria sampling to evaluate Primary and Secondary Contact Recreation uses.

FORT RIVER (SEGMENT MA34-27)

Location: Headwaters (confluence of Adams and Amethyst Brooks), Amherst, to the confluence with the Connecticut River, Hadley.

Segment Length: 12.8 miles.

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 (Appendix H, Table H1)

Amherst DPW Water Div. (9P10600801)

Belchertown Water District (9P10602401)

Hickory Ridge Country Club (10600803)

Hadley Water Department (9P210611701, 10611702)

NPDES (Appendix H, Table H2)

University of Massachusetts Coal Storage and Handling Facility (MA0032689)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data at the Fort River at Site 948 upstream from South Maple Street in Hadley in 2003 (Richards 2006). Only four fish species, and five total fish were collected. However, sampling efficiency was rated at 50% and comments indicated that the current was very swift and that section should be sampled with a barge instead of backpack electroshocking equipment. Two rock bass, 1 longnose dace, 1 fallfish, and 1 chain pickerel were collected.

Toxicity

Effluent

Whole effluent toxicity tests were conducted on the Coal Storage and Handling Facility treated effluent. Between August 2000 and April 2005, 16 valid tests were conducted using both *C. dubia* and *P. promelas*. The LC₅₀s were all $\geq 100\%$ effluent (n=16).

Chemistry - water

DWM conducted water quality sampling at Route 47 in Hadley, Station 27B, on this segment of the Fort River between April and October 2003 (Appendix B and E). Most measurements were indicative of good water quality conditions. Total phosphorus concentrations were elevated and ranged from 0.029 to 0.160 mg/L (half of the measurements exceeded 0.05 mg/L). It should be noted that on 6 August, a wet weather sampling date, TSS was 46 mg/L and turbidity was 8.9 NTU.

The Fort River is assessed as support for the *Aquatic Life Use* based on the good water quality data. Total phosphorus concentrations were frequently elevated and are of concern, and result in an Alert Status for this use.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the Fort River at Route 47 in Hadley (Station 27B) between April and November 2003 (Appendix B). The geometric mean of these samples was 254 cfu/100ml.

DWM personnel made field observations at Station 27B during surveys conducted between April and October 2003. No objectionable deposits or water odors were recorded. White foam was recorded on one occasion and water clarity was recorded as highly turbid on three occasions (MassDEP 2003).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated *E. coli* bacteria counts. The *Secondary Contact Recreation and Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the general lack of objectionable conditions. These uses are identified with an Alert Status due to high TSS concentrations and high turbidity documented during wet weather sampling.

Fort River (Segment MA34-27) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: <i>E. coli</i> bacteria Source: Unknown
Secondary Contact		SUPPORT*
Aesthetics		SUPPORT*

* Alert Status, see details in use assessment

RECOMMENDATIONS

Investigate the origin and pattern of highly turbid conditions noted on several occasions.

Consider this segment for bacteria source tracking work to investigate sources of elevated bacteria counts.

EAST BRANCH MILL RIVER (SEGMENT MA34-37)

Location: Headwaters, confluence of Bradford Brook, Williamsburg, to confluence with the West Branch Mill River (forming the headwaters of the Mill River), Williamsburg

Segment Length: 2.8 miles.

Classification: Class B, Cold Water Fishery.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 23 October 2003 MassDEP DWM biologists conducted a habitat assessment of the East Branch Mill River along Mill Road in Williamsburg. The total habitat score for the East Branch Mill River was 166 out of a possible 200 (Appendix D). The streambanks within this reach were observed to be moderately unstable, with ~50% of the bank displaying signs of erosion. The Riparian Vegetative Zone Width was rated as "suboptimal" due to the proximity of lawns.

Biology

MA DFG collected fish community data on the East Branch Mill River at Site 1344 along Williamsburg Valley Road in Williamsburg in 2005 (Richards 2006). Four pollution intolerant fluvial specialist fish species were collected in this sample. A total of 190 individual fish were collected, including: 74 blacknose dace, 44 longnose dace, 28 slimy sculpin, 26 Atlantic salmon, 16 brook trout (multiple age classes), 1 brown trout, and 1 common shiner. The presence of slimy sculpin and brook trout are indicative of a cold water fishery.

DWM conducted fish population sampling in the East Branch Mill River just upstream from the confluence with the West Branch mill River along Mill Road in Williamsburg on 23 October 2003 (Appendix D). Electro-fishing efficiency was rated as "excellent". Eight fish species were collected. The 60 individual fish collected during this survey were almost equally divided between pollution tolerant and intolerant species. Multiple age classes of brook trout, a pollution intolerant species, were collected in this sample. The presence of slimy sculpin and brook trout are indicative of a cold water fishery.

Chemistry - water

DWM conducted water quality sampling at East Main Street, Station EBMR01, on this segment of the East Branch Mill River between April and October 2003 (Appendix B). All measurements were indicative of excellent water quality conditions.

This segment of the East Branch Mill River is assessed as support for the *Aquatic Life Use* based on fish community data and the excellent water quality.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the East Branch Mill River at East Main Street Williamsburg between April and November 2003 (Appendix B). The geometric mean of these samples was 42 cfu/100ml.

DWM personnel made field observations at Station EBMR01 during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was always noted as clear (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

East Branch Mill River (Segment MA34-37) Use Summary Table

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

WEST BRANCH MILL RIVER (SEGMENT MA34-38)

Location: East Street, Goshen, to the confluence of Meekin Brook, Williamsburg

Segment Length: 5.9 miles.

Classification: Class B, Cold Water Fishery.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data at the Village Hill Road crossing in this segment of the West Branch Mill River in Williamsburg in 2004 and 2005 (Richards 2006). Site 965, sampled in 2004, was dominated by fluvial specialist species. A total of 214 fish were collected, representing 8 species, including: 69 Atlantic salmon, 57 blacknose dace, 44 longnose dace, 17 slimy sculpin, 11 brook trout (multiple age classes), 7 fallfish, 7 brown bullhead, and 2 white sucker. Site 1260, sampled in 2005, was also dominated by fluvial specialist species. A total of 327 fish were collected, represented by 14 species, including: 71 blacknose dace, 51 Atlantic salmon, 50 slimy sculpin, 46 longnose dace, 42 common shiner, 19 golden shiner, 14 pumpkinseed, 8 brook trout (multiple age classes), 7 brown trout (multiple age classes), 7 creek chubsucker, 5 brown bullhead, 4 bluegill, 2 white sucker, and 1 creek chub.

This segment of the West Branch Mill River is assessed as support for the *Aquatic Life Use* based on the diverse cold water fish community.

West Branch Mill River (Segment MA34-38) Use Summary Table

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

WEST BRANCH MILL RIVER (SEGMENT MA34-39)

Location: From the confluence of Meekin Brook, Williamsburg, to the confluence with the East Branch Mill River (forming the headwaters of the Mill River), Williamsburg

Segment Length: 0.6 miles.

Classification: Class B.

This is a new segment, and therefore it does not appear on the 2006 Integrated List.

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 23 October 2003 MassDEP DWM biologists conducted a habitat assessment of West Branch Mill River at the end of Mill Road in Williamsburg. The total habitat score was 162 out of a possible 200 (Appendix D).

Biology

DWM conducted fish population sampling in the West Branch Mill River at the end of Mill Road in Williamsburg on 23 October 2003 (Appendix D). Electro-fishing efficiency was rated as "excellent." A total of 31 fish were collected, including 6 fish species. Included in the sample were eight Atlantic salmon and one brook trout. The sample was comprised of fluvial specialist and dependent species, and three were pollution intolerant cold water species.

Chemistry – water

DWM conducted water quality sampling at Mill Street in Williamsburg, Station WBMR01, on this segment of the West Branch Mill River between April and October 2003 (Appendix B). All measurements were indicative of good water quality conditions.

This segment of the West Branch Mill River is assessed as support for the Aquatic Life Use based on the fish community and the good water quality conditions.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples at Mill Street in Williamsburg, Station WBMR01, on this segment of the West Branch Mill River between April and October 2003 (Appendix B). The geometric mean of these samples was 75 cfu/100ml.

DWM personnel made field observations at Station WBMR01 during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was always noted as clear (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

West Branch Mill River (Segment MA34-39) Use Summary Table

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

MILL RIVER-NORTHAMPTON (SEGMENT MA34-28)

Location: Headwaters (confluence of East and West Branch Mill River), Williamsburg, to the inlet of Paradise Pond, Northampton.

Segment Length: 10.0 miles.

Classification: Class B.

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

[Note: The section downstream from Paradise Pond, in the Mill River Diversion, is Segment MA34-32]

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Williamsburg Water Department (10634001)

Northampton Department Of Public Works (9P210621401, 10621401)

NPDES (Appendix H, Table H2)

Techalloy-Northampton (MA0004235) EPA list indicates permit terminated in August 2002.

Berkshire Electric Cable Co. (MA0032832)

Raytor Compounds Inc. (formerly Perstorp Compounds, Inc.) (MAG250960)

Pro Corporation – PMC of Florence (MAG250741)

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 23 July 2003 MassDEP DWM biologists conducted a habitat assessment of Mill River – Northampton about 300 meters upstream from USGS Gage 01171500 in Northampton (Station B0509). The overall habitat score was 149 out of a possible 200, with channel alteration and bank vegetative protection limiting the habitat score the most (Appendix C).

The USGS maintains a gage on the Mill River in Northampton, MA (Gage 01171500). The average annual discharge at this gage is 105.6 cfs (period of record 2000 to 2005). The maximum discharge at this gage occurred on 19 August 1955 (6,300 cfs). The minimum discharge occurred on 1 October 1950 (2.2 cfs)(period of record October 1938 to 2004) (Socolow et al. 2004).

Biology

DWM conducted benthic macroinvertebrate sampling in the Mill River- Northampton at Station B0509, upstream from USGS Gage 01171500 in Northampton on 23 July 2003. The Total Metric Score was 81% comparable to the reference condition, resulting in an assessment of "slightly impacted" (Appendix C).

MA DFG collected fish community data on the Mill River – Northampton at two sites (Richards 2006). Site 814 was sampled at Main Street in Northampton in 2002, while Site 941 was sampled at the Look Park picnic area in 2003. The fish community at Site 814 was dominated by fish species tolerant or moderately tolerant of pollution, although two species intolerant to pollution were present in very low numbers. A total of 342 fish were collected at Site 814, including: 146 common shiner, 100 blacknose dace, 37 longnose dace, 28 tessellated darter, 21 white sucker, 4 brown trout, 3 creek chub, 2 pumpkinseed, and 1 Atlantic salmon. The fish community at Site 941 was also dominated by fish species tolerant or moderately tolerant of pollution, although only one individual brown trout was collected that is considered pollution intolerant. A total of 249 fish were collected at Site 941, including: 187 blacknose dace, 44 longnose dace, 12 common shiner, 4 white sucker, 1 brown trout, and 1 brown bullhead.

Toxicity

Ambient

The Berkshire Electric Cable Co. staff collected water from the Mill River for use as dilution water in the facility's whole effluent toxicity tests. Survival of both *C. dubia* and *P. promelas* exposed (7-day) to the river water was >80% (n=1).

Effluent

One modified acute and chronic whole effluent toxicity test was conducted on the Berkshire Electric Cable Co. treated effluent in June 2004. The effluent did not exhibit any acute or chronic toxicity to either *C. dubia* or *P. promelas*.

Chemistry - water

DWM conducted water quality sampling one mile downstream from Clement Street, Station 28B, on this segment of the Mill River- Northampton between April and October 2003 (Appendix B). All measurements were indicative of good water quality conditions.

USGS collected water quality data on the Mill River in Northampton in the vicinity of Clement Street at USGS Gage # 01171500. These data were reported within an upper Connecticut River Basin total nitrogen report (Deacon et al 2006). Water quality parameters were measured monthly at this station on 43 occasions between December 2002 and September 2005. Summary statistics provided for this station showed that the minimum DO measurement collected at this location was 7.7 mg/L. The maximum water temperature reported was 22.6 deg C. TSS was generally low with a maximum of 17 mg/L. The maximum ammonia was 0.022 mg/L, though the median ammonia level was <0.005 mg/L. The mean and median pH was 7.2, though a minimum of 6.3 was reported.

This segment of the Mill River - Northampton is assessed as support for the *Aquatic Life Use* based on the benthic and fish communities, and the good water quality data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from the Mill River - Northampton one mile downstream from Clement Street (Station 02A) between April and November 2003 (Appendix B). The geometric mean of these samples was 133 cfu/100ml.

MassDEP biologists observed the water quality at the Mill River – Northampton monitoring station (B0509) on 23 July 2003. The water was clear, slightly turbid (likely due to heavy rain in the past 24 hours), odorless, and without any surface oils. This area is heavily used by dog-walkers (Appendix C).

DWM personnel made field observations at Station 28B during surveys conducted between April and October 2003. No objectionable deposits, scums or water odors were recorded and water clarity was generally noted as clear or slightly turbid (MassDEP 2003).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated *E. coli* bacteria counts, noted particularly during wet weather. The *Secondary Contact Recreation and Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the lack of objectionable conditions.

Mill River-Northampton (Segment MA34-28) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Elevated <i>E. coli</i> bacteria Source: Unknown
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

RECOMMENDATIONS

Conduct bacteria source tracking to determine the source(s) of elevated bacteria levels within this segment.

MILL RIVER DIVERSION (SEGMENT MA34-32)

Location: Headwaters, outlet Paradise Pond, Northampton, to the confluence with the Oxbow (east of Old Springfield Road), Northampton.

Segment Length: 2.5 miles.

Classification: Class B.

Hulberts Pond (MA34036) will no longer be reported on as an approximately 25 acre lake segment, it will be considered a run of the river impoundment (McVoy 2006). This decision is based on best professional judgement after review of the 2005 Mass GIS orthographic images of the area. Hulberts Pond is on the 2006 Integrated List of Waters in "Category 4c"- *Impairment Not Caused by a Pollutant* due to flow alteration (MassDEP 2007).

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

In Northampton the Mill River enters Paradise Pond and follows one of two paths. The interrupted/underground route (identified as the Mill River) appears on the eastern side of the railroad tracks and crosses under Route 5 and Route 91, ultimately discharging into the Connecticut River mainstem at the northern edge of the Oxbow. This interrupted section of the Mill River is currently not assessed in this report. The primary channel, the Mill River Diversion (MA34-32), flows generally south out of the Paradise Pond dam, crossing under Route 66 and Route 10 and flowing into Hulberts Pond. This pond then enters the western edge of the Oxbow.

USE ASSESSMENT

No recent data are available for the Mill River Diversion, thus all uses are not assessed.

Mill River Diversion (Segment MA34-32) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

MANHAN RIVER (SEGMENT MA34-10)

Location: Headwaters, (northeast of Norwich Pond) Huntington, to inlet Tighe Carmody Reservoir, Southampton.

Segment Length: 6.6 miles.

Classification: Class A.

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

White Reservoir (MA34100) will no longer be reported on as a lake segment since the 1998 synoptic survey conducted by DWM indicated the lake had been "drawn down" and the 2005 Mass GIS orthographic images also confirm the lack of water in this formerly 89-acre public water supply. It will be considered a run of the river impoundment (McVoy 2006). White Reservoir, now part of this segment of the Manhan River, is on the 2006 Integrated List of Waters in "Category 4c"- *Impairment Not Caused by a Pollutant* due to flow alteration (MassDEP 2007).

USE ASSESSMENT

No recent data are available for this segment of the Manhan River, thus all uses are not assessed.

Manhan River (Segment MA34-10) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality and biological monitoring to evaluate designated uses.

BRICKYARD BROOK (SEGMENT MA34-13)

Location: Headwaters, Westfield, to confluence with Manhan River, Westfield.

Segment Length: 1.6 miles.

Classification: Class B.

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

USE ASSESSMENT

No recent data are available for Brickyard Brook, thus all uses are not assessed.

Brickyard Brook (Segment MA34-13) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

MOOSE BROOK (SEGMENT MA34-17)

Location: Headwaters, Westfield, to confluence with Manhan River, Southampton.

Segment Length: 2.6 miles.

Classification: Class B, Cold Water Fishery.

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

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Southampton Country Club (10627602)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data at Moose Brook upstream from the Moose Brook Road crossing (Site 744) in Southampton in 2002 (Richards 2006). The sample was comprised solely of pollution intolerant fluvial specialist species. A total of 92 fish were collected at this station, including: 55 slimy sculpin, 26 brown trout (multiple age classes) and 16 brook trout (multiple age classes).

Moose Brook is assessed as support for the *Aquatic Life Use* based on the fish community data.

Moose Brook (Segment MA34-17) Use Summary Table

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

POTASH BROOK (SEGMENT MA34-12)

Location: Headwaters, Southampton, to confluence with Manhan River, Southampton.

Segment Length: 1.0 miles.

Classification: Class B.

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

USE ASSESSMENT

No recent data are available for Potash brook, thus all uses are not assessed.

Potash Brook (Segment MA34-12) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

TRIPPLE BROOK (SEGMENT MA34-16)

Location: Headwaters, Southampton, to confluence with Manhan River, Southampton.

Segment Length: 1.0 miles.

Classification: Class B, Cold Water Fishery.

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

USE ASSESSMENT

Biology

MA DFG collected fish community data at Tripple Brook upstream from East Street (Site 810) in Southampton in 2002 (Richards 2006). The sample was dominated by brook trout, a pollution intolerant fluvial specialist species. A total of 74 fish were collected at this station, including: 43 brook trout (multiple age classes) and 31 blacknose dace. Although this station is located in the headwaters of Tripple Brook, just upstream from the upper end of this 1.0 mile segment, the fish community was determined to be representative of the cold water conditions within this segment.

Tripple Brook is assessed as support for the *Aquatic Life Use* based on the fish community data.

Tripple Brook (Segment MA34-16) Use Summary Table

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

BROAD BROOK (SEGMENT MA34-18)

Location: Headwaters, Holyoke, to inlet Nashawannuck Pond, Easthampton.

Segment Length: 9.3 miles.

Classification: Class B, Cold Water Fishery.

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

Baystate Environmental Consultants, Inc., in an "Assessment of Stormwater Management Systems" report for the City of Easthampton, identified one stormwater outfall close to Broad Brook in Easthampton that was considered priority level two due to the presence of detergents and elevated nitrite concentrations or elevated levels of ammonia-nitrogen. Additional follow up was recommended for the priority level two outfalls (Baystate 2004).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Holyoke Water Works (10613711)

Easthampton Water Department (9P210608701, 10608701)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Broad Brook at Site 958 at Hendrick Street Easthampton in 2003 (Richards 2006). Brook trout, a pollution intolerant fluvial specialist species, was the dominant fish observed. Seventy-two fish were collected in total, including: 43 brook trout (multiple age classes), 13 slimy sculpin, 9 bluegill, 3 pumpkinseed, 2 blacknose dace, 1 creek chub, and 1 white sucker.

Broad Brook is assessed as support for the *Aquatic Life Use* based on the fish community data.

Broad Brook (Segment MA34-18) Use Summary Table

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

RECOMMENDATIONS

Evaluate whether the presence of stormwater outfalls noted by Baystate within this segment may be candidates for monitoring by the bacteria source tracking team.

Conduct water quality monitoring to evaluate designated uses.

WHITE BROOK (SEGMENT MA34-14)

Location: Headwaters, Westfield, to inlet Nashawannuck Pond, Easthampton.

Segment Length: 1.8 miles.

Classification: Class B.

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

USE ASSESSMENT

No recent data are available for White Brook, thus all uses are not assessed.

White Brook (Segment MA34-14) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

WILTON BROOK (SEGMENT MA34-15)

Location: Headwaters, Easthampton, to outlet Rubber Thread Pond, Easthampton.

Segment Length: 1.1 miles.

Classification: Class B, Warm Water Fishery.

Rubber Thread Pond (MA34105) will no longer be reported on as an approximately three acre lake segment. It will be considered a run of the river impoundment (McVoy 2006). This decision is based on review of depth and detention time data. Rubber Thread Pond, now part of this segment of Wilton Brook, is on the 2006 Integrated List of Waters in "Category 5"- *Waters Requiring a TMDL* because of noxious aquatic plants (MassDEP 2007). The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Rubber Thread Pond (Boettner 2007).

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

Baystate Environmental Consultants, Inc., in an "Assessment of Stormwater Management Systems" report for the City of Easthampton, identified two stormwater outfalls close to Wilton Brook in Easthampton that were considered priority level two due to the presence of detergents and elevated nitrite concentrations or elevated levels of ammonia-nitrogen. Additional follow up was recommended for the priority level two outfalls (Baystate 2004).

WITHDRAWALS AND DISCHARGES

NPDES (Appendix H, Table H2)

JPS Elastomerics (MA0001503)

USE ASSESSMENT

AQUATIC LIFE

Biology

The non-native aquatic macrophyte, *Trapa natans*, is present in Rubber Thread Pond (Boettner 2007).

Toxicity

Effluent

No acute or chronic whole effluent toxicity to *C. dubia* was detected in the three tests conducted between January 2006 and September 2007 on the JPS Elastomerics Company effluent.

The *Aquatic Life Use* is not assessed for the upper 0.7 miles of this segment. The lower 0.4 miles of this segment is assessed as impaired based on the presence of a non-native species.

Wilton Brook (Segment MA34-15) Use Summary Table

Designated Uses		Status
Aquatic Life		NOT ASSESSED Upper 0.7 miles IMPAIRED Lower 0.4 miles Cause: Non-native aquatic macrophyte infestation Source: Introduction of non-native macrophyte
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 users to the problem and their responsibility to prevent spreading these species.

Evaluate whether the presence of stormwater outfalls noted by Baystate within this segment may be candidates for monitoring by the bacteria source tracking team.

Conduct water quality monitoring to evaluate designated uses.

MANHAN RIVER (SEGMENT MA34-11)

Location: outlet Tighe Carmody Reservoir, Southampton, to confluence with Connecticut River, Easthampton.

Segment Length: 19.2 miles.

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 (Appendix H, Table H1)

Easthampton Water Department (9P210608701, 10608701)

Holyoke Water Works (10613711)

Southampton Water Department (9P210627601, 10627601)

NPDES (Appendix H, Table H2)

Easthampton WWTF (MA0101478)

USE ASSESSMENT

AQUATIC LIFE

Habitat

Currently, the Manhan Dam on the Manhan River in Easthampton blocks the upstream migration of anadromous fish. A project is underway to construct a fish ladder at the Manhan dam to enable anadromous fish to access spawning and nursery habitat upstream from the dam (USACOE 2007).

Biology

MA DFG collected fish community data at two sites on the Manhan River in Southampton in 2002 (Richards 2006). Site 784 was located upstream from Russelville/Manhan Roads, and Site 785 was located downstream from the Tripple Brook confluence. The fish community at Site 784 was dominated by fluvial specialist/dependant species that are tolerant or moderately tolerant to pollution. Twelve species were collected, including: 141 blacknose dace, 131 common shiner, 62 white sucker, 9 creek chub, 8 bluegill, 7 slimy sculpin, 6 brown trout (multiple age classes), 4 smallmouth bass, 3 golden shiner, 2 longnose dace, 1 fallfish, and 1 tessellated darter. The fish community at Site 785 was also dominated by fluvial specialist/dependant species that are tolerant or moderately tolerant to pollution. Eleven species were collected, including: 118 fallfish, 110 blacknose dace, 54 white sucker, 21 tessellated darter, 14 sea lamprey, 7 common shiner, 3 brook trout, 2 brown trout, 1 bluegill, 1 creek chub, and 1 redfin pickerel.

Chemistry - water

DWM conducted water quality sampling at two stations on this segment of the Manhan River between April and October 2003. Station 11A was located at Loudville Road in Easthampton, while Station 11C was located at Fort Hill Road in Easthampton (Appendix B and E). Water quality measurements at both stations generally met standards. Total phosphorus levels were slightly elevated at both stations, with a range of 0.018 to 0.061 mg/L observed at Station 11A and a range of 0.027 to 0.099 mg/L observed at 11C.

This segment of the Manhan River is assessed as support for the *Aquatic Life Use* based on the fish community and water quality data. Total phosphorus levels at the downstream station are high enough to be of concern, resulting in Alert Status for this use.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples at stations 11A and 11C on this segment of the Manhan River between April and November 2003 (Appendix B). The geometric mean of the samples collected at Station 11A was 99 cfu/100ml. The geometric mean of the samples collected at Station 11C was 157 cfu/100ml.

Baystate Environmental Consultants, Inc., in an "Assessment of Stormwater Management Systems" report for the City of Easthampton, identified two stormwater outfalls close to the Manhan River (in between the two DWM water quality stations) in Easthampton that were considered priority level one due

to the presence of detergents and the presence of elevated levels of ammonia or nitrite-nitrogen. Additional follow up was recommended for the priority level one outfalls (Baystate 2004).

DWM personnel made field observations at Station 11A and 11C during surveys conducted between April and October 2003. Station 11A was free from odors and scum during all visits, though trash was noted to be present on two surveys. The water clarity was recorded as highly turbid on one occasion (MassDEP 2003). Station 11C was free from odors during all visits, though trash was noted to be present on one survey and white foam was noted during another survey. Water clarity was reported as appearing highly turbid on two occasions, otherwise it was generally reported as clear (MassDEP 2003).

The upper 13.0 miles of this segment (upstream from Station 11A at Loudville Road in Easthampton) support the *Primary Contact Recreational Use*. However, the *Primary Contact Recreational Use* is assessed as impaired for the lower 6.2 miles (downstream from Station 11A) because of elevated *E. coli* bacteria counts. The *Secondary Contact Recreation and Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the lack of objectionable conditions.

Manhan River (Segment MA34-11) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT upper 13.0 miles IMPAIRED lower 6.2 miles Cause: Elevated <i>E. coli</i> bacteria Source: Unknown
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* Alert Status, see details in use assessment

RECOMMENDATIONS

According to the permit issued in September 2007, the City of Easthampton will be required to conduct whole effluent toxicity tests on their secondary Outfall #002 to the Manhan River. Review these tests results when they are available.

Bacteria monitoring should be conducted to assess the *Primary* and *Secondary Contact Recreation* uses in the upper and lower sections of this segment. Bacteria monitoring in the lower section could show reduced bacteria counts since the Easthampton Water Department's NPDES permit was reissued in 2007. Additionally, evaluate whether the presence of stormwater outfalls noted by Baystate within this segment may be candidates for monitoring by the bacteria source tracking team.

LAMPSON BROOK (SEGMENT MA34-06)

Location: Belchertown WWTP, Belchertown, to confluence with Weston Brook, Belchertown.

Segment Length: 1.2 miles.

Classification: Class B Warm Water Fishery.

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

WITHDRAWALS AND DISCHARGES

NPDES (Appendix H, Table H2)

Belchertown Department of Public Works Water Reclamation Facility (MA0102148)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Lampson Brook at George Hannum Road at Site 786 in Belchertown in 2002 (Richards 2006). Blacknose dace, a pollution tolerant fluvial specialist species, dominated the sample. A total of 281 fish were collected, representing 4 species, including: 257 blacknose dace, 17 white sucker, 5 brook trout, and 2 pumpkinseed.

Toxicity

Ambient

The Belchertown Water Reclamation Facility staff collected water from the Lampson Brook approximately 100 yards above the outfall, before the culvert on George Hannum Street, for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and August 2007, survival of *C. dubia* exposed (approximately 7 days) to the Lampson Brook water was > 80% (n=32). Hardness ranged from 56 to 106 mg/L (n=32).

Effluent

Whole effluent toxicity tests have been conducted on the Belchertown Water Reclamation Facility treated effluent. Between August 2000 and August 2007, 32 modified acute and chronic tests were conducted using *C. dubia*. The LC₅₀s using *C. dubia* were all >100% effluent (n=32). The CNOEC results ranged from 25 to 100%, and were less than 94% in six tests (February and November 2001, November 2004, November 2005 and January and February 2006). It should be noted that the facility has been meeting the CNOEC permit limit since May 2006.

Chemistry – water

DWM conducted water quality sampling at George Hannum Street, approximately 50 feet downstream from the Belchertown WWTP in Belchertown (Station 06A) on this segment of Lampson Brook between April and October 2003 (Appendix B). Most water quality parameters were indicative of good water quality conditions. However, all total phosphorus concentrations were very high, ranging from 0.07 to 0.37 mg/L.

This segment of Lampson Brook is assessed as support for the *Aquatic Life Use* based on the generally good water quality conditions and the fish community data. However, due to the elevated phosphorus concentrations, this use is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from Lampson Brook at George Hannum Street in Belchertown between April and November 2003 (Appendix B). The geometric mean of these samples was 33 cfu/100ml.

DWM personnel made field observations at Station 06A during surveys conducted between April and October 2003. This station was free from objectionable deposits during all visits, and the water clarity was generally clear or sometimes slightly turbid. White foam was noted on the water surface on four occasions, and a septic odor was noted on two occasions (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

Lampson Brook (Segment MA34-06) Use Summary Table

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

* Alert Status, see details in use assessment

RECOMMENDATIONS

Continue water quality monitoring downstream of the WWTP discharge to confirm the improved water quality data observed in 2003 and to monitor total phosphorus concentrations. Use deployed dissolved oxygen probes to record the dissolved oxygen levels over a period of days to confirm that it is not an impairment.

Investigate whether the CNOEC's observed in several years in the month of November are representative of a recurrent problem that occurs during that time of year.

WESTON BROOK (SEGMENT MA34-23)

Location: Headwaters, Belchertown, to inlet Forge Pond, Granby.

Segment Length: 2.7 miles.

Classification: Class B.

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

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Weston Brook at Site 750 at the corner of Eskett and Boardman Streets in Belchertown in 2002 (Richards 2006). The community was dominated by species that are tolerant or moderately tolerant of pollution. A total of 253 fish were collected, representing 7 species, including: 114 white sucker, 86 pumpkinseed, 21 bluegill, 13 fallfish, 9 brook trout, 8 blacknose dace, and 2 brown bullhead.

Chemistry - water

DWM conducted water quality sampling at Rural Street in Belchertown (Station 23A) on this segment of Weston Brook between April and October 2003 (Appendix B). Most parameters measured were indicative of good water quality conditions, with the exception of total phosphorus. Phosphorus concentrations were elevated, though they were generally lower than concentrations measured upstream in Lampson Brook.

This segment of Weston Brook is assessed as support for the *Aquatic Life Use* based on the water quality conditions and the fish community data. Due to the elevated phosphorus concentrations this use is identified with an Alert Status.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from Weston Brook at Rural Street in Belchertown (Station 23A) between April and November 2003 (Appendix B). The geometric mean of these samples was 46 cfu/100ml.

DWM personnel made field observations at Station 23A during surveys conducted between April and October 2003. Station CT06 was free from water odors during all visits, and the water clarity was recorded as clear except for one visit where it was slightly turbid. White foam was often observed at this station, and some trash was noted in the water on two occasions (MassDEP 2003).

Weston Brook (Segment MA34-23) Use Summary Table

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

*Alert Status, see details in use assessment

RECOMMENDATIONS

Continue water quality monitoring in this segment to confirm the improved water quality data observed in 2003 and to monitor total phosphorus concentrations. Use deployed dissolved oxygen probes to record the dissolved oxygen levels over a period of days to confirm that it is not an impairment.

BACHELOR BROOK (SEGMENT MA34-07)

Location: Outlet Forge Pond, Granby, to confluence with Connecticut River, South Hadley.

Segment Length: 11.6 miles.

Classification: Class B, Warm Water Fishery.

Aldrich Lake [East Basin] (MA34002) and Aldrich Lake [West Basin] (MA34106) will no longer be reported on as approximately 20-acre and 12-acre lake segments, respectively, they will be considered run of the river impoundments (McVoy 2006). Both lakes are now assessed as part of Bachelor Brook, Segment 34-07. The retention time of these waterbodies was estimated at approximately 3 days for Aldrich Lake [East Basin] and less than 1 day for Aldrich Lake [West Basin]. The retention time estimates were based on the annual historical mean discharge from two stream gages (01171300 and 01181000) and the normal storage volume of the dams reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al.* 1996, 2004 and MA DCR 2002).

Aldrich Lake East (formerly SEGMENT MA34002) is on the 2006 Integrated List of Waters in "Category 4a"- *TMDL is Completed* due to noxious aquatic plants (MassDEP 2007). The TMDL of phosphorus for selected Connecticut basin lakes states that phosphorus loads in Aldrich Lake East should be reduced from the current estimate loading of 1760 kg/year to a target load of 1342 kg/year (24% reduction) (MassDEP 2001). The proposed total phosphorus site- specific criteria for this water body is 0.030 mg/L (MassDEP 2006a).

Aldrich Lake West (formerly SEGMENT MA34106) is on the 2006 Integrated List of Waters in "Category 4a"- *TMDL is Completed* due to noxious aquatic plants (MassDEP 2007). The TMDL of phosphorus for selected Connecticut basin lakes states that phosphorus loads in Aldrich Lake West should be reduced from the current estimate loading of 1786 kg/year to a target load of 1393 kg/year (22% reduction) (MassDEP 2001). The proposed total phosphorus site- specific criteria for this water body is 0.030 mg/L (MassDEP 2006a).

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

Site specific criteria for copper (0.0257 and 0.0181 mg/L, acute and chronic, respectively) have been adopted into the Massachusetts Surface Water Quality Standards for this waterbody (MassDEP 2006a).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

South Hadley Fire District 2 Water Dept. (10627502)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data at Bachelor Brook upstream from Route 116 in South Hadley at Site 754 in August 2002 (Richards 2006). The fish community was comprised of fish tolerant or moderately tolerant to pollution, and four species are considered fluvial specialist/dependent. A total of 47 fish were collected, represented by 6 species, including: 30 tessellated darter, 4 common shiner, 4 white sucker, 3 longnose dace, 3 yellow bullhead, and 3 American eel.

Chemistry - water

DWM conducted water quality sampling at Hadley Street in South Hadley, Station 07A, on this segment of Bachelor Brook between April and October 2003 (Appendix B and E). Measurements were generally indicative of good water quality conditions. Total phosphorus concentrations were slightly elevated.

Bachelor Brook is assessed as support for the *Aquatic Life Use* based on the water quality data and the fish community data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from Bachelor Brook at Hadley Street in South Hadley (Station 07A) between April and November 2003 (Appendix B). The geometric mean of these samples was 51 cfu/100ml.

DWM personnel made field observations at Station 07A during surveys conducted between April and October 2003. A “musty basement” water odor was noted during one visit to this station, and trash along the bank was noted on another occasion. The water clarity was recorded as highly turbid on two occasions, and it was most often described as slightly turbid (MassDEP 2003).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as support due to the acceptable bacteria counts and the general lack of objectionable conditions.

Bachelor Brook (Segment MA34-07) Use Summary Table

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

RECOMMENDATIONS

Due to the presence of *Trapa natans* in Forge Pond (MA34024), this water body should be monitored for possible infestations in the future.

STONY BROOK (SEGMENT MA34-19)

Location: Headwaters, Granby, to confluence with Connecticut River, South Hadley.

Segment Length: 13.3 miles.

Classification: Class B, combined sewer overflow (Note: due to the elimination of the sole CSO discharge to this segment, the CSO designation should be removed from this segment during the next update of the water quality standards).

Upper Pond (MA340950) and Lower Pond (MA34049) will no longer be reported on as approximately 10-acre and 5-acre lake segments, respectively, since the retention time of these waterbodies was estimated at less than 1 day. They will be considered run of the river impoundments and assessed as part of this segment of Stony Brook (McVoy 2006). The retention time estimates were based on the annual historical mean discharge from two stream gages (01171300 and 01181000) and the normal storage volume of the dams reported by MA DCR in their Massachusetts Dam Safety Program Database (Socolow *et al.* 1996, 2004 and MA DCR 2002). Lower Pond is on the 2006 Integrated List of Waters in "Category 5"- *Waters Requiring a TMDL* because of noxious aquatic plants and exotic species (MassDEP 2007). Upper Pond 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).

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

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Westover Municipal Golf Course (9P2010616101)

NPDES (Appendix H, Table H2)

Town of South Hadley Wastewater Treatment Plant (MA0100455). This CSO was eliminated in September of 2007 (Boisjolie 2007).

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

On 22 July 2003 MassDEP DWM biologists conducted a habitat assessment of Stony Brook downstream from Route 116 in South Hadley (Station B0507). The overall habitat score was 160 out of a possible 200, (Appendix C). Habitat was most limited by in-stream cover for fish due to the lack of pools and refugia.

DWM fisheries biologists also conducted a habitat assessment of Stony Brook downstream of Route 116 on 23 October 2003. The overall habitat score was 151 out of a possible 200 (Appendix D).

Biology

A non-native species (*Trapa natans*) was observed in Upper Pond during the 1998 synoptic surveys (MassDEP 1998). The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in both Upper and Lower Ponds (Boettner 2007).

DWM conducted benthic macroinvertebrate sampling in Stony Brook at Station B0507, downstream from Route 116 in South Hadley on 22 July 2003 (Appendix C). Stony Brook was scored as 76% comparable to the reference station, Amethyst Brook, resulting in an assessment of "slightly impacted". The elevated biotic index score may indicate that the benthic community is dominated by species tolerant of organic pollution. The low species diversity at this station points towards a community with somewhat reduced health and function.

MA DFG collected fish community data in Stony Brook downstream of Route 116 at Station 758 in 2002 (Richards 2006). The fish community was comprised of fish species tolerant or moderately tolerant to pollution. A total of 113 fish were collected, represented by 12 species, including: 29 fallfish, 24 longnose dace, 15 white sucker, 14 bluegill, 11 smallmouth bass, 8 American eel, 4 tessellated darter, 2 brown bullhead, 2 largemouth bass, 2 rock bass, 1 chain pickerel, and 1 redbreast sunfish.

DWM conducted fish population sampling in Stony Brook at the same location as MA DFG (downstream of Route 116) on 23 October 2003 (Appendix D). Although electro-fishing efficiency was rated as “good”, it is possible that some fish escaped capture due to the width of the stream. The total number of fish collected was lower than the MA DFG sample from 2002 (n = 20) although 11 species were captured. The fish community was comprised of fish species tolerant or moderately tolerant to pollution, although one pollution intolerant species, Atlantic salmon, was present in this sample (n = 2).

Chemistry – water

DWM conducted water quality sampling at Route 116 in South Hadley, Station 19A, on this segment of Stony Brook between April and October 2003 (Appendix B). Measurements were generally indicative of good water quality conditions, although total phosphorus was slightly elevated. Total phosphorus concentrations ranged from 0.019 to 0.079 mg/L.

Stony Brook is assessed as support for the *Aquatic Life Use* based on benthic macroinvertebrate community, the water quality data, and the fish community. The downstream location from which these data were collected likely integrates the sum of the water quality influences along this lengthy segment, and allows the entire segment to be assessed as a whole for the *Aquatic Life Use*. However, this use is identified with an Alert Status because of low diversity within the benthic community, the elevated total phosphorus concentrations, and the pollution tolerance of the fish community. The *Aquatic Life Use* is assessed as impaired for the 0.5-mile length of this segment that runs through Upper and Lower Ponds because of the *T. natans* infestation.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

DWM collected *E. coli* samples from Stony Brook in South Hadley (Station 19A) between April and November 2003 (Appendix B). The geometric mean of these samples was 290 cfu/100ml.

DWM personnel made field observations at Station 19A during surveys conducted between April and October 2003. This station was free from odors and objectionable deposits during all visits, although the water clarity was recorded as highly turbid on four occasions. White foam on the water surface was commonly noted at this station (MassDEP 2003).

MassDEP personnel observed the water quality at Stony Brook in South Hadley on July 23, 2003. The water was tan and grey in color, slightly turbid, had a musty basement odor almost like sewage, and was without any surface oils. In-stream deposits of garbage were noted, including tires (Appendix C).

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as impaired for the lower 3.5 miles of this segment, downstream of the outlet of Lower Pond, based upon the chronic highly turbid conditions documented during water quality surveys and presence of garbage and tires. The *Primary Contact Recreational Use* in this lower section is also impaired because of elevated *E. coli* bacteria counts. The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are not assessed for the upper 9.8 miles of this segment upstream from the outlet of Lower Pond due to a lack of available data.

Stony Brook (Segment MA34-19) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT* 12.8 miles IMPAIRED 0.5 mile length through Upper and Lower Ponds Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED upper 9.8 miles IMPAIRED lower 3.5 miles Cause: Objectionable turbidity and elevated <i>E. coli</i> bacteria Source: Unknown
Secondary Contact		NOT ASSESSED upper 9.8 miles IMPAIRED lower 3.5 miles Cause: Objectionable turbidity Source: Unknown
Aesthetics		NOT ASSESSED upper 9.8 miles IMPAIRED lower 3.5 miles Cause: Objectionable turbidity Source: Unknown

* Alert Status, see details in use assessment

RECOMMENDATIONS

Evaluate whether this segment is a candidate for bacteria source tracking efforts to identify sources of bacteria contamination in this subwatershed.

Conduct further monitoring in the upper 9.8 mile portion of this segment in order to assess its designated uses.

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.

Due to the elimination of the sole CSO discharge to this segment, the CSO designation attached to this segment should be removed during the next update of the water quality standards.

CONNECTICUT RIVER (SEGMENT MA34-05)

Location: Holyoke Dam, Holyoke/South Hadley, to Connecticut state line, Longmeadow/Agawam.

Segment Length: 15.9 miles.

Classification: Class B, warm water fishery, combined sewer overflow.

This segment is on the 2006 Integrated List of Waters in "Category 5"- *Waters Requiring a TMDL* because of priority organics, pathogens and suspended solids (MassDEP 2007).

At the upper end of this segment, some flow from the Connecticut River is diverted into the Holyoke Hydroelectric Project three level canal system. This canal system is utilized to generate power (see FERC summary), and receives wastewater from several permittees (see NPDES wastewater discharge summary). Water quality conditions in the canal system itself are not assessed in this report.

The Gas Works in Holyoke manufactured combustible gas from coal and oil for residential, commercial, and industrial heating and lighting from 1852 to 1951. The former Gas Works once occupied a 2-acre peninsula on the Connecticut River 1500 feet downstream from the Holyoke Dam. Historic operations resulted in large releases of tar and oil to soil, groundwater, sediment, and surface water (Appendix I). Hard and soft tar patches found in the river contain high concentrations of polynuclear aromatic hydrocarbons (PAH), which are known to cause reproductive and teratogenic effects in a range of fish species (Kocan 1993). Federally endangered Shortnose sturgeon (*Acipenser brevirostrum*) and two state protected mussel species are known to use the habitat affected by the coal tar deposits. Remediation of coal tar patches was carried out between 2002 and 2006, but as many as 30 additional acres of tar may be present (Jones 2007). Additional information concerning this topic is provided in Appendix I.

Since 2002 the following projects on the Connecticut River have been completed, eliminating a total of 459 million gallons of CSO discharge per year (Boisjolie 2007)

Holyoke

1. Holyoke-CSO #21 - Green Brook Separation. This project reduced annual CSO discharge by approximately 30 MG/yr (from 58MG/yr to 28 MG/yr). It was completed late in 2001/early 2002.
2. CSO #014- Mosher Street Sewer Separation. This project eliminated CSO #014 (approximately 31 MG/yr). It was completed in 2005.
3. CSO #09- Berkshire Street CSO Screening and Disinfection Facility This was the largest CSO discharge to the Connecticut River (estimated 290 MG/yr). It was completed in October 2007.

Chicopee

1. CSO #09 -Paderewski Street. This project reduced CSO discharge by 5 MG/yr. It was completed late in 2006.
2. WWTP Bypass Disinfection Facility. This was located at the same location as the Chicopee Wastewater Treatment Plant. This project was completed in mid-2006 (43 MG/yr).

Springfield

1. Mill River project. This project was completed in December 2003 (60 MG/yr).

The following major CSO projects on the Connecticut River are presently in construction or design (Boisjolie 2007)

1. Chicopee CSO #01 - Fairview sewer separation. This project is in construction and it is scheduled to be completed in 2009 (32 MG/yr).
2. Chicopee CSO #07 - Jones Ferry. This is the second largest CSO discharge (173 MG/yr) to the Connecticut River. This project is in construction and it is scheduled to be completed in 2009.
3. Springfield CSO 07 & 049 - North End sewer separation. This project is in design and it is scheduled to be completed in 2011(65 MG/yr).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Intelicoat Technologies, LLC (10627501)

Open Square Properties (9P10613701)

Sonoco Products Company (10613706)

Holyoke Gas & Electric Department (10613708)

Hazen Paper Company (10613701)

Fountain Plating Co, Inc. (10632501)

NPDES (Appendix H, Table H2)

Intelicoat Technologies, LLC in South Hadley is authorized (MAG250968)

The City of Holyoke (MA0101630) Effluent and CSO discharges

Holyoke Gas and Electric Department (HG&E) (MA0035882, MA0035874, MA0035564, and MA0035866)

[Note: there are two additional stations (Skinner and Beebe-Holbrook) with unpermitted waterwheels which then go through the Riverside Station]

Holyoke Gas and Electric Department (HG&E) (MA0001520)

Hazen Paper Company (MAG250872)

Omniglow Corporation (MAG250010)

Town of South Hadley Wastewater Treatment Plant (MA0100455)

Atlas Copco Compressors (MAG250929) no longer discharges non-contact cooling water (closed loop), terminated by EPA in of July 2002

Hampden Papers, Inc. (MAG 250881)

Hercules, Inc. (MAG250848)

Chicopee Water Pollution Control Facility (MA0101508) Effluent and CSO discharges

Agri-Mark, Inc. (MA0029327)

Consolidated Edison Energy Massachusetts, Inc. (CEEMI) (MA0004707)

Springfield Water and Sewer Commission Regional Wastewater Treatment Facility (MA0101613)

Springfield Water and Sewer Commission (MA0103331) CSO discharges

Town of West Springfield (MA0101389) terminated by EPA in September 2000

Town of Agawam Department of Public Works (MA0101320) terminated September 2000.

Danaher Tool, Springfield (MAG250951) ceased operation so terminated by EPA in February 2006

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

Project Name	Owner	Project #	Issue Date	Expiration Date	River	Kilowatts
Holyoke	City of Holyoke (HG&E)	2004	20 August 1999	31 August 2039	Connecticut River	45,675
Holyoke No. 1	City of Holyoke (HG&E)	2386	28 February 1989	31 January 2019	Holyoke Canal	1,056
Holyoke No. 2	City of Holyoke (HG&E)	2387	28 September 1988	31 August 2018	Holyoke Canal	800
Holyoke No. 3	City of Holyoke (HG&E)	2388	28 September 1988	31 May 2020	Holyoke Canal	450
Holyoke No. 4	City of Holyoke (HG&E)	7758	15 August 2006	31 August 2039	Holyoke Canal System	760
Station No. 5	Holyoke Economic Dev & Indl Corp.	10806	29 June 1990	31 May 2030	Connecticut River	790
Mt Tom Mill	Harris Energy & Realty Corp.	2497	29 June 1989	28 February 2021	Holyoke Canal	500
Crocker Mill A/B	Harris Energy & Realty Corp.	2758	29 June 1989	28 February 2021	Holyoke Canal	350
Albion Mill (D Wheel)	Harris Energy & Realty Corp.	2766	29 June 1989	28 February 2021	Holyoke Canal	500

Project Name	Owner	Project #	Issue Date	Expiration Date	River	Kilowatts
Albion Mill (A Wheel)	Harris Energy & Realty Corp.	2768	29 June 1989	28 February 2021	Holyoke Canal	312
Crocker Mill (C Wheel)	Harris Energy & Realty Corp.	2770	29 June 1989	28 February 2021	Holyoke Canal	300
Linweave Warehouse (A Wheel)	Harris Energy & Realty Corp.	2772	29 June 1989	28 February 2021	Holyoke Canal	450
Linweave Warehouse (D Wheel)	Harris Energy & Realty Corp.	2775	29 June 1989	28 February 2021	Holyoke Canal	450
Nonotuck Mill	Harris Energy & Realty Corp.	2771	29 June 1989	28 February 2021	Holyoke Canal	500

USE ASSESSMENT

AQUATIC LIFE

Habitat/Flow

The USGS maintains a streamflow gage on the Connecticut River at the Interstate 391 bridge in Holyoke, MA (Gage 01172010). The average annual discharge at this gage is 15,820 cfs (period of record 2002 to 2004). The maximum discharge at this gage occurred on 2 April 2004 (91,700 cfs). The minimum discharge at this gage occurred on 10 July 2003 (1,960 cfs). From December 1983 to September 2002, a gage was located at a site 1 mi upstream from the current location. The discharge record is not equivalent because diversion through canal was not included (Socolow et al. 2004).

Biology

The Shortnose sturgeon (*Acipenser brevirostrum*), a federally endangered freshwater fish, is present in this section of the Connecticut River. This fish utilizes discrete habitats within this system for feeding and spawning. Historically, adult Shortnose sturgeon would spawn in the late spring near the confluence of the Deerfield and Connecticut Rivers and then migrate downstream to foraging areas as far downstream as Long Island Sound. At present, it is believed that the Holyoke Dam divides the Connecticut River Sturgeon into two separate populations (UMass 2007).

As part of the CEEMI permit requirements, macroinvertebrate sampling was conducted to assess potential biological impacts from the facility's thermal discharge (Kleinschmidt 2006a, 2007, and 2008). Benthic grab samples were collected on 28 August 2005 at three sites immediately upstream from the discharge and three sites just downstream from the discharge within the thermal mixing zone. Grab sampling was repeated in August 2006 and 2007. Sediment samples were collected with a shallow water bottom dredge concurrent with the benthic grab samples and were analyzed for percent gravel, sand, silt, and clay. In addition to the 2006 and 2007 grab sampling efforts, macroinvertebrate sampling using Hester-Dendy multiplates was conducted at ten sites upstream from the thermal discharge and at ten sites within and downstream from the thermal plume (Kleinschmidt 2006b). At this time results are inconclusive.

The CEEMI permit also required fish impingement and entrainment monitoring to evaluate potential biological impacts at the facility's intake (Kleinschmidt 2006a, 2007, and 2008). A two year impingement monitoring program was conducted between May 2005 and May 2007. Impingement samples were collected 3 times per week (only when cooling pumps were being operated). Approximately equal numbers of samples were collected during morning, afternoon, and night sampling time periods for the duration of the study. During the first year of the study (2005-2006), a total of 203 fish, representing 17 species, were collected. Bluegill was the most frequently impinged species. Based on actual impingement rates, annual projected impingement for year one was 7,749 fish. During the second year of the study (2006-2007), a total of 42 fish, representing 13 species, were collected. Again, bluegill was the

most frequently impinged species. Projected annual year-two impingement was 754 fish. No threatened or endangered species were collected during impingement sampling efforts.

Entrainment monitoring was conducted at the facility between May 2005 and May 2006. Samples were collected from a single fixed tap into the intake pipe at the facility. At the same time, egg and larvae collections were made using plankton nets at three set points across the river just upstream and in front of the cooling water intake structure. No fish eggs were reported entrained. Fish larvae entrainment monitoring for that time period indicated an estimated annual total entrainment of 591,401 larvae. Entrained fish larvae represented 10 taxa, and the total Adult equivalent loss calculation for the year was 24 adult fish (17 white sucker, 2 common carp, 2 shiner species, and 3 yellow perch). On May 24, 2005, a single shortnose sturgeon larvae (estimated to be 2-3 weeks old) was identified from an offshore ichthyoplankton sample collected in the middle of the Connecticut River in the location of the Memorial Bridge in West Springfield.

Toxicity

Ambient

The South Hadley Wastewater Treatment Facility staff collected water from the Connecticut River approximately ½ mile upstream from the outfall, at the playground over the South Hadley border, for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48-hours) to the Connecticut River water was $\geq 95\%$ (n=15). River water hardness ranged from 20 to 48mg/L (n=15).

The Chicopee Water Pollution Control Facility staff collected water from the Connecticut River approximately 100 yards upstream from the discharge at the boat ramp (just south of Route 90 Bridge) in Chicopee, for use as dilution water in the facility's whole effluent toxicity tests. Survival of *C. dubia* exposed (48 hours) to the Connecticut River water in August 2004 was 100% (n=1). Survival of *P. promelas* exposed (48 hours) to the Connecticut River water between August 2000 and September 2007 was $\geq 88\%$ (n=33). River water hardness ranged from 24 to 64 mg/L (n=33).

The Springfield Regional Wastewater Treatment Facility staff collected water from the Connecticut River at the North End Bridge for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and September 2007, survival of *C. dubia* exposed (48 hours) to the Connecticut River has been 100% (n=28). River water hardness ranged from 22 mg/L to 136 mg/L (n=28).

Effluent

Between August 2000 and September 2007, 15 acute whole effluent toxicity tests were conducted on the South Hadley WWTP effluent using *C. dubia*. With the exception of three test events (September 2004 LC₅₀=79.4% effluent, June 2005 LC₅₀=70.7% effluent, and September 2006 LC₅₀=70.7% effluent), no acute whole effluent toxicity has been detected. The facility has consistently passed its whole effluent toxicity testing limits.

Acute whole effluent toxicity tests have been conducted on the Holyoke Department of Public Works treated effluent. Between August 2000 and September 2007, 30 valid tests were conducted using *C. dubia*. The LC₅₀s were all $\geq 100\%$ effluent (n=30) with the exception of two test events (December 2000 and June 2005 LC₅₀s = 63.7 and 31.9% effluent, respectively).

Acute whole effluent toxicity tests have been conducted on the Chicopee WPCF treated effluent. Between August 2000 and September 2007, 31 valid tests were conducted using *P. promelas*. The LC₅₀s were all $>100\%$ effluent with the exception of three test events (May 2004, August and September 2007 with LC₅₀s = 94, 78.1, and 73.4 % effluent, respectively). No acute toxicity to *C. dubia* was detected in the August 2004 test event. It should also be noted that in August 2006 an acute whole effluent toxicity test was conducted on the "secondary bypass." This discharge was acutely toxic to *P. promelas* (LC₅₀=71.7% effluent).

Acute whole effluent toxicity tests have been conducted on the Springfield Regional Waste Water Treatment Facility treated effluent. Between August 2000 and September 2007, no acute whole effluent toxicity to *C. dubia* has been detected (LC₅₀ $>100\%$ effluent, n= 28).

Chemistry – water

DWM conducted water quality sampling at two stations on this segment of the Connecticut River between April and November 2003 (Appendix B and E). Station 05A was located at Route 90 in West Springfield/Chicopee and Station CT00 was located at USGS Gage 01197500 downstream of Route 190 in Suffield/Enfield Connecticut. Most measurements were indicative of good water quality conditions. Some elevated temperature measurements were recorded but did not exceed the warm water standard of 28.3°C. Total phosphorus was slightly elevated at Station CT00 and ranged from 0.029 to 0.058 mg/L.

USGS collected water quality data on the Connecticut River in Thompsonville, CT at USGS Gage 01184000 (Deacon et al 2006). Water quality parameters were measured monthly at this station on 43 occasions between December 2002 and September 2005. Summary statistics provided for this station showed that the minimum DO measurement collected at this location was 6.7 mg/L. The maximum water temperature reported was 27.0 deg C. TSS was generally low with a median value of 3 mg/L, however a maximum measurement of 135 mg/L was recorded at the maximum sampled flow. The maximum ammonia was 0.227 mg/L, and the median ammonia level was .041 mg/L. The mean and median pH was 7.4, and a minimum pH of 6.7 was recorded. Concentrations of total nitrogen ranged from 0.44 to 1.0 mg/L. Concentrations of total phosphorus ranged from 0.021 to 0.122 mg/L. The maximum concentration of total phosphorus was observed at the maximum streamflow at which samples were collected.

Chemistry- fish tissue

The Connecticut River Fish Tissue Contaminant Study (2000) was a collaborative federal and multi-state project designed to provide a baseline of tissue contaminant data from several fish species and learn what threat eating these fish poses to other mammals, birds, and fish (Hellyer 2006). This study reached the following conclusions: mercury poses a risk to fish-eating wildlife, DDT homologs (chemical physical, and biological breakdown products of the parent compound) pose a risk to fish-eating birds, coplanar PCBs pose a risk to fish-eating mammals and fish-eating birds, and dioxin constituted a risk to fish-eating wildlife.

This segment of the Connecticut River is assessed as support for the *Aquatic Life Use* based on the good survival of test organisms in ambient water, the generally lack of acute whole effluent toxicity, and the good water quality. However, this use is identified with an Alert Status due to the extent, potential toxicity and habitat impacts of the coal tar deposits and the risk that fish tissue contaminants pose to fish-eating wildlife.

FISH CONSUMPTION

The following site specific fish consumption advisory is recommended by MA DPH for the mainstem Connecticut River:

“(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB” (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

Metcalf & Eddy collected *E. coli* bacteria samples as part of the Connecticut River Bacteria Monitoring Project at seven stations within this segment (Metcalf & Eddy 2006). This project was funded to obtain river bacteria results upstream and downstream of combined sewer overflows during dry and wet weather conditions. Five samples were collected across a transect perpendicular to the river flow at these locations. Up to six rounds of sampling was performed at each transect location within a one to three day period in order to capture both dry and wet weather bacteria levels. Samples were collected at these locations during one dry weather (8 August 2001) and three wet weather periods (25-27 September 2001, 15-16 September 2002, and 16-18 October 2002). All valid samples collected at a single location have been pooled to calculate a single geometric mean. The geometric mean of all samples, and all samples collected during the primary contact recreation season (which excludes the 16-18 October sampling

event) at each location are presented below. Values exceeding the water quality standards appear in bold font.

Location	Description	Samples Collected during Primary Contact Recreation season	All samples (Secondary Contact Recreation)
		Geometric mean	Geometric mean
RIV-2	Connecticut River-Old County Bridge (Route 116)	136	116
RIV-3	Connecticut River-downstream of Holyoke WWTP	244	217
RIV-4	Connecticut River-downstream of Jones Ferry	270	225
RIV-5	Connecticut River-upstream of I-91	114	125
RIV-6	Connecticut River-Memorial Bridge	93	108
RIV-7	Connecticut River-South End Bridge	244	284
RIV-8	Connecticut River-downstream boundary	85	103

Metcalf & Eddy also collected *E. coli* bacteria samples at five CSO storm drain locations as part of the Connecticut River Bacteria Monitoring Project (Metcalf & Eddy 2006). These storm drains were sampled during one dry weather (8 August 2001) and two wet weather periods (25-27 September 2001, 15-16 September 2002) (Location SD-B not sampled in August 2001). Each location was sampled a maximum of two times, so no geometric mean has been calculated and they are not used for assessment. However, the data are presented below to document bacteria levels at these locations. Ranges of *E. coli* bacteria values for each station are presented below:

Location	Description	<i>E. coli</i> range (cfu 100m/L)
SD-A	Michigan Ave./Superior Ave.intersection-Holyoke	256-28,000
SD-B	Jones Ferry drain-Chicopee	150-2,900
SD-C	Ingleside Mall drain-Holyoke	170- 34,400
SD-D	Forest Park drain-Springfield	34-1,300
SD-E	Liberty St./Boylston St. intersection-Springfield	50-16,900

DWM collected *E. coli* samples from the Connecticut River at Station CT00 in 2003. Single grab samples were collected on five occasions at Station CT00 between April and November. The geometric mean of these samples was 21 cfu/100ml. Bacteria samples were only collected on three occasions at Station 05A, thus no geometric mean has been calculated (Appendix B).

DWM personnel made field observations at Station CT00 and 05A during surveys conducted between April and October 2003. At Station CT00, trash along the bank was noted on one occasion, a sulfide (rotten egg) smell was noted on one occasion, and the water was highly turbid during one visit (MassDEP 2003). At Station 05A, trash along the bank was noted on one occasion, but there were no other objectionable deposits, scums or water odors recorded and water clarity was noted as clear or slightly turbid (MassDEP 2003).

The *Primary Contact Recreational Use* is assessed as impaired because of elevated *E. coli* bacteria counts, noted particularly during wet weather periods. The *Secondary Contact Recreation and Aesthetics* uses are assessed as support based upon bacteria counts that are acceptable for secondary contact and the general lack of objectionable conditions.

Connecticut River (Segment MA34-05) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		IMPAIRED Cause: Elevated <i>E. coli</i> bacteria Source: Wet weather discharges, combined sewer overflows
Secondary Contact		SUPPORT
Aesthetics		SUPPORT

* Alert Status, see details in use assessment

RECOMMENDATIONS

Didymosphenia geminata, otherwise known as Didymo or “rock snot”, is considered an invasive algae and has been found in the Connecticut River in Vermont and New Hampshire. Infestation and nuisance blooms of Didymo can produce thick mats that blanket stream and river substrates, causing a loss of habitat for fish and other aquatic organisms. Didymo blooms can make fishing, swimming, or boating undesirable or impossible (MA DCR 2008). Although it is currently not known if Didymo will colonize and/or bloom in the Massachusetts section of the Connecticut River, every effort should be made to prevent the spread of this nuisance algae in the mainstem Connecticut River and its tributaries. MA DCR recommends the Check-Clean-Dry protocol be followed when exiting waters that may be infested with Didymo. For more information visit: http://www.mass.gov/dcr/waterSupply/lakepond/hot_topic.htm.

Continue to monitor acute toxicity in the South Hadley, Holyoke, and Chicopee waste water treatment plant effluent.

Continue to monitor ambient bacteria levels, particularly during wet weather events, to evaluate progress made due to CSO cleanup activities.

Review and evaluate submissions of data and reports required by 316a and 316b for CEEMI's West Springfield Station.

MILL RIVER-SPRINGFIELD (SEGMENT MA34-29)

Location: Outlet of Watershops Pond, Springfield, to confluence with the Connecticut River, Springfield (interrupted stream).

Segment Length: 1.3 miles.

Classification: Class B, combined sewer overflow.

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

A CSO elimination project on the Mill River – Springfield was completed in December 2003 (Boisjolie 2007). This project eliminated an estimated 60 MG/yr of CSO discharge.

WITHDRAWALS AND DISCHARGES

NPDES (Appendix H, Table H2)

Springfield Water and Sewer Commission (MA0103331) seven CSO outfalls.

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

Metcalf & Eddy collected *E. coli* bacteria samples as part of the Connecticut River Bacteria Monitoring Project at Station RIV-10 (Mill-Mill Pond at Walnut Street) in Springfield within this segment (Metcalf & Eddy 2006). This project was funded to obtain river bacteria results upstream and downstream of combined sewer overflows during dry and wet weather conditions. Up to six rounds of sampling was performed at each location within a one to three day period in order to capture both dry and wet weather bacteria levels. Samples were collected at this station during one dry weather (8 August 2001) and three wet weather periods (25-27 September 2001, 15-16 September 2002, and 16-18 October 2002). All valid samples collected at this location have been pooled to calculate a single geometric mean. The geometric mean of all samples collected during the primary contact recreation season (which excludes the 16-18 October sampling event) at Station RIV-10 was 1,253 cfu/100mL. The geometric mean of all samples collected was 1,071 cfu/100mL. It should be noted that all three dry weather bacteria samples collected were greater than the primary contact criteria for *E. coli*.

The *Primary* and *Secondary Contact Recreational* uses are assessed as impaired because of elevated *E. coli* bacteria counts. The *Aesthetics Use* is not assessed due to a lack of data.

Mill River-Springfield (Segment MA34-29) Use Summary Table

Designated Uses		Status
Aquatic Life		NOT ASSESSED
Fish Consumption		NOT ASSESSED
Primary Contact		IMPAIRED Cause: Elevated <i>E. coli</i> bacteria Source: Wet weather discharges and unknown
Secondary Contact		IMPAIRED Cause: Elevated <i>E. coli</i> bacteria Source: Wet weather discharges and unknown
Aesthetics		NOT ASSESSED

RECOMMENDATIONS

Conduct monitoring to evaluate water quality improvements in this segment since CSO abatement measures were implemented in 2003.

COOLEY BROOK (SEGMENT MA34-20)

Location: Headwaters, Longmeadow, to confluence with Connecticut River, Longmeadow.

Segment Length: 1.4 miles.

Classification: Class B.

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

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Cooley Brook at Site 779 downstream from Route 5 in Longmeadow in 2002 (Richards 2006). The sample was comprised of 180 blacknose dace, a pollution tolerant fluvial specialist species, and one individual American eel.

Cooley Brook is not assessed for the *Aquatic Life Use* due to too limited data.

Cooley Brook (Segment MA34-20) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

LONGMEADOW BROOK (SEGMENT MA34-21)

Location: Headwaters, Longmeadow, to confluence with Connecticut River, Longmeadow.

Segment Length: 4.5 miles.

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 (Appendix H, Table H1)

Longmeadow Country Club (10615902)

Twin Hills Country Club (10615901)

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Longmeadow Brook at Site 772 at Merriweather Road in Longmeadow in 2002 (Richards 2006). Four brook trout, a pollution intolerant fluvial specialist species, were collected in this sample (multiple age classes).

Longmeadow Brook is not assessed for the *Aquatic Life Use* based on the limited data. Although the presence of brook trout, a pollution intolerant species, is a good sign, 4 individual fish collected is insufficient data to assess the *Aquatic Life Use*.

Longmeadow Brook (Segment MA34-21) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

RASPBERRY BROOK (SEGMENT MA34-22)

Location: from Connecticut state line to confluence with Connecticut River, Longmeadow

Segment Length: 1.8 miles.

Classification: Class B.

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

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Raspberry Brook at Site 781 downstream of Route 5 in Longmeadow in 2002 (Richards 2006). The fish sample was comprised of 6 redbfin pickerel, a macrohabitat generalist species that is moderately tolerant of pollution. Sampling efficiency was noted as 100%.

Too limited data are available, thus the *Aquatic Life Use* for Raspberry Brook is not assessed.

Raspberry Brook (Segment MA34-22) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

TEMPLE BROOK (SEGMENT MA34-08)

Location: Headwaters (outlet Bradley Pond), Monson, to confluence with Scantic River, Hampden.

Segment Length: 3.7 miles.

Classification: Class B.

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

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data in Temple Brook at Site 767 at Scantic Road in Hampden in 2002 (Richards 2006). The fish community was dominated by fluvial specialist species, and a pollution intolerant species, brook trout, was the most frequently observed. A total of 197 fish, represented by six species, were collected, including: 85 brook trout (multiple age classes) 82 blacknose dace, 25 longnose dace, 2 tessellated darter, 2 pumpkinseed, and 1 American eel.

Temple Brook is assessed as support for the *Aquatic Life Use* based on the fish community data.

Temple Brook (Segment MA34-08) Use Summary Table

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

RECOMMENDATIONS

Fish community data collected in 2002 indicate that Temple Brook merits consideration to be designated as a cold water fishery. The appropriate fish community and temperature data should be collected to validate the designation of Temple Brook as a cold water fishery.

Conduct water quality monitoring to evaluate designated uses.

SCANTIC RIVER (SEGMENT MA34-30)

Location: From the Massachusetts/Connecticut border, Monson, to the MA/CT border, Hampden.

Segment Length: 9.6 miles.

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 (Appendix H, Table H1)

New Hampden Country Club (9P210612001) in tributary (Watchaug Brook) subwatershed

USE ASSESSMENT

AQUATIC LIFE

Biology

MA DFG collected fish community data at two stations in Hampden on the Scantic River in July 2002. Site 759 was located at Hancock Road, and Site 777 was located downstream from Mill Road (Richards 2006). Both stations were dominated by fluvial specialist fish species. A total of 159 fish were collected at site 759, represented by nine species, including: 108 brook trout (multiple age classes), 31 tessellated darter, 4 common shiner, 4 white sucker, 3 longnose dace, 3 yellow bullhead, 3 American eel, 2 blacknose dace, and 1 brown bullhead. A total of 107 fish were collected at Site 777, represented by nine species, including: 26 blacknose dace, 25 brook trout (multiple age classes), 15 tessellated darter, 13 fallfish, 9 brown trout (multiple age classes), 8 longnose dace, 7 white sucker, 2 American eel, and 2 redbfin pickerel.

The Scantic River is assessed as support for the *Aquatic Life Use* based on the fish community data.

Scantic River (Segment MA34-30) Use Summary Table

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

RECOMMENDATIONS

Fish community data collected in 2002 indicate that the Scantic River merits consideration to be designated as a cold water fishery. The appropriate fish community and temperature data should be collected to validate the designation of the Scantic River as a cold water fishery.

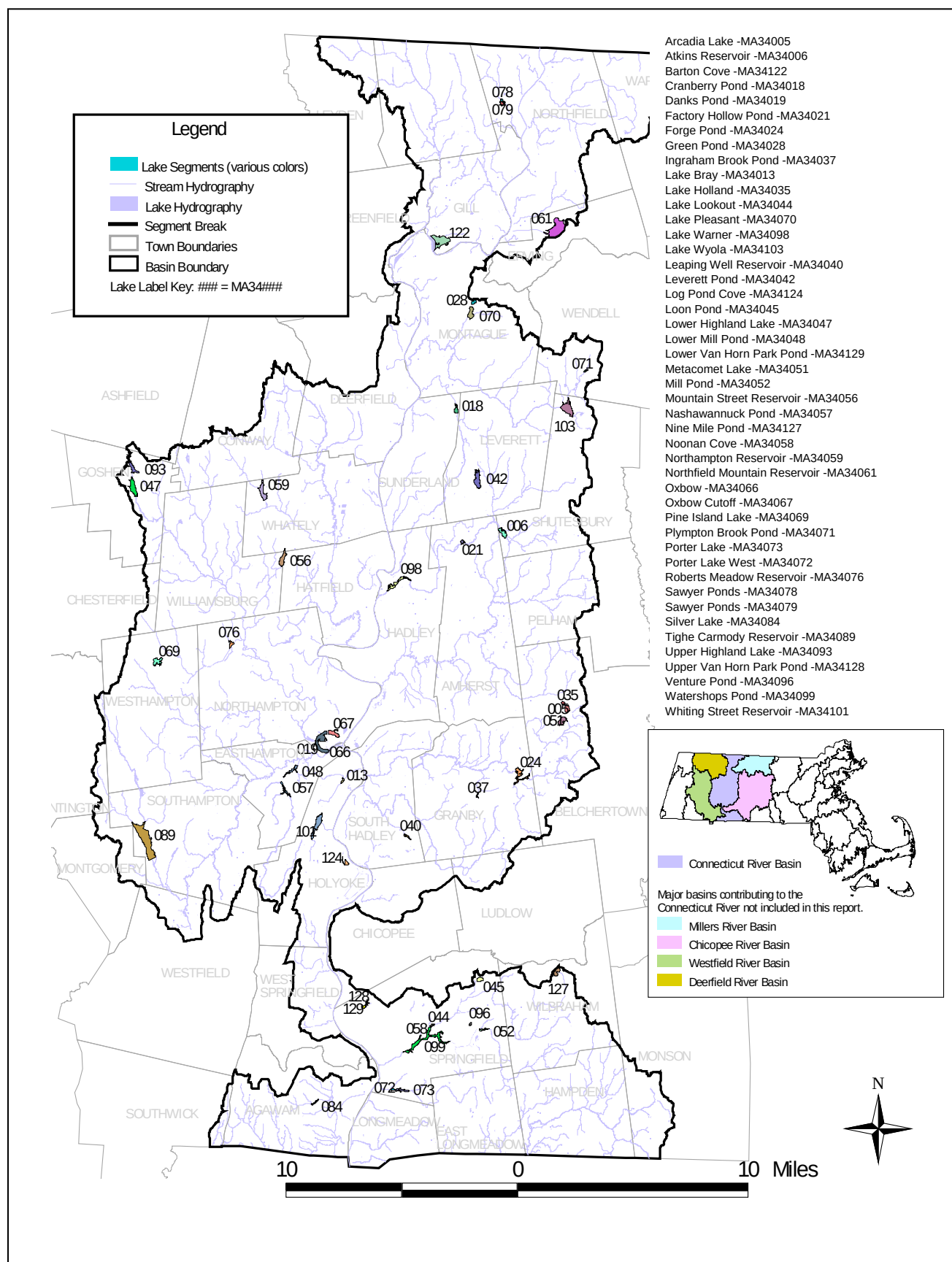
Conduct water quality monitoring to evaluate designated uses.

CONNECTICUT RIVER WATERSHED – LAKE SEGMENTS ASSESSED

Currently there is uncertainty associated with the accurate reporting of freshwater beach closure information to 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 these waterbodies. Bathing beaches located in this watershed are listed in their respective lake segments.

The City of Springfield received a grant to monitor the water quality of the lakes and ponds within the city limits, and monitoring was conducted during 2001 and 2002 (Godfrey 2007). A QAPP was submitted and approved in 2003 to document data collection methods. However, no additional data collection took place after 2002 under the direction of that QAPP (Connors 2007), thus these data are not used to make assessment decisions. Clear violations of criteria noted in these data have been described in the appropriate segment and may result in an Alert Status for the appropriate use.

Figure 8. Lake segments in the Connecticut River Watershed included in this report



ARCADIA LAKE (SEGMENT MA34005)

Location: Belchertown

Length/area: 32 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 and exotic species (MassDEP 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

Two non-native species (*Myriophyllum heterophyllum*, *Cabomba caroliniana*) were observed in Arcadia Lake during the 1998 synoptic surveys (MassDEP 1998).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

There is one beach along the shoreline of Arcadia Lake: Lake Arcadia Beach.

Arcadia Lake (SEGMENT MA34005) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native Macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

ATKINS RESERVOIR (SEGMENT MA34006)

Location: Shutesbury
Length/area: 46 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 (Appendix H, Table H1)**

Amherst DPW Water Division (9P10600801, 10600802)

USE ASSESSMENT

No recent data are available for Atkins Reservoir, thus all uses are not assessed.

Atkins Reservoir (SEGMENT MA34006) Use Summary Table

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

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

BARTON COVE (SEGMENT MA34122)

Location: (CT River) Gil

Length/area: 160 acres

Classification: Class B.

This waterbody is a cove of the Connecticut River.

This segment is on the 2006 Integrated List of Waters in "Category 5"- *Waters Requiring a TMDL* because of priority organics and exotic species (MassDEP 2007).

USE ASSESSMENT**AQUATIC LIFE**Biology

Three non-native species (*Myriophyllum spicatum*, *Cabomba caroliniana*, and *Potamogeton crispus*) have been observed on surveys and are known to occur in Barton Cove (MA DCR 2005).

Note: The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported isolated patches of this non-native aquatic macrophyte in the mainstem Connecticut River (MA34-02) along the shoreline upstream from Barton Cove near the end of Barton Cove Road and near the Turners Falls Rod and Gun club (Boettner 2007).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of non-native species.

FISH CONSUMPTION

Because Barton Cove is attached to the mainstem Connecticut River, the following site specific fish consumption advisory is recommended by MA DPH for the Connecticut River is also applicable to this water body:

"(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB" (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

Barton Cove (SEGMENT MA34122)

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of Non-Native Macrophyte
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
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 confirmed presence of *Trapa natans* immediately upstream means that it is a threat to colonize Barton Cove. This waterbody should be monitored for the presence of this invasive species so that action can be taken to remove it before it becomes established.

Conduct water quality monitoring to evaluate designated uses, particularly bacteria monitoring to assess the *Primary* and *Secondary Contact Recreation* uses observed in Barton Cove.

CRANBERRY POND (SEGMENT MA34018)

Location: Sunderland

Length/area: 28 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

Biology

A non-native species (*Myriophyllum spicatum*) was observed in Cranberry Pond during the 1998 synoptic surveys (MassDEP 1998).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

Cranberry Pond (SEGMENT MA34018) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

DANKS POND (SEGMENT MA34019)

Location: Northampton/Easthampton

Length/area: 3 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 recent data are available for Danks Pond, thus all uses are not assessed.

Danks Pond (SEGMENT MA34019) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

FACTORY HOLLOW POND (SEGMENT MA34021)

Location: Amherst

Length/area: 12 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 recent data are available for Atkins Reservoir, thus all uses are not assessed.

Factory Hollow Pond (SEGMENT MA34021) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

FORGE POND (SEGMENT MA34024)

Location: Granby

Length/area: 72 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 and exotic species (MassDEP 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of a substantial population of this non-native aquatic macrophyte in Forge Pond (Boettner 2007).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

Forge Pond (SEGMENT MA34024) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

GREEN POND (SEGMENT MA34028)

Location: Montague

Length/area: 15 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 (Appendix H, Table H1)**

Turners Falls Fire District (9P10619201, 10619201)

USE ASSESSMENT

No recent data are available for Green Pond, thus all uses are not assessed.

Green Pond (SEGMENT MA34028) Use Summary Table

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

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

INGRAHAM BROOK POND (SEGMENT MA34037)

Location: Granby

Length/area: 5 acres

Classification: Class B.

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

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Ingraham Brook Pond (Boettner 2007).

Ingraham Brook Pond (SEGMENT MA34037) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

LAKE BRAY (SEGMENT MA34013)

Location: Holyoke

Length/area: 10 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

Biology

A non-native species (*Potamogeton crispus*) was observed in Lake Bray during the 1998 synoptic surveys (MassDEP 1998). The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Lake Bray (Boettner 2007).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

Lake Bray (SEGMENT MA34013) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

LAKE HOLLAND (SEGMENT MA34035)

Location: Belchertown

Length/area: 11 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

Biology

Two non-native species (*Cabomba caroliniana*, *Myriophyllum heterophyllum*) were observed in Lake Holland during the 1998 synoptic surveys (MassDEP 1998).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

Lake Holland (SEGMENT MA34035) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

LAKE LOOKOUT (SEGMENT MA34044)

Location: Springfield

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 turbidity (MassDEP 2007).

USE ASSESSMENT

No recent data are available for Lake Lookout, thus all uses are not assessed.

Lake Lookout (SEGMENT MA34044) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

LAKE PLEASANT (SEGMENT MA34070)

Location: Montague

Length/area: 54 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 (Appendix H, Table H1)**

Turners Falls Fire District (9P10619201, 10619201)

USE ASSESSMENT

No recent data are available for Lake Pleasant, thus all uses are not assessed.

Lake Pleasant (SEGMENT MA34070) Use Summary Table

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

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

LAKE WARNER (SEGMENT MA34098)

Location: Hadley

Length/area: 65 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 nutrients, organic enrichment/low DO, noxious aquatic plants, turbidity [note: the TMDL for these pollutants was completed and approved by EPA in April 2002] and the presence of exotic (non-native) species (MassDEP 2007).

The TMDL of phosphorus for selected Connecticut basin lakes states that phosphorus loads in Lake Warner should be reduced from the current estimate loading of 7150 kg/year to a target load of 1790 kg/year (75% reduction) (MassDEP 2001).

There is a proposed site-specific total phosphorus criterion of 0.030 mg/L for this water body (MassDEP 2006a).

USE ASSESSMENT

AQUATIC LIFE

Biology

A non-native species (*Trapa natans*) was observed in Lake Warner during the 1998 synoptic surveys (MassDEP 1998). The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of a substantial population of this non-native aquatic macrophyte in Lake Warner (Boettner 2007). Volunteers conducting a plant survey on Lake Warner identified *Cabomba caroliniana* in the lake in 2003 and had the finding confirmed by Dr. Paul Joseph Godfrey (Schoen 2004).

Volunteers from the Mill River/ Lake Warner study group conducted a monitoring program on Lake Warner in 2003 and 2004 (Schoen 2004, 2005). A QAPP for this project was submitted and approved by MassDEP prior to the start of monitoring. Parameters measured included DO, Secchi disk depths, and total phosphorus. Each parameter was measured at least five times each year. Total phosphorus data were analyzed at the Umass Environmental Analytical Laboratory. Total phosphorus results generated by the Umass Environmental Analytical Laboratory in 2003 and 2004 are thought to be subject to significant uncertainty due to a settling step contained in the analytical procedure at that time. Because of this uncertainty, EAL Lake Warner TP data from 2003 and 2004 have not been used for assessment. DO concentrations and Secchi depth are considered valid and are considered here for assessment.

Secchi disk depths ranged from 0.69 to 2.13 m (n = 11), with only one measurement less than 1.2 meters. Dissolved oxygen concentrations measured at depth ranged from 4.6 to 9.9 mg/L (n = 9), with only one measurement less than 5.0 mg/L. It should be noted that the report states that DO measurements were generally made between 10AM and 2PM, and thus they likely do not represent the worst-case scenario.

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

Due to the good water clarity, as measured by Secchi disk depth, the *Secondary Contact Use* is supported. Due to a general lack of objectionable deposits or conditions, the *Aesthetics Use* is also supported. The *Primary Contact Recreation* is not assessed due to too limited data.

Lake Warner (SEGMENT MA34098) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

LAKE WYOLA (SEGMENT MA34103)

Location: Shutesbury

Length/area: 126 acres

Classification: Class B.

This segment is on the 2006 Integrated List of Waters in "Category 4a"- *TMDL is Completed* due to nutrients, organic enrichment/low DO and noxious aquatic plants (MassDEP 2007). The TMDL was completed and approved by EPA in April 2002.

There is a proposed site-specific total phosphorus criterion of 0.015 mg/L for this water body (MassDEP 2006a).

The TMDL of phosphorus for selected Connecticut basin lakes states that phosphorus loads in Lake Wyola should be reduced from the current estimate loading of 395 kg/year to a target load of 282 kg/year (29% reduction) (MassDEP 2001).

The Lake Wyola TMDL Implementation Project (00-16/319) implemented selected recommendations from the Lake Wyola Management Plan and Lake Wyola TMDL. Goals of this project included implementing residential and roadway BMPs to control erosion and sedimentation, and implementation of a comprehensive septic system management plan.

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

There are two beaches along the shoreline of Lake Wyola: Lake Wyola State Park Beach and a town beach.

No recent data are available for Lake Wyola, thus all uses are not assessed.

Lake Wyola (SEGMENT MA34103) Use Summary Table

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses, particularly bacteria monitoring to assess the *Primary* and *Secondary Contact Recreation* uses observed in Lake Wyola.

LEAPING WELL RESERVOIR (SEGMENT MA34040)

Location: South Hadley

Length/area: 9 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 (MassDEP 2007).

USE ASSESSMENT

No recent data are available for Leaping Well Reservoir, thus all uses are not assessed.

Leaping Well Reservoir (SEGMENT MA34040) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

LEVERETT POND (SEGMENT MA34042)

Location: Leverett

Length/area: 91 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 noxious aquatic plants, turbidity [note: the TMDL for these pollutants was completed and approved by EPA in April 2002] and the presence of exotic (non-native) species (MassDEP 2007).

There is a proposed site-specific total phosphorus criterion of 0.015 mg/L for this water body (MassDEP 2006a).

The TMDL of phosphorus for selected Connecticut basin lakes states that phosphorus loads in Leverett Pond should be reduced from the current estimate loading of 107 kg/year to a target load of 80 kg/year (25% reduction) (MassDEP 2001).

USE ASSESSMENT

AQUATIC LIFE

Biology

Two non-native species (*Myriophyllum spicatum* and *Najas minor*) were documented in Leverett Pond in 1998 (MassDEP 1998).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of non-native species.

Leverett Pond (SEGMENT MA34042) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

LOG POND COVE (SEGMENT MA34124)

Location: Holyoke

Length/area: 19 acres

Classification: Class B.

This waterbody is a cove of the Connecticut River.

This segment is on the 2006 Integrated List of Waters in "Category 5"- *Waters Requiring a TMDL* because of priority organics and exotic species (MassDEP 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported that Log Pond Cove is severely infested with this non-native aquatic macrophyte (Boettner 2007). Herbicide applications have been used in an attempt to control *Trapa natans* infestations in Log Pond Cove (2002-2006) (MassDEP 2006b).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

FISH CONSUMPTION

Because Log Pond Cove is attached to the mainstem Connecticut River, the following site specific fish consumption advisory is recommended by MA DPH for the Connecticut River is also applicable to this water body:

"(All towns between Northfield and Longmeadow)...Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from the Connecticut River and the general public should not consume channel catfish, white catfish, American eel, or yellow perch because of elevated levels of PCB" (MA DPH 2007).

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, the *Fish Consumption Use* is assessed as impaired.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

The *Primary Contact Recreation*, *Secondary Contact Recreation* and *Aesthetics* uses are assessed as impaired due to the severe *Trapa natans* infestation.

Log Pond Cove (SEGMENT MA34124) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
Secondary Contact		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
Aesthetics		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte

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.

Conduct water quality monitoring to evaluate designated uses.

LOON POND (SEGMENT MA34045)

Location: Springfield

Length/area: 25 acres

Classification: Class B.

This segment is on the 2006 Integrated List of Waters in "Category 4a"- *TMDL is Completed* for nutrients and noxious aquatic plants (MassDEP 2007). The TMDL's were completed and approved by EPA in April 2002.

There is a proposed site-specific total phosphorus criterion of 0.030 mg/L for this water body (MassDEP 2006a).

The TMDL of phosphorus for selected Connecticut basin lakes states that phosphorus loads in Loon Pond should be reduced from the current estimate loading of 47 kg/year to a target load of 41 kg/year (13% reduction) (MassDEP 2001).

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

There is one beach along the shoreline of Loon Pond: Jam's Beach.

No recent data are available for Loon Pond, thus all uses are not assessed.

Loon Pond (SEGMENT MA34045) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

LOWER HIGHLAND LAKE (SEGMENT MA34047)

Location: Goshen

Length/area: 91 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

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

There is one beach along the shoreline of Lower Highland Lake: Camp Howe Beach.

No recent data are available for Lower Highland Lake, thus all uses are not assessed.

Lower Highland Lake (SEGMENT MA34047) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

LOWER MILL POND (SEGMENT MA34048)

Location: Easthampton

Length/area: 30 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

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Lower Mill Pond (Boettner 2007).

The *Aquatic Life Use* for Lower Mill Pond is impaired based on the presence of a non-native species.

FISH CONSUMPTION

MassDEP biologists collected fish from Lower Mill Pond in East Hampton in June 2002. Mercury concentrations were well below the MA DPH trigger level of 0.5 mg/kg in the four samples analyzed. It should be noted that this included largemouth bass, a predatory species. Arsenic, lead, and cadmium levels were all below minimum detection limits. Selenium concentrations were low and are not of concern, ranging from 0.14 to 0.34 mg/kg. Trace concentrations of PCB Congeners, Aroclors, DDE and chlordane were well below MDPH or USFDA criteria (Appendix G).

MA DPH did not issue a site-specific advisory for Lower Mill Pond, so the Fish Consumption Use is currently not assessed.

Lower Mill Pond (SEGMENT MA34048) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

LOWER VAN HORN PARK POND (SEGMENT MA34129)

Location: Springfield

Length/area: 11 acres

Classification: Class B.

This is a new segment and therefore is not on the 2006 Integrated List of Waters.

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Lower Van Horn Park Pond (Boettner 2007).

The *Aquatic Life Use* for Lower Van Horn Park Pond is impaired based on the presence of a non-native species.

Lower Van Horn Park Pond (SEGMENT MA34129) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

METACOMET LAKE (SEGMENT MA34051)

Location: Belchertown
Length/area: 51 acres
Classification: Class B.

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

USE ASSESSMENT

AQUATIC LIFE

Biology

Two non-native species (*Cabomba caroliniana*, *Myriophyllum heterophyllum*) were observed in Metacomet Lake during the 1998 synoptic surveys (MassDEP 1998).

Water Chemistry

An *in-situ* profile was taken by DWM at the deep hole of Metacomet Lake on 9 July 2003. Dissolved oxygen concentrations ranged from 8.0 to 0.4 mg/L; percent saturations ranged from 104 to 4% (Appendix F). Low dissolved oxygen levels were measured in the bottom water at depths of 2.0 meters or greater. This corresponds to an approximate area equal to 34% of the total area of the waterbody. The depth integrated chlorophyll a concentration was 11.9 mg/m³. The Secchi disk depth was 2.1 m.

The *Aquatic Life Use* is assessed as impaired for Metacomet Lake since approximately 34% of the lake area had low dissolved oxygen levels. Additionally, the *Aquatic Life Use* is also impaired due to the presence of two invasive non-native macrophytes.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

Due to too limited data, the *Primary* and *Secondary Contact Uses* are not assessed. The *Aesthetics Use* is assessed as support based upon the lack of objectionable deposits or conditions and the good Secchi disk depth.

Metacomet Lake (SEGMENT MA34051) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s), low dissolved oxygen Source: Unknown, introduction of non-native macrophyte
Fish Consumption		NOT ASSESSED
Primary Contact		NOT ASSESSED
Secondary Contact		NOT ASSESSED
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.

Conduct water quality monitoring to evaluate designated uses.

MILL POND (SEGMENT MA34052)

Location: Springfield

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 taste, odor, and color and noxious aquatic plants (MassDEP 2007).

WITHDRAWALS AND DISCHARGES**WMA (Appendix H, Table H1)**

Wilbraham Water Department (9P210633901)

USE ASSESSMENT

No recent data are available for Mill Pond, thus all uses are not assessed.

Mill Pond (SEGMENT MA34052) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

MOUNTAIN LAKE (FORMERLY SEGMENT MA34055)

This water body in Chicopee is no longer reported on as a lake segment. Due to a dam breach in 2005 Mountain Lake no longer exists as a lake; the area has reverted to Willamansett Brook and wetland (Kurpaska 2007). No water quality data are available for Willamansett Brook; it is currently not a segment and has never been assessed.

MOUNTAIN STREET RESERVOIR (SEGMENT MA34056)

Location: Williamsburg/Hatfield/Whately

Length/area: 67 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 (Appendix H, Table H1)**

Northampton Department Of Public Works (9P210621401, 10621401)

NPDES (Appendix H, Table H2)

Northampton Water Treatment Plant (MAG640032)

USE ASSESSMENT

No recent data are available for Mountain Street Reservoir, thus all uses are not assessed.

Mountain Street Reservoir (SEGMENT MA34056) Use Summary Table

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

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

RECOMMENDATIONS

EPA and MassDEP are developing a revised general permit for water treatment plant discharges. Since the City of Northampton's permit MAG640032 is expired but has been administratively continued, the city should submit an application for the new general permit as soon as it is available.

Conduct water quality monitoring to evaluate designated uses.

NASHAWANNUCK POND (SEGMENT MA34057)

Location: Easthampton

Length/area: 30 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, organic enrichment/low DO and turbidity (MassDEP 2007).

As part of a 319 grant awarded in 2001 (Nashawannuck Pond Restoration, Phase II), stormwater BMPs were implemented on Broad Brook to reduce sediment and nutrient loads to Nashawannuck Pond.

Plans and specifications have recently been completed for a restoration (i.e., dredging) effort of Nashawannuck Pond. It has been determined that removal of pond sediments would improve/restore the open water habitat for fish and waterfowl resources. Pending the issuance of State and local permits, construction can commence during the spring of 2008 (USACOE 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported the presence of this non-native aquatic macrophyte in Nashawannuck Pond (Boettner 2007).

MA DFG collected fish community data in Nashawannuck Pond in Easthampton at Sites 613 and 614 in July 2002 (Richards 2006). A total of 670 fish were collected between the two stations, represented by 11 species, including: 352 largemouth bass, 154 bluegill, 80 pumpkinseed, 40 white sucker, 20 yellow perch, 8 rainbow trout, 4 brown bullhead, 4 brown trout, 4 bowfin, 2 chain pickerel, and 2 hybrid bluegill/pumpkinseed.

The *Aquatic Life Use* for Nashawannuck Pond is impaired based on the presence of a non-native species.

Nashawannuck Pond (SEGMENT MA34057) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

NINE MILE POND (SEGMENT MA34127)

Location: Wilbraham

Length/area: 33 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**PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES**

There is one beach along the shoreline of Nine Mile Pond: Nine Mile Pond Beach.

No recent data are available for Nine Mile Pond, thus all uses are not assessed.

Nine Mile Pond (SEGMENT MA34127) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

NOONAN COVE (SEGMENT MA34058)

Location: Springfield

Length/area: 3 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

No recent data are available for Noonan Cove, thus all uses are not assessed.

Noonan Cove (SEGMENT MA34058) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

NORTHAMPTON RESERVOIR (SEGMENT MA34059)

Location: Whately

Length/area: 80 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 waterbody is also referred to as Francis Ryan Reservoir and Ryan Reservoir.

WITHDRAWALS AND DISCHARGES**WMA (Appendix H, Table H1)**

Northampton Department of Public Works (9P210621401, 10621401)

USE ASSESSMENT

No recent data are available for Northampton Reservoir, thus all uses are not assessed.

Northampton Reservoir (SEGMENT MA34059) Use Summary Table

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

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

NORTHFIELD MOUNTAIN RESERVOIR (SEGMENT MA34061)

Location: Erving

Length/area: 237 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).

Public access to this waterbody is completely restricted.

USE ASSESSMENT

No recent data are available for Northfield Mountain Reservoir, thus all uses are not assessed.

Northfield Mountain Reservoir (SEGMENT MA34061) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

OXBOW (SEGMENT MA34066)

Description: The waterbody west of Route 91 (bounded on the northeast by Route 91, the southeast by the Manhan River, and the west by Old Springfield Road), Northampton/Easthampton (excluding the delineated segment; Danks Pond).

Length/area: 148 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).

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported a substantial population of this non-native aquatic macrophyte in the Oxbow (Boettner 2007).

The *Aquatic Life Use* is assessed as impaired because of the presence of a non-native aquatic macrophyte.

Oxbow (SEGMENT MA34066) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses, particularly bacteria monitoring to assess the *Primary* and *Secondary Contact Recreation* uses observed in the Oxbow.

OXBOW CUTOFF (SEGMENT MA34067)

Description: The waterbody north of Island Road and south of Oxbow Road (between Routes 91 and 5), Northampton.

Length/area: 49 acres

Classification: Class B.

This is a new segment and therefore does not appear on the 2006 Integrated List of Waters (MassDEP 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

The Silvio O. Conte National Fish and Wildlife Refuge has led an effort to control *Trapa natans* populations in the Connecticut River Watershed. They have reported a substantial population of this non-native aquatic macrophyte in Oxbow Cutoff (Boettner 2007).

The *Aquatic Life Use* is assessed as impaired because of the presence of a non-native aquatic macrophyte.

Oxbow Cutoff (SEGMENT MA34067) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

PINE ISLAND LAKE (SEGMENT MA34069)

Location: Westhampton

Length/area: 55 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

Biology

There is a report of *Myriophyllum* sp. in Pine Island Lake, but it is unknown if it is a native or non-native species (MassDEP 1998).

The *Aquatic Life Use* for Pine Island Lake is not assessed due to a lack of data, however it is identified with an Alert Status.

Pine Island Lake (SEGMENT MA34069) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status, see details in use assessment

RECOMMENDATIONS

Conduct aquatic plant surveys in Pine Island Lake to identify which *Myriophyllum* species and any other non-native plant species present in this waterbody.

Conduct water quality monitoring to evaluate designated uses.

PLYMPTON BROOK POND (SEGMENT MA34071)

Location: Wendell

Length/area: 5 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 recent data are available for Plympton Brook Pond, thus all uses are not assessed.

Plympton Brook Pond (SEGMENT MA34071) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

PORTER LAKE (SEGMENT MA34073)

Location: Springfield
Length/area: 28 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 exotic species (MassDEP 2007).

WITHDRAWALS AND DISCHARGES

WMA (Appendix H, Table H1)

Veterans & Franconia Golf Courses (9P210628101)

USE ASSESSMENT

AQUATIC LIFE

Biology

A non-native species, American Lotus (*Nelumbo lutea*), was observed in Porter Lake during the 1998 synoptic surveys (MassDEP 1998). There is an unconfirmed report of *P. crispus* in Porter Lake, and this water body has had repeated herbicide applications over the last four years (MassDEP 2006b).

Dissolved oxygen levels measured at depth by the Springfield Surface Water Action Monitoring Program in 2001 were observed at levels below 5 mg/L on four occasions (Godfrey 2007).

The *Aquatic Life Use* for Porter Lake is impaired based on the presence of a non-native species. An additional concern is the low dissolved oxygen levels recorded in 2001.

Porter Lake (SEGMENT MA34073) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct aquatic plant surveys to confirm the presence of *P. crispus*.

Conduct water quality monitoring to evaluate designated uses and the extent of low dissolved oxygen levels.

PORTER LAKE WEST (SEGMENT MA34072)

Location: Springfield

Length/area: 5 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 exotic species (MassDEP 2007).

USE ASSESSMENT

AQUATIC LIFE

Biology

A non-native species (*Nelumbo lutea*) was observed in Porter Lake West during the 1998 synoptic surveys (MassDEP 1998).

The *Aquatic Life Use* for Porter Lake West is impaired based on the presence of a non-native species.

Porter Lake West (SEGMENT MA34072) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

ROBERTS MEADOW RESERVOIR (SEGMENT MA34076)

Location: Northampton

Length/area: 22 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 (Appendix H, Table H1)**

Northampton Department Of Public Works (9P210621401, 10621401)

USE ASSESSMENT**PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES**

There is one beach along the shoreline of Roberts Meadow Reservoir: Musante Beach.

No recent data are available for Roberts Meadow Reservoir, thus all uses are not assessed.

Roberts Meadow Reservoir (SEGMENT MA34076) Use Summary Table

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

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

SAWYER PONDS (SEGMENT MA34078)

Location: [North Basin] Northfield

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 recent data are available for Sawyer Ponds (North basin), thus all uses are not assessed.

Sawyer Ponds (SEGMENT MA34078) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

SAWYER PONDS (SEGMENT MA34079)

Location: [South Basin] Northfield

Length/area: 12 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 recent data are available for Sawyer Ponds (South basin), thus all uses are not assessed.

Sawyer Ponds (SEGMENT MA34079) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

SILVER LAKE (SEGMENT MA34084)

Location: Agawam

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 recent data are available for Silver Lake, thus all uses are not assessed.

Silver Lake (SEGMENT MA34084) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

TIGHE CARMODY RESERVOIR (SEGMENT MA34089)

Location: Southampton
Length/area: 353 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 (Appendix H, Table H1)**

Holyoke Water Works (10613711)

USE ASSESSMENT

No recent data are available for Tighe Carmody Reservoir, thus all uses are not assessed.

Tighe Carmody Reservoir (SEGMENT MA34089) Use Summary Table

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

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

UPPER HIGHLAND LAKE (SEGMENT MA34093)

Location: Goshen

Length/area: 51 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

Water Chemistry

DWM conducted water quality sampling in Upper Highland Lake at the deep hole station in September 2003 (Appendix F). There was no evidence of oxygen depletion at depth. Secchi disk depth was 3.5 m. Total phosphorus and chlorophyll a concentrations were low. All measurements were indicative of good water quality conditions.

Upper Highland Lake is assessed a support for the *Aquatic Life Use* based upon the water quality data.

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS USES

There are two beaches along the shoreline of Upper Highland Lake: Campers Beach and Day-use Area Beach.

Due to too limited data, the *Primary* and *Secondary Contact Uses* are not assessed. The *Aesthetics Use* is assessed as support based upon the lack of objectionable deposits or conditions and the good Secchi disk depth.

Upper Highland Lake (SEGMENT MA34093) Use Summary Table

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

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses, particularly bacteria monitoring to assess the *Primary* and *Secondary Contact Recreation* uses observed in Upper Highland Lake.

UPPER VAN HORN PARK POND (SEGMENT MA34128)

Location: Springfield

Length/area: 8 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 and turbidity (MassDEP 2007).

USE ASSESSMENT

Dissolved oxygen levels measured at depth by the Springfield Surface Water Action Monitoring Program in 2001 were observed at levels below 5 mg/L on four occasions, thus the *Aquatic Life Use* is assessed with an Alert Status (Godfrey 2007).

No recent quality assured data are available for Upper Van Horn Park Pond, thus all uses are not assessed.

Upper Van Horn Park Pond (SEGMENT MA34128) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status, see details in use assessment

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

VENTURE POND (SEGMENT MA34096)

Location: Springfield

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, noxious aquatic plants, organic enrichment/low DO and turbidity (MassDEP 2007).

USE ASSESSMENT

Dissolved oxygen levels measured at depth by the Springfield Surface Water Action Monitoring Program in 2001 were observed at levels below 5 mg/L on three occasions, thus the *Aquatic Life Use* is assessed with an Alert Status (Godfrey 2007).

No recent quality assured data are available for Venture Pond, thus all uses are not assessed.

Venture Pond (SEGMENT MA34096) Use Summary Table

Aquatic Life*	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

* Alert Status, see details in use assessment

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

WATERSHOPS POND (SEGMENT MA34099)

Location: Springfield

Length/area: 162 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

WMA (Appendix H, Table H1)

Veterans & Franconia Golf Courses (9P210628101)

USE ASSESSMENT

Secchi disk depths measured by the Springfield Surface Water Action Monitoring Program in 2001 were observed to be less than 1.2m on three occasions, thus the *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses are identified with Alert Status (Godfrey 2007).

No recent quality assured data are available for Watershops Pond, thus all uses are not assessed.

Watershops Pond (SEGMENT MA34099) Use Summary Table

Aquatic Life	Fish Consumption	Primary Contact*	Secondary Contact*	Aesthetics*
				
NOT ASSESSED				

* Alert Status, see details in use assessment

RECOMMENDATIONS

Conduct water quality monitoring to evaluate designated uses.

WHITING STREET RESERVOIR (SEGMENT MA34101)

Location: Holyoke

Length/area: 102 acres

Classification: Class A.

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 (Appendix H, Table H1)

Holyoke Water Works (10613711)

USE ASSESSMENT

AQUATIC LIFE

Biology

The non-native species (*Myriophyllum spicatum*) was observed in Whiting Street Reservoir during the 1998 synoptic surveys (MassDEP 1998).

The *Aquatic Life Use* for this segment is assessed as impaired based on the presence of a non-native species.

Whiting Street Reservoir (SEGMENT MA34101) Use Summary Table

Designated Uses		Status
Aquatic Life		IMPAIRED Cause: Non-native macrophyte(s) Source: Introduction of non-native macrophyte
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.

Conduct water quality monitoring to evaluate designated uses.

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APPENDIX F

MASSDEP DWM 2003 LAKE SURVEY DATA IN THE CONNECTICUT RIVER WATERSHED

From Baseline Lake Survey 2003, Technical Memo CN 205.0.

In the Connecticut River Watershed, baseline lake surveys were conducted in July and September 2003. Metacomet Lake and Upper Highland Lake were each sampled on one occasion. Data were excerpted from the *Baseline Lake Survey 2003* Technical Memorandum (MassDEP 2007) and are presented in tables F1 and F2.

In-situ measurements using the Hydrolab® (measures dissolved oxygen, water temperature, pH, conductivity, and depth and calculates total dissolved solids and % oxygen saturation) were recorded. At deep hole stations measurements were recorded at various depths to create profiles. In-lake samples were also collected and analyzed for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling Standard Operating Procedure* and the *Hydrolab® Series 3 Multiprobe Standard Operating Procedure* (MassDEP 1999a and MassDEP 1999b). The Wall Experiment Station (WES), MassDEP's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the *WES Laboratory Quality Assurance Plan and Standard Operating Procedures* (MassDEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES Standard Operating Procedure (SOP). Information about data quality objectives (accuracy, precision, detection limits, holding times, representativeness and comparability) is available in the 2003 Data Validation Report (MassDEP 2005). Apparent color and chlorophyll *a* were measured according to standard procedures at the MassDEP DWM office in Worcester (MassDEP 2002a and MassDEP 2002b). No aquatic macrophyte survey was conducted at either lake.

Table F1. 2003 MassDEP DWM Connecticut River Watershed Baseline Lakes *physico-chemical* data.

CONNECTICUT RIVER/Metacomet Lake

Unique ID: W1068 Station: A

Description: deep hole, Belchertown

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth ¹	Sample Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
07/09/03	2.1	11:45	4.3												
				LC-0053	--	11:50	VDOR	nb	3.5	--	--	--	--	##* m	--
				LC-0051	LC-0052	11:37	MNGR	--	<0.5	--	--	--	--	##* m	35*
				LC-0052	LC-0051	11:37	MNGR	--	<0.5	--	--	--	--	##* m	36*
				LC-0055	--	11:53	DINT	--	0 - 3.5	11.9*	--	--	--	--	--

CONNECTICUT RIVER//Upper Highland Lake

Unique ID: W1080 Station: A

Description: deep hole, southern end, Goshen

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth ¹	Sample Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
09/03/03	3.5	10:13	4.5												
				LC-0059	--	10:35	VDOR	nb	4.2	--	<0.02	--	## bh	0.012	--
				LC-0058	--	10:30	MNGR	--	<0.5	--	<0.02	--	## bh	0.009	27*
				LC-0060	LC-0061	10:50	DINT	--	0 - 3.5	2.4*	--	--	--	--	--
				LC-0061	LC-0060	10:55	DINT	--	0 - 3.5	1.9*	--	--	--	--	--

¹ Relative depth key: nb = near bottom.

Table F2. 2003 MassDEP DWM Connecticut River Watershed Baseline Lakes *in-situ* data.

CONNECTICUT RIVER//Metacomet Lake, Unique ID: W1068 Station: A

Description: deep hole, Belchertown

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
07/09/03									
	LC-0056	10:48	0.5	28.1	6.5 u	127	81.0	8.0	104
	LC-0056	10:58	1.5	26.9	6.2	128	81.9	6.8 u	87 u
	LC-0056	11:28	1.7	24.6 u	5.8	124	79.2	5.5 u	68 u
	LC-0056	11:05	2.0	23.2	6.1	121	77.6	3.9 u	46 u
	LC-0056	11:12	2.5	18.7	6.2 u	119	76.3	0.6	7
	LC-0056	11:19	3.0	15.6	6.2 u	124	79.1	0.4	4

CONNECTICUT RIVER//Upper Highland Lake, Unique ID: W1080 Station: A

Description: deep hole, southern end, Goshen

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
09/03/03									
	LC-0062	10:46	0.1 i	20.4	6.8 u	34.0	22.0	7.4	82
	LC-0062	10:49	0.5	20.4	6.8	34.0	22.0	7.3	81
	LC-0062	10:52	0.8	20.4	6.8	34.0	22.0	7.3	81
	LC-0062	10:55	1.4	20.4	6.9	34.0	22.0	7.3	81
	LC-0062	10:57	1.9	20.4	6.9	35.0	23.0	7.3	81
	LC-0062	10:59	2.5	20.4	6.9 c	34.0	22.0	7.3	81
	LC-0062	11:03	2.9	20.4	6.9 c	34.0	22.0	7.3	81
	LC-0062	11:05	3.5	20.4	6.9 c	34.0	22.0	7.2 u	80 u
	LC-0062	11:08	4.0	20.4	6.9	34.0	22.0	7.1 u	79 u

Data Qualifiers

The following data qualifiers or symbols used in the MassDEP/DWM Water Quality Database (WQD) have been applied to qualify or censor these water quality and multi-probe data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data.

General Symbols (applicable to all types):

“ ## ” = Censored data (i.e., data that has been discarded for some reason). NOTE: Prior to 2001 data,

“**” denoted either censored or missing data.

“ ** ” = Missing data (i.e., data that should have been reported). See NOTE above.

“ -- ” = No data (i.e., data not taken/not required)

* = Analysis performed by Laboratory OTHER than DEP’s Wall Experiment Station (WES)

[] = A result reported inside brackets has been “censored”, but is shown for informational purposes (e.g., high blank results).

Multi-probe-specific Qualifiers:

“ i ” = inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses.

“i” = General Depth Criteria: Apply to each OWMID#

- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

Specific Depth Criteria: Apply to entirety of depth data for survey date

- If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, ie. that all positive readings may be in error.)

“ u ” = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

“ c ” = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified (“c”) conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

Sample-Specific Qualifiers:

“ b ” = blank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).

“ h ” = holding time violation (usually indicating possible bias low)

“ m ” = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

Sample codes for sampling:

OWMID: Office of Watershed Management Identification Code for the bottle.

QAQC: the OWMID codes (e.g. LB-1903) refer to the field duplicate sample (usually immediately above or below in the table) to be compared with the current sample.

Time: Local time.

SymTyp: Sample Type- VDOR= Van Dorn; DINT= Depth integrated by vertical hose; MNGR= Manual Grab; NR= not recorded.

RelDepth: Relative Depth- s= Near Surface; m= middle depth; nb= near bottom.

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Appendix E

CONNECTICUT RIVER WATERSHED

2003 Chlorophyll a and Periphyton Technical Memorandum

Joan Beskenis

Watershed Planning Program
Worcester, MA

December, 2006

CN: 105.7

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Robert W. Golledge, Jr., Secretary
Department of Environmental Protection
Arleen O'Donnell, Acting Commissioner
Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner
Division of Watershed Management
Glenn Haas, Director

Introduction

Biological assessment was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at several stations in the Connecticut River Basin during the summer of 2003. Because the Connecticut River is a large, often deep, often slow river, it can maintain a resident population of phytoplankton. In order to learn more about the phytoplankton biomass in this river, chlorophyll *a* samples were collected to gather information on the main stem water quality and to determine if it was impacted by sources of nutrients (phosphorus and nitrogen) located along the river; in particular, agricultural runoff and discharges from wastewater treatment plants. Chlorophyll *a* is a pigment that is found in all plants and algae and provides an estimate of biomass as well as an indication of the biological production of the water body.

In the tributaries, samples were collected for the identification of periphyton, described here as including the attached microscopic and macroscopic algae. Estimates were made of the percent algal cover within the riffle of the sampling reach. Algal type and abundance were also recorded. Periphyton sampling was limited to sites chosen for macroinvertebrate/habitat investigations.

Objectives of the periphyton sampling were to provide additional information for assessment by adding another biological community to the macroinvertebrate and habitat information, and to examine temporal changes in the amount and type of algae present in the assemblage. The periphyton assessment provides information to aid in determining if the designated uses, as described in the Surface Water Quality Standards (MassDEP 1996), are being supported, threatened or lost in particular segments. Periphyton data can be used to evaluate two designated uses of the Connecticut River: Aquatic Life and Aesthetics.

Aquatic life evaluations determine if suitable habitat is available for "sustaining a native, naturally diverse, community of aquatic flora and fauna." Natural diversity and the presence of native species may not be sustained when there are dense growths of a monoculture of a particular alga. This alteration of the community structure may indicate that the aquatic life use support is lost or threatened. Loss of parts of the food web, which is vital for aquatic life use support, may result from this alteration. In addition, the die-off and decomposition of large amounts of biomass from macroalgae can fill in the interstitial sites in the substrate and destroy this habitat for the benthic invertebrates and compromise the aquatic life use support.

The algal data are also used to determine if aesthetics have been impacted. Floating rafts of previously attached benthic mats can make a waterbody visually unappealing, as can large areas of the bottom substrates covered with long streamers of algae that can discourage waders and hinder fishermen by making the substrata slippery for walking. Fishermen can also snag their fishing lines on the filamentous algae. Nuisance amounts of algae, which can compromise aesthetics, can be determined by estimating the percent macroalgal cover in a particular habitat (e.g. riffles or pool) (Biggs 1996) (Barbour et al. 1999). Nuisance amounts of macroalgae are present, if the percent cover is greater than 40 % by filamentous green algae (Biggs 1996) (Barbour et al. 1999).

Periphyton sampling is typically done on first, second or third order streams and rivers that are small, shallow, and often fast moving. At each of the stations an estimate of the percent cover of the periphyton and benthic algae is made and samples are collected for algal identification. Periphyton samples are typically scrapes of one type of substrata in the riffle zone. The algal scrapes are used in the qualitative microscopic examination to determine the presence and relative abundance of the phyla that contributes the most to the biomass in the riffle or pool habitats. The estimate of percent cover of the filamentous algae (macroalgae) is used in conjunction with the microscopic examination to determine if uses of the river (Aquatic Life Support and Aesthetics) are lost or threatened because of excessive algal growth.

Materials and Methods

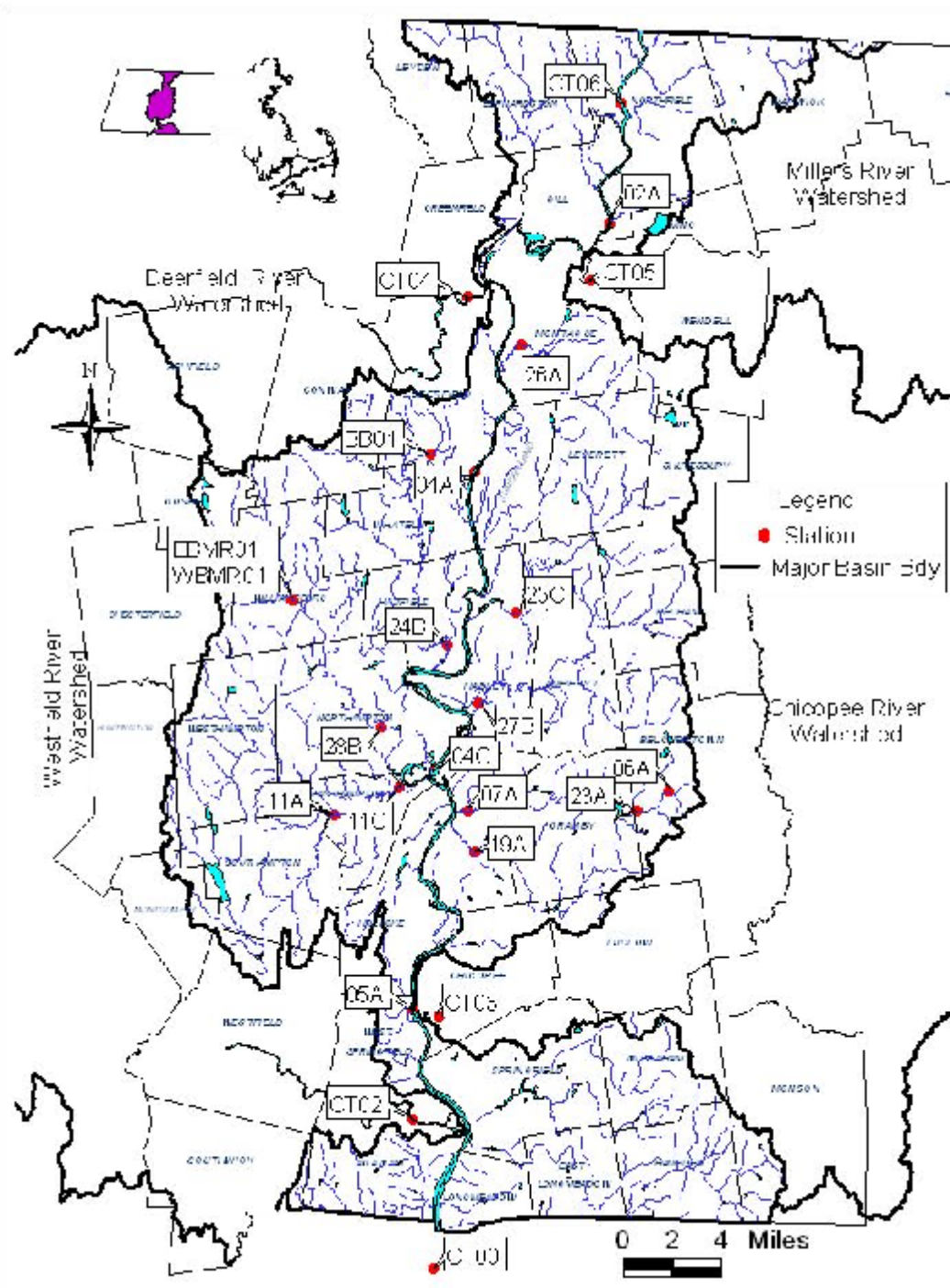
Chlorophyll a

Samples for chlorophyll *a* analysis and phytoplankton identifications were collected on July 9, Aug. 6 and Sept. 10 by reaching into the main flow of the river using a pole with a sample container attached. Grab samples were collected just below the surface in plastic containers that were placed into iced coolers until they could be returned to MassDEP's laboratory in Worcester for analysis. Samples were processed within the 24-hour holding period. A list of chlorophyll *a* sampling stations is included in Table 1 and shown in Figure 1.

A Turner Designs, Inc. TD-700 fluorometer was used in the chlorophyll *a* analysis (MassDEP 2000). Fifty milliliters of sample water were filtered through a glass fiber filter. The filter was ground using a motor driven grinder and a glass pestle. The ground material was transferred to plastic centrifuge tubes that were kept in the dark and refrigerated for 24 hours while the chlorophyll *a* extraction continued in 90% acetone. The plastic centrifuge tubes were kept in the dark, brought to room temperature, and then decanted into borosilicate disposable cuvettes that were placed in the TD-700 fluorometer for analysis. Results are reported in mg chlorophyll *a* per m³ water.

Table 1. 2003 Connecticut River Chlorophyll a Sampling Locations		
Station ID	Location	Mile Point
CT06	Connecticut River -Route 10 Bridge, Northfield	64.4
02A	Connecticut River -Downstream of Fourmile Brook confluence, Northfield and east of Pisgah Mountain Rd., Gill	58.7
04A	Connecticut River -Route 116, Deerfield/Sunderland	40.2
04C	Connecticut River -Upstream of the confluence of the Mill River, near the Oxbow, Northampton/Hadley	22.4
05A	Connecticut River -Route 90 boat launch, West Springfield/Chicopee	9.9
CT00	Connecticut River -At the USGS flow gage #01184000 downstream of Route 190, Suffield/Enfield, Connecticut	-2.9
07A	Bachelor Brook -At Route 47 (Hadley St.), South Hadley	0.9
11A	Manhan River -Loudville Rd., Easthampton	5.6
11C	Manhan River -Fort Hill Rd., Easthampton	0.8
27B	Fort River -At Route 47, Hadley	0.6
24B	Mill River -Maple St., Hatfield	2.1
BB01	Bloody Brook -Whately Rd., Deerfield	1.6
25C	Mill River -Mill River Lane, Hadley	0.9

Figure 1- Sampling Locations in the Connecticut River Watershed



Map is from Mitchell (2005)

Periphyton Identifications and Relative Abundance

Periphyton samples were gathered along with the macroinvertebrate samples and habitat information using methods described in Barbour et al (1999). Sampling was done by the macroinvertebrate sampling crew and consisted of randomly scraping rocks and cobble substrates, typically within the riffle area, but other habitats were occasionally sampled. Material was removed with a knife or by hand from rock substrata and then added to labeled glass vials containing sample water. Table 3 contains descriptions of the station locations where periphyton was collected. The samples were transported to the lab at MassDEP-Worcester in one liter plastic jars containing stream water to keep them cool. Once at the lab, they were refrigerated until identifications were completed. Samples held longer than a week were preserved using M³ with a dose rate of 2 ml of preservative per 100 ml of sample (Reinke 1984).

Vials were shaken to get uniform samples before subsampling. Filamentous algae were removed first, identified separately and then the remainder of the sample was examined. An Olympus BH2 compound microscope with Nomarski optics was used for the identifications (Appendix B contains the references used for identifications). Slides were typically examined under 200 power. A modified method for periphyton analysis developed by Bahls (1993) was used. The scheme developed by Bahls for determining abundance on a slide is as follows:

R (rare)	fewer than one cell per field of view at 200x, on the average;
C (common)	at least one, but fewer than five cells per field of view;
VC (very common)	between 5 and 25 cells per field;
A (abundant)	more than 25 cells per field, but countable;
VA (very abundant)	number of cells per field too numerous to count.

A visual determination was also made of whether or not the algal covering was composed of micro or macroalgae, in particular, the green filamentous algae. The microalgae typically appear as a thin film, often green or blue-green, or as a brown floc. Macroalgal (green filamentous algae) cover over greater than 40% of the substrata in the riffle/run is considered to be indicative of organic enrichment (Barbour et al 1999) to the extent that the aesthetic quality of the stream may be compromised.

Results

Chlorophyll a

Channel characteristics of the Connecticut River, such as depth and retention time, favor the establishment of an indigenous phytoplankton population. The biomass of the phytoplankton was estimated by determining the chlorophyll a concentration in a water column sample. The chlorophyll results remained fairly constant over the sampling period (Table 2) as most stations exhibited the same value or less than a 1.0 mg/m³ change from July to September. Exceptions to this were station 11 C on the Manhan River which had its highest algal production in August (5.1 mg/m³ chlorophyll a) but then dropped in September to 1.8 mg/m³. Bloody Brook (BB01) peaked in July at 8.8 mg/m³, but then decreased in August and September.

Table 2. 2003 Connecticut River Water-column Chlorophyll a Data (mg/m ³)				
Station ID	Water Column color/transparency	Sampling Dates		
		July 9	August 6	September 10
CT06	Water typically colored brown	<1.0	1.0	<1.0
02A	Water column was usually clear	<1.0 (1.1)*	1.3 (1.1)	1.6 (1.7)
04A	Water column slightly turbid and brown	<1.0 (<1.0)	--	<1.0
04C	Slightly turbid, brown	<1.0	1.3	1.1
05A	Water was typically slightly turbid, and brown	1.4	1.0	1.7
CT00	Water column clear	--	1.7 (1.6)	2.3
07A	Water always colored tan or brown and turbid	--	1.3	<1.0
11A	Water usually clear, yet low gradient and pasture land	--	2.1	<1.0
11C	Water brown colored	--	5.1	1.8
27B	Water was brown and turbid	--	3.1	<1.0
24B	Slightly turbid, brown	1.3	--	--
BB01	Water usually brown	8.8 (7.9)	3.2 (5.7)	3.4
25C	Water was usually slightly turbid and brown	1.5 (1.3)	--	--
* Values for duplicate samples appear in parentheses				

Periphyton

The three periphyton sampling locations, their percent canopy cover and percent algal cover are described in Table 3. Appendix A lists algal genera that were identified at these sites.

Table 3. 2003 Periphyton samples from selected Connecticut River Tributaries				
Unique ID	Location	% Canopy Cover	% Algal Cover	Dominant Algae in riffle
B0510	Mill River (Hatfield), ~100-meters upstream of Mountain Drive, below the confluence of West Brook, Hatfield, MA	50	65	Filamentous cyanobacteria <i>Phormidium</i> VA.
B0507	Stony Brook, ~30-meters upstream of powerlines, downstream from Route 116, South Hadley, MA	90	2	Filamentous green <i>Cladophora glomerata</i> and diatom <i>Cocconeis</i> sp.
B0515	Sawmill River, upstream at South Ferry Road, Montague, MA	70	30	Diatom chain (<i>Melosira brevigulata</i>)- planktonic, lake organisms

The Stony Brook station (B0507) had only 2% algal cover, and a high percentage of the river bottom was shaded by the canopy (90%) (Table 3). Isolated clumps of the green filamentous alga *Cladophora glomerata* were recovered in the algal scrapes (Table 3, Appendix A).

At the Mill River location (B0510) the percent algal cover was high at 65% with filamentous cover in the riffle dominated by the cyanobacteria-*Phormidium* sp. Although *Phormidium* sp. covered a large part of the substrata, the short microscopic filaments do not have the same nuisance factor as macroscopic algae. Canopy cover here was the lowest of the three stations at 50%.

According to field sheets, non-point source pollution was evident at the Sawmill River in Montague (B0515). Cows had access to the river at this station and their droppings were found in the riparian zone. The water column was slightly turbid and had a grayish color. The diatom chain *Melosira brevigulata* was a major constituent of the periphyton that covered 30% of the substrata in the riffle.

Discussion

Algal production, as indicated by the chlorophyll a values, was low at the stations included for sampling at the Connecticut River. As indicated in Table 3, many of the stations had highly colored and often turbid water. Agricultural land-use is prevalent throughout this watershed. In the technical memorandum presenting the 2003 water quality data for the Connecticut River Mitchell (2005) mentions possible sources for the turbidity present in the water column. The turbidity may have resulted from the sandy soil types that formed the banks of the river in several areas like CT06, 11A, 11C, where slumping or erosion of sandy/muddy banks was noted (Mitchell 2005). This common phenomenon along the Connecticut River could be caused by erosion of lake-bottom deposits (Typically clay, silt and sand) that are prevalent along both sides of the river-remnants of glacial Lake Hitchcock, which extended up to the Massachusetts border with Vermont.

Other sources of turbidity could be from non-point source run-off. Stations 02A-Northfield, 27 B-Amherst and 25C-University of Massachusetts all receive run-off from towns. Station 11C is located 0.75 miles below the Easthampton Wastewater Treatment Plant, another source of solids and nutrients to the river. Agricultural run-off may impact stations 02A, 05A, 11A, 27B and 25 C (Mitchell 2005).

The turbid and colored waters may have limited algal productivity by reducing available light penetration. Chlorophyll a values (an indicator of algal production) were often 1 mg/m³ or less from stations that stretched from mile point 64.4 down to mile point -2.9 at CT00 in Enfield, Connecticut.

A closed canopy appeared to affect periphyton production at tributary sites including B0507 and B0515. A significant inverse relationship (r^2 equal to .9959 ($F=0.040783$)) was found in a regression using % algal cover (y) and % canopy cover (x).

In areas with elevated nutrients and open canopy the green filamentous alga *Cladophora glomerata* is often found in abundance. The growth of this alga at B0507 might be more luxuriant if the canopy was more open.

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Appendix A: 2003 Connecticut River Tributary Periphyton - Algal Taxonomic Identifications and Abundance Data					
Unique ID	Location	Date	Family	Genus/Species	Abundance*
B0515	Sawmill River, upstream at South Ferry Road, Montague, MA	22-July	Bacillariophyceae	<i>Fragilaria</i> sp.	C
			Bacillariophyceae	<i>Melosira brevigulata</i>	VA
			Bacillariophyceae	<i>Synedra</i> sp.	C
			Bacillariophyceae	<i>Ui** pennate diatoms</i>	R
			Chlorophyceae	<i>Chlamydomonas</i> sp.	C
			Chlorophyceae	<i>Closterium</i> sp.	C
			Chlorophyceae	<i>Scenedesmus</i> sp.	C
			Chlorophyceae	<i>Spirogyra</i> sp.	C
			Chlorophyceae	<i>Ui** desmids</i>	C
			Cyanophyceae	<i>Oscillatoria</i> sp.	R
B0507	Stony Brook, ~30-meters upstream of powerlines, downstream from Route 116, South Hadley, MA	22-July	Bacillariophyceae	<i>Cocconeis</i> sp.	VA
			Chlorophyceae	<i>Cladophora glomerata</i>	VA
B0510 Sample 1	Mill River (Hatfield), ~100-meters upstream of Mountain Drive, below the confluence of West Brook, Hatfield, MA	23-July	Bacillariophyceae	<i>Cymbella</i> sp.	R
			Bacillariophyceae	<i>Cyclotella</i> sp.	R
			Bacillariophyceae	<i>Navicula</i> sp.	A
			Bacillariophyceae	<i>Pinnularia</i> sp.	R
			Bacillariophyceae	<i>Surirella</i> sp.	R
			Chlorophyceae	<i>Scenedesmus</i> sp.	R
			Chlorophyceae	<i>Staurastrum</i> sp.	R
			Cyanophyceae	<i>Phormidium</i> sp.	VA
			Euglenophyceae	<i>Euglena</i> sp.	R
B0510 Sample 2	Mill River (Hatfield), ~100-meters upstream of Mountain Drive, below the confluence of West Brook, Hatfield, MA	23-July	Bacillariophyceae	<i>Cocconeis</i> sp.	VA
			Bacillariophyceae	<i>Cyclotella</i> sp.	VC
			Chlorophyceae	<i>Closterium</i> sp.	R
			Chlorophyceae	<i>Microspora</i> sp.	R
			Chlorophyceae	<i>Ulothrix</i> sp.	A
			Chlorophyceae	<i>ui** filament</i>	VC
			Cyanophyceae	<i>Cylindrocapsa</i> sp.	A

* R (rare)
C (common)
VC (very common)
A (abundant)
VA (very abundant)

** unidentified

Appendix B: References Used for Taxonomic Identifications of the Algae

- Collins, F. S. 1970. *Green Algae of North America*. Bibliotheca Phycologica, Band 11. Verlag von J. Cramer. New York. 106 p., 11 plates
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Appendix D

2003 Connecticut River Watershed Fish Population Assessment

Peter Mitchell

Watershed Planning Program
Worcester, MA

January, 2007

CN: 105.4

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Ian Bowles, Secretary
Department of Environmental Protection
Arleen O'Donnell, Acting Commissioner
Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner
Division of Watershed Management
Glenn Haas, Director

The Massachusetts Division of Watershed Management (MA DWM) conducted fish population surveys on the Connecticut River and selected tributaries during September and October of 2003. Sampling was conducted as part of a comprehensive water quality monitoring project by MA DWM. Surveys of the resident fish populations were conducted at a total of six stations (Table 1). Surveys were conducted using techniques similar to Rapid Bioassessment Protocol V (fish) as described by Barbour et al (1999).

Fish Population Sample Collection, Processing, and Analysis

Fish populations were sampled by electrofishing using a Coffelt Mark 18 gas-powered backpack electrofisher. A reach of between 80m and 100m was sampled by passing a pole-mounted anode ring side to side through the stream channel and in and around likely fish holding cover. All stunned fish were netted and held in buckets. Sampling proceeded from an obstruction or constriction, upstream to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, measured, weighed, and released.

The RBP V protocol (Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI for Massachusetts currently exists, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of the overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).
2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain and Knight (1996) modified regionally following discussions with MA DEP and MA Division of Fisheries and Wildlife (DFW) biologists.
3. Trophic Classes- Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al.(1999).

For a more complete explanation of MA DWM fish collection procedures, please see CN75.1 “Fish Collection Procedures for Evaluation of Resident Fish Populations” (Mass DEP 2003). Tabulated results of the fish population surveys can be found in Table 3.

Habitat Assessment

These surveys also included a habitat assessment component modified from Rapid Bioassessment Protocols V (Barbour et al. 1999). Recording site characteristics and rating habitat qualities is important to the interpretation of biomonitoring data. The habitat data and assessments help distinguish between pollution impacts and habitat limitations. These data can also help identify causes of habitat destruction and loss.

Habitat assessment is accomplished by a visual-based method (Barbour et al. 1999) conducted at the time of sample collection. Each of ten habitat categories is rated from 0 (lowest, “poor”) to 20 (highest, “optimal”). The ten categories are: Instream cover (fish); Epifaunal substrate (in sampled portions of reach); Embeddedness; Channel alteration; Sediment deposition; Velocity-depth combinations; Channel flow status; Bank vegetative protection (each bank scored separately for a maximum of 10 points each); Bank stability (each bank scored separately for a maximum of 10 points each); Riparian vegetated zone width (each bank scored separately for a maximum of 10 points each). Descriptions of the considerations for scoring each habitat category can be found in Barbour et al. (1999). Tabulated results of this habitat assessment can be found in Table 2. For a more in-depth examination of habitat conditions, and benthic communities, see Connecticut River Watershed 2003 Biological Assessment (CN 105.3)(Mitchell 2006).

Results

The Connecticut River Watershed was affected by above-average rainfall during the time of sampling (MA DCR. Online). This condition resulted in slightly elevated water levels, decreased water temperatures, and an increase of available habitat as expressed by the high “channel flow status” habitat scores in Table 2.

Station Specific Conditions and Findings:

Cushman Brook

Most of the habitat measures were found to be within the “optimal” range. Channel Flow Status, Instream Fish Cover, Epifaunal Substrate, Channel Alteration, Velocity-Depth Combinations, and Bank Vegetative Protection were all within the “optimal” habitat range (see Table 2). The habitat parameters Embeddedness, Sediment Deposition, Bank Stability, and Riparian Vegetative Zone Width were rated as “suboptimal”. The reduction in these habitat parameters is most likely due to the abundance of sand and gravel in the surrounding area – as is evidenced by the sand and gravel pit across South Street from the sampled reach. This potentially unstable geologic condition leaves the stream banks prone to erosion and the substrates prone to embeddedness. The suboptimal rating of the Riparian Vegetative Zone Width was due to the proximity of State Street near the right bank, and frequently utilized trails along the left bank. The total habitat score arrived at for this fish population survey was 167/200. This represents the second best habitat score of all six stations examined within the Connecticut River Watershed in 2003.

Electro-fishing efficiency was rated as excellent. Five fish species were collected from this station. Intolerant, Fluvial Specialist / Dependant, Top Carnivore, Cold-water species dominated the 42 fish collected at this station (Halliwell et al. 1999, Bain and Meixler 2000). The collected 26 brown trout (*Salmo trutta*) and the one brook trout (*Salvelinus fontinalis*) represented cold-water species. The 26 brown trout (70mm – 210mm) seem to represent multiple age classes, as evidenced by the variety of fish lengths. Although brown trout are considered cold-water species, they have a higher thermal tolerance. (Wismer and Christie 1987, New Mexico Environment Department 1999, Brungs and Jones 1977). Although Cushman Brook appears to support a healthy, cold-water fish population, the abundance of brown trout may pose a competitive threat to sensitive native fishes, such as brook trout.

Falls River

As was the case with Cushman Brook, the Channel Flow Status here was rated as “optimal” (18/20). The river at this sampled reach flows through a sparsely populated valley, with old farms on either side. There is an extensive (> 18 meters – “optimal”) riparian buffer zone on river right, but an abbreviated buffer (< 6 meters – “marginal”) between the hay field and the river left bank. The fish population survey noted “optimal” habitat ratings for all parameters with exceptions regarding Bank Vegetative Protection on the left bank (“suboptimal”), and Bank Stability on the right bank (“suboptimal”). The overall habitat score was 175 / 200. This was the best habitat score of all six stations sampled in the Connecticut River Watershed in 2003.

Electro-fishing efficiency was rated as “excellent”. Seven fish species were collected during this survey. Blacknose dace (*Rhinichthys atratulus*, n=122) numerically dominated the 157 fish collected. The collected fish were dominated by tolerant, fluvial specialist / dependant, generalist feeding species. The 11 slimy sculpin (*Cottus cognatus*), 5 Atlantic salmon, and 5 brook trout made up the cold-water species collected at this site. The slimy sculpin appear to have a lower tolerance to heat than do any of the salmonids (Wismer and Christie, 1987). This reach appears to be capable of supporting a cold-water fishery.

Mill River - Hadley

Although located near the Amherst WWTF, the discharge from that plant is to the Connecticut River and not Mill River – Hadley. The Mill River – Hadley, at this reach, flows south, between Route 116 and the UMass/Amherst parking lots and ball fields. Upstream of this reach, the river receives the outfall from

Campus Pond and the storm water runoff from the Umass/Amherst coal-cinder parking lot. The reach is within the Connecticut River Valley floor. As such, the river is of relatively low gradient with a sandy bottom. As was the case at all stations examined during the 2003 Connecticut River Watershed fish population surveys, the abundance of rainfall placed the Channel Flow Status habitat parameter within the "optimal" range. The Epifaunal Substrate habitat parameter was rated as "poor" (3 / 20), due to the lack of any significant riffles, and the abundance of sand. Embeddedness and Sediment Deposition habitat parameters were rated as "marginal" (7/20 and 8/20 respectively). This was also due to the prevalence of sand. The Velocity-Depth Combinations habitat parameter was also rated as "marginal" (8/20), due to the lack of variety of conditions. The Channel Alteration was rated as "suboptimal", due to diversion created by Route 116. The Bank Stability was also rated as "suboptimal", due to the steep, and unstable, sand banks. The total habitat score for the Mill River – Hadley site was 112/200. This is the poorest score of all stations examined in the watershed in 2003.

Electro-fishing efficiency was rated as "poor". Due to the depth, and width, of the stream, some fish were not captured. Eight fish species were collected in this reach. The 15 individual fish collected were dominated by moderately tolerant, and fluvial specialist / dependant species. Only the one collected rainbow trout (*Oncorhynchus mykiss*) was considered to be a cold-water species. It appears that proximal warm water habitats are influencing the fish community within this reach.

East Branch Mill River - Northampton

The East Branch Mill River – Northampton flows, for the most part, through a sparsely populated, forested watershed. It is not until the stream enters the sampled reach that the surrounding area may be considered "thickly-settled".

The Channel Flow Status and Instream Cover were rated as "optimal". There were a great variety of snags, undercut banks, and stable habitat throughout the sampled reach. Sediment Deposition was rated as "suboptimal", with some noticeable increases of gravel and sand affecting the substrate. This may be due, in part, to the Bank Stability (rated as "marginal"). The banks were observed to be moderately unstable, with ~50% of the banks displaying signs of erosion. The Riparian Vegetative Zone Width was rated as "suboptimal" due to the proximity of lawns. The total habitat score for the East Branch Mill River – Northampton was 166 / 200.

Electro-fishing efficiency was rated as "excellent". Eight fish species were collected during this fish survey. The 60 individual fish collected during this survey were almost equally divided between "Intolerant" and "Tolerant" species. The collected fish were numerically dominated by Fluvial Specialist / Dependant species, Generalist Feeder species. Twelve salmonids (11 brook trout, and 1 brown trout) were collected at this station. The lengths of the collected brook trout ranged from 75mm to 190mm, and point towards a reproducing population of these fish. The 12 salmonids, and the 14 slimy sculpin, are representatives of cold-water species. The collected fish assemblage is indicative of excellent water and habitat quality.

West Branch Mill River - Northampton

Human development appears greater within the West Branch watershed than the East Branch watershed. The West Branch parallels and crosses Route 9 for much of its course. Aside from the increase in commercial and residential development along Route 9, sections of the stream banks have been stabilized in order to prevent damage to Route 9.

The Channel Alteration habitat parameter was rated as "suboptimal". Much of the river-right bank has been stabilized with large stone and rip-rap. The Velocity-Depth Combinations parameter was rated as "marginal". The West Branch displayed a lack of variety of flow regimes, and a uniform depth throughout the sampled reach. The proximity of Route 9 and the commercial development decreased the Riparian Vegetative Zone Width parameter rating along the right-bank to "marginal". A parking lot beyond the stone retaining wall has replaced a vegetated riparian zone. The total habitat score for the West Branch Mill River – Northampton was 162 / 200.

Electro-fishing efficiency was rated as “excellent”. Six fish species were collected during this survey. The thirty-one collected fish were numerically dominated by “Intolerant”, “Fluvial Specialist / Dependant”, “Benthic Insectivore” species. Included in the sample were eight Atlantic salmon (*Salmo salar*) and one brook trout. The nine collected salmonids and nine slimy sculpin are all cold-water species, and accounted for the majority of the collected fish. This stream appears capable of supporting a healthy fish community and indicates excellent habitat and water quality.

Stony Brook

Stony Brook begins its course in Granby, MA and is relatively low-gradient until after it emerges from the two ponds (Upper Pond and Lower Pond) on the Mount Holyoke College campus. After the two ponds, Stony Brook picks up gradient and then parallels Route 116. It then flows underneath Route 116 and enters the sampled reach.

As with the other sampled reaches, the Channel Flow Status was rated as “optimal”. However, the Instream Cover was rated as “marginal”. Only about 20% of the sampled reach had a mix of stable habitat, and the substrates appeared frequently disturbed. The Embeddedness and Sediment Deposition habitat parameters both were rated as “suboptimal”. The substrate was quite sandy, and the sand filled in around many of the larger stones and cobbles. The Velocity – Depth Combinations parameter was also rated as “suboptimal”. Aside from one high velocity pool at the top of the reach, the channel was relatively uniform in terms of depth and velocity. All other habitat parameters were within the “optimal” range.

Although electro-fishing efficiency was rated as “good”, it is possible that some fish escaped capture due to the width of the stream. The total number of fish collected was low ($n = 20$) and the species present included a number of macrohabitat generalists. These included redbreast sunfish, bluegill, smallmouth and largemouth bass, chain pickerel and pumpkinseed. Collected fluvial species included longnose dace, tessellated darter, Atlantic salmon, and white sucker. The variety of macrohabitat generalist species collected indicates that the sampled stream reach is well connected to lower gradient habitats. Slow, meandering stream habitats exist downstream of the sampled reach, and continue to the confluence with the Connecticut River. It is likely that macrohabitat generalists are entering the stream reach from these downstream habitats.

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Table 1: 2003 Connecticut Watershed Fish Population Station Locations

Waterbody	Location	Lat. / Lon.	Date
Cushman Brook	In Amherst Con-Com Park, south side of State Street, Amherst	42.24.56/ 72.30.41	17 September 2003
Falls River	Upstream of Bascom Road, Gill	42.38.42/ 72.32.32	17 September 2003
Mil River - Hadley	North of Amherst WWTP, east of Route 116, Amherst	42.23.18/ 72.32.20	17 September 2003
East Branch Mill River - Northampton	Left side of Mill Road, Williamsburg	42.23.32/ 72.43.38	23 October 2003
West Branch Mill River - Northampton	End of Mill Road, Williamsburg	42.23.31/ 72.43.40	23 October 2003
Stony Brook	West of Route 116, South Hadley	42.14.45/ 72.34.53	23 October 2003

Table 2: Habitat assessment summary for fish population stations sampled during the 2003 Connecticut River Watershed survey. For instream parameters, scores ranging from 16-20 = Optimal; 11-15 = Suboptimal; 6-10 = Marginal; 0-5 = Poor. For bank and riparian parameters, each bank was scored separately. Scores ranging from 9-10 = Optimal; 6-8 = Suboptimal; 3-5 = Marginal; 0-2 = Poor. Refer to Table 1 for a listing and description of sampling stations.

Habitat Parameter	Cushman Brook		Falls River		Mill River - Hadley		East Branch Mill River - Northampton		West Branch Mill River - Northampton		Stony Brook	
Instream Cover	19		18		11		19		18		7	
Epifaunal Substrate	18		18		3		18		18		18	
Embeddedness	13		19		7		17		18		12	
Channel Alteration	19		19		11		20		13		18	
Sediment Deposition	13		17		8		13		19		12	
Velocity-Depth Combination	18		20		8		19		10		12	
Channel Flow Status	17		18		18		19		18		16	
Bank Vegetative Protection	9(L)	9(R)	7	9	9	9	9	9	9	7	9	9
Bank Stability	8	8	9	8	6	6	4	4	9	9	9	9
Riparian Vegetative Zone - Width	8	8	4	9	7	9	8	7	9	5	10	10
TOTAL SCORE	167		175		112		166		162		151	

(L) = Left Bank

(R) = Right Bank

Table 3. Fish population data collected by DWM at six biomonitoring stations in the Connecticut River Watershed on 17 September and 23 October 2003. Refer to Table 1 for a listing and description of sampling stations.

TAXON (SORTED BY FAMILY)	Habitat Class ¹	Trophic Class ²	Tolerance Class ³	Cushman Brook	Falls River	Mill River - Hadley	Stony Brook	East Branch Mill River - Northampton	West Branch Mill River - Northampton
American eel <i>Anguilla rostrata</i>	MG	TC	T	--	--	--	1	--	--
common shiner <i>Luxilus cornutus</i>	FD	GF	M	--	--	--	--	9	1
Eastern blacknose dace <i>Rhinichthys atratulus</i>	FS	GF	T	13	122	--	--	12	8
longnose dace <i>Rhinichthys cataractae</i>	FS	BI	M	1	9	1	6	--	4
creek chub <i>Semotilus atromaculatus</i>	FS	GF	T	--	4	--	--	9	--
fallfish <i>Semotilus corporalis</i>	FS	GF	M	--	--	4	--	--	--
slimy sculpin <i>Cottus cognatus</i>	FS	BI	I	--	11	--	--	14	9
white sucker <i>Catostomus commersonii</i>	FD	GF	T	1	--	1	1	3	--
tessellated darter <i>Etheostoma olmstedii</i>	FS	BI	M	--	--	4	1	--	--
Atlantic salmon <i>Salmo salar</i>	FD	TC	I	--	5	--	2	--	8
rainbow trout <i>Oncorhynchus mykiss</i>	FD	TC	I	--	--	1	--	--	--
brown trout <i>Salmo trutta</i>	FD	TC	I	26	--	--	--	1	--
brook trout <i>Salvelinus fontinalis</i>	FD	TC	I	1	5	--	--	11	1
yellow bullhead <i>Ameiurus natalis</i>	MG	GF	T	--	--	2	--	--	--
chain pickerel <i>Esox niger</i>	MG	TC	M	--	--	--	2	1	--
redbreast sunfish <i>Lepomis auritus</i>	MG	GF	M	--	--	--	1	--	--
bluegill <i>Lepomis macrochirus</i>	MG	GF	T	--	--	1	1	--	--
smallmouth bass <i>Micropterus dolomieu</i>	MG	TC	M	--	--	--	2	--	--
largemouth bass <i>Micropterus salmoides</i>	MG	TC	M	--	--	--	1	--	--
pumpkinseed <i>Lepomis gibbosus</i>	MG	GF	M	--	1	--	2	--	--
Central mudminnow <i>Umbra limi</i>	FD	GF	T	--	--	1	--	--	--
Total Number of Fish Collected	-	-	-	42	157	15	20	60	31

¹Habitat Class - FS (fluvial specialist), FDR (fluvial dependant reproduction), MG (macrohabitat generalist). From Bain and Meixler (2000), modified for Massachusetts

²Trophic Class - GF (generalist feeder), BI (benthic invertivore), TC (top carnivore), WC (water column invertivore). From Halliwell et al. (1999)

³Tolerance Classification - I (intolerant), M (moderately tolerant), T (tolerant). From Halliwell et al. (1999) Classification described as tolerance to "environmental perturbation".



Appendix C

Technical Memorandum TM-34-6

CONNECTICUT RIVER WATERSHED 2003 BIOLOGICAL ASSESSMENT

BENTHIC MACROINVERTEBRATES

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April 2006

CN 105.3

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INTRODUCTION

Biological monitoring is a useful, cost-effective method of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Barbour et al. 1999, Barbour et al. 1995). Surveying and assessing the status of these aquatic communities and the quality of their habitats are the principle tools of biomonitoring.

As part of the Massachusetts Department of Environmental Protection/Division of Watershed Management's (MassDEP/DWM) 2003 Connecticut River watershed assessments, aquatic benthic macroinvertebrate biomonitoring and habitat assessment were conducted to evaluate the biological health of selected portions of the watershed. A total of six benthic stations were sampled to investigate the effects of a variety of potential stressors on resident biological communities.

Collection and analysis of macroinvertebrate data provide information necessary for making aquatic life use-support determinations required by Section 305(b) of the Clean Water Act. All Connecticut River watershed biomonitoring stations were compared to a reference station (Amethyst Brook - station B0514) most representative of the "best attainable" (i.e., least-impacted) conditions in the watershed. The selection of the reference station to use for comparisons to a study site was based on comparability of stream morphology, flow regimes, and drainage area. Use of a watershed reference station is particularly useful in assessing nonpoint source pollution originating from multiple and/or unknown sources in a watershed (Hughes 1989). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities. Effects of habitat features can be minimized by comparing collected data to reference stations with similar habitats (Barbour et al. 1999). Sampling highly similar habitats also reduces metric variability attributable to factors such as current speed and substrate type.

During "year 1" of its "5-year basin cycle", areas of concern within the Connecticut River watershed were defined more specifically through such processes as coordination with appropriate groups, assessing existing data, and conducting site visits. Following these activities, the 2003 biomonitoring plan was more closely focused and the study objectives better defined. The main objectives of the 2003 biomonitoring in the Connecticut River watershed were: (a) to determine the biological health of streams within the watershed by conducting assessments based on aquatic macroinvertebrate communities; and (b) to identify impaired stream segments so that efforts can be focused on developing remediation strategies. Specific tasks were:

1. Conduct benthic macroinvertebrate sampling and habitat assessments at locations throughout the Connecticut River watershed;
2. Based upon the benthic macroinvertebrate and habitat data, identify river segments within the watershed with potential impairments and pollution problems; and
3. Using the benthic macroinvertebrate community data, and supporting water chemistry (when available) and field/habitat data:
 - assess the types of water quality and/or water quantity problems that are present.
 - make recommendations for remedial actions or additional monitoring and assessment.
 - provide macroinvertebrate and habitat data to MassDEP/DWM's Environmental Monitoring and Assessment Program for assessments of aquatic life use and aesthetics use-support status required by Section 305(b) of the Federal Clean Water Act (CWA).
 - provide macroinvertebrate and habitat data for other informational needs of Massachusetts regulatory agencies, non-governmental organizations, and others.

Biomonitoring station locations, along with station identification numbers and sampling dates, are noted in Table 1. Sampling locations are also shown in Figure 1.

Table 1. List of benthic biomonitoring stations sampled during the 2003 Connecticut River watershed survey, including station identification number, mile point (distance from mouth), upstream drainage area, station description, and sampling date.

Station ID	Mile Point	Upstream Drainage Area (mi ²)	Connecticut River Watershed Benthic Station Description	Sampling Date
B0507	2.0	21	Stony Brook, ~30-meters upstream of powerlines, downstream from Route 116, South Hadley, MA	22 July 2003
B0508	0.5	14.6	Cushman Brook, ~300-meters upstream of Factory Hollow Pond, State Street, Amherst, MA	22 July 2003
B0509	3.6	54	Mill River (Northampton), West of Vernon Street, ~300-meters upstream of USGS gage 01171500, Northampton, MA	23 July 2003
B0510	9.3	35	Mill River (Hatfield), ~100-meters upstream of Mountain Drive, below the confluence of West Brook, Hatfield, MA	23 July 2003
B0514	0.8	9.3	Amethyst Brook, upstream of swale off end of Allen Mill Road, Amherst, MA	22 July 2003
B0515	2.5	31	Sawmill River, upstream at South Ferry Road, Montague, MA	22 July 2003

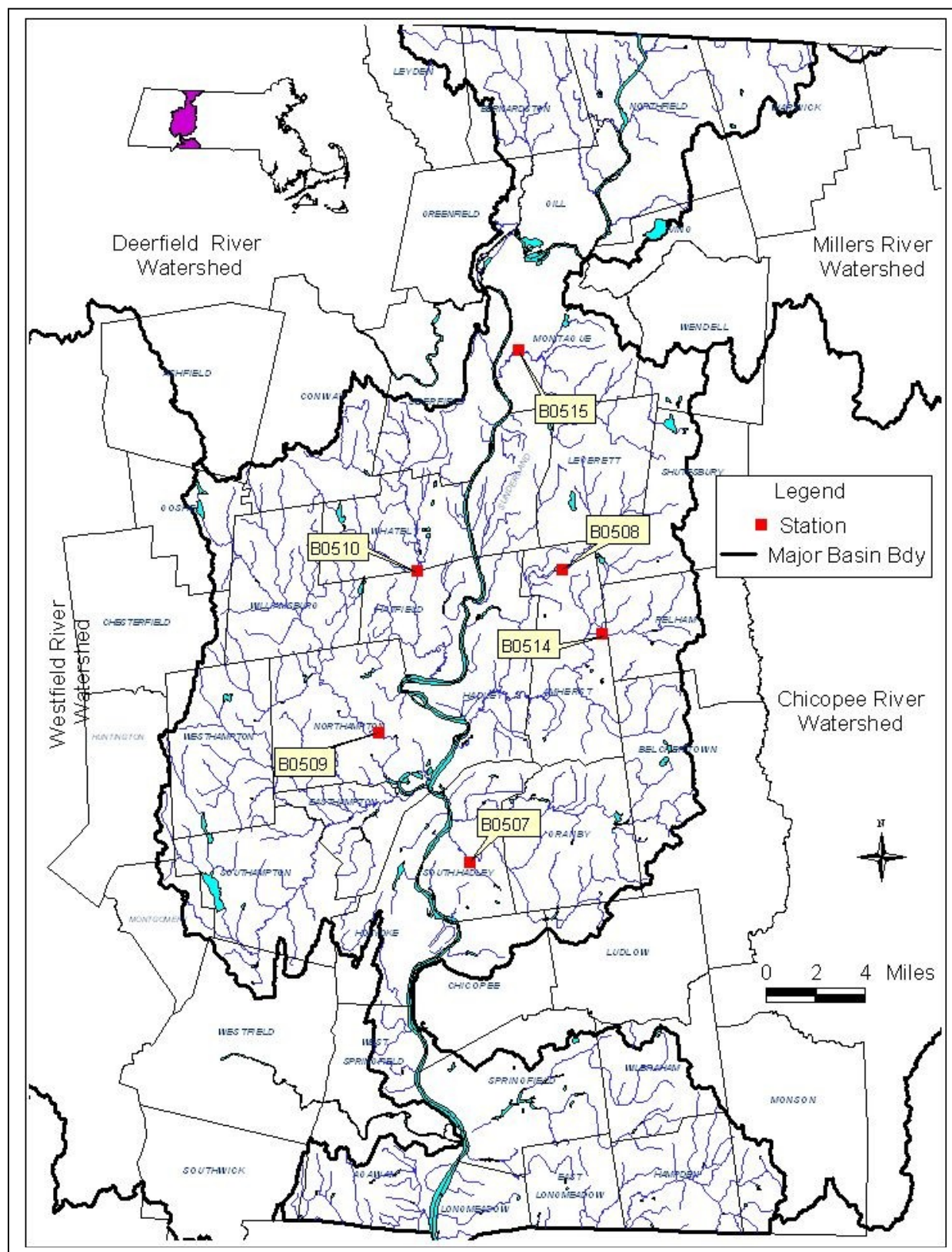


Figure 1: 2003 Connecticut River Watershed Biomonitoring Stations

METHODS

MACROINVERTEBRATE SAMPLING

The macroinvertebrate sampling procedures employed during the 2003 Connecticut River Watershed biomonitoring survey are described in the *Standard Operating Procedures (Draft): Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates* (Nuzzo 2002), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Barbour et al. 1999). The macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream. Sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (MassDEP 2003a). Sampling was conducted by MassDEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (boulder, cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m². Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the MassDEP/DWM lab for further processing.

MACROINVERTEBRATE SAMPLE PROCESSING AND ANALYSIS

The macroinvertebrate sample processing and analysis procedures employed for the 2003 Connecticut River watershed biomonitoring samples are described in the standard operating procedures (Nuzzo 2002) and were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (MassDEP 2003a). Macroinvertebrate sample processing entailed random selection of specimens from the other materials in the sample until approximately 100 organisms ($\pm 10\%$) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity. Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Plafkin et al. 1989). Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for a selected “least-impacted” reference station yields an impairment score for each site. The analysis separates sites into four categories: non-impacted, slightly impacted, moderately impacted, and severely impacted. Each impact category corresponds to a specific aquatic life use-support determination used in the CWA Section 305(b) water quality reporting process—non-impacted and slightly impacted communities are assessed as “support” in the 305(b) report; moderately impacted and severely impacted communities are assessed as “impaired.” A description of the *Aquatic Life* use designation is outlined in the *Massachusetts Surface Water Quality Standards* (SWQS) (MassDEP 1996). Impacts to the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Barbour et al. 1999). Those biological metrics calculated and used in the analysis of 2003 Connecticut River watershed macroinvertebrate data are listed and defined below [For a more detailed description of metrics used to evaluate benthos data, and the predicted response of these metrics to increasing perturbation, see Barbour et al. (1999)]:

1. Taxa Richness—a measure based on the number of taxa present. Generally increases with increasing water quality, habitat diversity, and habitat suitability. The lowest possible taxonomic level is assumed to be genus or species.
2. EPT Index—a count of the number of genera/species from the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). As a group these are considered three of the more pollution sensitive aquatic insect orders. Therefore, the greater the contribution to total richness from these three orders, the healthier the community.
3. Biotic Index—Based on the Hilsenhoff Biotic Index (HBI), this is an index designed to produce a numerical value to indicate the level of organic pollution (Hilsenhoff 1987). Organisms have been assigned a value ranging from zero to ten based on their tolerance to organic pollution. Tolerance values (TV) currently used by MassDEP/DWM biologists were originally developed by Hilsenhoff and have since been supplemented by Bode et al. (1991) and Lenat (1993). A value of zero indicates the

taxon is highly intolerant of pollution and is likely to be found only in pollution-free waters. A value of ten indicates the taxon is tolerant of pollution and may be found in highly polluted waters. The number of organisms and the individually assigned values are used in a mathematical formula that describes the degree of organic pollution at the study site. The formula for calculating HBI is:

$$HBI = \frac{\sum x_i t_i}{n}$$

where

x_i = number of individuals within a taxon

t_i = tolerance value of a taxon

n = total number of organisms in the sample

4. **Ratio of EPT and Chironomidae Abundance**—The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Skewed populations having a disproportionate number of the generally tolerant Chironomidae (“midges”) relative to the more sensitive insect groups may indicate environmental stress.
5. **Percent Contribution Dominant Taxon**—is the percent contribution of the numerically dominant taxon (genus or species) to the total numbers of organisms. A community dominated by few species indicates environmental stress. Conversely, more balance among species indicates a healthier community.
6. **Ratio of Scraper and Filtering Collector Functional Feeding Groups**—This ratio reflects the community food base. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source (Barbour et al. 1999). Scrapers predominate when diatoms are the dominant food resource, and decrease in abundance when filamentous algae and mosses prevail. Filtering collectors thrive where filamentous algae and mosses are prevalent and where fine particulate organic matter (FPOM) levels are high.
7. **Community Similarity**—is a comparison of a study site community to a reference site community. Similarity is often based on indices that compare community composition. Most Community Similarity indices stress richness and/or richness and abundance. Generally speaking, communities with comparable habitat will become more dissimilar as stress increases. In the case of the Connecticut River watershed bioassessment, an index of macroinvertebrate community composition was calculated based on similarity (i.e., affinity) to the reference community, expressed as percent composition of the following organism groups: Oligochaeta, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera, Chironomidae, and Other. This approach is based on a modification of the Percent Model Affinity (Novak and Bode 1992). The reference site affinity (RSA) metric is calculated as:

$$100 - (\sum \delta \times 0.5)$$

where δ is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBPIII scores as follows: <35% receives 0 points; 2 points in the range from 35 to 49%; 4 points for 50 to 64%; and 6 points for $\geq 65\%$.

HABITAT ASSESSMENT

An evaluation of physical habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986, Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sampling reach during the 2003 Connecticut River watershed macroinvertebrate biosurveys, habitat qualities were scored, and assessed, using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and related streamside features. Most parameters evaluated are instream physical attributes often related to overall land-use and are potential

sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follow: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a reference station to provide a final habitat ranking.

QUALITY CONTROL

Field and laboratory Quality Control (QC) activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for biomonitoring and habitat assessment (MassDEP 2003a). Quality Control procedures are further detailed in the standard operating procedures (Nuzzo 2002).

FIELD SAMPLING QUALITY CONTROL

Field Sampling QC entails: 1) Pre- and post-sampling rinses, inspection of, and picking of nets, sieves, and pans to prevent organisms collected from one station to be transferred to samples taken elsewhere. 2) On-site preservation of benthos sample in 95% ethanol to ensure proper preservation, and 3) collection of a duplicate sample at one in ten biomonitoring stations. A duplicate is collected as a “side by side” (where different assessment results are not expected due to the apparent absence of additional stressors) to each of the 10 kicks making up the “original” sample. A duplicate sample is composited in a similar manner to the original sample, yet, is preserved in a separate sample bottle marked “duplicate” and with all other information regarding station location remaining the same. Duplicate samples are used for the calculation of Precision of the benthos data.

FIELD ANALYTICAL QUALITY CONTROL

Habitat analysis QC entails multiple observers (at least both DWM benthic biologists, and often a third person) performing the Habitat Assessment at each macroinvertebrate biomonitoring station. A standardized Habitat Assessment Field Scoring Sheet is completed at all biomonitoring stations. Disagreement in habitat parameter scoring is discussed and resolved before the Habitat Assessment can be considered complete.

FIXED LABORATORY QUALITY CONTROL

Fixed Laboratory QC entails the following: 1) Taxonomy bench sheets are examined by a reviewer (the DWM biologist not responsible for the initial taxonomic identifications) for errors in transcription from bench notebook, count totals, and spelling. All bench sheets are examined, and detected errors are brought to the taxonomist's attention, discussed, and corrected. 2) Taxonomic duplication, in which “spot checks” are performed by a reviewer (the DWM biologist not responsible for the initial taxonomic identifications) on taxonomy, are performed at the reviewer's discretion. In general, all taxa that are rarely encountered in routine benthos samples, or taxa that the primary taxonomist may be less than optimally proficient at identifying, are checked. Spot checks are performed for all stations. Specimens may be sent to authorities for particular taxonomic groups. 3) Data reduction and analysis, including biological metric scoring (metric values are calculated through queries run in the DWM Benthic Macroinvertebrate Database), comparisons to reference station metrics, and impairment designations, are checked by a reviewer (the DWM biologist not responsible for performing the initial taxonomy and data analysis) for all benthos data at all stations. Detected errors are brought to the original taxonomist's attention and resolved. 4) Precision, a measure of mutual agreement among individual measurements or enumerated values of the same property of a sample and usually expressed as a standard deviation in absolute or relative terms, is compared using raw benthos data and metric values. If metric values and resulting scoring are significantly different (i.e., beyond an acceptable Relative Percent Difference) between the original and duplicate samples, the investigators will attempt to determine the cause of the discrepancy. Guidance regarding the calculation of Precision, including Relative Percent Difference (RPD) calculations and recommendations, can be found in US EPA (1995) and Barbour et al. (1999).

BASIN DESCRIPTION

The Connecticut River is the longest river in New England (USFWS 2006). It flows 405 miles from the Canadian border to Long Island Sound, and occupies a watershed area of 11,250 square miles (Kennedy and Weinstein 2000). In Massachusetts the Connecticut River watershed is, "located in Franklin, Hampshire, and Hampden Counties of west-central Massachusetts, and contains all or part of 46 cities and towns, including the cities of Holyoke, Chicopee, Westfield, Springfield, and Northampton. The elevation of the valley floor ranges from about 40 ft, where the Connecticut River crosses into Connecticut, to about 330 ft, except for long ridges of volcanic rock that reach altitudes of 600 to almost 1,000 ft. Elevations in the upland areas of the basin are as much as 1,500 ft." (USGS 2006a).

The mainstem of the Connecticut River within Massachusetts runs 67-miles from the VT / NH border to the CT border. Along this course, the Connecticut River receives the waters from the Millers, Deerfield, Chicopee and Westfield rivers. While these rivers are tributaries of the Connecticut, each of them is treated by MassDEP as a separate watershed for monitoring, assessment and other water quality management activities. The influence of these four major rivers is not inconsequential. Their combined discharge has a significant influence on flows within the Connecticut River (Mitchell 2006). The in-state watershed area of the Connecticut River watershed is 670 square-miles (Kennedy and Weinstein 2000) exclusive of the four major tributaries. The watershed areas of the four major tributaries are:

Millers River:	310 square-miles (Massachusetts portion only) (total area = 392 square-miles)
Deerfield River:	347 square-miles (Massachusetts portion only) (total area = 665 square-miles)
Chicopee River:	723 square-miles (entire watershed lays within Massachusetts)
Westfield River:	517 square-miles (Massachusetts portion only) (total area = 537 square-miles).

If the above watersheds were included with the Massachusetts portion of the Connecticut River Watershed, then the Connecticut River watershed would be 1,897 square-miles (Massachusetts portions only). This is roughly 18% of the entire area of Massachusetts.

According to the USGS streamflow within the Connecticut River Watershed was "Normal" during the time of biological sample collection (USGS 2006b).

RESULTS AND DISCUSSION

B0514 - Amethyst Brook

Mile point 0.8, Upstream of swale off end of Allen Mill Road, Amherst, MA

Habitat

Amethyst Brook is a "Class B" water (MassDEP 1996), and has never been assessed by the DWM. The brook begins at the confluence of Buffum and Harris brooks, in the Town of Pelham, MA. From this point, Amethyst Brook flows through a rather high-gradient reach within a narrow valley. Aside from a solitary road crossing (North Valley Road in Pelham), the abutting landuse is primarily forested. The brook then enters a small impoundment (one-mile from the Buffum Brook / Harris Brook confluence). The high-gradient nature of the stream continues upon leaving this impoundment, and Amethyst Brook enters B0514 0.4-miles from the upstream impoundment.

The within-reach habitat conditions were quite good (157 / 200)(Table A3). This score ranks B0514 third of the six stations examined. B0514 scored "marginal" in only one area – "Velocity / Depth Combinations" (10 / 20). This was due to the lack of any deep habitats. Indeed, the riffles were estimated at 0.1 meters deep, the runs at 0.2 meters deep, and the pools at 0.3 meters deep. However, this may be the natural state of the brook, as the water filled much of the available bed, and resulted in optimal Channel Flow

Status. Instream cover was assessed as “suboptimal” (12 / 20) due to few pools and a lack of stable refugia for fish, although the substrate was dominated by cobble (80%).

The brook, within this reach, is bordered by heavily used trails on both sides of the channel – and appears to be favored by dog-walkers. On the right bank, the trails run through a forested area. On the left bank, the trails run between the brook and residential land. The left bank vegetative protection score was 8 / 10 (suboptimal). This is due to the presence of residences and lawns along the left bank. The Riparian Vegetative Zone Width scored “suboptimal” (7 / 10) for both banks. The primary detraction was from the heavily used trails. The Bank Stability along the right bank also scored sub-optimally (8 / 10). There were extensive areas of “cut-bank” erosion along the right bank.

Amethyst Brook had extensive canopy cover (95%). Trees along both banks provided the shade. The types of trees observed included: Hemlock (*Tsuga canadensis*), Hornbeam (*Carpinus caroliniana*), Red Oak (*Quercus rubra*), Yellow Birch (*Betula lutea*), White Pine (*Pinus strobus*), Striped Maple (*Acer pensylvanicum*), Ash (*Fraxinus* sp.), White Oak (*Quercus alba*), and Elm (*Ulmus* sp.). Aquatic vegetation covered 5% of the available habitat and consisted entirely of mosses. There was no algae coverage within the reach.

Benthos

The collected benthos was dominated by the Filtering - Collectors (28%) and the Shredders (27%) functional feeding groups. B0514 had the lowest (best) Biotic Index score (3.48) of all stations examined. B0514 also had the lowest percent dominant taxa (14%), and the second highest taxa richness. The dominant taxon collected was Leuctra sp., a highly sensitive stonefly. The combination of these conditions makes Amethyst Brook a very satisfactory reference condition for wadeable streams within the Connecticut River Basin.

B0507 – Stony Brook

Mile point 2.0, approximately 30-meters upstream of powerlines, downstream from Route 116, South Hadley, MA

Habitat

Stony Brook – within this segment – is classified as Class B water as defined in the Massachusetts Surface Water Quality Standards (MassDEP 1996). The watershed contributing to B0507 is 21 mi². Stony Brook begins at the confluence of two unnamed, first-order streams east of Chicopee Road in Granby. It then passes through the Westover Municipal Golf Course in Ludlow. From here, it passes into Chicopee and Westover Metropolitan Airport. Stony Brook then flows north-northeast, back into Granby, and then into South Hadley. In South Hadley (both near and on the Mount Holyoke College campus) Stony Brook is impounded into Upper Pond and Lower Pond. Stony Brook flows out of these ponds and makes its way generally southward. The approximately 450-meters immediately upstream of Benthic Station B0507 finds Stony Brook paralleling Route 116. This stream reach is rather high-gradient, and Stony Brook flows under an old mill building, and is crossed by several small bridges that access commercial properties along Route 116. There is very little shading or canopy cover in the stream reach along Route 116.

The immediate habitat conditions within B0507 were deemed to be the highest of all stations examined during the 2003 Connecticut River Watershed Benthic Survey (160 / 200), including the regional reference station B0514. (Table A3). The Riparian Vegetative Zone Width (both left and right banks) and Riparian Bank Protection (both left and right banks) scored high. This is due, in part, to the lack of human activity within the sampled reach. Many rose bushes and stinging nettles were found along both banks. This condition dissuades people from accessing this reach. While open upstream the canopy cover at the sampling site was estimated at 80% and shaded the entire vicinity of the station. The riparian trees included Catalpa (*Catalpa speciosa*), Silver Maple (*Acer saccharinum*), Ash (*Fraxinus* sp.), Red Maple (*Acer rubrum*), and Elm (*Ulmus* sp.).

The sampled reach contained extensive riffles, and the Channel Flow Status was rated as optimal. The riffle depths were estimated at 0.2 meters deep, the runs at 0.4 meters deep, and the solitary pool (at the top of the reach) at 0.6 meters deep. Cobble dominated the inorganic substrates (80%), and detritus (CPOM – Coarse Particulate Organic Matter = >1mm) dominated the organic substrates (90%). The epifaunal substrate was optimal (17 / 20) for benthic macroinvertebrates due to the extensive areas of riffles, but there was poor (7 / 20) instream cover for fish due to the lack of pools and refugia. The within-reach algae coverage was estimated at 2%. Observed algae included both green filamentous and brown thin-film types. All algae were observed to be in the riffle zones. There were no aquatic plants observed within the sampled reach.

Benthos

The B0507 sample from Stony Brook was 76% comparable to the reference sample (Amethyst Brook, Amherst, MA), resulting in an assessment of “slightly impacted”. The benthic community was dominated by filter-collectors from the families Hydropsychidae and Philopotamidae. The upstream presence of impoundments (including Upper Pond and Lower Pond) augments the conditions favorable for the propagation of each of these families (Mackay and Waters 1986, Whiles and Dodds 2002). The dominance of filter – collectors alludes to an increase in nutrients and/or FPOM (Fine Particulate Organic Matter = <1mm). Although CPOM was the dominant organic substrate component observed within this reach, it is possible that, due to the stream velocities, FPOM was not being deposited within this reach.

The macroinvertebrate assemblage from Stony Brook had the highest (worst) Biotic Index score (5.05) and the lowest Taxa Richness (23) of all six Connecticut benthic stations examined during the 2003 Connecticut Benthic Survey. The elevated biotic index score indicates that the benthic community is dominated by species tolerant of eutrophication and/or organic pollution. The lower species diversity points towards a community with somewhat reduced health and function. Based on the high habitat score for this station, it is likely that the impact is due to water quality conditions.

B0508 – Cushman Brook

Mile point 0.5, approximately 300-meters upstream of Factory Hollow Pond, State Street, Amherst, MA

Habitat

Cushman Brook, a Class B water (MassDEP 1996), has never been assessed by MassDEP. Cushman Brook begins at the outfall of Atkins Reservoir (a drinking water supply for the Town of Amherst) in Shutesbury, MA. It flows through a narrow valley, paralleling East Leverett Road for 1.25 miles. Cushman Brook then flows under the road, and enters the Mill River conservation area. This conservation area contains trails that both parallel and cross Cushman Brook. The trails appeared to be well maintained, and not causing any instream habitat degradation. The 2003 benthic sample was collected from within this area.

The total habitat score for Cushman Brook was 154 / 200 (Table A3). This score ranks Cushman Brook fourth among the 6 stations examined during the 2003 Connecticut River Benthic Survey. Both banks were steep and only marginally stable – making them prone to erosion. Fallen trees were observed along the left bank. The Velocity-Depth Combinations parameter was reduced (10 / 20), and the sediment deposition was increased. The increase in sediment deposition may be responsible for the reduction in the number and size of the riffle areas, as well as an increase in the embeddedness of the substrates. Sediment deposition may be a natural occurrence. There is a gravel pit across State Street from this benthic station, and similar gravel rich soils most likely exist within the sampled stream reach. Nonetheless, the above-mentioned conditions reduced the overall habitat score.

Canopy cover was estimated to be 80%, providing adequate shading to the stream. The trees providing this cover included: Hemlock (*Tsuga canadensis*), Yellow Birch (*Betula lutea*), Hornbeam (*Carpinus caroliniana*), Striped Maple (*Acer pennsylvanicum*), Sycamore (*Platanus occidentalis*), Red Oak (*Quercus rubra*), and Sugar Maple (*Acer saccharum*). The Channel Flow Status was optimal (18 / 20). The riffle depths were estimated at 0.2 meters. Run depth was not recorded, and there were no pools (> 0.5

meters) within the sampled reach. Even though there were no deep (> 0.5 meters) habitats within the sampling reach, both the Instream Cover, and Epifaunal Substrate habitat measures scored in the “optimal” range. There was a good assortment of snags, logs and other refugia for fish, as well as a good variety of velocities flowing through the riffle zones. Cobble dominated the inorganic portion of the substrates within the sampled reach (80%), and CPOM dominated the organic fraction. Algal coverage was less than 5% throughout the reach, and was represented by green, thin-film algae.

Benthos

The total metric score for Cushman Brook is 86% comparable to the reference station (Amethyst Brook) in terms of community structure, resulting in an assessment of “non-impacted” (Table A2). The functional feeding groups (FFG) were well represented, with the exception of Scrapers (6% of the collected benthics). The low number of Scrapers collected may be related to the reduced algal coverage (especially thin-film periphyton) within the reach. The Gathering – Collector functional feeding group were the most dominant FFG (30%), but other FFGs were also well represented: Filter – Collectors (25%), Predators (13%), and Shredders (26%). The Gathering – Collectors were (with the exception of the mayfly genus *Paraleptophlebia* sp.) dominated by Chironomidae (78%). The Biotic Index for Cushman Brook was 3.86 – the second best score of all stations examined. This low Biotic Index points towards a community with good representation by intolerant species. The Cushman Brook benthic community had a Taxa Richness of 28. This ranks Cushman Brook as fourth of the six stations sampled in terms of richness.

B0509 – Mill River (Northampton)

Mile Point 3.6, west of Vernon Street, approximately 300-meters upstream of USGS gage 01171500, Northampton, MA

Habitat

The Mill River – Northampton (within this segment) is classified as Class B water (MassDEP 1996). The watershed contributing to B0509 is 54 mi². The Mill River – Northampton begins in the Town of Williamsburg at the confluence of the East and West Branches of the Mill River. The river flows 8.5 miles from this confluence to B0509. Along its way, it flows through many industrial revolution era impoundments, and heavily developed residential areas – including the city of Northampton. Station B0509 was located within a city-operated park (off of Burts Pit Road – locally known as “The Fields”). This park consists of an array of trails through old farmland. The overall habitat score for within reach conditions was 149 / 200 (Table A3). The bank stability of the right bank was marginal (4 / 10). This stands in contrast to the left bank that received a score of 10 / 10 for bank stability. The high scoring left bank contained a 2 meter high, concrete retaining wall that ran approximately 60-meters along the left bank from the top of the reach. This wall greatly affected flow conditions and bank conditions along the opposite bank. The wall forces the water towards the right bank. As a result, the right bank consisted of deposits of cobble, gravel and sand – with very little herbaceous cover. Also, heavy foot-traffic has further removed vegetation from the right bank. The foot traffic and deposition of coarse substrates on the right bank also reduced the bank vegetative protection score to a marginal level (4 / 10). The retaining wall on the left bank, and the trail atop the wall, reduced the bank vegetative protection score to a suboptimal level (7 / 10). The retaining wall also represents an alteration to natural channel morphology. As a result, the channel alteration score was observed to be suboptimal (13 / 20). Also, the riparian vegetative zone width scores (for both banks) were reduced. The effects of the retaining wall and the trail along the left bank reduced the riparian vegetative zone width score to suboptimal (8 / 10). The deposited gravel and foot traffic reduced the right bank riparian vegetative zone width score to marginal (4 / 10).

While the above habitat parameters diminished the overall habitat score, there were several habitat measures that scored well. The Channel Flow Status was optimal (17 / 20). The depth at the riffles was 0.3 meters. The depth at the runs was 1 meter, and the depth at the pools was 1.5 meters. Cobble dominated the inorganic portion of the instream substrates (50%). CPOM dominated the organic component of the instream substrates (95%). Algae coverage was estimated at 90%. Green, thin-film algae represented the observed type of algae and it was attached to rocks in both the pools and riffles. Canopy cover to the stream was estimated at 50%. The trees providing the shade included Red Oak

(*Quercus rubra*), Sycamore (*Platanus occidentalis*), Grey Birch (*Betula populifolia*), Red Maple (*Acer rubrum*), Ash (*Fraxinus* sp.), Elm (*Ulmus* sp.), Hornbeam (*Carpinus* sp.), White Pine (*Pinus strobus*), and Cottonwood (*Populus* sp.).

Benthos

The total metric score for B0509 is 81% comparable to the reference condition (Amethyst Brook, Amherst, MA) in terms of metric performance, resulting in an assessment of “slightly impacted” (Table A2). The functional feeding groups from B0509 were dominated by Scrapers (34%), and Filtering – Collectors (33%). The high percentage of Scrapers is to be expected given the extensive algal coverage. However, no single taxon accounted for more than 10% of the entire sample. This reduced percent dominant taxa denotes diversity among the taxa collected. The percent dominant taxa score at B0509 was the lowest (best) of all 6 stations examined in the Connecticut Watershed. There were 30 different taxa collected at B0509 which was the third highest of all six stations examined. The Biotic Index score for B0509 was the second highest (worst) of all six stations (4.98). This high score alludes to a community populated by taxa tolerant of eutrophication and organic pollution.

B0510 – Mill River (Hatfield)

Mile Point 9.3, upstream of Mountain Drive, below the confluence with West Brook, Hatfield, MA

Habitat

Mill River – Hatfield is classified as Class B water (MassDEP 1996). The Mill River – Hatfield watershed (serving B0510) is 35 mi². The river begins on the northeast slope of Fisher Hill in Conway, MA. The stream is very high-gradient, and flows over a bedrock, boulder, and cobble bed as it parallels Route 116. This portion of the watershed is heavily forested, with many conifers. Just as the stream enters the Town of Deerfield, the nature of the stream changes dramatically. Immediately below a “blown-out” dam, the stream enters the Connecticut River valley floor. Here, the stream becomes a low-gradient, meandering stream. It flows through fields and pastures, and loses much of its shading. In the Town of Whatley, the sandy soils allow for extensive meanders, and, during the summer months, portions of the stream have been known to dry up. After receiving the flows from Bloody Brook, Roaring Brook, and Great Swamp, the Mill River - Hatfield begins to parallel Route 91. The Mill River – Hatfield then enters the Town of Hatfield. The benthic station B0510 is located near the Hatfield / Whatley border.

The overall habitat score for B0510 was 158 / 200 (second only to the Stony Brook station B0507)(Table A3). Four of the 13 habitat measures scored below the optimal range. Channel Alteration scored sub-optimally (14 / 20) due to the boulders placed along the left bank to stabilize Route 91. The Left Bank Riparian Vegetative Zone Width score also received a designation of “suboptimal” (8/10). This is also due to the highway stabilization. The Sediment Deposition score was “suboptimal” (13 / 20) due to gravel deposits within the stream reach. These gravel deposits may be emanating from West Brook, which enters the Mill River – Hatfield immediately upstream of this reach. Channel Flow Status received a “marginal” score (9 / 20). Many of the substrates (primarily gravel) were left exposed. This condition may be due to water withdrawals from Roaring Brook by the Town of South Deerfield, or ground water recharge. All other habitat measures scored within the optimal range.

Although the Channel Flow Status was found to be suboptimal, the instream depths were adequate. Riffle zones were noted to be 0.3 meters deep, as were the run areas. The pools were deeper at 0.6 meters. The stream had a canopy coverage estimated at 50%. Thin lines of trees populated both banks. These included, Cottonwood (*Populus* sp.), Ash (*Fraxinus* sp.), Sugar Maple (*Acer saccharinum*), Sycamore (*Platanus occidentalis*), Elm (*Ulmus* sp.), and Dogwood (*Cornus florida*). Behind the trees, on the right bank was an area of field and behind the trees on the left bank was Route 91.

The instream habitat contained a large riffle zone - one of the last riffle zones available (not associated with a dam) before the river enters the Connecticut River. Cobble was the dominant inorganic portion of the substrates (65%), and CPOM was the dominant organic portion (100%). Algae coverage was estimated at 65%. Observed algae types included green filamentous and green mats. Both types were

attached to rocky substrates and found in both pools and riffles. Aquatic macrophyte coverage was also extensive, with 40% coverage noted within the reach.

Benthos

The B0510 total metric score is 71% comparable to the reference station (Amethyst Brook, Amherst, MA). This condition results in an assessment of “slightly impacted” (Table A2). All functional feeding groups were well represented, with the most even distribution of all stations examined. The dominant functional feeding group was Scrapers (36%). The dominant family within this group was Chironomidae (55%). The presence of many members of this family is considered to be a sign of reduced water quality. However, the four genera of Chironomidae collected had tolerance values of either five or six. These tolerance values classify the collected genera as mid-to-slightly tolerant. The Biotic Index score for B0510 was 4.70. While tolerance values are prescribed as a measure of a macroinvertebrates ability to tolerate eutrophication and organic pollution, the presence of tolerant taxa are to be expected from within a low-gradient stream, downstream of an extensive wetland. Mill River – Hatfield had the second lowest Taxa Richness (24). This reduced diversity points towards a community that may be structurally and functionally compromised. The high habitat evaluation, dense algal and macrophyte coverage, and lowest total metric score of all stations, points towards a community that reflects water quality limitations – likely related to nutrient loading.

B0515 – Sawmill River

Mile Point 2.5, upstream at South Ferry Road, Montague, MA

Habitat

The Sawmill River begins at the outfall of Lake Wyola in Shutesbury, MA. The river flows through a high-gradient valley of sparse residential development in the towns of Leverett and Montague. At 6.2 miles from Lake Wyola, the Sawmill River passes under Route 63 in Montague. The gradient downstream from this bridge to B0515 is not as high as it is upstream of Route 63. Here, the stream enters the Connecticut River valley floor. The Sawmill River begins to meander through an area of pastures and the thickly settled village of Montague. The river then passes down a bedrock falls that was once the site of an industrial revolution-era dam. This is the last large drop the river takes before it enters the Connecticut River. B0515 is located 0.8 miles from the bedrock falls, and approximately 10 miles from Lake Wyola.

The within-reach habitat conditions at B0515 were deemed to be the worst of all six stations examined (137 / 200)(Table A3). The reductions in the habitat score are primarily due to abutting agricultural practices. The reach flows through an area of pasture that contains cows. These cows have direct access to the stream and have worn paths to, and through, the stream. This has caused degradation of the vegetation on both banks. The reduced Bank Vegetative Protection score for both banks exemplifies the condition of obvious disruption. The right bank received a score of 4 / 10, and the left bank received a score of 5 / 10. Most of the herbaceous plants that are preferentially consumed by ruminants (such as cows) were not present. There is a very limited understory beneath the thin rows of trees along each bank. Much of the understory consisted of rose bushes (*Rosa* sp.). The Riparian Vegetative Zone Width score was also reduced on both banks. The left bank received a score of 3 / 10. This is a “marginal” rating, with the riparian zone being reduced to between 6 – 12 meters. The left bank received a score of 2 / 10. This is a “poor” rating with the riparian zone being reduced to less than 6 meters. The reduction in score is due to the removal of trees to create pastureland, and the impact that grazing animals have had on the native vegetation.

The Bank Stability along the right bank was rated as “marginal” (4 / 10), with “cut-bank” erosion being quite obvious. This may be a natural occurrence as the reach was within the Connecticut River valley floor. Here, the soils are much more sandy, and prone to erosion. Sediment Deposition was rated as suboptimal with some new increases in bar formation. This, also, may be a natural occurrence due to the sandy nature of the localized soils. The Instream Cover available to aquatic biota was marginal (8 / 20). Only 10-30% of the area had a stable habitat and the substrates (dominated by cobble – 80%) were often disturbed.

Channel Flow Status scored in the optimal range, with water reaching the base of both banks and minimal amounts of substrates exposed. The Velocity-Depth combinations were also optimal with all four patterns (shallow-fast, shallow-slow, deep-fast, deep-slow) being represented. The depths of the instream habitats within this 5-meter wide river were adequate. The riffles were estimated at 0.2 meters deep. The runs were 0.3 meters deep, and the pools were 0.4 meters deep.

The canopy cover was estimated at 70%. The trees providing this shade included: Sugar Maple (*Acer saccharum*), Elm (*Ulmus* sp.), Willow (*Salix* sp.), and Hornbeam (*Carpinus caroliniana*). No algae, or aquatic macrophytes were observed within this reach.

Benthos

The benthic community collected at B0515 did not reflect the perturbation observed in the within-reach habitat. The community appeared to be in good health. The total metric score for B0515 is 90% comparable to the reference condition (B0514 – Amethyst Brook)(Table A2) resulting in an assessment of “non-impacted”. The Scraper functional feeding group (34%) dominated the collected benthic community from B0515. In turn, the family Elmidae dominated the Scraper functional feeding group (69%). This family is known to feed on attached algae and diatoms. The dominant taxon within the family Elmidae was *Optioservus* sp. This taxon is fairly sensitive to pollution, and requires high concentrations of dissolved oxygen. The Biotic Index score was 4.31. This score ranks B0515 third in comparison to the five other stations examined. When compared with other stations assessed, the collected benthic community from B0515 exhibited the highest number of different taxa (Taxa Richness = 35). This condition points towards a diverse community with good health and function. The EPT Index score (16) was also the best of all stations examined in the Connecticut Basin.

SUMMARY AND RECOMMENDATIONS

Benthic monitoring stations within the Connecticut River Basin included wadeable streams that were monitored employing DWM kick-net methodologies (Nuzzo 2002). The reference station (B0514 – Amethyst Brook) was chosen based on the reduced development within the contributing watershed, the lack of significant water withdrawals upstream of B0514, and high scoring metric values.

Cushman Brook (B0508) was initially considered a potential reference station. Contributing to B0508 is a Class A drinking water supply (Atkins Reservoir), and the watershed supplying that reservoir is well protected. However, the withdrawal of water could potentially affect the instream community, and there is significant agricultural and residential activity below the reservoir, and along East Leverett and Market Hill Roads. These two roads parallel the course of Cushman Brook, on either side of the stream.

Overall habitat scores (with the exception of B0515 – Sawmill River) were fairly comparable. They ranged from 149 / 200 at B0509 (Mill River – Northampton) to 160 / 200 at B0507 (Stony Brook). This is quite a tight range (11 points). The Sawmill River (B0515) stands out with the lowest habitat score (137 / 200).

The biomonitoring station used for a reference condition in the Connecticut River Watershed was Amethyst Brook (B0514). This station supports the diverse and well-balanced aquatic community expected in a “least-impacted” stream system. Including the reference station, three Connecticut River watershed biomonitoring study stations were found to be non-impacted. The other three stations were considered slightly impacted relative to reference conditions. Impacts to resident biota in this watershed were generally a result of habitat degradation and/or nonpoint source-related water quality impairment, with potential point source effects, observed as well.

Overall, collected benthic communities revealed “Non-Impacted” conditions at the following stations:

Stations with Non-Impacted Benthic Communities

Cushman Brook	B0508
Amethyst Brook	B0514 (Reference Station)
Sawmill River	B0515

Benthic communities revealed “slightly impacted” conditions at the following stations:

Stations with Slightly Impacted Benthic Communities

Stony Brook	B0507
Mill River – Northampton	B0509
Mill River – Hatfield	B0510

The schematic below (Figure 2) is based on a proposed conceptual model that predicts the response of aquatic communities to increasing human disturbance. It incorporates both the biological condition impact categories outlined in the RBPIII biological assessment methodology currently used by MassDEP and the Tiered Aquatic Life Use (TALU) conceptual model developed by the US EPA and refined by various state environmental agencies (US EPA 2003). The model summarizes the main attributes of an aquatic community (in this case the benthic macroinvertebrate community **only**) that can be expected at each level of the biological condition category, and how these metric-based bioassessments can then be used to make aquatic life use determinations as part of the 305(b) reporting process. Slightly or non-impacted aquatic communities, such as those encountered at all Connecticut stations, *support* the Massachusetts SWQS designated *Aquatic Life* use in addition to meeting the objective of the Clean Water Act (CWA), which is to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters (Environmental Law Reporter 1988). No benthic communities assessed in this study failed to support the *Aquatic Life* use goal of the CWA. This is not to say that stations achieving a designation of *non-impacted* should be considered pristine. There may be stressors affecting water quality, aesthetics, and other biotic communities that have little impact upon the benthic community.

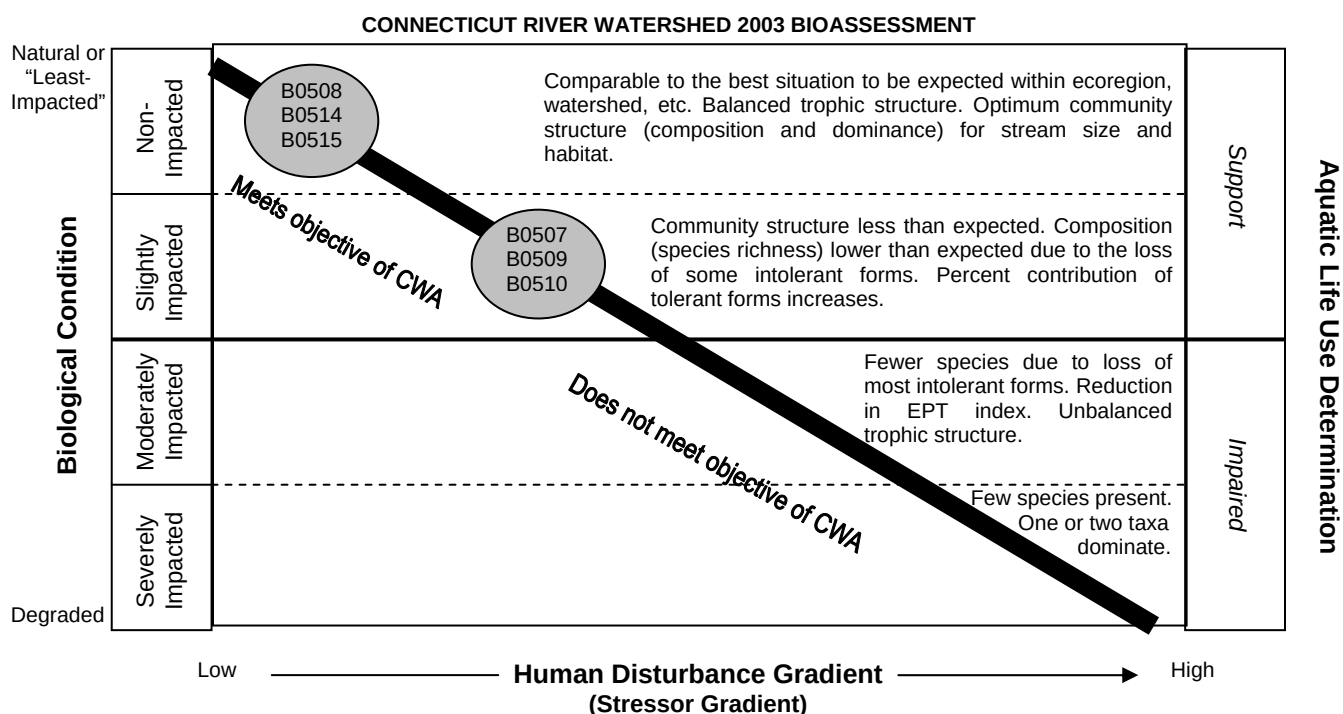


Figure 2. Schematic of the predictive response of aquatic communities to increasing human disturbance. Included is the performance (Biological Condition and Aquatic Life Use determinations) of the Connecticut River watershed 2003 biomonitoring stations along the Human Disturbance Gradient. NOTE: reference station (B0514) is considered to represent the “best attainable” conditions and to be supportive of the *Aquatic Life* use.

Amethyst Brook

Benthos: "Non-Impacted" (Reference Station)
Habitat: 157 / 200

Observations and Recommendations:

B0514 was used as the regional reference station to which all other Connecticut River Watershed benthic stations were compared. Amethyst Brook runs through a high-gradient area from its headwaters (the confluence of Harris Brook and Buffum Brook) all the way through station B0514. The contributing watershed is sparsely populated and mostly forested.

Much of the area surrounding B0514 is conservation land owned by the Town of Amherst. There are many trails that cross, and parallel, Amethyst Brook. These include the Metacomet-Monadnock Trail, and the Robert Frost Trail. Mountain bikers and dog walkers heavily utilize the trails around Amethyst Brook. Although there were obvious signs of recreational use, the trail system did not appear degraded. Nor did there appear to be any major impacts to the stream as a result of recreational activity. The homes on the left side of the brook were set back far enough from the brook so as to not have a major impact on the instream habitat. The Town of Amherst has a history of preserving open space, and maintaining conservation lands. It is recommended that the Town of Amherst continue with its sound trail maintenance and conservation efforts.

Stony Brook

Benthos: "Slightly Impacted"
Habitat: 160 / 200 (100% Comparability to Reference Station)

Observations and Recommendations:

It is highly probable that the aquatic health of Stony Brook could be greatly improved with the application of sound Non-Point Source (NPS) pollution reduction practices. NPS best management practices can reduce the amount of nutrients and toxins that enter surface waters (MassDEP 2006).

Cushman Brook

Benthos: "Non – Impacted"
Habitat: 154 / 200 (98% Comparable to Reference Station)

Observations and Recommendations:

The presence of a gravel pit across State Street from this station indicates that large amounts of gravel and sand occur within the localized soils. It is quite likely that this same gravel deposit extends within the B0508 area. If so, this condition will always leave B0508 exposed to potential stream bank erosion and sediment deposition. Continued good maintenance of trails within this conservation area would tend to reduce future sediment deposition and bank erosion. If erosion and sediment deposition can be reduced, then the health of the aquatic fauna may be improved.

Mill River – Northampton

Benthos: "Slightly Impacted"
Habitat: 149 / 200 (95% Comparable to Reference Station)

Observations and Recommendations:

Many mills were established along the Mill River – Northampton during the industrial revolution. This development required the installation of associated dams to ensure adequate water supply during the summer months. Manufacturing practices, and other development, within the Mill River watershed have had a significant impact upon the instream and riparian habitats. Many of these mills are now gone; yet

many of their impacts (and dams) still exist. The dams pose a barrier to fish passage, and can have a deleterious effect upon habitat, flow, and water chemistry.

The area surrounding B0509 showed signs of heavy recreational pressure. The extensive trail network (on both sides of the examined reach) is often frequented by runners and dog-walkers. The heavy foot traffic has compacted the soils, and removed much of the grasses and herbaceous vegetation. The retaining wall along the left bank has increased the deposition of gravel and cobble onto the right bank. Also, as a result of the left bank retaining wall, spring flooding can only “over bank” on the right bank. This (along with the foot traffic) has reduced the presence of grasses and herbaceous vegetation.

Sound within-watershed development, and remediation of past impacts, should be followed to improve the quality of aquatic life in the Mill River – Northampton. It is quite likely that upstream NPS pollution (including storm-water runoff) is a primary impact to the instream biota. Assessments of storm drains and abutting land use should be made, and remediated as conditions require. Also, upstream dams should be examined to determine if they continue to serve beneficial purposes or may be candidates for removal.

Mill River – Hatfield

Benthos: “Slightly Impacted”

Habitat: 158 / 200 (101% Comparable to Reference Station)

Observations and Recommendations:

The Mill River – Hatfield has two distinctly different habitats. The upstream portion (upstream of Route 116, Deerfield, MA) is very high-gradient and the streambed contains large amounts of bedrock, boulders and cobble. The portion downstream of Route 116 is lower gradient and the streambed contains large amounts of gravel, sand, and mud / muck. B0510 was located in the lower gradient portion of the river. This was done in order to assess the biological condition in response to the largest amount of contributing watershed.

The lower portion of Mill River – Hatfield (downstream of Route 116) parallels Route 91 for much of its course. The result is the straightening of what would otherwise be a meandering river. Also, the proximity of Route 91 greatly increases the potential for road-run off into the river. Road salt, motor oil, and solid waste can easily enter the river. Aside from Route 91, the proximal upstream landuse consists of heavily developed agriculture. While much of this agriculture consists of pastureland, there are also extensive areas of tilled land. Chemical applications, without adequate buffering, can find their way into this river.

Continued monitoring of watershed conditions, such as those being performed by Smith College (Clark Science Center 2000), is recommended. Agricultural Best Management Practices should be followed to reduce the potential for groundwater and stream impacts. Highway maintenance (along Route 91 and Route 116) should be performed with care. Stormwater runoff – from the industrialized portion of South Deerfield – should be mitigated. Monitoring of Bloody Brook should also continue as this stream receives much of the runoff from South Deerfield. Water withdrawal volume from Roaring Brook reservoir should be monitored to assure adequate instream flows in Mill River – Hatfield.

Sawmill River

Benthos: “Non-Impacted”

Habitat: 137 / 200 (87% Comparable to Reference Station)

Observations and Recommendations:

B0515 had the poorest habitat score of all station examined. This is primarily due to livestock having created trails into and through the river. The livestock (primarily cows) have browsed and trampled much of the riparian vegetation. They also contribute manure to the banks and the river. The stream banks are quite prone to erosion within this reach. The stream, at this point, has entered the Connecticut River Valley floor. Here, the sediments are much finer (sand) than those encountered in headwaters (cobble

and boulder). In the presence of conditions such as these, it is important to preserve as much of the stabilizing vegetation as possible.

This portion of the Sawmill River could benefit from a more active land management strategy. Since the pastureland that abuts both sides of the Sawmill River is used for grazing cattle, it may be necessary to apply agricultural BMPs (Best Management Practices). These practices may include the construction of a bridge and fencing to keep cattle out of the river, yet allow them access to both pastures.

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APPENDIX

Macroinvertebrate taxa list, RBPIII benthos analyses, and Habitat evaluations

Table A1. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2003 Connecticut River watershed survey July 2003.

TAXON	FFG ¹	TV ²	B0507	B0515	B0514 ³	B0508	B0510	B0509
Hydrobiidae	SC	8	4					
<i>Ferrissia</i> sp.	SC	6						2
Pisidiidae	FC	6	3					
Enchytraeidae	GC	10			1			
<i>Nais behningi</i>	GC	6		1	2	2		1
Lumbriculidae	GC	7		3			3	3
Erpobdellidae	PR	8	1					
<i>Caecidotea communis</i>	GC	8	3					
<i>Hydrachnidia</i>	PR	6			1			1
<i>Baetis</i> (subeq. term.) sp.	GC	6	2		2			8
Baetidae (short term. fil.)	GC	6					2	
Baetidae (subeq. term.)	GC	6		6				
<i>Caenis</i> sp.	GC	6		1				
<i>Serratella</i> sp.	GC	2		3	2			2
Heptageniidae	SC	4	10	2		1	5	5
<i>Epeorus</i> (Iron) sp.	SC	0				1		
<i>Isonychia</i> sp.	GC	2	2					1
Leptophlebiidae	GC	2		2	1			
<i>Habrophlebia</i> sp.	GC	4			1			
<i>Paraleptophlebia</i> sp.	GC	1				5		
Chloroperlidae	PR	1					1	
Leuctridae	SH	0				11		
<i>Leuctra</i> sp.	SH	0			14			
Leuctridae/Capniidae	SH	2		5				
Perlidae	PR	1		1		2		
<i>Acroneuria</i> sp.	PR	0			3	2		
<i>Agnetina</i> sp.	PR	2		1		1		
<i>Paragnetina</i> sp.	PR	1	2	1				
<i>Nigronia</i> sp.	PR	0		1				
<i>Nigronia serricornis</i>	PR	0			2			
<i>Brachycentrus</i> sp.	FC	1		1				
Glossosomatidae	SC	0					3	
<i>Agapetus</i> sp.	SC	0		3				
<i>Glossosoma</i> sp.	SC	0		1		2		
<i>Helicopsyche</i> sp.	SC	3		2				
Hydropsychidae	FC	4						1
<i>Cheumatopsyche</i> sp.	FC	5	19		7	1	8	6
<i>betteni</i>	FC	6	15				21	
<i>Hydropsyche morosa</i> gr.	FC	6		7	2	2		4
<i>Lepidostoma</i> sp.	SH	1	1		4			
<i>Oecetis</i> sp.	PR	5	1					
<i>Apatania</i> sp.	SC	3			1			1
Odontoceridae	SH	0			2			
Philopotamidae	FC	3				1		
<i>Chimarra</i> sp.	FC	4	14					3
<i>Dolophilodes</i> sp.	FC	0		1	3			
<i>Polycentropus</i> sp.	PR	6			1			
<i>Rhyacophila</i> sp.	PR	1		1		4		
<i>Neophylax</i> sp.	SC	3	1	3				3
<i>Optioservus</i> sp.	SC	4		21			12	4
<i>Oulimnius latiusculus</i>	SC	4		1	5	1	1	2
<i>Promoresia</i> sp.	SC	2			5	1	5	1
<i>Stenelmis</i> sp.	SC	5	8	3			9	10
<i>Dineutus</i> sp.	PR	4		1			3	
<i>Psephenus herricki</i>	SC	4	3				1	6
<i>Chironomini</i>	GC	6		1				
<i>Microtendipes pedellus</i> gr.	FC	6		1	1			
<i>Microtendipes rydalensis</i> gr.	FC	6			2	1		

TAXON	FFG ¹	TV ²	B0507	B0515	B0514 ³	B0508	B0510	B0509
<i>Polypedilum</i> sp.	SH	6		2				
<i>Polypedilum aviceps</i>	SH	4		3	5	16		
<i>Polypedilum fallax</i>	SH	6					1	1
<i>Polypedilum flavum</i>	SH	6	3	1				2
<i>Micropsectra dives</i> gr.	GC	7			1	3		
<i>Micropsectra polita</i> gr.	GC	7		1	2	5		
<i>Micropsectra/Tanytarsus</i> sp.	FC	7		2		1		
<i>Rheotanytarsus</i> sp.	FC	6	1					
<i>Rheotanytarsus exiguus</i> gr.	FC	6	3	3			2	9
<i>Rheotanytarsus pellucidus</i>	FC	5	4	2	1		1	3
<i>Stempellina</i> sp.	GC	2			1			
<i>Sublettea coffmani</i>	FC	4						7
<i>Tanytarsus</i> sp.	FC	6		8	11	20		
<i>Zavrelia/Stempellinella</i> sp.	GC	4				2		
<i>Diamesa</i> sp.	GC	5	6				13	
<i>Pagastia</i> sp.	GC	1					2	
<i>Potthastia longimana</i> gr.	GC	2		1				
Orthoclaadiinae	GC	5		1				
<i>Corynoneura</i> sp.	GC	4			1			
<i>Cricotopus triannulatus</i>	SH	7						4
<i>Cricotopus vierriensis</i>	SH	7						4
<i>Eukiefferiella</i> sp.	GC	6		1				
<i>Eukiefferiella devonica</i> gr.	GC	4					1	
<i>Nanocladius (Plecopteracoluthus)</i> sp.	GC	3				1		
<i>Parachaetocladius</i> sp.	GC	2			1	3		
<i>Parametriocnemus</i> sp.	GC	5			3	4		
<i>Rheocricotopus</i> sp.	GC	6			1			
<i>Rheocricotopus robacki</i>	GC	5						1
<i>Tvetenia paucunca</i>	GC	5	1		3	7	2	
Tanypodinae	PR	7		1				
<i>Ablabesmyia mallochi</i>	PR	8				1		
<i>Conchapelopia</i> sp.	PR	6		2	2	1	1	1
<i>Chelifera</i> sp.	PR	6						1
<i>Hemerodromia</i> sp.	PR	6		2		1	1	
<i>Simulium</i> sp.	FC	5	2				1	
Tipulidae	SH	5						1
<i>Antocha</i> sp.	GC	3						3
<i>Dicranota</i> sp.	PR	3		1	3	1		
<i>Hexatoma</i> sp.	PR	2				1		
<i>Tipula</i> sp.	SH	6	1		1		1	
TOTAL NUMBER OF ORGANISMS			110	105	98	105	100	101

¹Functional Feeding Group (FFG). The feeding habit of each taxon. SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.

²Tolerance Value (TV). An assigned value used to calculate the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant.

³Reference station

Table A2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Connecticut River watershed survey – July 2003. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Amethyst Brook (B0514) reference station, and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	B0514		B0507		B0508		B0509		B0510		B0515	
STREAM	Amethyst Brook		Stony Brook		Cushman Brook		Mill River - Northampton		Mill River – Hatfield		Sawmill River	
HABITAT SCORE	157		160		154		149		158		137	
TAXA RICHNESS	34	6	23	4	28	6	30	6	24	4	35	6
BIOTIC INDEX	3.48	6	5.05	2	3.86	6	4.98	2	4.70	4	4.31	4
EPT INDEX	12	6	10	4	10	4	9	2	6	0	16	6
EPT/CHIRONOMIDAE	1.23	6	3.72	6	0.51	2	1.06	6	1.74	6	1.37	6
SCRAPER/FILTERER	0.41	6	0.43	6	0.23	6	1.03	6	1.09	6	1.44	6
% DOMINANT TAXON	14%	6	17%	6	19%	6	10%	6	21%	4	20%	4
REFERENCE SITE AFFINITY	100%	6	62%	4	73%	6	76%	6	67%	6	78%	6
TOTAL METRIC SCORE	42		32		36		34		30		38	
% COMPARABILITY TO REFERENCE	100%		76%		86%		81%		71%		90%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	Reference		Slightly Impacted		Non-Impacted		Slightly Impacted		Slightly Impacted		Non-Impacted	

Table A3. Habitat assessment summary for biomonitoring stations sampled during the Connecticut River watershed survey – July 2003. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a complete listing and description of sampling stations.

Habitat Parameter	B0514*		B0507		B0508		B0509		B0510		B0515	
Instream Cover	12		7		18		17		16		8	
Epifaunal Substrate	19		17		18		16		18		18	
Embeddedness	16		15		14		14		16		19	
Channel Alteration	18		18		19		13		14		18	
Sediment Deposition	16		14		9		17		13		15	
Velocity-Depth Combinations	10		15		10		18		17		16	
Channel Flow Status	18		17		18		17		9		16	
Bank Vegetative Protection	8 ^L	9 ^R	10	10	9	8	7	4	10	10	5	4
Bank Stability	9	8	9	9	5	7	10	4	9	9	9	4
Riparian Vegetative Zone Width	7	7	9	10	10	9	8	4	8	9	3	2
TOTAL SCORE	157		160		154		149		158		137	

L = Left Bank
R = Right Bank
* = Reference Station



Appendix B

Technical Memorandum 34-5

CONNECTICUT RIVER WATERSHED DWM 2003 WATER QUALITY MONITORING DATA

DWM Control Number: CN 105.2

Prepared by
Peter Mitchell

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Introduction

Water quality sampling of the Connecticut River Watershed was conducted in April - September 2003, "Year Two" of MassDEP's five-year rotating watershed monitoring and management schedule. The primary objective of this "Year Two" sampling, as outlined in *CN 127.0 Quality Assurance Project Plan: 2003, Monitoring in the Blackstone, Chicopee, Connecticut and Nashua Watersheds* (MassDEP / DWM 2003), was to obtain sufficient data to determine the status of selected mainstem segments and tributaries with regard to their attainment of the Massachusetts Surface Water Quality Standards and designated uses.

The DWM sampling plan matrix for the monitoring in the Connecticut Watershed is presented in Table 1. Sampling components at river stations included: *insitu* Multi-probe[®] measurements, and physicochemical, nutrient, and bacteria sampling.

This technical memorandum presents the water quality sampling component of the survey. Results of other monitoring efforts, such as biological assessments and monitoring to support the development of lake Total Maximum Daily Loads, are reported in separate technical memoranda.

Methods

Water quality samples were collected in the Connecticut River Watershed on the dates and for the parameters shown in Table 1 (see Figure 1 for station locations). The parameters included in the sampling were: *insitu* Multi-probe[®] measurements (dissolved oxygen, percent dissolved oxygen saturation, pH, conductivity, water temperature and total dissolved solids), and total suspended solids, ammonia - nitrogen, nitrate – nitrite - nitrogen, total phosphorus, chlorophyll-a, and fecal coliform and *E. coli* bacteria (Table 1). The water quality sampling procedures are included in the publication: *CN 001.2 Sample Collection Techniques for DWM Surface Water Quality Monitoring* (Chase 2003a). Standard operating procedure *CN 004.2 Standard operating procedure: Water Quality Multi-probes* (Haynes *et al.* 2001) outlines the standard operating procedures for multi-probe sampling. Samples for total suspended solids, turbidity, fecal coliform and *E. coli* bacteria were analyzed at Severn Trent Laboratories, Inc., a private environmental testing lab in Westfield, Massachusetts, following their approved analytical laboratory SOPs. All other collected water chemistry samples were analyzed at the Division of Environmental Analysis Senator William X. Wall Experiment Station in Lawrence, MA.

Quality Assurance and Control

DWM quality assurance and database management staff reviewed lab data reports and all multi-probe data. The data were validated and finalized per MassDEP / DWM data validation procedures, as described in standard operating procedure *CN 56.2 Data Validation and Usability* (Chase 2005a). In general, all water sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). A complete summary of censoring and qualification decisions for 2003 DWM data is provided in *CN 211.0 Data Validation Report for Year 2002 Project Data* (Chase *et al.* 2005b). A list of symbols and qualifiers used for DWM data is presented in Appendix 3.

TABLE 1: Connecticut River Watershed 2003 Water Quality Sampling Stations and Parameters

Site Description	Station No.	April 30	June 4	July 9	Aug 6	Sept 10	Oct 1
Westfield River, Route 147 Bridge, Agawam / West Springfield	CT02	N1, T, TSS	N1, T, TSS	N1, T, TSS	N1, T, TSS	N2, T, TSS	N2, T, TSS
Deerfield River, Route 5 / 10 Bridge, Deerfield / Greenfield	CT04	N1, T, TSS	N1, T, TSS	N1, T, TSS	N1, T, TSS	N2, T, TSS	N2, T, TSS
Connecticut River, Route 10 Bridge, Northfield	CT06	B, N1, M, T, TSS	A/H, B, N1, M, T, TSS	A/H, B, C, N1, T, TSS	A/H, B, C, M, N1, T, TSS	B, C, M, N2, TSS	B, M, N2, TSS
Connecticut River, downstream of Fourmile Brook confluence, Northfield and east of Pisgah Mountain Road, Gill	02A	--	--	A/H, B, C, M, N1, T, TSS	A/H, B, C, M, N1, T, TSS	B, C, M, N2, TSS	--
Connecticut River, Route 116, Deerfield / Sunderland	04A	B, M, N1, T, TSS	A/H, B, M, N1, T, TSS	A/H, B, C, M, N1, T, TSS	A/H, B, C, M, N1, T, TSS	B, C, M, N2, TSS	--
Connecticut River, Upstream of the confluence with the Mill River, near the Oxbow, Northampton / Hadley	04C	--	--	A/H, B, C, M, N1, T, TSS	A/H, B, C, M, N1, T, TSS	B, C, M, N2, TSS	--
Connecticut River, Route 90, West Springfield / Chicopee	05A	--	--	A/H, B, C, M, N1, T, TSS	A/H, B, C, M, N1, T, TSS	B, C, M, N2, TSS	--
Connecticut River, at USGS gage 01184000, downstream of Route 190, Suffield / Enfield, CT	CT00	B, M, N1, T, TSS	A/H, B, M, N1, T, TSS	A/H, B, C, M, N1, T, TSS	M, C	B, C, M, N2, TSS	B, M, N2, T, TSS
Stony Brook, College Street (Route 116) upstream of confluence of Leaping Well Brook, South Hadley	19A	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, T, TSS
Bachelor Brook, Route 47, South Hadley	07A	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, T, TSS	B, C, M, N1, TSS	B, C, M, N1, T, TSS
Weston Brook, Rural Street, Belchertown	23A	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, T, TSS
Lampson Brook, George Hannum Street, approximately 50-feet downstream of Belchertown WWTP discharge, Belchertown	06A	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, T, TSS
Manhan River, Loudville Road, Easthampton	11A	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, T, TSS
Manhan River, Fort Hill Road, Easthampton	11C	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, T, TSS
Mill River, approximately 1 mile downstream of Clement Street and USGS gage 0117150, Northampton	28B	B, M, N1, T, TSS	B, M, N1, T, TSS	B, N1, T, TSS	B, M, N1, T, TSS	B, M, N2, TSS	B, M, N2, TSS
East Branch Mill River, south of East Main Street, approximately 200 feet upstream of confluence with West Branch Mill River, Williamsburg	EBMR01	B, M, N1, T, TSS	B, M, N1, T, TSS	B, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, TSS	B, M, N1, TSS
West Branch Mill River, Mill Street, Williamsburg	WBMR01	B, M, N1, T, TSS	B, M, N1, T, TSS	B, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, TSS	B, M, N1, TSS
Fort River, Route 47, Hadley	27B	B, M, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, T, TSS
Mill River, Maple Street, Hatfield	24B	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, TSS	B, M, N1, TSS
Bloody Brook, Whatley Road, Deerfield	BB01	B, M, N1, T, TSS	B, M, N1, T, TSS	B, N1, T, TSS	B, C, M, N1, T, TSS	B, C, M, N1, TSS	B, M, N1, TSS
Mill River, Mill River Lane, Hadley	25C	B, M, N1, T, TSS	B, M, N1, T, TSS	B, C, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, TSS	B, M, N1, TSS
Sawmill River, South Ferry Road, Montague	26A	B, M, N1, T, TSS	B, M, N1, T, TSS	B, N1, T, TSS	B, M, N1, T, TSS	B, M, N1, TSS	B, M, N1, TSS
Millers River, Route 63 Bridge, Erving / Montague	CT05	N1, T, TSS	N1, T, TSS	N1, T, TSS	N1, T, TSS	N2, T, TSS	N2, T, TSS
Chicopee River, Route 116 Bridge, Chicopee	CT03	N1, T, TSS	N1, T, TSS	N1, T, TSS	N1, T, TSS	N2, T, TSS	N2, T, TSS

A/H = Alkalinity and Hardness

B = Bacteria (fecal coliform and *E.coli*)

C = Chlorophyll-a

M = Multi-probe (temperature, pH, conductance, total dissolved solids, dissolved oxygen)

(Note: Some multi-probe measurements were obtained on adjacent dates)

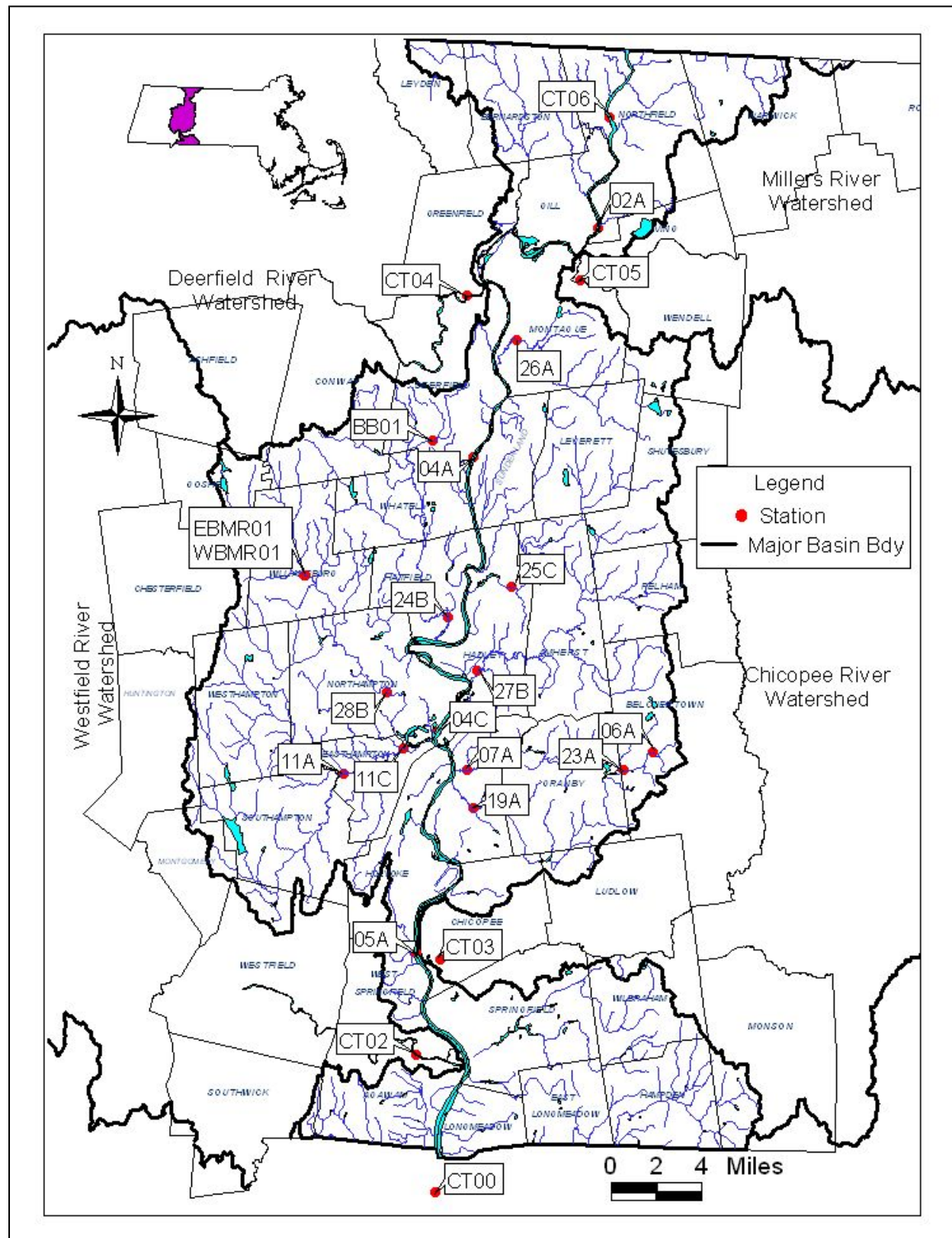
N1 = Ammonia – Nitrogen (NH₃-N), Total phosphorous (TP)

N2 = Ammonia – Nitrogen (NH₃-N), Total phosphorous (TP), Nitrate – Nitrite – Nitrogen (NO₃-NO₂-N),
Total Nitrogen (TN)

T = Turbidity

TSS = Total suspended solids

Figure 1: Connecticut River Watershed 2003 Water Quality Sampling Stations



Survey Conditions

Hydrological and meteorological conditions prior to each sampling event were characterized by examining discharge and precipitation data. Discharge data were obtained from USGS streamflow gages, and precipitation data from gauges (operated by MA DCR) proximal to the above streamflow gages.

STREAMFLOW DATA

There are 25 active USGS gage stations in the Massachusetts portion of the greater Connecticut River Watershed (Socolow *et al.* 2004). These include gages in the Millers River Watershed (4), the Deerfield River Watershed (5), the Chicopee River Watershed (10), the Westfield River Watershed (3), and the Farmington River Watershed (1). There are two Connecticut River mainstem USGS gages in the Massachusetts portion of the Connecticut River Watershed (excluding the above major tributary rivers), and one mainstem Connecticut River gage 2.5-miles south of the Massachusetts / Connecticut boundary (Morrison *et al.* 2003). There is also one USGS gage on a small tributary (Mill River at Northampton, MA – 01171500) to the Connecticut River. Information pertaining to these latter four gages is presented below:

<u>Gage Number</u>	<u>Gage Description</u>
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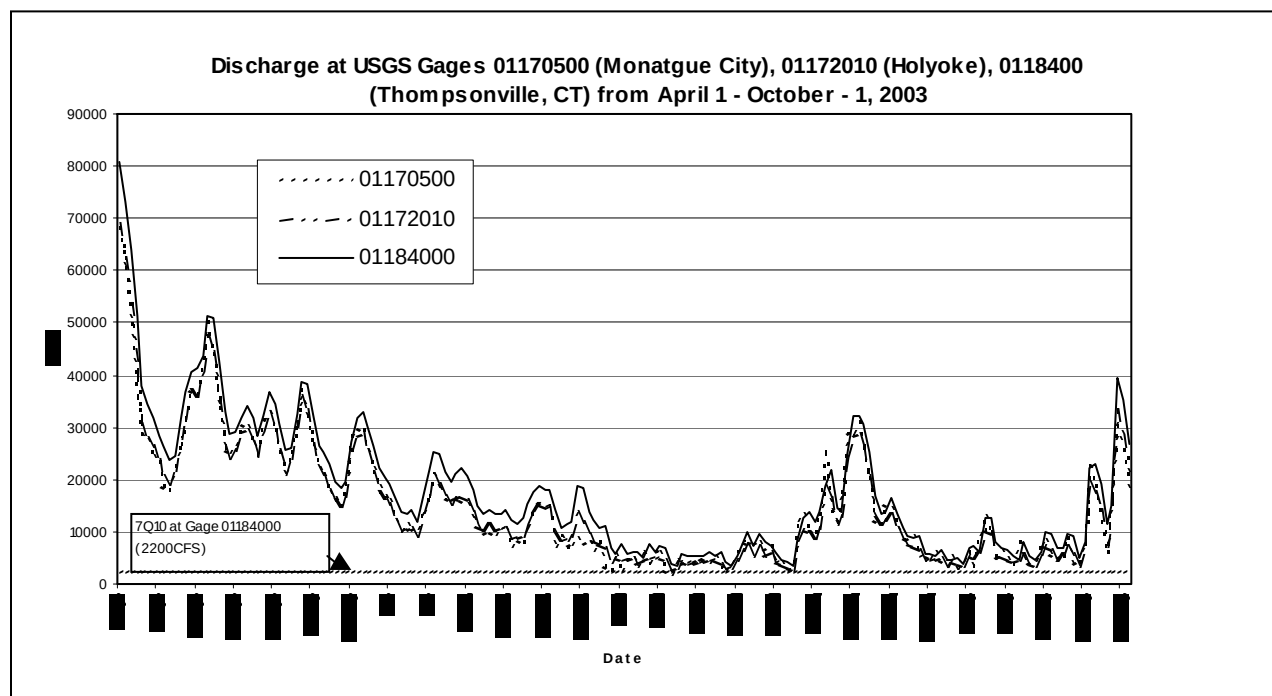
01170500	CONNECTICUT RIVER AT MONTAGUE CITY, MA Drainage Area: 7860 mi ² *7Q10: 1727 cfs (Ries 1998)
01171500	MILL RIVER AT NORTHAMPTON, MA Drainage Area: 52.6 mi ² 7Q10: 6.31 cfs (Ries 1998)
01172010	CONNECTICUT RIVER AT INTERSTATE 391 BRIDGE AT HOLYOKE, MA. Drainage Area: 8332 mi ² 7Q10: not calculated
01184000	CONNECTICUT RIVER AT THOMPSONVILLE, CT Drainage Area: 9660 mi ² 7Q10: 2200 cfs (Wandle 1984)

*7Q10 is defined as the lowest stream flow for seven consecutive days that would be expected to occur once in ten years.

Streamflow data from gages 01170500, 01172010 and 01184000 may be used to describe flow conditions along the mainstem Connecticut River. Gage 01171500 measured streamflow from a run-of-river stream (Mill River, Northampton). These data may be used to estimate several flow conditions within the proximal, wadeable streams, and smaller rivers.

There are three dams along the mainstem of the Connecticut River that have the potential of modifying flow conditions within the river. They are: the Vernon Dam in Vermont, the Turner's Falls Dam in Turner's Falls, MA, and the Holyoke Dam in Holyoke, MA. The discharge measurements from the three mainstem Connecticut River USGS gage stations reveal a pronounced similarity (Figure 2). The discharge measurements were more than 95% correlated ($p < 0.05$) with each other. Mainstem flow conditions between the USGS gage at Montague City and the USGS gage at Thompsonville, CT were consistent with run-of-river flow conditions throughout the survey. This indicates that mainstem flow conditions were not modified to an extent measurable by gages 01170500, 01172010, and 01184000. However, no gage exists between the Vernon Dam and the Turners Falls Dam. It is known that flow modification affects this length of the river. Flow modification within this upper section of the Connecticut River is evidenced by the continued bank erosion within this section. Also, the Turner's Falls power canal diverts water from the natural river channel. At present, minimum instream flows from the base of the Turner's Falls dam to the outfall of the power canal is 200 cfs. The adequacy of this volume of water for the support of aquatic life is currently under debate.

Figure 2: Streamflow at Three Mainstem Connecticut River Gages



Streamflow measurements from the furthest downstream gages on the major contributing rivers to the Connecticut River within Massachusetts (Millers River, Deerfield River, Chicopee River, and Westfield River) were also examined as they contribute significant volumes of water to the Connecticut River. These gages were:

<u>Gage Number</u>	<u>Gage Description</u>
01166500	MILLERS RIVER AT ERVING, MA Drainage Area: 372 mi ² 7Q10: 46.8 cfs (Wandle 1984)
01170000	DEERFIELD RIVER NEAR WEST DEERFIELD, MA Drainage Area: 557 mi ² 7Q10: 95.6 cfs (Wandle 1984)
01177000	CHICOPEE RIVER AT INDIAN ORCHARD, MA Drainage Area: 689 mi ² 7Q10: 128 cfs (Wandle 1984)
01183500	WESTFIELD RIVER NEAR WESTFIELD, MA Drainage Area: 497 mi ² 7Q10: 77.3 cfs (Wandle 1984)

Discharge from the four major contributing rivers had a great impact on the measured flow at USGS Gage 01184000 (Thompsonville, CT). The combined discharge from these rivers, on average, accounted for 26% of the water in the Connecticut River during the examined period (April 1 – October 1) (Figure 3). Also, on a total of 14-days, from April 1 to October 1, these four major rivers contributed more than 40% of the water flowing past the Thompsonville Gage. Further examination of the discharge data for the studied time period shows that the Millers River average contribution was approximately 4%. The average

contribution from the Deerfield River was approximately 9%. The average contribution from the Chicopee River was approximately 7%, and the average contribution from the Westfield River was approximately 6% (Figure 4).

Streamflow measurements from the sole Farmington River gage (01185500 - WEST BRANCH FARMINGTON RIVER NEAR NEW BOSTON, MA) located in Massachusetts were not addressed, as the mouth of the Farmington River is in the state of Connecticut, and does not affect the streamflow in the Massachusetts portion of the Connecticut River.

Figure 3: Combined Percent Streamflow Contribution from Four Major Rivers April 1 to October 1

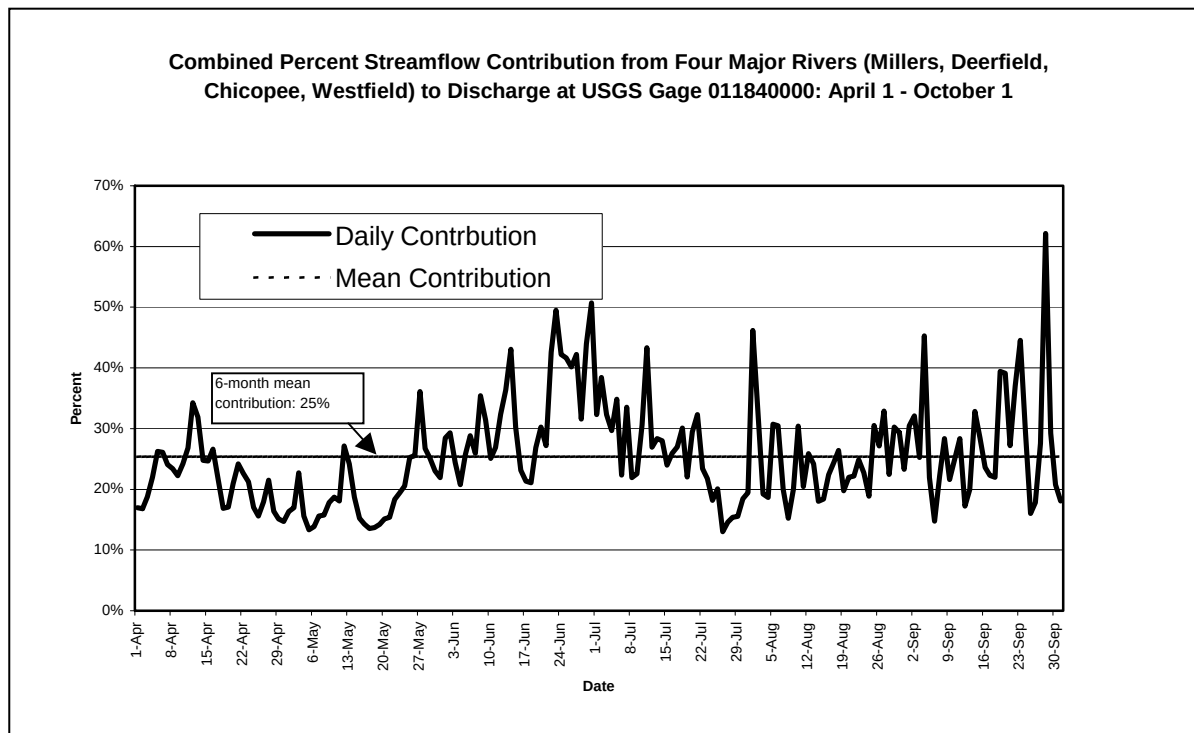
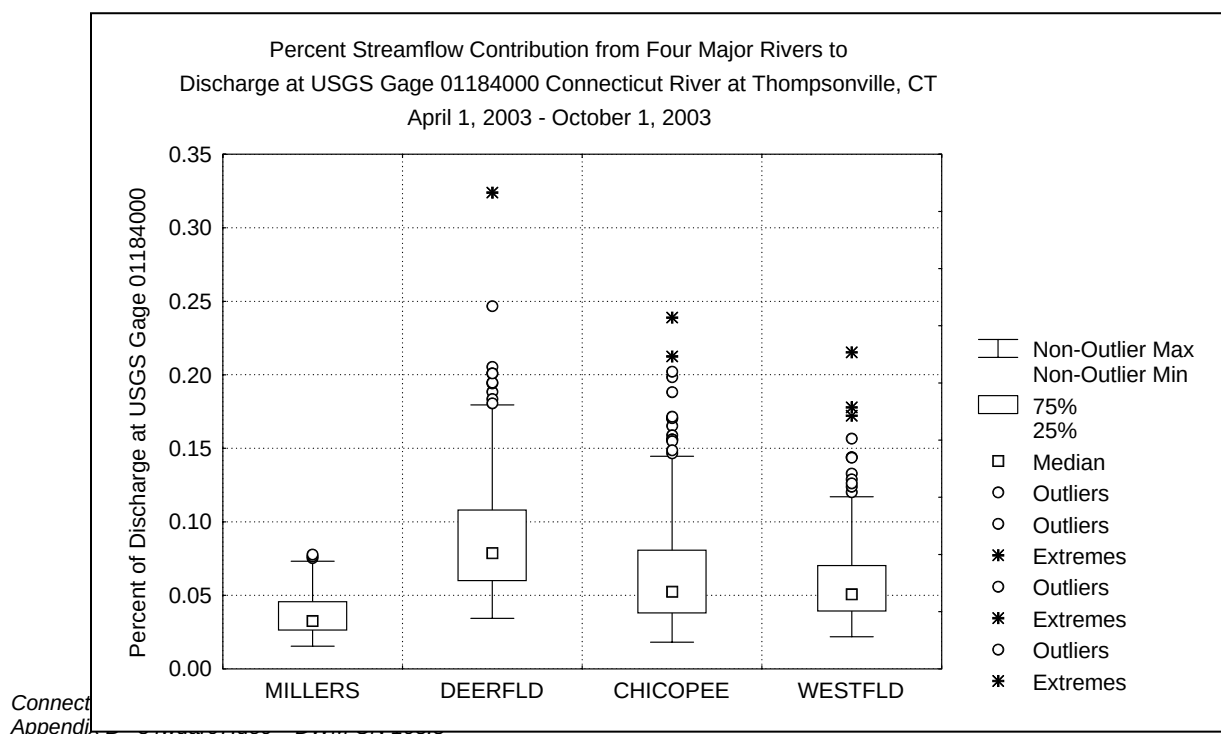


Figure 4: Individual Percent Streamflow Contribution from Four Major Rivers April 1 to October 1



RAINFALL MEASUREMENTS

The Massachusetts Department of Conservation and Recreation (MA DCR) manages rainfall measurements from over 100 gauges across the Commonwealth. Measurements taken at three gauges, located along the length of the Connecticut River, were used in this examination (Marler 2004 and MA DCR undated). Rainfall data were used to determine if collected water quality samples might be considered “wet-weather” or “dry-weather” samples. The three MA DCR rainfall gauges are:

<u>Gage Number</u>	<u>Gage Description</u>
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GRE203	Greenfield Waste Water Treatment Facility, Greenfield, MA
AMH307	Amherst Waste Water Treatment Facility, Amherst, MA
HOL217	Holyoke Dam, Holyoke, MA

The Greenfield rainfall measurements were very similar to those recorded at Amherst. The total rainfall measured from April 1 to October 1 was 32.05-inches at the Greenfield gauge, and 32.84-inches at the Amherst gauge. The maximum daily precipitation event occurred on September 29th, and measured 3.09 inches at the Greenfield gauge. At the Amherst gauge, the maximum daily precipitation event also occurred on September 29th, and measured 2.31 inches. Precipitation conditions as measured at the Holyoke gauge were different from the Greenfield gauge and the Amherst gauge. The total rainfall measured at the Holyoke gauge from April 1 to October 1 was 25.78 inches. The maximum daily precipitation event at Holyoke occurred on September 24th, and measured 2.9 inches.

The three selected MA DCR rainfall gauges were located near the mainstem of the Connecticut River, and were located in the northern, central, and southern sections of the Connecticut River Watershed in Massachusetts. The water quality monitoring stations were also dispersed throughout the watershed, and each was associated with the most proximal (nearest) rainfall gauge to determine the conditions that prevailed leading up to the time of sampling.

MA DCR rainfall gauge GRE203 (Greenfield) was nearest to the following water quality stations:

CT04	Deerfield River
BB01	Bloody Brook
26A	Sawmill River
CT05	Millers River

MA DCR rainfall gauge AMH307 (Amherst) was associated with the following water quality stations:

CT06	Connecticut River
02A	Connecticut River
04A	Connecticut River
04C	Connecticut River
05A	Connecticut River
CT00	Connecticut River
28B	Mill River (Northampton)
EBMR01	East Branch Mill River (Northampton)
WBMR01	West Branch Mill River (Northampton)
27B	Fort River
24B	Mill River (Hatfield)
25C	Mill River (Hadley)
CT02	Westfield River
CT03	Chicopee River

MA-DCR rainfall gauge HOL217 (Holyoke) was nearest to the following water quality stations:

19A	Stony Brook
07A	Bachelor Brook
23A	Weston Brook
06A	Lampson Brook
11A	Manhan River
11C	Manhan River

All mainstem Connecticut River samples were associated with precipitation data from the MA DCR rainfall station AMH307 (Amherst). Although it is the case that mainstem stations CT06 and 02A are closest to the Greenfield rain gauge, and mainstem stations 05A and CT00 are closest to the Holyoke rain gauge, the Amherst rain gauge was used to describe precipitation conditions that potentially affect all mainstem stations. This relationship between all mainstem stations and the Amherst rainfall station (AMH307) was formed in the interest of clarity and uniformity. The streamflow within the Connecticut River in Massachusetts is affected by rainfall within many subwatersheds. As such, a rain gauge located in the most central portion of the Connecticut River Watershed was chosen. Figures 5 and 6 illustrate the relationship between rainfall measurements at AMH307 and discharge measurements at Montague City (01170500) and Thompsonville, CT (01184000). Both the northernmost (USGS gage number 01170500) and southernmost (USGS gage number 01184000) streamflow gages respond similarly when compared to rainfall data from the central location.

Figure 5: Amherst Rainfall and Streamflow at Montague City

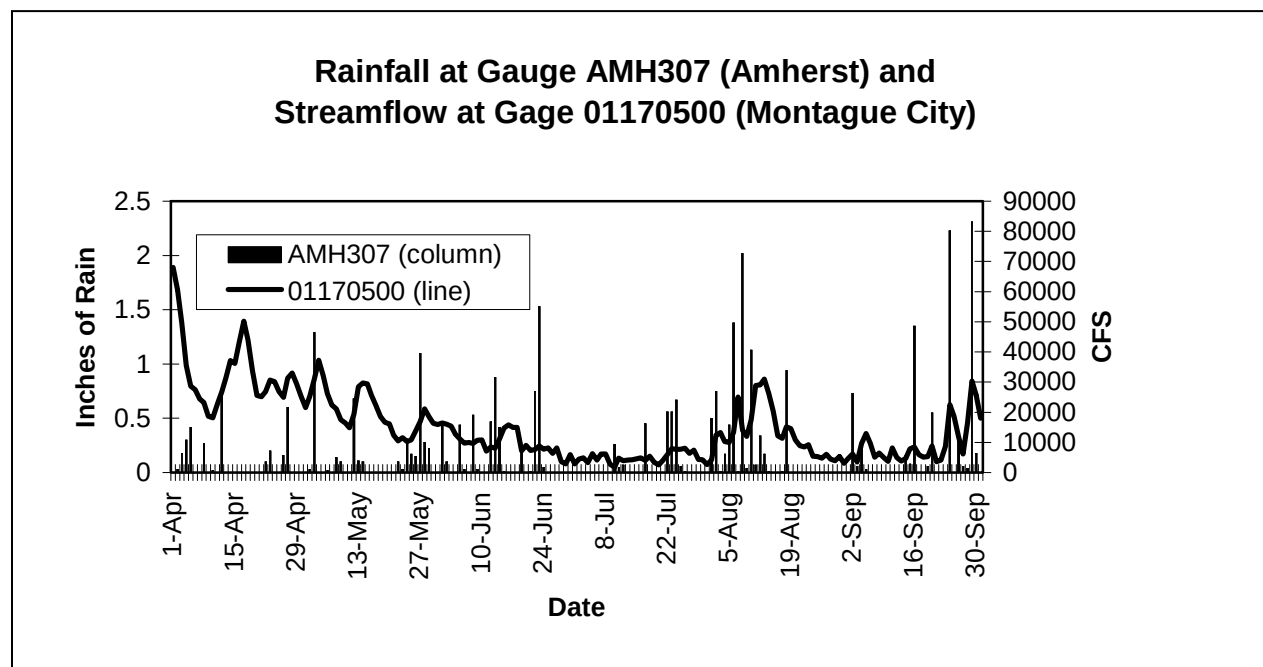
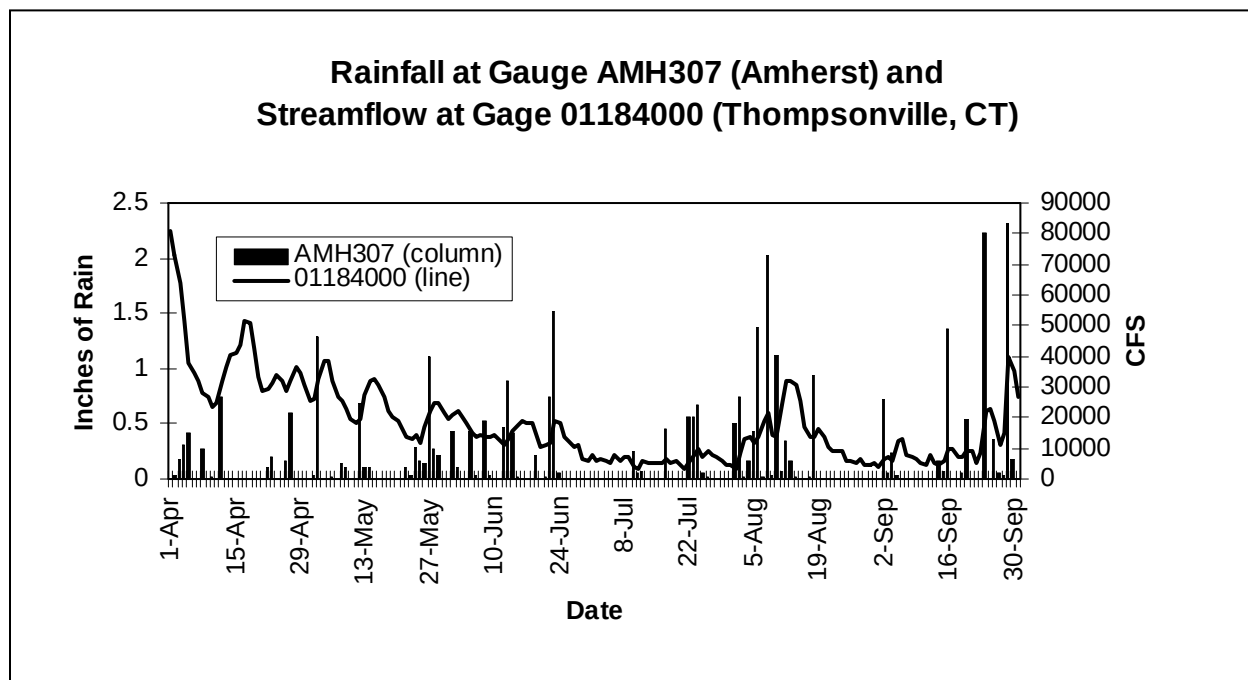


Figure 6: Amherst Rainfall and Streamflow at Thompsonville, CT



The data from the three MA DCR rainfall gauges (Tables 2, 3 and 4) show that some “wet-weather” samples were collected during the sampling season. It is the practice of DWM to define a “wet-weather” sample as one that was collected at a location that received at least 0.5 inches of rainfall within the 72-hours antecedent to sample collection. However, a significant precipitation event (> 0.5 inches) should be accompanied by a noticeable response in instream flow. If the ground is quite dry, then the rain may be absorbed and have no noticeable effect upon instream flow. Also, the impounded conditions encountered within the Connecticut River Watershed may mask the effects of a precipitation event.

Table 2: 2003 precipitation data from MA DCR gauge GRE203 (Greenfield)						
	5-days prior	4-days prior	3-days prior	2-days prior	1-day prior	Sample Date
Date	25-April	26-April	27-April	28-April	29-April	30-April
Rain (Inches)	0	0.06	0.72	0	0	0
Date	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun
Rain (Inches)	0.01	0	0.45	0.04	0	0
Date	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul
Rain (Inches)	0	0	0	0	0	0
Date	1-Aug	2-Aug	3-Aug	4-Aug	5-Aug	6-Aug
Rain (Inches)	0.48	1.4	0	0.32	0.22	0.75
Date	5-Sep	6-Sep	7-Sep	8-Sep	9-Sep	10-Sep
Rain (Inches)	0.03	0	0	0	0	0
Date	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	1-Oct
Rain (Inches)	0.26	0.1	0.02	3.09	0.14	0.01

*Significant rain events (>0.5-inches) in **bold**

Table 3: 2003 precipitation data from MA DCR gauge AMH307 (Amherst)						
	5-days prior	4-days prior	3-days prior	2-days prior	1-day prior	Sample Date
Date	25-April	26-April	27-April	28-April	29-April	30-April
Rain (Inches)	0	0.16	0.6	0	0	0
Date	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun
Rain (Inches)	0	0	0.43	0.1	0	0
Date	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul
Rain (Inches)	0	0	0	0	0	0
Date	1-Aug	2-Aug	3-Aug	4-Aug	5-Aug	6-Aug
Rain (Inches)	0.5	0.75	0.01	0.17	0.44	1.38
Date	5-Sep	6-Sep	7-Sep	8-Sep	9-Sep	10-Sep
Rain (Inches)	0.03	0	0	0	0	0
Date	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	1-Oct
Rain (Inches)	0.36	0.06	0.04	2.31	0.18	0

*Significant rain events (>0.5-inches) in **bold**

Table 4: 2003 precipitation data from MA DCR gauge HOL217 (Holyoke)						
	5-days prior	4-days prior	3-days prior	2-days prior	1-day prior	Sample Date
Date	25-April	26-April	27-April	28-April	29-April	30-April
Rain (Inches)	0	0	0	0	0	0
Date	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun
Rain (Inches)	0	0	0.63	0.16	0	0
Date	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul
Rain (Inches)	0	0	0	0	0	0
Date	1-Aug	2-Aug	3-Aug	4-Aug	5-Aug	6-Aug
Rain (Inches)	0	0	0	0.19	0	0
Date	5-Sep	6-Sep	7-Sep	8-Sep	9-Sep	10-Sep
Rain (Inches)	0.02	0	0	0	0	0
Date	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	1-Oct
Rain (Inches)	0	0	0.6	2.23	0.16	0.06

*Significant rain events (>0.5-inches) in **bold**

The samples collected from the stations on the dates listed in Table 5 are considered to be representative of wet-weather conditions.

Table 5: 2003 Wet-weather Sample Determination	
Sample Collection Date	Water Quality Station
April 30	CT04, BB01, 26A, CT05, CT06, 02A, 04A, 04C, 05A, CT00, 28B, EMBR01, WBMRO1, 07B, 24B, 25C, CT02, CT03
June 4	19A, 07A, 23A, 06A, 11A, 11C
July 9	No samples considered to be "wet-weather" samples
August 6	CT04, BB01, 26A, CT05, CT06, 02A, 04A, 04C, 05A, CT00, 28B, EMBR01, WBMRO1, 07B, 24B, 25C, 27B, CT02, CT03
September 10	No samples considered to be "wet-weather" samples
October 1	All samples considered to be "wet-weather" samples

Pertinent Observations Regarding Stations and Conditions

Station CT02: Westfield River, Route 147 bridge, Agawam/West Springfield

This station was located on the downstream side of the route 147 bridge – 2.25 miles upstream from the confluence with the Connecticut River. At this point, the Westfield River defines the border between the town of Agawam and the city of West Springfield. The station was accessed by parking in the Rocky's hardware parking lot and walking to the sidewalk on the downstream side of the route 147 bridge. Water samples were collected via "Bottle Basket Sampling Device" (see CN001.4. *MADEP/DWM Bottle Basket Sampling Device* (Chase 2003b) because there was no reasonable method to access the river at this site. These data were used to assess the nutrient loading from the Westfield River to the Connecticut River.

Due to the height of the bridge, visual observations of proximal water and habitat conditions were limited. However, the water was usually clear (and without color) except on the two sampling occasions (August 6th and October 1st) when high flows were accompanied by an increase in turbidity.

Station CT04: Deerfield River, Route 5/10 bridge, Deerfield/Greenfield

This station was located between the downstream side of the Route 5 / 10 Bridge and the upstream side of the railroad bridge (approximately 1 mile upstream from the mouth of the river). Parking under the railroad bridge and walking down to the river along the southern bank accessed the station. Water samples were collected by wading into the river from the right bank. Data from this site will be used to assess the nutrient loading to the Connecticut River.

The substrate at this location was a mix of sand and gravel. These finer sediments are prone to erosion, and slumping and undercut banks were observed during station visits. The water was usually clear (and without color) except on the two sampling occasions (August 6th and October 1st) when high flows were accompanied by an increase in turbidity, and the water had a yellow / tan color. This was evidence of suspended sediment. The nearby, upstream (river-left) golf course is frequently flooded, as is the nearby, upstream (river-right) field.

Station CT06: Connecticut River, Route 10 bridge, Northfield

This station was located at the Route 10 bridge in Northfield. It was the most upstream mainstem water quality station during the 2003 survey (3.5 river miles from the Vermont / New Hampshire border). Data collected from this station was used to assess water quality conditions as the river entered the state. Survey vehicles were parked in the Bennett Meadow Conservation Area parking lot. From there, survey crews walked to the center of the bridge, and collected samples via "Bottle Basket Sampling Device" from the downstream side of the bridge.

The height of the bridge made habitat observations difficult. The water was most often colored brown, and the bottom was most often unobservable due to depth and lack of water clarity. The riverbanks are prone to erosion in this reach. The soft sand banks may become inundated when the Turner's Falls dam holds back water. On occasion, this water has been released faster than it can drain from the sandy soils. These saturated soils become unstable, and have often slumped into the river. Studies and remediation of this condition continue through the hands of both government and non-government entities. Bank erosion mitigation projects have included the application of used tires (in a variety of patterns), rip-rap, re-grading, re-vegetation, and other bio-engineering techniques (Simons *et al.* 1978).

Station 02A: Connecticut River, downstream of Fourmile Brook confluence, Northfield and east of Pisgah Mountain Road, Gill

This station was located approximately 5.5-river miles downstream of station CT06, at the Northfield Mountain Pumped Storage picnic area in Northfield. Between the two stations, there are inputs from the

Town of Northfield, Northfield Mount Hermon Preparatory Academy, and riparian agricultural activities. Flow modification affects this site due to the operations of the Vernon Dam (VT), the Turner's Falls Dam, and the Northfield Mountain Pumped Storage Facility. Survey vehicles were parked near, or within, the picnic parking area. Samples were collected by launching a canoe (with permission from Northfield Mountain) from the boat dock near the picnic area. Due to high water, and a concern for safety, only three sets of samples (July 9, August 6, September 10) were collected.

Although the water was clear on two of the three sampling occasions, the river bottom (at the thalweg) was unobservable from a canoe (due to the depth). The "feel" of the anchor on the bottom led the survey crews to believe that the substrates were a combination of coarse gravel and cobble.

Station 04A: Connecticut River, Route 116, Deerfield / Sunderland

This station was located 9.3 river miles downstream of the confluence with the Deerfield River, and it is assumed that the Deerfield and the Connecticut rivers are fully mixed by the time their waters pass this station. This station was downstream from the discharges from the City of Greenfield, the Bitzer State Fish Hatchery, the Turner's Falls Dam, and the industrialized power canal at Turner's Falls.

Samples were collected from this station using both the "Bottle Basket Sampling Device" and via canoe. The first two sampling events (April 30, June 4) employed the "Bottle Basket Sampling Device" from the Route 116 Bridge. However, the high volume of traffic on the bridge made this an unsafe method of sample collection. The subsequent three surveys utilized a canoe to collect the samples. Survey vehicles were parked at the boat launch on the Sunderland side of the river, and the canoe was paddled out into the river. The power-lines that cross the Connecticut River were used as a guide. The canoe was positioned under these power-lines at the time of sample collection.

The river was quite shallow, and wide, at this station. The cobble and boulder substrates were usually observable during the daytime surveys. Submerged aquatic plants were also observed during two of the surveys, but their density was rated as "sparse". The clarity of the water was most often noted as being "slightly turbid" with a brownish color. Although the bank material is quite comparable to conditions found upstream of the Turner's Falls Dam (Stations CT06 and 02A), this station was not affected by erosion as observed at the upstream stations.

Station 04C: Connecticut River, upstream of the confluence of the Mill River near the Oxbow, Northampton/Hadley

Station 04C was located 0.45 miles upstream from the state boat launch located at the Oxbow formed at the confluence of the Manhan and Connecticut rivers. The station was accessed by parking at the state boat launch and launching a canoe into the Oxbow. Survey crews then paddled the canoe 0.45 miles upstream to a point marked by the end of power-lines, a dirt farm road, and the start of a forested riparian buffer on the river-left bank. This station was sampled on three occasions (July 9th, August 6th, and September 10th). Spring high-flows made sampling unsafe on April 30th and June 4th. A large rain event (September 29th) also made sampling by canoe unsafe on the October 1st sampling collection date.

This reach of the Connecticut River is heavily used for boat recreation, as well as for recreational fishing. The water, most often, was slightly turbid, with a brown color. The proximal upstream land-use is still primarily agricultural.

Station 05A: Connecticut River, Route 90, West Springfield/Chicopee

This station was located approximately 500 feet downstream of the Route 90 (Mass Turnpike) bridge that connects Chicopee and West Springfield. This station was accessed by parking at the state boat launch (Medina Street, Chicopee) and launching a canoe into the Connecticut River. Samples were collected underneath the power-lines that cross the river below the Route 90 Bridge. This station was located approximately 5.4 river miles downstream from the Holyoke Dam, immediately upstream of the Chicopee

WWTF outfall, and 0.4-river miles upstream from the mouth of the Chicopee River. There was no sidewalk on the Route 90 Bridge, and flows were too high to put in a canoe (from the boat launch) on all but three sampling occasions. Sampling was completed on July 9th, August 6th, and September 10th.

Prominent upstream features included the urban areas of Holyoke, North Chicopee, and South Hadley Falls. The banks were stable, with no obvious signs of erosion. The substrate was primarily sand, with some large boulders in the vicinity of the bridge and boat ramp.

Station CT00: Connecticut River at USGS Gage 01184000, downstream of Route 190, Suffield/Enfield, CT

This station was located at the USGS Gage (01184000) on the river-right bank of the Connecticut River and approximately 100 meters upstream of the Windsor Locks Canal. Boat access at this station was not possible. As such, samples were collected from the river-right bank.

This was the furthest downstream mainstem Connecticut River station, and was used to document water quality conditions as they leave Massachusetts. The water was clear for the majority of the six sampling events. There were signs of erosion on the steep banks.

Station 19A: Stony Brook, College Street (Route 116) upstream of confluence of Leaping Well Brook, South Hadley

The water at this station comes from a 19.6 mi² drainage area. It flows through both residential and agricultural landuses, and then through the town of South Hadley. The proximity of the stream to Route 116 allows for little riparian buffering, or canopy cover; opening this stream to potential NPS impacts. Also, Stony Brook flows under many old commercial buildings. This station was accessed by parking in the Chap de Laine's furniture store parking lot (with permission), and walking to the stream. The samples were collected, by wading, immediately upstream of the Route 116 bridge crossing. Station 19A is 2.5 miles from the confluence with the Connecticut River. The water color was most often dark tan, and the clarity was most often highly cloudy.

Station 07A: Bachelor Brook, Route 47 (Hadley Street), South Hadley

Bachelor Brook runs along the southern foot of the Holyoke Range, from the outlet of Forge Pond, Granby to the Connecticut River, South Hadley. This station had a 31mi² drainage area. Many small farms, wetlands, and residences exist within the proximal upstream watershed. Bachelor Brook is not a high-gradient stream. The stream meanders through most of its course to the Connecticut River. Station 07A is 1 mile upstream of the confluence with the Connecticut River.

This station was accessed by parking along the side of Route 47, and walking to the Route 47 bridge. Samples were collected from the upstream, river-left bank using a sample collection pole. The water always appeared colored (either brown or tan), and usually was turbid. The substrates were primarily sand and mud.

Station 23A: Weston Brook, Rural Street, Belchertown

This station has a 3.7 mi² contributing drainage area. It has received, in the past, discharges of un-ionized ammonia from the Belchertown WWTP (1.86 miles upstream of this station on Lampson Brook, and 12-miles from the confluence with the Connecticut River)(Kennedy and Weinstein 2000). The town of Belchertown has upgraded their WWTP within the past five years. Data from this station will be used to determine the effectiveness of the remediation techniques.

Weston Brook is a very small stream with low gradient. The majority of the upstream watershed is dominated by Lampson Brook. This station was accessed by parking along Rural Street and walking to

the upstream side of the Rural Street bridge. Due to the small width (and depth) of this stream, samples were collected by wading into the center of the stream. The substrates were primarily coarse gravel and sand. The immediate riparian zone was dominated by residential landuse. The water was clear on all but the final sample collection (October 1), when the water was slightly turbid. This may be a result of the heavy rain on September 29th. The water color was most often brown.

Station 06A: Lampson Brook, George Hannum Street, approximately 50 feet downstream of Belchertown WWTP discharge, Belchertown

This station has a 1.8 mi² contributing drainage area. Lampson Brook is a tributary to Weston Brook (Station 23A). Lampson Brook is the receiving water for the Belchertown WWTP outfall. The Lampson Brook station is located immediately below the Belchertown WWTP (and 0.86-miles upstream of the confluence with Weston Brook). The WWTP, in 2001, was retrofitted to mitigate un-ionized ammonia discharges (Kennedy and Weinstein 2000).

Lampson Brook, at this station 14-miles upstream of the Connecticut River, was quite small. It was possible to straddle the stream during all surveys. This station was accessed approximately 100 feet downstream from the outfall of the final settling pond associated with the Belchertown WWTF. Here, the stream enters a wetland area with very little canopy coverage. The substrates are dominated by the mud and muck associated with wetlands. Water clarity and color were like those observed at Weston Brook (Station 23A). The water was clear on all but the final sample collection (October 1), when the water was slightly turbid. The water color was most often brown.

Station 11A: Manhan River, Loudville Road, Easthampton

This station has a 58 mi² contributing drainage area, and is 5.7 miles upstream from the Connecticut River. Station 11A was located upstream of the most urbanized portion of Easthampton. A downstream site (Station 11C) was used to compare conditions with the upstream site.

The Manhan River, at this station, is a low-gradient stream. It meanders through an area of pasture and residential landuse. This station was accessed by parking along the side of Loudville Road, and walking to the sample collection point, approximately 100-feet upstream of the Loudville Road bridge. The substrates were primarily sand, and the banks showed some signs of cut-bank erosion. The water was clear on all sampling occasions except August 6th and October 1st. At these times, the water was slightly turbid and murky.

Station 11C: Manhan River, Fort Hill Road, Easthampton

This station is the furthest downstream accessible location on the Manhan River, and is 0.86 miles from the confluence with the Connecticut River. The station has a drainage area of 84 mi². The Manhan River flows through several mills in Easthampton. Between station 11B and this station (11C), the Manhan River receives the inflow from Lower Mill Pond. This pond, fed by Broad Brook, Rubber Thread Pond, and Nashawannuck Pond, receives the majority of the potential industrial effluent. This station is also 0.75 miles downstream of the Easthampton WWTP.

This station was accessed by parking along the side of Fort Hill Street and walking to the upstream side of the Fort Hill Road bridge. Samples were collected by using the "Bottle Basket Sampling Device". The water color was almost always brown (except during the April and June samplings). There were signs of erosion in the sandy / muddy banks. It is assumed that the substrates are primarily comprised of sand and mud, but the bottom was unobservable due to the depth (and turbidity) of the water.

Station 28B: Mill River, approximately 1 mile downstream of Clement Street (location of USGS gage 01171500 prior to October 2002), Northampton

Station 28B was the furthest downstream of three water quality stations in the Mill River (Northampton) Watershed. Station 28B is 3.6 miles upstream from the Connecticut River. The drainage area upstream of this location (including both East and West Branches) is 54 mi². This station was located at the old USGS gage house near Smith College. The Mill River flows through historically industrial and currently dense residential landuse types before it reaches this station.

This station was accessed by parking in the lot just west of the community gardens (Burts Pit Road). Survey teams walked down the park-trail to the USGS gage house. Samples were collected by wading into the river from the river-right bank. The substrates were primarily large cobble and boulder. The water was often slightly turbid with a brown color.

Station EBMR01: East Branch Mill River, south of East Main Street, approximately 200 feet from confluence with West Branch Mill River, Williamsburg

Station EBMR01 is 10.7 miles upstream of the Connecticut River. Station EBMR01 was sampled in concert with Stations 28B and WBMR01, as they are all within the Mill River (Northampton) Watershed. The data from all these stations can describe the Mill River – Northampton watershed as a whole. The upstream drainage area is 9.5 mi². Although there are nearby residences in the immediate upstream watershed, the watershed was primarily forested. This station was accessed by parking at the end of Mill Street (dead end) and walking to the stream. The substrates were primarily cobble at this station. The instream habitat conditions looked optimal for the support of aquatic life. The water clarity was always clear at this station. The water color was clear and blue on all but the August 6th sampling event (when it was light tan).

Station WBMR01: West Branch Mill River, Mill Street, Williamsburg

Station WBMR01 is 10.7 miles upstream of the Connecticut River. Data from this station is best associated with data from stations EBMR01 and 28B. Together, they provide a description of water quality conditions in the Mill River (Northampton) and its tributaries. The drainage area upstream of this location is approximately 12.75 mi².

This station was accessed by parking at the end of Mill Street (dead end) and walking to the stream. Substrate conditions in the West Branch of the Mill River were similar to those observed in the East Branch of the Mill River. The substrates were primarily cobble. However, the West Branch appears to have been straightened. This has resulted in an increase in velocity, and slightly larger substrates than occurred in the East Branch. The water clarity and color were also similar to the conditions observed in the East Branch.

Station 27B: Fort River, Route 47, Hadley

Station 27B was located approximately 0.7 miles upstream of the confluence with the Connecticut River. Approximately 56.4 mi² of drainage area lie upstream of this location. The majority of the river is low-gradient, with a relatively sandy substrate. Much of the water passing Station 27B comes from Lawrence Swamp (a high-density area of ground water supply). The river meanders heavily on its way to the Connecticut River. At this station, the Fort River has received runoff from the Town of Amherst, the Mill Valley Golf Course, and agricultural runoff from several farms. This station was accessed by parking along Route 47, and walking to the upstream side of the bridge. Samples were collected from the river-left bank, at a minor constriction in the river created by the remains of an industrial-era dam. The water was brown and turbid for the majority of the sampling events (except during the June sampling event – when it was clear).

Station 24B: Mill River, Maple Street, Hatfield

This station has a contributing drainage area of 48.4 mi², and lies 2.5 miles upstream of its confluence with the Connecticut River. Aside from its high-gradient headwaters, the Mill River takes a low-gradient and meandering course through the farms of Hatfield. In addition to potential NPS agricultural runoff, there are potential impacts from Route 91, a fertilizer company (LESCO), industries located in South Deerfield (via Bloody Brook), and water withdrawals by the towns of Northampton and South Deerfield.

This station was accessed by parking at the pumping station, and walking to the sample collection point which was located approximately 100-feet upstream of the Maple Street bridge, on the river-left bank. Substrates were mostly sand and gravel at this station. The water color was most often brown, and the clarity was most often slightly turbid (except during the April sampling event – when it was clear).

Station BB01: Bloody Brook, Whately Road, Deerfield

Bloody Brook begins its course in the Pocumtuck Range (Deerfield). It quickly loses its high-gradient nature as it enters the Connecticut River valley floor. It flows through farms, residential areas, and then through the Town of South Deerfield. After crossing under Route 91, it crosses Whately Road at Station BB01.

This station (21 miles upstream of the Connecticut River) was accessed by parking on the side of Whately Road and walking to the upstream side of the Whately Road bridge. Samples were collected immediately upstream from the bridge. Bloody Brook, at this station, is very low-gradient. The substrates are mostly mud and sand. The water velocity is also very low. The water was always turbid and brown.

Station 25C: Mill River, Mill River Lane, Hadley

The drainage area upstream of this station is 26.8 mi². This station lies 2.9 miles upstream from the confluence with the Connecticut River. The headwaters of the Mill River (Hadley) drain Atkins Reservoir (a drinking water supply to the Town of Amherst) and Factory Hollow Pond (aka Puffer's Pond – a heavily used recreational area). Cushman Brook emerges from this pond via an overflow dam. It receives the runoff from residential and commercial land use in North Amherst. The stream crosses Route 116 and joins Eastman Brook (which receives the discharges from Bioshelters Fish Hatchery and the Cronin National Fish Hatchery) where it becomes "Mill River (Hadley)". The stream then turns south and parallels Route 116. Here, it receives runoff from several farms, and the majority of runoff from the UMass / Amherst Campus.

This station was accessed by parking at the end of Mill Site Road, where the bridge is "out". Survey crews then walked to the river-left bridge abutment and collected samples from the river-left bank. The Mill River (Hadley), at this location, is low gradient, and the substrates were primarily mud and sand. The stream meanders quite a bit, except near Route 116, where it has been straightened. The water was usually slightly turbid and brown during the survey.

Station 26A: Sawmill River, South Ferry Road, Montague

The Sawmill River drains 31 mi², from its origin at the outfall of Lake Wyola to its confluence with the Connecticut River. Station 26A was 2.5 miles upstream from the confluence with the Connecticut River. The Sawmill River surrenders much of its gradient by the time it reaches the sampling location, where it begins to meander through the softer substrates that make up the Connecticut River valley floor. At this sampling location, the river receives runoff from the town of Montague, as well as potential agricultural inputs.

This station was accessed by parking along the side of South Ferry Road and walking to the upstream side of the South Ferry Road bridge. Samples were collected approximately 10 feet upstream of the bridge. The substrates were primarily gravel, and some cobble. Pasture and some residences dominated

the immediate upstream landuse. On all but two occasions (August 6th and October 1st), the water was clear and had no color. On August 6th and October 1st the water was slightly turbid and light tan in color in response to a rain event.

Station CT05: Millers River, Route 63 Bridge, Erving / Montague

This station was accessed by parking in the Renovator's Supply parking lot (with permission), and walking to the river-right, downstream side of the Route 63 Bridge (1.86 miles upstream from the confluence with the Connecticut River. Samples were collected from this bank. The Millers River substrates at this location are dominated by cobble and boulder. The water was clear, with a light tan color, on most of the sampling events. However, slight turbidity was noted on the August 6th and October 1st sampling occasions. This is most likely due to recent rainfall.

Station CT03: Chicopee River, Route 116 Bridge, Chicopee

This station was accessed by parking along the side of Granby Road, and walking to a point on the river-right bank of the river, approximately 250-feet upstream of the Route 116 bridge (0.9 miles upstream of the confluence with the Connecticut River. Samples were collected from this river-right bank. The water was most often clear, but with a brown or tan color.

Water Quality Data

Raw data files, field sheets, lab reports and chain of custody (COC) records are stored in open files at the DWM in Worcester. All MassDEP DWM water quality data are managed and maintained in the *Water Quality Data Access Database*. Data exports for publishing are provided by DWM's database manager. Data Tables 1 and 2 are **QC Status 4** ("Final") data exports for the Connecticut Watershed. This level of data reflects project-level review by appropriate staff for reasonableness, completeness and acceptability. These data can be freely used and cited in documents without caution or caveat.

Water quality data for multi-probe parameters (dissolved oxygen, percent dissolved oxygen saturation, pH, conductivity, water temperature and total dissolved solids) are in Data Table 1, and for nutrients (total phosphorus, nitrate-nitrite, ammonia), fecal coliform and *E. coli* bacteria are in Data Table 2.

Data validation procedures are described in *Data Validation Report for Year 2003 Project Data* (Chase et al 2005b). Validation of data from discrete water samples is based on acceptable relative percent differences for field duplicates and the lack of contamination (i.e. less than method detection limits) for ambient field blanks. Quality control sample data are provided in Appendices 1 and 2. Definitions of symbols and qualifiers used in DWM data tables are provided in Appendix 3.

Data Table 1: Connecticut River Watershed Survey 2003 Multiprobe Data - Temperature, pH, Conductivity, Total Dissolved Solids, Dissolved Oxygen, % Saturation

(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 3.)

Connecticut, (2003) (QC Status: 4) Exported: 10/4/2005 11:24:21 AM

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W0478 Station: CT06, Mile Point: 64.425

Description: [Route 10 bridge, Northfield.]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0130	10:48	0.4	8.9	7.1 c	92.5	59.2	12.1	106
06/02/03	34-0180	23:15	0.6 i	16.6	7.2	122	77.9	9.4	99
08/05/03	34-0348	00:01	0.2 i	23.9	7.2 c	121	77.2	7.7 u	92 u
08/06/03	34-0406	07:48	0.4 i	23.9	7.0 c	120	76.8	7.0	84
09/09/03	34-0453	00:24	0.9 i	21.5	7.3 ic	153	98.0	8.5	97
10/01/03	34-0518	08:15	0.3 i	15.8	7.2	112 u	71.9 u	9.4 u	95 u

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1044 Station: 02A, Mile Point: 58.772

Description: [downstream of Fourmile Brook confluence, Northfield and east of Pisgah Mountain Road, Gill]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
07/08/03	34-0246	00:39	1.1	27.7	7.6	139	90.0	8.3 i	105 i
07/09/03	34-0304	09:07	1.0	27.2	7.5	138	89.0	7.8 i	99 i
08/05/03	34-0356	00:10	1.0	23.7	7.2 uc	119	78.0	7.6	90
08/06/03	34-0414	07:57	0.7 u	23.7	7.3 c	108	70.0	7.5	88
09/09/03	34-0461	00:08	1.0	21.7	7.5 uc	152	99.0	9.3	106

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1045 Station: 04A, Mile Point: 40.229

Description: [Route 116, Deerfield/Sunderland]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0132	12:10	0.3	9.0	7.0 cu	91.9	58.8	12.1	106
06/03/03	34-0189	00:31	0.2 i	15.9	7.0	116	74.1	9.5	98
07/08/03	34-0188	01:49	1.4	26.6	7.4 u	135	88.0	7.6 i	95 i
07/09/03	34-0305	10:23	1.0	26.3	7.4	136	88.0	7.3 i	91 i
08/05/03	34-0357	01:12	0.6	24.4	7.4 c	121	78.0	7.8	93
08/06/03	34-0415	09:53	0.6 u	23.6	7.4 uc	118	77.0	8.0	94
09/09/03	34-0462	01:05	1.1 u	21.4	7.4 uc	141	91.0	8.7	98

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1046 Station: 04C, Mile Point: 22.403

Description: [upstream of the confluence of the Mill River, near the Oxbow, Northampton/Hadley]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
07/08/03	34-0248	02:59	2.3 u	27.2	7.6	138	89.0	8.2 i	103 i
07/09/03	34-0306	11:29	2.3	27.0	7.8	136	88.0	8.8 i	111 i
08/05/03	34-0358	02:10	1.1	24.9	7.5 c	128	83.0	7.8	94
08/06/03	34-0416	10:42	0.8 u	24.0	7.4 uc	117	76.0	7.9 u	94 u
09/09/03	34-0463	02:02	1.0 u	21.7	7.5 c	141	92.0	8.9	102

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1047 Station: 05A, Mile Point: 9.947

Description: [Route 90, West Springfield/Chicopee]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
07/08/03	34-0249	04:02	1.2 u	27.5	7.4	143	93.0	7.5 i	95 i
07/09/03	34-0307	12:29	1.1	27.3	7.6	139	90.0	8.3 i	105 i
08/05/03	34-0359	03:11	0.9	25.0	7.4 c	139	90.0	7.4	90
08/06/03	34-0417	11:37	0.8 u	25.1	7.4 c	128	83.0	7.7 u	93 u
09/09/03	34-0464	02:59	0.9 u	22.2	7.4 c	149	97.0	8.8	101

CONNECTICUT RIVER (SARIS: 3417100)**Unique_ID: W1395 Station: CT00, Mile Point: -2.994**Description: [At the USGS flow gaging station #01184000 downstream of Route 190, Suffield/Enfield Connecticut
(The point in Arcview is as close as the MA state quad image allows, actual point is further downstream.)]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0139	08:26	0.5	10.4	7.0 c	98.3	62.9	11.1	101
06/02/03	34-0172	23:37	0.5	16.1	7.0	114	72.9	9.2	95
07/08/03	34-0230	00:33	0.5	27.9	7.4	162	105	8.0 i	101 i
08/05/03	34-0340	00:11	0.4	24.7	7.2 uc	159	103	7.3	87
08/06/03	34-0398	08:00	0.5	24.6	7.3 uc	151	98.0	7.3	88
09/09/03	34-0445	00:25	0.7	22.4	7.5 u	157	102	9.0	104
10/01/03	34-0510	08:08	0.9	15.7	7.1 u	108	70.0	9.6	97

STONY BROOK (SARIS: 3417925)**Unique_ID: W1053 Station: 19A, Mile Point: 2.277**

Description: [College Street (Route 116) upstream of confluence of Leaping Well Brook, South Hadley]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0142	11:21	0.9	16.2	7.4 c	151	97.0	9.7	101
06/03/03	34-0175	01:46	0.5	16.1	7.5	149	95.2	9.3	97
07/08/03	34-0240	03:15	0.9	25.9	7.7 u	180	117	8.0 i	99 i
08/05/03	34-0343	02:10	0.5 u	23.7	7.8 c	176	115	8.2	97
08/06/03	34-0401	09:59	## m	## m	## m	## m	## m	## m	## m
09/09/03	34-0448	02:19	0.7	19.8	7.6 u	173	112	9.0	99
10/01/03	34-0513	10:33	1.6	13.7	7.5 u	121	79.0	10.7	103

BACHELOR BROOK (SARIS: 3418000)**Unique_ID: W1052 Station: 07A, Mile Point: 0.916**

Description: [Route 47 (Hadley Street), South Hadley]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0143	11:52	1.0	14.6	7.4 c	164	105	10.2	102
06/03/03	34-0176	02:18	0.6	16.1	7.3	151	97.0	9.0	93
07/08/03	34-0241	03:43	0.8	25.2	7.5 u	158	103	7.4 i	90 i
08/05/03	34-0344	02:31	0.8	23.3	7.4 uc	209	136	7.2	85
08/06/03	34-0402	10:27	0.6	23.0	7.5 c	195	127	8.0	93
09/09/03	34-0449	02:43	0.9	18.9	7.5 u	182	118	8.2 u	89 u
10/01/03	34-0514	10:52	1.4	13.7	7.3 u	129	84.0	10.3	99

WESTON BROOK (SARIS: 3418100)**Unique_ID: W1054 Station: 23A, Mile Point: 0.441**

Description: [Rural Street, Belchertown]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0140	10:12	0.1 i	12.1	7.1 c	281	180	10.2	97
06/03/03	34-0173	00:40	0.1 i	13.6	7.0	235	151	8.7 u	85 u
07/08/03	34-0238	02:15	0.3	20.7	7.3	329	214	7.8 i	87 i
08/05/03	34-0341	01:10	0.2	20.5	7.3 uc	283	184	7.7	86
08/06/03	34-0399	09:00	0.2	20.5	7.2 c	252	164	7.7	86
09/09/03	34-0446	01:27	0.4 i	15.5	7.4	380	247	9.2	93
10/01/03	34-0511	09:37	0.4	10.8	7.0	224	145	9.7 u	88 u

LAMPSON BROOK (SARIS: 3418125)**Unique_ID: W1055 Station: 06A, Mile Point: 0.907**

Description: [George Hannum Street, approximately 50 feet downstream of Belchertown WWTP (MA0102148) discharge, Belchertown]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0141	10:41	0.2	13.2	7.1 c	327	209	10.5	102
06/03/03	34-0174	01:04	0.2	13.0	7.2 u	415 u	265 u	9.4 u	92 u
07/08/03	34-0239	02:37	0.3	19.9	7.6 u	500	325	8.9 i	98 i
08/05/03	34-0342	01:34	0.3	20.7	7.6 uc	434 u	282 u	8.4	94
08/06/03	34-0400	09:24	0.2	20.2	7.5 c	295	192	8.5	94
09/09/03	34-0447	01:47	0.4 i	17.7	7.7	554 u	360 u	9.2	97
10/01/03	34-0512	09:59	0.5	12.5 u	7.4	301 u	196 u	10.2	96

MANHAN RIVER (SARIS: 3418175)**Unique_ID: W1064 Station: 11A, Mile Point: 5.633**

Description: [Loudville Road, Easthampton]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
04/29/03	34-0145	14:33	0.6	13.0	6.9 c	96.8	62.0	10.1	97
06/03/03	34-0179	03:26	1.2	14.5	7.0 u	110	70.3	9.2 u	92 u
07/08/03	34-0244	05:13	0.8	20.8	7.1 u	140	91.0	8.0 iu	90 iu
08/05/03	34-0347	04:13	0.7	20.3	7.1 uc	117	76.0	7.8	87
08/06/03	34-0405	12:06	0.5	20.6	7.1 uc	120	78.0	8.3	92
09/09/03	34-0452	04:10	0.7	15.7	7.2 u	154	100	8.9	89
10/01/03	34-0517	12:14	0.7	13.0	6.9 u	96.0	62.0	10.0 u	95 u

MANHAN RIVER (SARIS: 3418175)**Unique_ID: W1065 Station: 11C, Mile Point: 0.842**

Description: [Fort Hill Road, Easthampton]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
04/29/03	34-0146	13:48	2.0	13.2	7.1 cu	131	83.5	10.2	98
06/03/03	34-0178	03:50	0.3	13.8	6.8 c	84.8	54.3	9.1	90
07/08/03	34-0243	04:52	0.4	22.8	7.2 u	175	114	7.4 i	86 i
08/05/03	34-0346	03:38	0.4	21.6	7.3 c	144	94.0	8.0	91
08/06/03	34-0404	11:32	0.4	21.5	7.3 c	153	99.0	8.3	94
09/09/03	34-0451	03:44	0.7 u	17.4	7.3	186	121	8.4	88
10/01/03	34-0516	11:50	1.7 u	13.5	7.0 u	113	74.0	10.1	97

MILL RIVER (SARIS: 3418825)**Unique_ID: W1059 Station: 28B, Mile Point: 0.611**

Description: [approximately 1 mile downstream of Clement Street (location of USGS gage 01171500 prior to October 2002), Northampton]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
04/29/03	34-0138	16:17	0.6	13.2	8.2 c	98.1	62.7	10.8 u	105 u
06/03/03	34-0187	03:38	## i	13.6	6.8 c	101	64.5	10.0 u	99 u
08/05/03	34-0355	04:08	## i	22.0	7.1 c	115	73.5	8.1	94
08/06/03	34-0413	12:51	0.2 i	22.1	7.4 c	97.9	62.7	8.6	100
09/09/03	34-0460	04:01	## i	16.7	## i	150	96.0	9.0	94
10/01/03	34-0525	13:27	0.2 i	12.4	6.9	92.4 u	59.2 u	10.3 u	97 u

EAST BRANCH MILL RIVER (SARIS: 3419150)**Unique_ID: W1056 Station: EBMR01, Mile Point: 0.038**

Description: [south of East Main Street approximately 200 feet from confluence with West Branch Mill River, Williamsburg]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
04/29/03	34-0137	15:22	0.7	11.4	7.0 c	57.3	36.7	10.4	97
06/03/03	34-0186	02:50	## i	11.4	6.7 c	61.3	39.2	10.3	97
08/05/03	34-0354	03:24	## i	19.7	7.0 c	67.2	43.0	8.5	94
08/06/03	34-0412	12:02	## i	19.3	7.2 c	59.9	38.4	8.8	97
09/09/03	34-0459	03:18	## i	14.5	## i	84.5	54.1	9.4	93
10/01/03	34-0524	12:47	## i	10.9	7.0	52.4	33.6	10.5 u	96 u

WEST BRANCH MILL RIVER (SARIS: 3419225)**Unique_ID: W1057 Station: WBMR01, Mile Point: 0.069**

Description: [Mill Street, Williamsburg]

Date	OWMID	Time (24hr)	Depth (m)	Temp (°C)	pH (SU)	Cond@ 25°C (uS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
04/29/03	34-0136	15:10	0.3	12.3	6.9 c	101	64.4	10.1 u	96 u
06/03/03	34-0185	02:38	## i	11.2	6.8 cu	102	65.5	10.5	98
08/05/03	34-0353	03:14	## i	19.1	7.2 c	104	66.8	8.7	96
08/06/03	34-0411	11:50	## i	19.8	7.4 c	95.2	60.9	8.8	97
09/09/03	34-0458	03:09	## i	14.6	## i	137	87.5	9.6 u	96 u
10/01/03	34-0523	12:37	## i	11.7	7.0	99.2	63.5	10.4 u	97 u

FORT RIVER (SARIS: 3419425)**Unique_ID: W1051 Station: 27B, Mile Point: 0.696**

Description: [Route 47, Hadley]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0144	12:42	0.9	14.5	6.9 c	124	79.1	9.8	98
06/03/03	34-0177	02:51	0.5	14.3	6.8	112	71.7	8.9 u	89 u
07/08/03	34-0242	04:10	0.9	22.7	7.1 u	162	105	7.5 i	87 i
08/05/03	34-0345	03:05	0.5	22.3	7.2 uc	170	111	7.5	86
08/06/03	34-0403	10:55	0.5 u	22.1	7.1 c	150	98.0	7.4	85
09/09/03	34-0450	03:15	0.9	17.0	7.2	156	102	8.8	91
10/01/03	34-0515	11:15	0.7	13.2	6.9 u	111	72.0	9.6	91

MILL RIVER (SARIS: 3419825)**Unique_ID: W1061 Station: 24B, Mile Point: 2.182**

Description: [Maple Street, Hatfield]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0135	14:29	0.7	14.6	7.1 c	181	116	9.8	98
06/03/03	34-0184	02:06	## i	15.2	6.9 cu	185	118	9.3 u	95 u
08/05/03	34-0352	02:41	## i	22.2	7.1 c	260	167	7.4	86
08/06/03	34-0410	11:11	0.2 i	22.8	7.0 c	225 u	144 u	7.5	89
09/09/03	34-0457	02:37	## i	18.4	## i	269	172	7.6 u	82 u
10/01/03	34-0522	11:54	0.6 i	13.3	6.8 c	136	87.1	9.3	90

BLOODY BROOK (SARIS: 3420150)**Unique_ID: W1063 Station: BB01, Mile Point: 1.651**

Description: [Whately Road, Deerfield]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0133	13:09	0.7	12.8 u	6.5	417 iu	267 iu	7.9	76
06/03/03	34-0182	00:51	0.4 i	14.1 u	6.1 c	693 u	444 u	6.9	69
08/05/03	34-0350	01:21	0.4 i	21.4 u	6.4	350	224	2.0	23
08/06/03	34-0408	09:33	0.2 i	21.7	6.4	240	153	3.9 u	45 u
09/09/03	34-0455	01:29	0.3 i	17.0	6.2 i	583 u	373 u	1.6 u	17 u
10/01/03	34-0520	10:16	## i	12.3	6.5 c	305 u	195 u	7.6	72

MILL RIVER (SARIS: 3420175)**Unique_ID: W1050 Station: 25C, Mile Point: 0.998**

Description: [Mill River Lane, Hadley]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0134	13:46	0.5	13.6	6.7	194	124	9.5	93
06/03/03	34-0183	01:33	## i	13.7	6.5 c	193	123	8.3	82
08/05/03	34-0351	02:03	## i	21.7	6.8	193 u	124 u	7.0	81
08/06/03	34-0409	10:28	0.6 i	21.4	6.7	208	133	6.2	71
09/09/03	34-0456	02:03	## i	17.6	6.6 i	189	121	8.0 u	85 u
10/01/03	34-0521	11:05	0.6 i	12.4	6.6 c	152 u	97.0 u	8.9 u	84 u

SAWMILL RIVER (SARIS: 3420550)**Unique_ID: W1048 Station: 26A, Mile Point: 2.516**

Description: [South Ferry Road, Montague]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25°C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
04/29/03	34-0131	11:33	0.3	12.0	6.7	76.0	48.6	10.6	100
06/03/03	34-0181	00:00	## i	13.2	6.5 c	70.7	45.3	10.0	97
08/05/03	34-0349	00:43	## i	20.4	6.9 uc	79.9	51.1	8.4	94
08/06/03	34-0407	08:43	0.1 i	20.1	6.7	61.3	39.2	8.7	97
09/09/03	34-0454	01:01	## i	16.0	6.8 i	99.9	63.9	9.2	94
10/01/03	34-0519	09:17	## i	11.7	6.6 c	63.3	40.5	10.4	96

Data Table 2: Connecticut River Watershed Survey 2003 Water Quality Data

(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 3.)

Connecticut, (2003) (QC Status: 4) Exported: 10/4/2005 3:16:02 PM

WESTFIELD RIVER (SARIS: 3208250)

Unique_ID: W0474 Station: CT02, Mile Point: 2.244

Description: [Route 147 bridge, Agawam/West Springfield.]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0148	--	08:35	--	--	0.46* mr	--	--	--	0.09 mrd	--	--	0.037 mr	<2.0* mr
06/04/03	34-0226	--	08:37	--	--	0.53*	--	--	--	0.14	--	--	0.035	3*
07/09/03	34-0285	--	13:50	--	--	0.45*	--	--	--	<0.02	--	--	0.031	<2*
08/06/03	34-0394	--	12:35	--	--	1.3*	--	--	--	<0.02	--	--	0.053	10*
09/10/03	34-0499	--	12:36	--	--	0.43* f	--	--	--	0.08	0.56	0.88 bh	0.056	<2*
10/01/03	34-0564	--	08:30	--	--	1.2*	--	--	--	<0.06	0.27 f	0.93 fh	0.038 h	9*

DEERFIELD RIVER (SARIS: 3312900)

Unique_ID: W0476 Station: CT04, Mile Point: 1.119

Description: [Route 5/10 bridge, Deerfield/Greenfield. Center of approximately 300 foot wide stream.]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0164	--	09:30	--	--	0.58*	--	--	--	<0.02	--	--	0.009	<2.0*
06/04/03	34-0229	--	09:15	--	--	0.37*	--	--	--	<0.02	--	--	0.015	<2*
07/09/03	34-0287	--	08:19	--	--	0.35*	--	--	--	0.06	--	--	0.015	<2*
08/06/03	34-0397	--	09:15	--	--	0.99*	--	--	--	<0.02	--	--	0.029	6*
09/10/03	34-0501	--	09:09	--	--	0.35* f	--	--	--	<0.02	0.25	0.55 bh	0.013	<2*
10/01/03	34-0567	--	09:45	--	--	1.0*	--	--	--	<0.02	0.18 f	0.71 fh	0.022 h	7*

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W0478 Station: CT06, Mile Point: 64.425

Description: [Route 10 bridge, Northfield.]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0159	--	08:00	2*	1*	1.4*	--	--	--	<0.06	--	--	0.021	5.2*
06/04/03	34-0202	--	08:05	20*	5*	0.40*	26	37	--	<0.02	--	--	0.016	2*
07/09/03	34-0314	--	08:20	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0260	--	08:15	30*	16*	0.46*	28	44	--	<0.02	--	--	0.011	<2*
08/06/03	34-0370	--	07:45	250*	30*	1.0*	25	33	1.0*	0.11	--	--	0.019	4*
09/10/03	34-0475	--	08:00	4*	2*	--	--	--	<1.0*	<0.02	0.17	0.42 bh	0.010	<2*
10/01/03	34-0540	--	08:20	500*	120*	--	--	--	--	<0.02	0.14 f	0.72 fh	0.025 h	6*

CONNECTICUT RIVER (SARIS: 3417100)**Unique_ID: W1044 Station: 02A, Mile Point: 58.772**

Description: [downstream of Fourmile Brook confluence, Northfield and east of Pisgah Mountain Road, Gill]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
07/09/03	34-0273	--	09:09j	24*	20*	--	--	--	--	--	--	--	--	--
07/09/03	34-0274	--	09:09j	40*	12*	--	--	--	--	--	--	--	--	--
07/09/03	34-0308	34-0309	09:09j	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0309	34-0308	09:09j	--	--	--	--	--	1.1*	--	--	--	--	--
07/09/03	34-0270	34-0271	09:09	30*	10*	0.50*	30	44	--	<0.06	--	--	0.011	<2*
07/09/03	34-0271	34-0270	09:09	30*	10*	0.56*	30	43	--	0.06	--	--	0.011	<2*
08/06/03	34-0383	--	07:52j	500*	160*	--	--	--	--	--	--	--	--	--
08/06/03	34-0384	--	07:52j	600*	70*	--	--	--	--	--	--	--	--	--
08/06/03	34-0380	34-0381	07:55	1900*	130*	1.3*	23 d	29	1.3*	<0.02	--	--	0.020	2*
08/06/03	34-0381	34-0380	07:55	1700*	100*	1.3*	12 d	29	1.1*	<0.02	--	--	0.019	2*
09/10/03	34-0488	--	08:12j	10*	8*	--	--	--	--	--	--	--	--	--
09/10/03	34-0489	--	08:12j	12*	10*	--	--	--	--	--	--	--	--	--
09/10/03	34-0485	34-0486	08:15	<2*	<2*	--	--	--	1.6*	<0.02	0.16	0.54 bh	0.008	<2*
09/10/03	34-0486	34-0485	08:15	12*	6*	--	--	--	1.7*	<0.02	0.16	0.51 bh	0.008	<2*

Note: The following bacteria samples (identified by the OWMID number) were collected from the left side of the river:

34-0273, 34-0383, 34-0488

The following bacteria samples (identified by the OWMID number) were collected from the right side of the river:

34-0274, 34-0384, 34-0489

The following bacteria samples (identified by the OWMID number) were collected from the center of the river:

34-0270, 34-0271, 34-0380, 34-0381, 34-0485, 34-0486

The purpose in collecting three samples along a transect was to determine if there was any variability in water quality conditions as a result of incomplete mixing below a discharge.

CONNECTICUT RIVER (SARIS: 3417100)**Unique_ID: W1045 Station: 04A, Mile Point: 40.229**

Description: [Route116, Deerfield/Sunderland]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0166	--	10:35	10*	2*	1.3*	--	--	--	<0.02	--	--	0.029	10.0*
06/04/03	34-0217	--	10:40	10*	4*	0.44*	23	34	--	<0.02	--	--	0.016	4*
07/09/03	34-0276	--	10:20j	20*	<2*	--	--	--	--	--	--	--	--	--
07/09/03	34-0277	--	10:20j	30*	8*	--	--	--	--	--	--	--	--	--
07/09/03	34-0311	--	10:20j	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0275	--	10:20	10*	<2*	0.30*	28	41	--	<0.02	--	--	0.012	<2*
08/06/03	34-0386	--	09:52j	400*	50*	--	--	--	--	--	--	--	--	--
08/06/03	34-0387	--	09:52j	450*	80*	--	--	--	--	--	--	--	--	--
08/06/03	34-0385	--	09:55	460*	60*	0.51*	23	31	<1.0*	<0.02	--	--	0.016	3*
09/10/03	34-0491	--	09:42j	20*	4*	--	--	--	--	--	--	--	--	--
09/10/03	34-0492	--	09:42j	30*	8*	--	--	--	--	--	--	--	--	--
09/10/03	34-0490	--	09:45	6*	4*	--	--	--	<1.0*	<0.02	0.19	0.50 bh	0.008	<2*

Note: The following bacteria samples (identified by the OWMID number) were collected from the left side of the river:

34-0276, 34-0386, 34-0491

The following bacteria samples (identified by the OWMID number) were collected from the right side of the river:

34-0277, 34-0387, 34-0491

The following bacteria samples (identified by the OWMID number) were collected from the center of the river:

34-0275, 34-0385, 34-0490

The purpose in collecting three samples along a transect was to determine if there was any variability in water quality conditions as a result of incomplete mixing below a discharge.

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1046 Station: 04C, Mile Point: 22.403

Description: [upstream of the confluence of the Mill River, near the Oxbow, Northampton/Hadley]

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
07/09/03	34-0279	--	11:21j	820*	50*	--	--	--	--	--	--	--	--	--
07/09/03	34-0280	--	11:21j	260*	50*	--	--	--	--	--	--	--	--	--
07/09/03	34-0312	--	11:21j	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0278	--	11:26	700*	22*	0.83*	27	39	--	<0.02	--	--	0.015	<2*
08/06/03	34-0389	--	10:41j	3100*	450*	--	--	--	--	--	--	--	--	--
08/06/03	34-0390	--	10:41j	1200*	250*	--	--	--	--	--	--	--	--	--
08/06/03	34-0388	--	10:45	2000*	410*	0.87*	25	31	1.3*	<0.02	--	--	0.026	3*
09/10/03	34-0494	--	10:37j	32*	2*	--	--	--	--	--	--	--	--	--
09/10/03	34-0495	--	10:37j	50*	18*	--	--	--	--	--	--	--	--	--
09/10/03	34-0493	--	10:40	30*	18*	--	--	--	1.1*	<0.02	0.20	0.59 bh	0.012	<2*

Note: The following bacteria samples (identified by the OWMID number) were collected from the left side of the river:

34-0279, 34-0389, 34-0494

The following bacteria samples (identified by the OWMID number) were collected from the right side of the river:

34-0280, 34-0390, 34-0495

The following bacteria samples (identified by the OWMID number) were collected from the center of the river:

34-0281, 34-0391, 34-0493

The purpose in collecting three samples along a transect was to determine if there was any variability in water quality conditions as a result of incomplete mixing below a discharge.

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1047 Station: 05A, Mile Point: 9.947

Description: [Route 90, West Springfield/Chicopee]

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
07/09/03	34-0282	--	12:26j	230*	12*	--	--	--	--	--	--	--	--	--
07/09/03	34-0283	--	12:26j	390*	22*	--	--	--	--	--	--	--	--	--
07/09/03	34-0313	--	12:26j	--	--	--	--	--	1.4*	--	--	--	--	--
07/09/03	34-0281	--	12:26	220*	12*	0.49*	27	40	--	<0.06	--	--	0.026	<2*
08/06/03	34-0392	--	11:38j	1800*	200*	--	--	--	--	--	--	--	--	--
08/06/03	34-0393	--	11:38j	10400*	330*	--	--	--	--	--	--	--	--	--
08/06/03	34-0391	--	11:40	2000*	150*	0.66*	27	35	1.0*	<0.02	--	--	0.027	2*
09/10/03	34-0497	--	11:42j	182*	114*	--	--	--	--	--	--	--	--	--
09/10/03	34-0498	--	11:42j	200*	86*	--	--	--	--	--	--	--	--	--
09/10/03	34-0496	--	11:42	96*	50*	--	--	--	1.7*	<0.06	0.21	0.55 bh	0.022	<2*

Note: The following bacteria samples (identified by the OWMID number) were collected from the left side of the river:

34-0282, 34-0392, 34-0497

The following bacteria samples (identified by the OWMID number) were collected from the right side of the river:

34-0283, 34-0393, 34-0498

The following bacteria samples (identified by the OWMID number) were collected from the center of the river:

34-0281, 34-0391, 34-0496

The purpose in collecting three samples along a transect was to determine if there was any variability in water quality conditions as a result of incomplete mixing below a discharge.

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1395 Station: CT00, Mile Point: -2.994

Description: [At the USGS flow gaging station #01184000 downstream of Route 190, Suffield/Enfield Connecticut (The point in Arcview is as close as the MA state quad image allows, actual point is further downstream.)]

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
04/30/03	34-0147	--	08:01	27*	1*	0.95*	--	--	--	<0.02 d	--	--	0.029	8.0*
06/04/03	34-0192	--	08:05	110*	28*	0.57*	22	35	--	0.08	--	--	0.039	4*
07/09/03	34-0319	34-0320	08:25j	--	--	--	--	--	** *	--	--	--	--	--
07/09/03	34-0320	34-0319	08:25j	--	--	--	--	--	** *	--	--	--	--	--
07/09/03	34-0250	--	08:20	14*	<10*	2.3*	27	43	--	<0.06 p	--	--	0.058 pd	<2*
08/06/03	34-0418	34-0419	08:00j	--	--	--	--	--	1.7*	--	--	--	--	--
08/06/03	34-0419	34-0418	08:00j	--	--	--	--	--	1.6*	--	--	--	--	--
09/10/03	34-0465	--	08:47	120*	66*	--	--	--	2.3*	<0.02	0.28	0.61 bh	0.036	<2*
10/01/03	34-0530	--	08:00	1100*	210*	1.3*	--	--	--	<0.06	0.24 f	0.96 fh	0.055	14*

STONY BROOK (SARIS: 3417925)

Unique_ID: W1053 Station: 19A, Mile Point: 2.277

Description: [College Street (Route 116) upstream of confluence of Leaping Well Brook, South Hadley]

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
04/30/03	34-0154	--	10:41	98*	75*	1.1*	--	--	--	<0.02 d	--	--	0.019	<2.0*
06/04/03	34-0197	--	10:27	256*	145*	2.2*	--	--	--	<0.02	--	--	0.053	3*
07/09/03	34-0255	--	10:35	2760*	600*	5.6*	--	--	--	<0.02	--	--	0.079 d	4*
08/06/03	34-0365	--	10:00	1200*	940*	5.8*	--	--	--	<0.06	--	--	0.071	6*
09/10/03	34-0470	--	10:33	560*	190*	--	--	--	** *	<0.06	--	--	0.045	2*
10/01/03	34-0535	--	10:30	800*	510*	2.1*	--	--	--	<0.02	--	--	0.056 h	3*

BACHELOR BROOK (SARIS: 3418000)

Unique_ID: W1052 Station: 07A, Mile Point: 0.916

Description: [Route 47 (Hadley Street), South Hadley]

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
04/30/03	34-0155	--	10:53	16*	1*	1.0*	--	--	--	<0.02 d	--	--	0.024	4.4*
06/04/03	34-0198	--	10:43	180*	100*	1.2*	--	--	--	<0.02	--	--	0.054	14*
07/09/03	34-0256	--	10:56	800*	200*	2.0*	--	--	--	0.07	--	--	0.062 d	5*
08/06/03	34-0366	--	10:26	1100*	580*	2.1*	--	--	1.3*	<0.02	--	--	0.047	8*

09/10/03	34-0471	--	10:52	220*	76*	--	--	--	<1.0*	<0.06	--	--	0.027	<2*
10/01/03	34-0536	--	10:50	200*	20*	1.1*	--	--	** *	<0.02	--	--	0.035 h	5*

WESTON BROOK (SARIS: 3418100)

Unique_ID: W1054 Station: 23A, Mile Point: 0.441

Description: [Rural Street, Belchertown]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0150	--	09:50	17*	<0.9*	0.79*	--	--	--	<0.02 d	--	--	0.056	3.6*
06/04/03	34-0193	--	09:38	78*	57*	0.91*	--	--	--	<0.06	--	--	0.098	3*
07/09/03	34-0251	--	09:26	370*	210*	2.5*	--	--	--	<0.02 p	--	--	0.16 pd	8*
08/06/03	34-0361	--	08:55	800*	420*	2.1*	--	--	--	<0.02	--	--	0.17	10*
09/10/03	34-0466	--	09:44	72*	70*	--	--	--	** *	<0.06	--	--	0.068	<2*
10/01/03	34-0531	--	09:35	150*	30*	0.87*	--	--	--	<0.02	--	--	0.078 h	<2*

LAMPSON BROOK (SARIS: 3418125)

Unique_ID: W1055 Station: 06A, Mile Point: 0.907

Description: [George Hannum Street, approximately 50 feet downstream of Belchertown WWTP (MA0102148) discharge, Belchertown]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0151	34-0152	10:06	15*	<0.9*	0.61*	--	--	--	## d	--	--	0.071	<2.0*
04/30/03	34-0152	34-0151	10:06	16*	<0.9*	0.63*	--	--	--	## d	--	--	0.074	2.4*
06/04/03	34-0194	34-0195	09:50	86*	44*	0.95*	--	--	--	0.10	--	--	0.10	2*
06/04/03	34-0195	34-0194	09:50	60*	37*	0.93*	--	--	--	0.09	--	--	0.11	2*
07/09/03	34-0252	34-0253	09:54	140*	90*	1.7*	--	--	--	<0.06	--	--	## d	5* d
07/09/03	34-0253	34-0252	09:54	350*	80*	1.7*	--	--	--	0.07	--	--	## d	10* d
08/06/03	34-0363	34-0364	09:22	330*	310*	2.2*	--	--	--	<0.06	--	--	0.12	6*
08/06/03	34-0364	34-0363	09:22	310*	150*	2.1*	--	--	--	<0.02	--	--	0.14	6*
09/10/03	34-0467	34-0468	10:00	500* d	32*	--	--	--	** *	0.12	--	--	0.37	12*
09/10/03	34-0468	34-0467	10:00	140* d	36*	--	--	--	** *	0.14	--	--	0.37	13*
10/01/03	34-0532	34-0533	09:55	100*	50*	2.2*	--	--	--	<0.02	--	--	0.12 h	6*
10/01/03	34-0533	34-0532	09:55	60*	60*	2.2*	--	--	--	<0.06	--	--	0.12 h	6*

MANHAN RIVER (SARIS: 3418175)

Unique_ID: W1064 Station: 11A, Mile Point: 5.633

Description: [Loudville Road, Easthampton]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0157	--	12:22	20*	<0.9*	0.95*	--	--	--	<0.02 d	--	--	0.018	4.4*
06/04/03	34-0201	--	12:09	180*	167*	1.0*	--	--	--	<0.02	--	--	0.031	5*
07/09/03	34-0259	--	13:05	1820*	1120*	1.2*	--	--	--	<0.02	--	--	0.035 d	3*
08/06/03	34-0369	--	12:05	2500*	780*	2.7*	--	--	2.1*	<0.06	--	--	0.061	11*
09/10/03	34-0474	--	12:35	70*	46*	--	--	--	<1.0*	<0.06	--	--	0.019	<2*
10/01/03	34-0539	--	12:10	400*	160*	1.7*	--	--	--	<0.06	--	--	0.043 h	16*

MANHAN RIVER (SARIS: 3418175)**Unique_ID: W1065 Station: 11C, Mile Point: 0.842**

Description: [Fort Hill Road, Easthampton]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0158	--	11:59	58*	5*	1.3*	--	--	--	0.06 d	--	--	0.029	3.6*
06/04/03	34-0200	--	11:46	170*	168*	1.4*	--	--	--	0.08	--	--	0.043	8*
07/09/03	34-0258	--	12:35	590*	260*	1.5*	--	--	--	0.07	--	--	0.066 d	6*
08/06/03	34-0368	--	11:35	3700*	720*	4.5*	--	--	5.1*	<0.06	--	--	0.099	31*
09/10/03	34-0473	--	11:53	260*	210*	--	--	--	1.8*	0.08	--	--	0.027	2*
10/01/03	34-0538	--	11:50	600*	460*	3.2*	--	--	--	0.08	--	--	0.067 h	20*

MILL RIVER (SARIS: 3418825)**Unique_ID: W1059 Station: 28B, Mile Point: 0.611**

Description: [approximately 1 mile downstream of Clement Street (location of USGS gage 01171500 prior to October 2002), Northampton]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0171	--	12:40	18*	3*	0.46*	--	--	--	<0.02	--	--	0.011	<2.0*
06/04/03	34-0211	--	13:03	190*	93*	0.54*	--	--	--	<0.06	--	--	0.021	2*
07/09/03	34-0269	--	12:45	830*	610*	0.56*	--	--	--	<0.02	--	--	0.024	<2*
08/06/03	34-0379	--	12:50	6200*	1180*	1.9*	--	--	--	<0.02	--	--	0.045	13*
09/10/03	34-0484	--	12:01	260*	184*	--	--	--	--	<0.02	0.46	0.80 bh	0.013	<2*
10/01/03	34-0549	--	13:25	230*	150*	--	--	--	--	<0.02	0.33 f	0.93 fh	0.021 h	<2*

EAST BRANCH MILL RIVER (SARIS: 3419150)**Unique_ID: W1056 Station: EBMR01, Mile Point: 0.038**

Description: [south of East Main Street approximately 200 feet from confluence with West Branch Mill River, Williamsburg]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0170	--	11:55	4*	<0.9*	0.31*	--	--	--	<0.02	--	--	<0.005	<2.0*
06/04/03	34-0210	--	12:30	50*	20*	0.33*	--	--	--	<0.06	--	--	0.012	<2*
07/09/03	34-0268	--	12:05	1880*	1370*	0.30*	--	--	--	<0.02	--	--	0.011	<2*
08/06/03	34-0378	--	12:03	1600*	210*	0.68*	--	--	--	<0.02	--	--	0.024	4*
09/10/03	34-0483	--	11:10	30*	22*	--	--	--	--	<0.02	--	--	<0.005	<2*
10/01/03	34-0548	--	12:35	100*	50*	--	--	--	--	<0.02	--	--	0.009 h	<2*

WEST BRANCH MILL RIVER (SARIS: 3419225)**Unique_ID: W1057 Station: WBMR01, Mile Point: 0.069**

Description: [Mill Street, Williamsburg]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0169	--	11:50	4*	1*	0.23*	--	--	--	<0.02	--	--	0.009	<2.0*
06/04/03	34-0209	--	12:25	58*	49*	0.23*	--	--	--	0.14	--	--	0.007	<2*
07/09/03	34-0267	--	12:00	2280*	1250*	1.0*	--	--	--	<0.02	--	--	0.018	2*
08/06/03	34-0377	--	11:50	1000*	390*	0.77*	--	--	--	<0.02	--	--	0.025	6*
09/10/03	34-0482	--	11:05	72*	72*	--	--	--	--	<0.02	--	--	<0.005	<2*
10/01/03	34-0547	--	12:40	170*	100*	--	--	--	--	<0.02	--	--	0.013 h	<2*

FORT RIVER (SARIS: 3419425)**Unique_ID: W1051 Station: 27B, Mile Point: 0.696**

Description: [Route 47, Hadley]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0156	--	11:17	80*	16*	2.6*	--	--	--	<0.02 d	--	--	0.029	8.0*
06/04/03	34-0199	--	11:05	284*	247*	2.5*	--	--	--	0.09	--	--	0.046	8*
07/09/03	34-0257	--	11:24	690*	300*	4.4*	--	--	--	<0.06	--	--	0.058 d	6*
08/06/03	34-0367	--	10:54	12500*	3000*	8.9*	--	--	3.1*	0.08	--	--	0.16	46*
09/10/03	34-0472	--	11:13	672*	234*	--	--	--	<1.0*	<0.06	--	--	0.030	4*
10/01/03	34-0537	--	11:15	800*	320*	4.5*	--	--	--	0.35	--	--	0.10 h	22*

MILL RIVER (SARIS: 3419825)**Unique_ID: W1061 Station: 24B, Mile Point: 2.182**

Description: [Maple Street, Hatfield]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0168	--	11:25	15*	<0.9*	0.93*	--	--	--	<0.02	--	--	0.019	<2.0*
06/04/03	34-0208	--	11:33	100*	62*	1.3*	--	--	--	<0.02	--	--	0.036	2*
07/09/03	34-0318	--	11:20j	--	--	--	--	--	1.3*	--	--	--	--	--
07/09/03	34-0266	--	11:15	108* e	200* e	2.5*	--	--	--	<0.06	--	--	0.032	<2*
08/06/03	34-0376	--	11:04	2500*	190*	2.0*	--	--	--	0.11	--	--	0.057	6*
09/10/03	34-0481	--	10:30	272*	208*	--	--	--	--	0.08	--	--	0.027	3*
10/01/03	34-0546	--	11:50	140*	140*	--	--	--	--	0.11	--	--	0.042 h	3*

BLOODY BROOK (SARIS: 3420150)**Unique_ID: W1063 Station: BB01, Mile Point: 1.651**

Description: [Whately Road, Deerfield]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0165	--	09:54	50*	36*	1.3*	--	--	--	0.34	--	--	0.058	<2.0*
06/04/03	34-0206	--	10:10	380*	354*	7.4*	--	--	--	0.33	--	--	0.12	9*
07/09/03	34-0264	--	09:40	2680*	140*	11*	--	--	--	0.21	--	--	0.11	9*
08/06/03	34-0374	34-0420	09:44	11500*	2280*	4.9*	--	--	3.2* d	0.11	--	--	0.16	5*
08/06/03	34-0420	34-0374	09:44	--	--	--	--	--	5.7* d	--	--	--	--	--
09/10/03	34-0479	--	09:25	680*	408*	--	--	--	3.4*	0.20	--	--	0.089	12*
10/01/03	34-0544	--	10:10	900*	150*	--	--	--	--	0.10	--	--	0.065 h	2*

MILL RIVER (SARIS: 3420175)**Unique_ID: W1050 Station: 25C, Mile Point: 0.998**

Description: [Mill River Lane, Hadley]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0167	--	10:54	32*	4*	1.0*	--	--	--	<0.02	--	--	0.025	2.4*
06/04/03	34-0207	--	11:00	198*	185*	1.0*	--	--	--	<0.02	--	--	0.033	3*
07/09/03	34-0315	34-0316	10:35j	--	--	--	--	--	1.5*	--	--	--	--	--
07/09/03	34-0316	34-0315	10:35j	--	--	--	--	--	1.3*	--	--	--	--	--
07/09/03	34-0265	--	10:35	690*	380*	2.2*	--	--	--	<0.06	--	--	0.034	2*
08/06/03	34-0375	--	10:16	10600*	1950*	4.2*	--	--	--	<0.02	--	--	0.10	18*
09/10/03	34-0480	--	09:55	250*	136*	--	--	--	--	<0.02	--	--	0.026	<2*
10/01/03	34-0545	--	11:00	300*	140*	--	--	--	--	<0.06	--	--	0.038 h	5*

SAWMILL RIVER (SARIS: 3420550)**Unique_ID: W1048 Station: 26A, Mile Point: 2.516**

Description: [South Ferry Road, Montague]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0162	34-0161	08:58j	30*	1*	0.30*	--	--	--	<0.02	--	--	0.010	2.0*
04/30/03	34-0161	34-0162	08:58	32*	2*	0.29*	--	--	--	<0.02	--	--	0.010	<2.0*
06/04/03	34-0203	34-0204	09:40	160*	107*	0.32*	--	--	--	<0.02	--	--	0.012	<2*
06/04/03	34-0204	34-0203	09:40	170*	105*	0.31*	--	--	--	<0.02	--	--	0.014 h	2*
07/09/03	34-0261	34-0262	09:05	1050*	408* d	1.2*	--	--	--	<0.02	--	--	0.016	6*
07/09/03	34-0262	34-0261	09:05	1250*	1240* d	0.48*	--	--	--	<0.02	--	--	0.018	4*
08/06/03	34-0371	34-0372	08:35	2200*	680*	1.2*	--	--	--	0.06	--	--	0.038	14*
08/06/03	34-0372	34-0371	08:35	2200*	610*	1.2*	--	--	--	<0.06	--	--	0.035	14*
09/10/03	34-0476	34-0477	09:00	60*	14*	--	--	--	--	<0.02	--	--	0.007	<2*
09/10/03	34-0477	34-0476	09:00	44*	28*	--	--	--	--	<0.02	--	--	0.008	<2*
10/01/03	34-0541	34-0542	09:15	30* m	20* m	--	--	--	--	<0.02	--	--	0.015 h	<2*
10/01/03	34-0542	34-0541	09:15	60* m	40* m	--	--	--	--	<0.02	--	--	0.015 h	<2*

MILLERS RIVER (SARIS: 3522150)**Unique_ID: W0477 Station: CT05, Mile Point: 1.811**

Description: [Route 63 bridge, Erving/Montague.]

Date	OWMID	QAQC	Time	Fecal	E.coli	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0160	--	08:40	--	--	0.73*	--	--	--	<0.02	--	--	0.026	<2.0*
06/04/03	34-0228	--	08:45	--	--	0.84*	--	--	--	<0.02	--	--	0.044	4*
07/09/03	34-0286	--	07:40	--	--	1.2*	--	--	--	<0.02	--	--	0.048	<2*
08/06/03	34-0396	--	07:22	--	--	1.5*	--	--	--	<0.02	--	--	0.062	8*
09/10/03	34-0502	--	07:40	--	--	1.1* f	--	--	--	<0.02	0.42	0.96 bh	0.037	<2*
10/01/03	34-0566	--	08:50	--	--	1.5*	--	--	--	<0.02	0.23 f	1.0 fh	0.049 h	3*

CHICOPEE RIVER (SARIS: 3625000)

Unique_ID: W0475 Station: CT03, Mile Point: 0.839

Description: [Route 116 bridge, Chicopee.]

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
04/30/03	34-0149	--	09:18	--	--	0.98*	--	--	--	<0.02 d	--	--	0.024	3.2*
06/04/03	34-0227	--	08:59	--	--	1.1*	--	--	--	<0.06	--	--	0.048	3*
07/09/03	34-0284	--	12:54	--	--	2.0*	--	--	--	<0.02	--	--	0.051	2*
08/06/03	34-0395	--	12:08	--	--	2.5*	--	--	--	<0.02	--	--	0.065	10*
09/10/03	34-0500	--	12:13	--	--	0.99* f	--	--	--	<0.02	0.36	0.76 bh	0.027	<2*
10/01/03	34-0565	--	09:00	--	--	1.5*	--	--	--	<0.06	0.32 f	1.0 fh	0.041 h	<2*

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Appendix 1: Connecticut River Watershed Survey 2003 Blank QC Sample Results

(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4)

Connecticut, (2003) (QC Status: 4) Exported: 10/11/2005 2:02:44 PM

Date	OWMID	QAQC	Time (24hr)	Fecal CFU/100mL	E.coli CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
04/30/03	34-0153	Blank	10:06j	<0.9*	<0.9*	<0.10*	--	--	--	<0.02 d	--	--	<0.005	<2.0*
04/30/03	34-0163	Blank	08:58j	<0.9*	<0.9*	<0.10*	--	--	--	<0.02	--	--	<0.005	<2.0*
06/04/03	34-0196	Blank	09:50j	<2*	<0.9*	<0.10*	--	--	--	<0.02	--	--	<0.005	<2*
06/04/03	34-0205	Blank	09:40j	<2*	<0.9*	<0.10*	--	--	--	<0.02	--	--	<0.005	<2*
07/09/03	34-0254	Blank	09:54j	<2*	<2*	<0.10*	--	--	--	<0.02	--	--	<0.005 d	<2*
07/09/03	34-0263	Blank	09:10j	<2*	<2*	<0.10*	--	--	--	<0.02	--	--	<0.005	<2*
07/09/03	34-0272	Blank	09:09j	<2*	<2*	0.15* b	<2	<0.66	--	<0.06	--	--	<0.005	<2*
07/09/03	34-0310	Blank	09:09j	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0317	Blank	10:35j	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0321	Blank	08:25j	--	--	--	--	--	** *	--	--	--	--	--
08/06/03	34-0373	Blank	08:20j	<10*	<10*	<0.10*	--	--	--	<0.02	--	--	<0.005	<2*
08/06/03	34-0382	Blank	07:52j	<10*	<10*	<0.10*	<2	<0.66	<1.0*	<0.02	--	--	<0.005	<2*
08/06/03	34-0421	Blank	09:30j	--	--	--	--	--	<1.0*	--	--	--	--	--
08/06/03	34-0360	Blank	08:00	[2200*] b	[700*] b	1.7* b	[28] b	[38] b	<1.0*	<0.06	--	--	0.052 b	3* b
08/06/03	34-0362	Blank	09:22	<10*	<10*	<0.10*	--	--	--	<0.02	--	--	<0.005	<2*
09/10/03	34-0469	Blank	10:00j	<2*	<2*	--	--	--	** *	<0.02	--	--	<0.005	<2*
09/10/03	34-0478	Blank	09:00j	<2*	<2*	--	--	--	--	<0.02	--	--	<0.005	<2*
09/10/03	34-0487	Blank	08:12j	<2*	<2*	--	--	--	<1.0*	<0.02	<0.02	0.15 bh	<0.005	<2*
10/01/03	34-0534	Blank	09:55j	<10*	<10*	<0.10*	--	--	--	<0.02	--	--	<0.005 h	<2*
10/01/03	34-0543	Blank	09:15j	<10*	<10*	--	--	--	--	<0.02	--	--	<0.005 h	<2*

Appendix 2: Connecticut River Watershed Survey 2002 Relative Percent Difference Results

(Note: Symbols and Qualifiers Used for DWM Data can be found in Appendix 4)

Connecticut, (2003) (QC Status: 4) Exported: 10/12/2005 3:04:34 PM

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1044 Station: 02A, Mile Point: 58.772

Description: [downstream of Fourmile Brook confluence, Northfield and east of Pisgah Mountain Road, Gill]

Date	OWMID	QAQC	Time (24hr)	Log10(Fecal) CFU/100mL	Log10(E.coli) CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
07/09/03	34-0308	34-0309	09:09j	--	--	--	--	--	<1.0*	--	--	--	--	--
07/09/03	34-0309	34-0308	09:09j	--	--	--	--	--	1.1*	--	--	--	--	--
07/09/03	34-0270	34-0271	09:09	1.477*	1.000*	0.50*	30	44	--	<0.06	--	--	0.011	<2*
07/09/03	34-0271	34-0270	09:09	1.477*	1.000*	0.56*	30	43	--	0.06	--	--	0.011	<2*
Relative	Percent	Difference		0.0%	0.0%	11.3%	0.0%	2.3%	9.5%	0.0%	--	--	0.0%	0.0%
08/06/03	34-0380	34-0381	07:55	3.279*	2.114*	1.3*	23 d	29	1.3*	<0.02	--	--	0.020	2*
08/06/03	34-0381	34-0380	07:55	3.230*	2.000*	1.3*	12 d	29	1.1*	<0.02	--	--	0.019	2*
Relative	Percent	Difference		1.5%	5.5%	0.0%	62.9%	0.0%	16.7%	0.0%	--	--	5.1%	0.0%
09/10/03	34-0485	34-0486	08:15	0.301*	0.301*	--	--	--	1.6*	<0.02	0.16	0.54 bh	0.008	<2*
09/10/03	34-0486	34-0485	08:15	1.079*	0.778*	--	--	--	1.7*	<0.02	0.16	0.51 bh	0.008	<2*
Relative	Percent	Difference		112.8%	88.4%	--	--	--	6.1%	0.0%	0.0%	5.7%	0.0%	0.0%

CONNECTICUT RIVER (SARIS: 3417100)

Unique_ID: W1395 Station: CT00, Mile Point: -2.994

Description: [At the USGS flow gaging station #01184000 downstream of Route 190, Suffield/Enfield Connecticut (The point in Arcview is as close as the MA state quad image allows, actual point is further downstream.)]

Date	OWMID	QAQC	Time (24hr)	Log10(Fecal) CFU/100mL	Log10(E.coli) CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
07/09/03	34-0319	34-0320	08:25j	--	--	--	--	--	** *	--	--	--	--	--
07/09/03	34-0320	34-0319	08:25j	--	--	--	--	--	** *	--	--	--	--	--
Relative	Percent	Difference		--	--	--	--	--	--	--	--	--	--	--
08/06/03	34-0418	34-0419	08:00j	--	--	--	--	--	1.7*	--	--	--	--	--
08/06/03	34-0419	34-0418	08:00j	--	--	--	--	--	1.6*	--	--	--	--	--
Relative	Percent	Difference		--	--	--	--	--	6.1%	--	--	--	--	--

LAMPSON BROOK (SARIS: 3418125)**Unique_ID: W1055 Station: 06A, Mile Point: 0.907**

Description: [George Hannum Street, approximately 50 feet downstream of Belchertown WWTP (MA0102148) discharge, Belchertown]

Date	OWMID	QAQC	Time	Log10(Fecal)	Log10(E.coli)	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
04/30/03	34-0151	34-0152	10:06	1.176*	-0.046*	0.61*	--	--	--	## d	--	--	0.071	<2.0*
04/30/03	34-0152	34-0151	10:06	1.204*	-0.046*	0.63*	--	--	--	## d	--	--	0.074	2.4*
Relative	Percent	Difference		2.4%	0.0%	3.2%	--	--	--	--	--	--	4.1%	18.2%
06/04/03	34-0194	34-0195	09:50	1.934*	1.643*	0.95*	--	--	--	0.10	--	--	0.10	2*
06/04/03	34-0195	34-0194	09:50	1.778*	1.568*	0.93*	--	--	--	0.09	--	--	0.11	2*
Relative	Percent	Difference		8.4%	4.7%	2.1%	--	--	--	10.5%	--	--	9.5%	0.0%
07/09/03	34-0252	34-0253	09:54	2.146*	1.954*	1.7*	--	--	--	<0.06	--	--	## d	5* d
07/09/03	34-0253	34-0252	09:54	2.544*	1.903*	1.7*	--	--	--	0.07	--	--	## d	10* d
Relative	Percent	Difference		17.0%	2.7%	0.0%	--	--	--	15.4%	--	--	--	66.7%
08/06/03	34-0363	34-0364	09:22j	2.519*	2.491*	2.2*	--	--	--	<0.06	--	--	0.12	6*
08/06/03	34-0364	34-0363	09:22j	2.491*	2.176*	2.1*	--	--	--	<0.02	--	--	0.14	6*
Relative	Percent	Difference		1.1%	13.5%	4.7%	--	--	--	100.0%	--	--	15.4%	0.0%
09/10/03	34-0467	34-0468	10:00	2.699* d	1.505*	--	--	--	** *	0.12	--	--	0.37	12*
09/10/03	34-0468	34-0467	10:00	2.146* d	1.556*	--	--	--	** *	0.14	--	--	0.37	13*
Relative	Percent	Difference		22.8%	3.3%	--	--	--	--	15.4%	--	--	0.0%	8.0%
10/01/03	34-0532	34-0533	09:55	2.000*	1.699*	2.2*	--	--	--	<0.02	--	--	0.12 h	6*
10/01/03	34-0533	34-0532	09:55	1.778*	1.778*	2.2*	--	--	--	<0.06	--	--	0.12 h	6*
Relative	Percent	Difference		11.7%	4.6%	0.0%	--	--	--	100.0%	--	--	0.0%	0.0%

BLOODY BROOK (SARIS: 3420150)**Unique_ID: W1063 Station: BB01, Mile Point: 1.651**

Description: [Whately Road, Deerfield]

Date	OWMID	QAQC	Time	Log10(Fecal)	Log10(E.coli)	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
08/06/03	34-0374	34-0420	09:44	4.061*	3.358*	4.9*	--	--	3.2* d	0.11	--	--	0.16	5*
08/06/03	34-0420	34-0374	09:44	--	--	--	--	--	5.7* d	--	--	--	--	--
Relative	Percent	Difference		--	--	--	--	--	56.2%	--	--	--	--	--

MILL RIVER (SARIS: 3420175)**Unique_ID: W1050 Station: 25C, Mile Point: 0.998**

Description: [Mill River Lane, Hadley]

Date	OWMID	QAQC	Time	Log10(Fecal)	Log10(E.coli)	Turb	Alk	Hard	Chl-a	NH3-N	NO3-NO2-N	TN	TP	TSS
			(24hr)	CFU/100mL	CFU/100mL	NTU	mg/L	mg/L	mg/m3	mg/L	mg/L	mg/L	mg/L	mg/L
07/09/03	34-0315	34-0316	10:35j	--	--	--	--	--	1.5*	--	--	--	--	--
07/09/03	34-0316	34-0315	10:35j	--	--	--	--	--	1.3*	--	--	--	--	--
Relative	Percent	Difference		--	--	--	--	--	14.3%	--	--	--	--	--

SAWMILL RIVER (SARIS: 3420550)
Unique_ID: W1048 Station: 26A, Mile Point: 2.516
Description: [South Ferry Road, Montague]

Date	OWMID	QAQC	Time (24hr)	Log10(Fecal) CFU/100mL	Log10(E.coli) CFU/100mL	Turb NTU	Alk mg/L	Hard mg/L	Chl-a mg/m3	NH3-N mg/L	NO3-NO2-N mg/L	TN mg/L	TP mg/L	TSS mg/L
04/30/03	34-0162	34-0161	08:58j	1.477*	0.000*	0.30*	--	--	--	<0.02	--	--	0.010	2.0*
04/30/03	34-0161	34-0162	08:58	1.505*	0.301*	0.29*	--	--	--	<0.02	--	--	0.010	<2.0*
Relative	Percent	Difference		1.9%	200.0%	3.4%	--	--	--	0.0%	--	--	0.0%	0.0%
06/04/03	34-0203	34-0204	09:40	2.204*	2.029*	0.32*	--	--	--	<0.02	--	--	0.012	<2*
06/04/03	34-0204	34-0203	09:40	2.230*	2.021*	0.31*	--	--	--	<0.02	--	--	0.014 h	2*
Relative	Percent	Difference		1.2%	0.4%	3.2%	--	--	--	0.0%	--	--	15.4%	0.0%
07/09/03	34-0261	34-0262	09:05	3.021*	2.611* d	1.2*	--	--	--	<0.02	--	--	0.016	6*
07/09/03	34-0262	34-0261	09:05	3.097*	3.093* d	0.48*	--	--	--	<0.02	--	--	0.018	4*
Relative	Percent	Difference		2.5%	16.9%	85.7%	--	--	--	0.0%	--	--	11.8%	40.0%
08/06/03	34-0371	34-0372	08:35	3.342*	2.833*	1.2*	--	--	--	0.06	--	--	0.038	14*
08/06/03	34-0372	34-0371	08:35	3.342*	2.785*	1.2*	--	--	--	<0.06	--	--	0.035	14*
Relative	Percent	Difference		0.0%	1.7%	0.0%	--	--	--	0.0%	--	--	8.2%	0.0%
09/10/03	34-0476	34-0477	09:00	1.778*	1.146*	--	--	--	--	<0.02	--	--	0.007	<2*
09/10/03	34-0477	34-0476	09:00	1.643*	1.447*	--	--	--	--	<0.02	--	--	0.008	<2*
Relative	Percent	Difference		7.9%	23.2%	--	--	--	--	0.0%	--	--	13.3%	0.0%
10/01/03	34-0541	34-0542	09:15	1.477* m	1.301* m	--	--	--	--	<0.02	--	--	0.015 h	<2*
10/01/03	34-0542	34-0541	09:15	1.778* m	1.602* m	--	--	--	--	<0.02	--	--	0.015 h	<2*
Relative	Percent	Difference		18.5%	20.7%	--	--	--	--	0.0%	--	--	0.0%	0.0%

Appendix 3: Symbols and Qualifiers Used for DWM Data

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and multi-probe data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data.

General Symbols (applicable to all types):

“ ## ” = Censored data (i.e., data that has been discarded for some reason). NOTE: Prior to 2001 data, “**” denoted either censored or missing data.

“ ** ” = Missing data (i.e., data that should have been reported). See NOTE above.

“ -- ” = No data (i.e., data not taken/not required)

* = Analysis performed by Laboratory OTHER than DEP’s Wall Experiment Station (WES)

[] = A result reported inside brackets has been “censored”, but is shown for informational purposes (e.g., high blank results).

Multi-probe-specific Qualifiers:

“ i ” = inaccurate readings from multi-probe likely; may be due to significant pre-survey calibration problems, post-survey checks outside typical acceptance ranges for the low ionic and deionized water checks, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses. Where documentation on unit pre-calibration is lacking, but SOPs at the time of sampling dictated pre-calibration prior to use, then data are considered potentially inaccurate.

Qualification Criteria for Depth (i):

General Depth Criteria: Apply to each OWMID#

- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

Specific Depth Criteria: Apply to entirety of depth data for survey date

- If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, i.e. that all positive readings may be in error.)

“ m ” = method not followed; one or more protocols contained in the DWM multi-probe SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

“ s ” = field sheet recorded data were used to accept data (i.e., not data electronically recorded in a data logger or in cases where data logging is not possible (e.g., single-probes)).

“ u ” = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

“ c ” = unit not calibrated for a particular parameter and/or greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified (“c”) conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

“ r ” = data not representative of actual field conditions.

“ ? ” = Light interference on Turbidity sensor (Multi-probe error message). Data is typically censored.

Sample-Specific Qualifiers:

“ a ” = accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

“ b ” = blank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).

“ d ” = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

“ e ” = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

“ f ” = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

“ h ” = holding time violation (usually indicating possible bias low)

“ j ” = ‘estimated’ value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the ‘reporting’ limit or RDL and greater than the method detection limit or MDL ($mdl < x < rdl$). Also used to note where values have been reported at levels less than the mdl.

“ m ” = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (eg. sediment in sample, floc formation), lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

“ p ” = samples not preserved per SOP or analytical method requirements.

“r” = samples collected may not be representative of actual field conditions, including the possibility of “outlier” data and flow-limited conditions (e.g., pooled).

APPENDIX A

ASSESSMENT METHODOLOGY GUIDELINES FOR EVALUATING DESIGNATED USE STATUS OF MASSACHUSETTS SURFACE WATERS - 2007

The Clean Water Act (CWA) Section 305(b) water quality reporting process is an essential aspect of the Nation's water pollution control effort. It is the principal means by which EPA, Congress, and the public evaluate existing water quality, assess progress made in maintaining and restoring water quality, and determine the extent of remaining problems. By this process, states report on waterbodies within the context of meeting their designated uses. These uses include: *Aquatic Life, Fish Consumption, Drinking Water, Primary Contact Recreation, Secondary Contact Recreation, Shellfish Harvesting and Aesthetics*. Two subclasses of Aquatic Life are also designated in the Massachusetts Surface Water Quality Standards (SWQS): Cold Water Fishery – waters capable of sustaining a year-round population of cold water aquatic life, such as trout – and Warm Water Fishery – waters that are not capable of sustaining a year-round population of cold water aquatic life (MassDEP 2006).

The SWQS, summarized in Table A1, prescribe minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be applied (MassDEP 2006). In rivers the lowest flow conditions at and above which aquatic life criteria must be applied are the lowest mean flow for seven consecutive days to be expected once in ten years (7Q10). In waters where flows are regulated by dams or similar structures, the lowest flow conditions at which aquatic life criteria must be applied are the flows equal to or exceeded 99% of the time on a yearly basis or another equivalent flow that has been agreed upon (see Mass DEP 2006 for more detail). In coastal and marine waters and for lakes, the Massachusetts Department of Environmental Protection (MassDEP) will determine on a case-by-case basis the most severe hydrological condition for which the aquatic life criteria must be applied.

The availability of appropriate and reliable scientific data and technical information is fundamental to the 305(b) reporting process. It is EPA policy (EPA Order 5360.1 CHG 1) that any individual or group performing work for or on behalf of EPA establish a quality system to support the development, review, approval, implementation, and assessment of data collection operations. To this end MassDEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by the MassDEP are of known and documented quality and are suitable for their intended use. For external sources of information, MassDEP requires the following: 1) an appropriate Quality Assurance Project Plan (QAPP) including a laboratory Quality Assurance /Quality Control (QA/QC) plan; 2) use of a state certified lab (or as otherwise approved by DEP for a particular analysis); and 3) sample data, QA/QC and other pertinent sample handling information documented in a citable report. This information will be reviewed by MassDEP to determine its validity and usability to assess water use support. Data use could be modified or rejected due to poor or undocumented QAPP implementation, lack of project documentation, incomplete reporting of data or information, and/or project monitoring objectives unsuitable for MassDEP assessment purposes.

EPA provides guidelines to states for making their use support determinations (EPA 1997 and 2002, Grubbs and Wayland III 2000 and Wayland III 2001). The determination of whether or not a waterbody supports each of its designated uses is a function of the type(s), quality and quantity of available current information. Although data/information older than five years are usually considered “historical” and used for descriptive purposes they can be utilized in the use support determination provided they are known to reflect the current conditions. While the water quality standards (Table A1) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance from available literature may be applied in lieu of actual numerical criteria (e.g., freshwater sediment data may be compared to *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* 1993 by D. Persaud, R. Jaagumagi and A. Hayton). Excursions from criteria due solely to “naturally occurring” conditions (e.g., low pH in some areas) do not constitute violations of the SWQS.

Each designated use within a given segment is individually assessed as **support** or **impaired**. When too little current data/information exist or no reliable data are available, the use is **not assessed**. In this report, however, if there is some indication that water quality impairment may exist, and it 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 ponds, rivers, and estuaries have **never been assessed**; the status of their designated uses has never been reported to EPA in the Commonwealth's 305(b) Report or the Integrated List of Waters nor is information on these waters maintained in the waterbody system database (WBS) or the new assessment database (ADB).

Table A1. Summary of Massachusetts Surface Water Quality Standards (MassDEP 2006, MA DPH 2002, FDA 2003).

Dissolved Oxygen	<u>Class A and Class B Cold Water Fishery (BCWF) and Class SA:</u> ≥ 6.0 mg/L <u>Class A and Class B Warm Water Fishery (BWFF) and Class SB:</u> ≥ 5.0 mg/L <u>Class C:</u> Not < 5.0 mg/L at least 16 hours of any 24-hour period and not < 3.0 mg/L at any time. <u>Class SC:</u> Not < 5.0 mg/L at least 16 hours of any 24-hour period and not < 4.0 mg/L anytime. For all classes, where natural background conditions are lower than the criteria stated for each class, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall also be maintained.
Temperature	<u>Class A CWF:</u> $\leq 68^{\circ}\text{F}$ (20°C) based on the mean of the daily maximum temperature over a seven day period in cold water fisheries, unless naturally occurring and ΔT due to a discharge $\leq 1.5^{\circ}\text{F}$ (0.8°C). <u>Class A WWF:</u> $\leq 83^{\circ}\text{F}$ (28.3°C) and ΔT due to a discharge $\leq 1.5^{\circ}\text{F}$ (0.8°C). <u>Class BCWF:</u> $\leq 68^{\circ}\text{F}$ (20°C) based on the mean of the daily maximum temperature over a seven day period in all cold water fisheries, unless naturally occurring, and ΔT due to a discharge $\leq 3^{\circ}\text{F}$ (1.7°C) <u>Class BWFF:</u> $\leq 83^{\circ}\text{F}$ (28.3°C) and ΔT due to a discharge $\leq 5^{\circ}\text{F}$ (2.8°C) in rivers (based on the minimum expected flow for the month) and ΔT due to a discharge $\leq 3^{\circ}\text{F}$ (1.7°C) in the epilimnion (based on the monthly average of maximum daily temperatures) in lakes, <u>Class C and Class SC:</u> $\leq 85^{\circ}\text{F}$ (29.4°C) and ΔT due to a discharge $\leq 5^{\circ}\text{F}$ (2.8°C) <u>Class SA:</u> $\leq 85^{\circ}\text{F}$ (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and ΔT due to a discharge $\leq 1.5^{\circ}\text{F}$ (0.8°C) <u>Class SB:</u> $\leq 85^{\circ}\text{F}$ (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and ΔT due to a discharge $\leq 1.5^{\circ}\text{F}$ (0.8°C) between July and September and $\leq 4.0^{\circ}\text{F}$ (2.2°C) between October and June. <i>For all classes, natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained. There shall be no changes from natural background conditions that would impair any uses assigned to each class, including those conditions necessary to protect normal species diversity, successful migration, reproductive functions or growth of aquatic organisms.</i> <i>For CWF waters, where a reproducing cold water aquatic community exists at a naturally higher temperature, the temperature necessary to protect the community shall not be exceeded and natural daily and seasonal temperature fluctuations necessary to protect the community shall be maintained.</i> <u>Class B, C, SA, SB, and SC:</u> See MassDEP 2006 for language specific to alternative effluent limitations relating to thermal discharges and cooling water intake structures.
pH	<u>Class A, Class BCWF and Class BWFF:</u> 6.5 - 8.3 SU and $\Delta 0.5$ outside the natural background range. <u>Class C:</u> 6.5 - 9.0 SU and $\Delta 1.0$ outside the natural background range. <u>Class SA and Class SB:</u> 6.5 - 8.5 SU and $\Delta 0.2$ SU outside the natural background range. <u>Class SC:</u> 6.5 - 9.0 SU and $\Delta 0.5$ SU outside the natural background range. There shall be no change from natural background conditions that would impair any use assigned to each class.
Solids	<u>All Classes:</u> <i>These waters shall be free from floating, suspended, and settleable solids in concentrations or combinations that would impair any use assigned to each class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.</i>
Color and Turbidity	<u>All Classes:</u> <i>These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use.</i>
Oil and Grease	<u>Class A and Class SA:</u> <i>Waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.</i> <u>Class SA:</u> <i>Waters shall be free from oil and grease and petrochemicals.</i> <u>Class B, Class C, Class SB and Class SC:</u> <i>Waters shall be free from oil, grease, and petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course, or are deleterious or become toxic to aquatic life.</i>
Taste and Odor	<u>Class A and Class SA:</u> <i>None other than of natural origin.</i> <u>Class B, Class C, Class SB and Class SC:</u> <i>None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to each class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.</i>
Aesthetics	<u>All Classes:</u> <i>All surface waters shall be 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.</i>

Table A1 (continued). Summary of Massachusetts Surface Water Quality Standards (MassDEP 2006, MA DPH 2002, FDA 2003).

Toxic Pollutants	<i>All Classes: All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822-R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction (see Mass DEP 2006 for more detail regarding permit limits, conversion factors, site specific criteria).</i>
Nutrients	<i>Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to these Standards.</i>
Bacteria (MassDEP 2006 and MA DPH 2002) Class A criteria apply to the <i>Drinking Water Use</i>. Class B and SB criteria apply to <i>Primary Contact Recreation Use</i> while Class C and SC criteria apply to <i>Secondary Contact Recreation Use</i>.	<u>Class A:</u> <i>At water supply intakes in unfiltered public water supplies: either fecal coliform shall not exceed 20 organisms/100 ml in all samples taken in any six month period, or total coliform shall not exceed 100 organisms/ 100 ml in 90% of the samples taken in any six month period. If both total and fecal coliform are measured, then only the fecal coliform criterion must be met.</i> <u>Class A other waters, Class B:</u> Where <i>E. coli</i> is the chosen indicator at public bathing beaches as defined by MA DPH: The geometric mean of the five most recent <i>E. coli</i> samples taken within during the same bathing season shall not exceed 126 colonies/ 100 ml and no single sample taken during the bathing season shall exceed 235 colonies/ 100 ml (these criteria may be applied on a seasonal basis at the Department's discretion). Where Enterococci are the chosen indicators at public bathing beaches: The geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies /100 ml and no single <i>Enterococci</i> sample taken during the bathing season shall exceed 61 colonies /100 ml. For other waters and, during the non bathing season, for waters at public bathing beaches: The geometric mean of all <i>E. coli</i> samples taken within the most recent six months shall not exceed 126 colonies/ 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies/ 100 ml. These criteria may be applied on a seasonal basis at the Department's discretion. The geometric mean of all <i>Enterococci</i> samples taken within the most recent six months shall not exceed 33 colonies/ 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies/ 100 ml. These criteria may be applied on a seasonal basis at the Department's discretion. <u>Class C:</u> <i>The geometric mean of all E. coli samples taken within the most recent six months shall not exceed 630 E. coli/ 100 ml, typically based on a minimum of five samples and 10% of such samples shall not exceed 1260 E. coli/ 100 ml. This criterion may be applied on a seasonal basis at the discretion of the Department.</i> <u>Class SA:</u> Waters designated for shellfishing: <i>Fecal coliform bacteria shall not exceed a geometric mean (Most Probable Number (MPN) method) of 14 organisms/100 ml, nor shall more than 10% of the samples exceed an MPN of 28 organisms/100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide for the Control of Molluscan Shellfish Areas (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5)).</i> <u>Class SB:</u> Waters designated for shellfishing: <i>Fecal coliform median or geometric mean MPN shall not exceed 88 organisms/100 ml, nor shall more than 10% of the samples exceed an MPN of 260 organisms/100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide for the Control of Molluscan Shellfish Areas (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5)).</i>

	<u>Class SA and Class SB:</u> At public bathing beaches, as defined by MA DPH: No single <i>Enterococci</i> sample taken during the bathing season shall exceed 104 colonies /100 ml and the geometric mean of the five most recent <i>Enterococci</i> samples taken within the same bathing season shall not exceed 35 colonies /100 ml. At public bathing beaches during the non-bathing season and in non bathing beach waters: No single <i>Enterococci</i> sample shall exceed 104 colonies/ 100 ml and the geometric mean of all samples taken within the most recent six months, typically a minimum of five samples, shall not exceed 35 colonies/ 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department). <u>Class SC:</u> <i>The geometric mean of all Enterococci samples taken within the most recent six months shall not exceed 175 colonies/ 100 ml, typically based on the five most recent samples, and 10% of such samples shall not exceed 350 colonies/ 100 ml. This criterion may be applied on a seasonal basis at the discretion of the Department.</i>
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Note: Italics are direct quotations.

Δ criterion (referring to a change from natural background conditions) is applied to the effects of a permitted discharge.

DESIGNATED USES

The Massachusetts Surface Water Quality Standards designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected. Each of these uses is briefly described below (MassDEP 2006):

- *AQUATIC LIFE* - suitable habitat for sustaining a native, naturally diverse, community of aquatic flora and fauna, including, but not limited to, wildlife and threatened and endangered species and for their reproduction, migration, growth and other critical functions. Two subclasses of aquatic life are also designated in the standards for freshwater bodies: *Cold Water Fishery* - capable of sustaining a year-round population of cold water aquatic life, such as trout; *Warm Water Fishery* - waters that are not capable of sustaining a year-round population of cold water aquatic life. In certain waters, excellent habitat for fish, other aquatic life and wildlife may include, but is not limited to, seagrass.
- *FISH CONSUMPTION* - pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption.
- *DRINKING WATER* - used to denote those waters used as a source of public drinking water. They may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). These waters are designated for protection as Outstanding Resource Waters under 314 CMR 4.04(3).
- *SHELLFISH HARVESTING* (in SA and SB segments) – Class SA waters where designated shall be suitable for shellfish harvesting without depuration (Approved and Conditionally Approved Shellfish Areas); Class SB waters where designated shall be suitable for shellfish harvesting with depuration (Restricted and Conditionally Restricted Shellfish Areas).
- *PRIMARY CONTACT RECREATION* - suitable for any recreation or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water. These include, but are not limited to, wading, swimming, diving, surfing and water skiing.
- *SECONDARY CONTACT RECREATION* - suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, including human consumption of fish, boating and limited contact incident to shoreline activities. Where designated, secondary contact recreation also includes shellfishing, including human consumption of shellfish. Human consumption of fish and shellfish are assessed as the *Fish Consumption* and *Shellfish Harvesting* uses, respectively.
- *AESTHETICS* - all surface waters shall be 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.
- *AGRICULTURAL AND INDUSTRIAL* - suitable for irrigation or other agricultural process water and for compatible industrial cooling and process water.

The guidance used to assess the *Aquatic Life*, *Fish Consumption*, *Drinking Water*, *Shellfish Harvesting*, *Primary* and *Secondary Contact Recreation* and *Aesthetics* uses follows.

Note: Waterbodies affected by Combined Sewer Overflow (CSO) discharges are qualified in the standards, however, unless a variance has been granted and states otherwise, excursions from criteria are not allowed during storm events (designated uses are still applicable).

AQUATIC LIFE USE

This use is suitable for sustaining a native, naturally diverse, community of aquatic flora and fauna, including, but not limited to, wildlife and threatened and endangered species and for their reproduction, migration, growth and other critical functions. The results of biological (and habitat), toxicological, and chemical data are integrated to assess this use. The nature, frequency, and precision of the MassDEP's data collection techniques dictate that a weight of evidence be used to make the assessment, with biosurvey results used as the final arbiter of borderline cases. The following chart provides an overview of the guidance used to assess the status (support or impaired) of the *Aquatic Life Use*.

Variable	Support Data available clearly indicates support or minor modification of the biological community. Excursions from chemical criteria (Table A1) not frequent or prolonged and may be tolerated if the biosurvey results demonstrate support.	Impaired There are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community.
BIOLOGY		
Rapid Bioassessment Protocol (RBP) III*	Non/Slightly impacted	Moderately or Severely Impacted
Fish Community	Best Professional Judgment (BPJ)	BPJ
Habitat and Flow	BPJ	Dewatered streambed due to artificial regulation or channel alteration, BPJ
Eelgrass Bed Habitat (Howes <i>et al.</i> 2003, Costello 2003)	Stable (No/minimal loss), BPJ	Loss/decline, BPJ
Non-native species	BPJ	Non-native species present, BPJ
Plankton/Periphyton	No/infrequent algal blooms	Frequent and/or prolonged algal blooms
TOXICITY TESTS**		
Water Column/Ambient	>75% survival either 48 hr or 7-day exposure	<75% survival either 48 hr or 7-day exposure
Sediment	≥75% survival	<75% survival
CHEMISTRY-WATER**		
Dissolved oxygen (DO) (MassDEP 2006, EPA 1997)	Infrequent excursion from criteria (Table A1), BPJ (minimum of three samples representing critical period)	Frequent and/or prolonged excursion from criteria [river and shallow lakes - exceedances >10% of representative measurements; deep lakes (with hypolimnion) - exceedances in the hypolimnetic area >10% of the surface area during maximum oxygen depletion].
pH (MassDEP 2006, EPA 1999a)	Infrequent excursion from criteria (Table A1)	Criteria exceeded >10% of measurements.
Temperature (MassDEP 2006, EPA 1997)	Infrequent excursion from criteria (Table A1) ¹ CWF excursion based on mean of the daily maximum temperatures over a 7-day period.	Criteria exceeded >10% of measurements. CWF excursion based on mean of the daily maximum temperatures over a 7-day period.
Toxic Pollutants (MassDEP 2006, EPA 1999a) Ammonia-N (MassDEP 2006, EPA 1999b) Chlorine (MassDEP 2006, EPA 1999a)	Infrequent excursion from criteria (Table A1) Ammonia is pH and temperature dependent ² 0.011 mg/L (freshwater) or 0.0075 mg/L (saltwater) total residual chlorine (TRC) ³	Frequent and/or prolonged excursion from criteria (exceeded >10% of measurements).
CHEMISTRY-SEDIMENT**		
Toxic Pollutants (Persaud <i>et al.</i> 1993)	Concentrations ≤ Low Effect Level (L-EL), BPJ	Concentrations ≥ Severe Effect Level (S-EL) ⁴ , BPJ
CHEMISTRY-TISSUE		
PCB – whole fish (Coles 1998)	≤500 µg/kg wet weight	BPJ
DDT (Environment Canada 1999)	≤14.0 µg/kg wet weight	BPJ
PCB in aquatic tissue (Environment Canada 1999)	≤0.79 ng TEQ/kg wet weight	BPJ

*RBP II analysis may be considered for assessment decision on a case-by-case basis, **For identification of impairment, one or more of the following variables may be used to identify possible causes/sources of impairment: NPDES facility compliance with whole effluent toxicity test and other limits, turbidity and suspended solids data, nutrient (nitrogen and phosphorus) data for water column/sediments. ¹Maximum daily mean T in a month (minimum six measurements evenly distributed over 24-hours) less than criterion. ²Saltwater is temperature dependent only. ³The minimum quantification level for TRC is 0.05 mg/L. ⁴For the purpose of this report, the S-EL for total polychlorinated biphenyl compounds (PCB) in sediment (which varies with Total Organic Carbon (TOC) content) with 1% TOC is 5.3 ppm while a sediment sample with 10% TOC is 53 ppm.

Note: National Academy of Sciences/National Academy of Engineering (NAS/NAE) guideline for maximum organochlorine concentrations (i.e., total PCB) in fish tissue for the protection of fish-eating wildlife is 500µg/kg wet weight (ppb, not lipid-normalized). PCB data (tissue) in this report are presented in µg/kg wet weight (ppb) and are not lipid-normalized to allow for direct comparison to the NAS/NAE guideline.

FISH CONSUMPTION USE

Pollutants shall not result in unacceptable concentrations in edible portions of marketable fish or for the recreational use of fish, other aquatic life or wildlife for human consumption. The assessment of this 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).

1. The MA DPH "...is advising pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age to refrain from eating the following marine fish; shark, swordfish, king mackerel, tuna steak and tilefish. In addition, MA DPH is expanding its previously issued statewide fish consumption advisory which cautioned pregnant women to avoid eating fish from all freshwater bodies due to concerns about mercury contamination, to now include women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age (MA DPH 2001)."
2. Additionally, MA DPH "...is recommending that pregnant women, women of childbearing age who may become pregnant, nursing mothers and children under 12 years of age limit their consumption of fish not covered by existing advisories to no more than 12 ounces (or about 2 meals) of cooked or uncooked fish per week. This recommendation includes canned tuna, the consumption of which should be limited to 2 cans per week. Very small children, including toddlers, should eat less. Consumers may wish to choose to eat light tuna rather than white or chunk white tuna, the latter of which may have higher levels of mercury (MA DPH 2001)."

Other statewide advisories that MA DPH has previously issued and are still in effect are as follows (MA DPH 2001):

1. Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCB) and other contaminants, no individual should consume lobster tomalley from any source. Lobster tomalley is the soft green substance found in the tail and body section of the lobster.
2. Pregnant and breastfeeding women and those who are considering becoming pregnant should not eat bluefish due to concerns about PCB contamination in this species.

The following is an overview of EPA's guidance used to assess the status (support or impaired) of the *Fish Consumption Use*. Because of the statewide advisory no waters can be assessed as support for the *Fish Consumption Use*. Therefore, if no site-specific advisory is in place, the *Fish Consumption Use* is not assessed.

Variable	Support No restrictions or bans in effect	Impaired There is a "no consumption" advisory or ban in effect for the general population or a sub-population for one or more fish species or there is a commercial fishing ban in effect.
MA DPH Fish Consumption Advisory List	Not applicable, precluded by statewide advisory (Hg)	Waterbody on MA DPH Fish Consumption Advisory List

Note: MA DPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

Northeast Regional Mercury TMDL: On 20 December 2007 the U.S. EPA approved the Northeast Regional Mercury Total Maximum Daily Load (TMDL). This TMDL is a Federal Clean Water Act mandated document that identifies pollutant load reductions necessary for regional waterbodies to meet and maintain compliance with state and federal water quality standards. It 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 inland 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). The TMDL will be reassessed in 2010 based on an evaluation of new on-going monitoring and air deposition data. Final targets will be determined at that time.

DRINKING WATER USE

The term *Drinking Water Use* denotes those waters used as a source of public drinking water. These waters may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). They are designated for protection as Outstanding Resource Waters in 314 CMR 4.04(3). MassDEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act (SDWA). Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) all public drinking water supplies are monitored as finished water (tap water). Monitoring includes the major categories of contaminants established in the SDWA: bacteria, volatile and synthetic organic compounds, inorganic compounds and radionuclides. The DWP maintains current drinking supply monitoring data. The suppliers currently report to MassDEP and EPA the status of the supplies on an annual basis in the form of a consumer confidence report (<http://yosemite.epa.gov/ogwdw/ccr.nsf/Massachusetts>). Below is EPA's guidance to assess the status (support or impaired) of the drinking water use.

Variable	Support	Impaired
	No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply).	Has one or more advisories or more than conventional treatment is required or has a contamination-based closure of the water supply.
Drinking Water Program (DWP) Evaluation	See note below	See note below

Note: While this use is not assessed in this report, information on drinking water source protection and finish water quality is available at <http://www.mass.gov/dep/water/drinking.htm> and from local public water suppliers.

SHELLFISHING USE

This use is assessed using information from the Department of Fish and Game's Division of Marine Fisheries (DMF). A designated shellfish growing area is an area of potential shellfish habitat. Growing areas are managed with respect to shellfish harvest for direct human consumption, and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (described below) with respect to shellfish harvest. Shellfish areas under management closures are *not* assessed. Not enough testing has been done in these areas to determine whether or not they are fit for shellfish harvest, therefore, they are closed for the harvest of shellfish.

Variable	Support	Impaired
	SA Waters: Approved ¹ SB Waters: Approved ¹ , Conditionally Approved ² , or Restricted ³	SA Waters: Conditionally Approved ² , Restricted ³ , Conditionally Restricted ⁴ , or Prohibited ⁵ SB Waters: Conditionally Restricted ⁴ or Prohibited ⁵
DMF Shellfish Project Classification Area Information (MA DFG 2000)	Reported by DMF	Reported by DMF

NOTE: Designated shellfish growing areas may be viewed using the MassGIS datalayer available from MassGIS at <http://www.mass.gov/mgis/dsga.htm>. This coverage currently reflects classification areas as of July 1, 2000.

¹ **Approved** - "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events.

² **Conditionally Approved** - "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations..." A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area.

³ **Restricted** - area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area.

⁴ **Conditionally Restricted** - "...subject to intermittent microbiological pollution..." During the time area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft-shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification).

⁵ **Prohibited** - Closed for harvest of shellfish.

PRIMARY CONTACT RECREATION USE

This use is suitable for any recreational or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water during the primary contact recreation season (1 April to 15 October). These include, but are not limited to, wading, swimming, diving, surfing and water skiing. The chart below provides an overview of the guidance used to assess the status (support or impaired) of the *Primary Contact Recreation Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	Support Criteria are met, no aesthetic conditions that preclude the use	Impaired Frequent or prolonged violations of criteria and/or formal bathing area closures, or severe aesthetic conditions that preclude the use
Bacteria (105 CMR 445.000) Minimum Standards for Bathing Beaches State Sanitary Code (MassDEP 2006)	At "public bathing beach" areas: Formal beach postings/advisories neither frequent nor prolonged during the swimming season (the number of days posted or closed cannot exceed 10% during the locally operated swimming season). Collected samples* meet criteria (Table A1). Shellfish Growing Area classified as "Approved by DMF.	At "public bathing beach" areas: Formal beach closures/postings >10% of time during swimming season (the number of days posted or closed exceeds 10% during the locally operated swimming season). Collected samples* do not meet the criteria (Table A1).
Aesthetics (MassDEP 1996) - All surface waters shall be 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 [growth or amount] species of aquatic life		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥ 1.2 meters ($\geq 4'$) (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth < 1.2 meters ($< 4'$) (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

* Data sets to be evaluated for assessment purposes must be representative of a sampling location (at least five samples per station recommended) and the season being analyzed, as described in the SWQS (see Table 1). Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use. Because of low sample frequency (i.e., less than ten samples per station) an impairment decision will not be based on a single sample exceedance (i.e., the geometric mean of five samples is < 126 *E. coli* colonies/100 ml but one of the five sample exceeds 235 *E. coli* colonies/100 ml). The method detection limit (MDL) will be used in the calculation of the geometric mean when data are reported as less than the MDL (e.g., use 20 cfu/100 ml if the result is reported as < 20 cfu/100 ml). Those data reported as too numerous to count (TNTC) will not be used in the geometric mean calculation; however frequency of TNTC sample results should be presented.

**Waters

SECONDARY CONTACT RECREATION USE

This use is suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities. Following is an overview of the guidance used to assess the status (support or impaired) of the *Secondary Contact Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	Support Criteria are met, no aesthetic conditions that preclude the use	Impaired Frequent or prolonged violations of criteria, or severe aesthetic conditions that preclude the use
Bacteria (MassDEP 2006)	Collected samples* meet the Class C or SC criteria (see Table A1). Shellfish Growing Area classified as "Approved" by DMF.	Collected samples* do not meet the Class C or SC criteria (see Table A1).
<i>Aesthetics (MassDEP 2006) - All surface waters shall be 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 [growth or amount] species of aquatic life</i>		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥ 1.2 meters ($\geq 4'$) (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth < 1.2 meters ($< 4'$) (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

*Data sets to be evaluated for assessment purposes must be representative of a sampling location (at least five samples per station recommended) over time. Because of low sample frequency (i.e., less than ten samples per station) an impairment decision will not be based on a single sample exceedance. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use.

AESTHETICS USE

All surface waters shall be 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. The aesthetic use is closely tied to the public health aspects of the recreational uses (swimming and boating). Below is an overview of the guidance used to assess the status (support or impaired) of the *Aesthetics Use*.

Variable	Support Narrative "free from" criteria met	Impaired Objectionable conditions frequent and/or prolonged
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥ 1.2 meters ($\geq 4'$) (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth < 1.2 meters ($< 4'$) (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

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Appendix I

The Former Holyoke Gas Works & The Holyoke Gas Tar Deposits

Project Summary Written by Lisa Jones, Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup December 2007

The Gas Works in Holyoke manufactured combustible gas from coal and oil for residential, commercial, and industrial heating and lighting from 1852 to 1951. The former Gas Works once occupied a 2-acre peninsula on the Connecticut River 1500 feet downstream of the Holyoke Dam. Historic operations resulted in large releases of tar and oil to soil, groundwater, sediment, and surface water. Assessment and cleanup are required under the Massachusetts Contingency Plan. The potentially responsible parties (PRPs), conducting the cleanup work, are the former owner/operators of the facility: Holyoke Water Power Company (HWP), owner/operator from 1852-1902, Holyoke Gas & Electric Department (HG&E), owner/operator from 1902-1952, and the City of Holyoke. Northeast Utilities Service Company, agent for HWP, is conducting the cleanup of tar deposits in the river (RTN 1-1055), and HG&E is conducting the cleanup of the upland area and the No.2 Raceway (RTN 1-816). Massachusetts Department of Environmental Protection (MassDEP) site management oversees the work. As of December 2007, approximately \$20 million dollars has been spent on assessment and remediation at the two sites. The future costs are unknown.

The Gas Works utilized two types of manufacturing processes: coal carbonization and the carbureted water-gas (CWG) process. Each process generated tar as a by-product, namely coal tar and carbureted water-gas tar. According to records research and calculations performed by MassDEP, this manufactured gas plant ("MGP") produced approximately ten million gallons of MGP tar during its 100 years of operations. (The term "MGP tar" refers to both coal tar and carbureted water-gas tar since it is not necessary to distinguish between the two.)

Holyoke Gas Tar Deposits (River) – RTN 1-1055

While MGP tar was typically a valuable resource that could be sold or used by a gas works, tar was often released to the environment via spills, leaks, and direct surface water discharges. In the early years of the industry, excess tar was typically disposed or discarded into nearby water bodies since uses for tar, other than as fuel, had not yet been developed. As the industry progressed, MGP tar was less likely to be discarded however tar/ water emulsions produced by the CWG process became problematic: when an emulsion would not properly separate, it was usually discarded.

An 1898 plan of the Holyoke Gas Works shows that the facility was initially equipped with a piping system that enabled direct discharges of tar into the Connecticut River to the north and into the No. 2 Overflow Raceway ("Raceway") to the south. Additional site plans from the 1930s and 1940s show the presence of overflow and drain pipes originating from underground tar storage areas (tar wells), extending through the flood wall, and emptying into the river and Raceway. Tar inventory records of Holyoke Gas Works for the period between 1903 and 1952 revealed that 126,000 gallons of MGP tar and 124,000 gallons of gas-making oil were "lost" to the river during floods, reconstruction of the floodwall, and unexplained incidents. Tar and oil losses from prior years, 1852-1902, are presumed to have occurred but detailed bookkeeping records were

not found. Some large, one-time events occurred such as the loss of 30,000 gallons of tar and 87,000 gallons of gas oil lost in the 1936 flood, and 38,000 gallons of oil lost in the 1938 flood and hurricane.

Gas oil and tar emulsions released to the river may have floated or been suspended, but tar usually sank in waterways. The tar settled over very large areas of the Connecticut River within the 2.7-mile stretch between the Route 116 bridge in South Hadley Falls and the south end of Springdale Park in Holyoke. Visible tar deposits, observed by divers, occupy around 3 acres, and submerged tar areas may occupy another 20 to 30 acres. Tar thickness varies from 2 inches to 3 feet. Overlying substrates vary in composition- sand, silt, gravel, and cobbles, and the thickness of material covering tar deposits ranges from zero to 3.5 feet. Exposed areas are noted to silt over during summer and support caddis fly larvae. The topside of tar deposits is sometimes hardened like a rind, while underneath it can be sticky or friable. Softer tar deposits were observed to release liquid blebs on occasion and soft tar reportedly fouls the diver's tools. Tar hardness changes with water temperatures and UV influence.

The tar deposits exist in an area known to provide spawning habitat for the federally endangered short-nose sturgeon (*Acipenser brevirostrum*). Tar deposits also coexist in habitat for two state-protected mussel species and numerous finfish and shellfish. Human health exposures may occur through recreational activities taking place in and along the river. Under the presumption that tar deposits pose readily apparent harm and substantial environmental hazard, MassDEP required remediation of the tar deposits. HWP signed a consent order to complete the actions required by MassDEP. HWP also settled with federal and State natural resource trustees on a claim for injured resources.

Removal of tar deposits performed in 2002-2006 resulted in the removal and disposal of 11,714 yd³ of tar and tarry sediment. The removal was accomplished using mechanical excavation in dry (dewatered) areas and in wet excavations where dewatering was impractical or not feasible. The project involved the use of temporary flow diversions, cofferdams, and silt curtains to minimize contaminant migration and prevent exposure to biota during excavation. The work was performed during summer and fall months to avoid critical fish life cycles, migratory periods, and dangerous high flow conditions. Mussel and fish relocation were conducted to reduce exposures in work areas. A barge-mounted excavator with a special environmental bucket was used to dredge in the river. Dry excavation was done with standard equipment. The excavated material was placed into containers on floats, transported to the shoreline, lifted out of the river, placed onto a staging pad, dewatered, then loaded and transported to an off-site treatment facility. Contaminated remedial wastewater, drained from the dredge spoils, was collected in fractionation tanks and treated to meet criteria established in a permit issued by the Holyoke Department of Public Works. The treated wastewater was then discharged into the main city sewer interceptor line and sent directly to the water pollution control facility.

Prompted by MassDEP's observation of unmapped tar deposits in 2005, HWP was required to conduct a more intensive survey for tar in 2006. Information obtained during remediation and diver surveys, confirmed that the extent of tar deposits was much greater than initial estimates. The tar deposits were originally thought to occupy less than 2 acres, but the new estimate is around 30 acres. Because of the larger volume and associated cost for removal, HWP proposed to complete a comprehensive ecological and human health risk characterization to guide in risk management and remediation planning rather than to continue with removal under the presumption of harm to biota.

An important aspect of the site, now being scrutinized, is the hardness due to weathering of some tar deposits. Studies and risk assessment tools are proposed to determine if the more weathered tar has undergone changes that render it less toxic and mobile than the softer tar deposits, and therefore, whether it poses less or no significant risk of harm to biota.

MassDEP is currently reviewing the revised risk characterization Scope of Work, which has been developed to investigate if any substantial hazard has been mitigated by the remediation conducted to date and weathering processes that have reduced the mobility and toxicity of the tar.

Former Holyoke Gas Works (Land Site) RTN 1-816

Coal tar and water gas tar are the most widespread contaminants at the two sites. Ten million gallons of tar were produced over the life of the plant and much of the tar was released into the environment. The properties of tar make the assessment and remediation very complex and technically challenging. Coal tar is a dense non-aqueous phase liquid (DNAPL) whereas CWG tar reportedly has a density nearly equivalent to water. Over time tar fractionates into light non-aqueous phase liquid (LNAPL) and DNAPL. Constituents of tar also dissolve more readily into groundwater when comingled with gas oil. Fate and transport of tar is complicated since the LNAPL and dissolved LNAPL move with groundwater while DNAPL sinks and flows along the underlying bedrock and seeps into bedrock fractures. Recovery of NAPL tar is necessary, expensive, and expected to take 10 to 20 years. Listed below are summarized findings, tasks, and plans pertaining to the Gas Works site:

- 8 acres, industrial /commercial area with residential areas 0.25 miles from site
- Oil / tar breaking out in the Tailrace first observed and reported to MassDEP in 1990
- Sources removed in 1994 to 1995 include 3 underground storage tanks, 2 aboveground storage tanks, 3 tar wells, 1000 yd³ soil, & 100,000 gal. of tar / oil / water mix were recovered and recycled
- Gas oil and fuel oil (LNAPLs), and tar (DNAPL) observed to be migrating > 700 feet from sources; contaminants in groundwater & bedrock as seen in monitoring wells and soil borings
- Quarterly groundwater gauging program initiated in March 2001
- Weekly tar thickness gauging and tar bailing program initiated in November 2001
- Two pilot-scale NAPL recovery systems installed in 2003: no heat system along Tailrace; thermally-enhanced (steam sparge) on property near former east tar well
- In 2004, approximately 8000 tons of tar-impacted soil were removed from 2 gasholders and a tar separator, treated via on-site solidification & stabilization using addition of Portland cement (8%) and liquid asphalt (8 gallons per ton), and the end product was re-used as backfill in the gasholders
- Re-evaluation of arsenic and residual tar impacts in soil concluded no significant future health risk as long as site use is restricted to non-residential activities
- Removal and off-site disposal of approximately 1000 tons of tar solids and soil near valves along northern floodwall: accessible soil excavated & disposed off-site in 2005.
- Both NAPL recovery systems were upgraded to full scale between August 2006 and April 2007: installed cost of \$750 K with estimated annual operational cost of \$140 K
 - Steam-enhanced system has 7 sparge points and 7 recovery wells

- Tailrace collection is non-thermal and uses 21 overburden recovery wells and 4 bedrock recovery wells; spacing is at 10-foot intervals.
- Future Remedies-
 - 2009 Raceway: In-situ Capping & Heated Recovery Well Installation
 - 2010 Tailrace: Bulkhead Installation and/or Embankment Capping

APPENDIX H
SUMMARY OF WMA REGISTRATION AND PERMITTING
AND NPDES PERMITTING INFORMATION
CONNECTICUT RIVER BASIN

Table H1. Water Management Act registration and permits in the Connecticut River Watershed.

Registration#	Permit	Water Supply System Name	Registered Volume (MGD)	Registered Withdrawal (Days)	Permitted Volume (MGD)	Permit Withdrawal (Days)	Segment	PWSID
10600802	9P10600801	Amherst DPW Water Division	3.34	365	1.21	365	MA34-27 subwatershed: five wells - 01G, 02G, 04G, 05G, 06G, and one inactive 07G MA34006 (01S -Atkins Reservoir) MA34-35 (02S -Amythest Brook Hawley Hill Intake)	1008000
	9P10619202	Australis Aquaculture, LLC	NA	NA	0.41	365	MA34-02 (Well #1)	
	9P10602401	Belchertown Water District	NA	NA	0.4	365	MA34-27 subwatershed (05G Daigle Well)	1024000
	9P010602901	Bernardston Fire & Water District	NA	NA	0.17	365	MA34-33 (03G Sugarhouse Well)	1029000
	9P210633701	Chang Farms, Inc	NA	NA	0.15	365	MA34-04 (onsite wellfield)	
10600502		Crestview Country Club	0.06	184	0	184	MA34-05 (Wells #1, 2, 3 and country club pond)	
	9P2010602902	Crumpin Fox Club	NA	NA	0.08	210	MA34-33 (well #1 and a pond)	
10628904		Delta Sand And Gravel, Inc.	0.11	365	NA	NA	MA34-09	
10611705		Earle M. Parsons & Sons, Inc.	1.03	90	NA	NA	MA34-04 (01S Connecticut River)	
	9P210621702	East Northfield Water Company	NA	NA	0.14	365	MA34-01 (01S Grandin Reservoir)	1217001
10608701	9P210608701	Easthampton Water Department	3.31	365	0	365	MA34-11 (07G Maloney Well) MA34-18 (04G Hedrick Street , 08G Nonotuck Park, 05G Pines Well, and 09G Well #9)	1087000
	9P210608501	Elmcrest Country Club	NA	NA	0.226	183	Tributary to Scantic River in CT	
10632501		Fountain Plating Co, Inc.	0.12	365	NA	NA	Tributary to MA34-05 (FP Well #1 and #2)	
	9P210621703	Four Star Farms, Inc.	NA	NA	0.167	150	MA34-02 (01S)	
10628902	9P210628901	Great Swamp Farm, Inc.	0.21	365	0.39	365	Subwatershed of MA34-25 (S3, S4, Podick Brook)	
10611702	9P210611701	Hadley Water Department	0.79	365	0.13	365	Subwatershed of MA34-04(01G and 02G Mt. Warner wells) MA34-27 (03G and 04G Callahan wells)	1117002
10612702		Hatfield Water Department	0.35	365	NA	NA	Tributary to MA34-24 (01S	1127000

Registration#	Permit	Water Supply System Name	Registered Volume (MGD)	Registered Withdrawal (Days)	Permitted Volume (MGD)	Permit Withdrawal (Days)	Segment	PWSID
							Running Gutter Brook Reservoir, 01G Running Gutter Brook Well, 02G Omasta Well)	
10613701		Hazen Paper Company	0.13	365	NA	NA	MA34-05 (01G, 02G, and 03G Wells near 3 rd level canal Holyoke)	
10600803		Hickory Ridge Country Club	0.06	184	NA	NA	MA34-27 (surface withdrawal Fort River)	
10613708		Holyoke Gas & Electric Department	0.61	365	NA	NA	MA34-05 (Intake #01 and #02)	
10613711		Holyoke Water Works	8.04	365	NA	NA	MA34-18 (02G Pequot Well) MA34089, and MA34101	1137000
10627501		Intelicoat Technologies	0.2	365	NA	NA	Tributary to MA34-05 (01G Well#1)	
	9P210627502	Ledges Golf Club	NA	NA	0.89	214	MA34-04 (Connecticut River Intake)	
10615902		Longmeadow Country Club	0.1	184	NA	NA	MA34-21 (Longmeadow Country Club Pond)	
10606102		Mckinstry Market Garden	0.1	92	NA	NA	MA34-04 (Connecticut River Surface supply)	
10628903		Mohawk Trout Hatchery	1.44	365	NA	NA	Tributary subwatershed to MA34-04 (Well)	
10613712		Mt Tom Generating Company, LLC.	113.6	365	NA	NA	MA34-04 (Connecticut River intake)	
	9P210612001	New Hampden Country Club	NA	NA	0.135	365	Tributary to MA34-30 (Unlined irrigation ponds, greenhouse well, maintenance shed well, clubhouse well, caretakers well)	1120008 for clubhouse well
10621401	9P210621401	Northampton Department Of Public Works	3.96	365	0.84	365	Tributaries to MA34-28 (01G and 02G), MA34056 (01S), MA34059 (03S), tributary system to MA34-24 (04S), and MA34076 (02S emergency only)	1214000
10607401		Nourse Farms, Inc.	0.2	184	NA	NA	MA34-04 (five surface withdrawals Long Plain Road, Home Pump #2, Home Pump #3, Field Farm #4, and MAGDYZ #6 and one well Dripline #1)	
	9P10613701	Open Square Properties, LLC.	NA	NA	0.235	365	MA34-05 (Well 1A Holyoke	

Registration#	Permit	Water Supply System Name	Registered Volume (MGD)	Registered Withdrawal (Days)	Permitted Volume (MGD)	Permit Withdrawal (Days)	Segment	PWSID
							Canals)	
10613706		Sonoco Products Company	0.85	365	NA	NA	MA34-05 (Sonoco Intake Holyoke Canals)	
10607402		South Deerfield Water District	0.65	365	NA	NA	Tributary to MA34-24 (01S Roaring Brook Dam and 02S Whately Reservoir) and MA34-04 (01G Sugarloaf Street Wellfield)	1074001
10627502		South Hadley Fire District 2 Water Dept.	0.68	365	NA	NA	MA34-04 (04G Dry Brook well and 05G Dry Brook Backup Well which is currently inactive), MA34-07 (Elmer Brook Dug well 03G is an emergency source)	1275001
10627602		Southampton Country Club	0.1	180	NA	NA	MA34-17 (Moose Brook Pumphouse)	
	9P210627601	Southampton Water Department	NA	NA	0.36	365	MA34-11 (Glendale Well 01G and replacement 02G)	1276000
10619203		Southworth Paper Company	0.88	365	NA	NA	MA34-03	
10628901		Sunderland National Salmon Station	0.28	365	NA	NA	MA34-25 (Wells #1, 2, and 3)	
10628907	9P210628902	Sunderland State Fish Hatchery	2.79	365	0	365	Tributary to MA34-04 (Sunderland Hatchery Well and Well #2 and Bitzer Hatchery Well)	
10628905		Sunderland Water District	0.24	365	NA	NA	Tributary to MA34-04 (Ralicki Well 01G and Sawmill Brook Reservoir) and MA34-09 (Hubbard Well 02G)	1289000
10600501		Tuckahoe Turf Farm	0.07	153	NA	NA	Tributary to Connecticut River in Connecticut (five surface water withdrawals)	
10619201	9P10619201	Turners Falls Fire District	1.04	365	0.14	365	MA34070 (Lake Pleasant 02S and Hannegan Brook Well 03G) MA34028 (Green Pond 03S) MA34-41 (Well Station 01G and Gravel Pack Well #2 02G)	1192000
10615901		Twin Hills Country Club	0.1	184	NA	NA	MA34-21 subwatershed (no source identified in database)	
	9P210628101	Veterans & Franconia Golf Courses	NA	NA	0.2	210	Upstream MA34073 (Pecousic Brook withdrawal)	

Registration#	Permit	Water Supply System Name	Registered Volume (MGD)	Registered Withdrawal (Days)	Permitted Volume (MGD)	Permit Withdrawal (Days)	Segment	PWSID
							Upstream MA34099 (South Branch Mill River withdrawal)	
	9P201061610 1	Westover Municipal Golf Course	NA	NA	0.12	210	MA34-19 (Wade Pond)	
	9P210633901	Wilbraham Water Department	NA	NA	0.864	365	Upstream MA34052 (Well #1)	1339000
10634001		Williamsburg Water Department	0.2	365	NA	NA	MA34-38 (South Street Wells #1 and #2)	1340000

Notes: NA=Not Applicable

One voluntary registrant Wyckoff Country Club, Inc. V10613705

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Table H2. NPDES permittees in the Connecticut River Watershed.

PERMITTEE Town of Agawam	NPDES # MA0101320	SEGMENT 34-05
The Town of Agawam permit (MA0101320 issued in September 1995) to discharge combined sewer overflows via Outfall #012 (Leonard Street Overflow) to the Connecticut River was terminated by EPA in September 2000.		
PERMITTEE Agri-Mark, Inc.	NPDES # MA0029327	SEGMENT Tributary to MA34-05
Agri-Mark, Inc. in West Springfield (MA0029327 issued in May 2004) to discharge 0.12 MGD process wastewater via Outfall 001 to Bagg Brook, a tributary to the Connecticut River. The facility is engaged in the manufacturing of heavy cream, condensed milk, nonfat dry milk, and butter. The discharge is from process condensate water.		
PERMITTEE Town of Amherst	NPDES # MAG640046	SEGMENT Tributary to MA34-35
The Town of Amherst is authorized (MAG640046 issued January 2001) to discharge 0.048 MGD (average monthly and daily maximum) of effluent from the Centennial Water Treatment Plant to Harris Brook (mistakenly identified as Amethyst Brook in the permit). The total residual chlorine (TRC) limit is 0.74 mg/L average monthly and 1.0 mg/L daily maximum. One modified acute and chronic whole effluent toxicity test using <i>C. dubia</i> was required and conducted in June 2001. No acute toxicity was detected but the CNOEC result was 50% effluent. Survival of <i>C. dubia</i> exposed (7-day) to water collected from Harris Brook just downstream from the intake reservoir on Harris Brook was 100%. Hardness of the river water was 10 mg/L.		
PERMITTEE Town of Amherst	NPDES # MA0100218	SEGMENT MA34-04
The Town of Amherst is authorized (MA0100218 issued in September 2006) to discharge from the Amherst Wastewater Treatment Plant a flow of 7.1 MGD (average monthly) of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit is 1.00 mg/L (daily maximum) between 1 April and 31 October. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and June 2007 ranged from <0.075 to 29 mg/L (n=11) while TRC concentrations ranged from <0.02 to 0.09 mg/L (n=12).		
PERMITTEE Australis Aquaculture, LLC	NPDES # MA0110264	SEGMENT MA34-02
Australis Aquaculture, LLC is authorized (MA0110264 issued in September 2003) to discharge from the facility at 15 Industrial Boulevard in Turner Falls an average monthly and daily maximum flow of 0.3 MGD of treated effluent from the indoor farming facility currently for <i>Australis barramundi</i> via Outfall #001 to the Deep Hole of the Connecticut River (until relocation and termination of the discharge, or expiration of the permit). (This permit was formerly issued to Mass Fin Tech, LLC and prior to that Aqua Partners Technologies, LLC). The TRC limit is 0.01 mg/L average monthly and 0.019 mg/L daily maximum. The total phosphorus limit is 0.2 mg/L average monthly. The permit also authorizes this discharge via Outfall #002 to the Connecticut River (following relocation and the termination of the discharge from "Deep Hole").		
PERMITTEE Town of Belchertown Department of Public Works	NPDES # MA0102148	SEGMENT MA34-06
The Town of Belchertown Department of Public Works is authorized (MA0102148 issued in December 2005) to discharge from the Belchertown Water Reclamation Facility a flow of 1.0 MGD average monthly of treated effluent via Outfall #001 to Lampson Brook. The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ and $C\text{-NOEC} \geq 94\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis. The total phosphorus limit is 0.25 mg/L average monthly. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and August 2007 ranged from <0.01 to 1.70 mg/L (n=32). Total Residual Chlorine (TRC) concentrations reported during the same time period were <0.05 mg/L (n=32).		
PERMITTEE Berkshire Electric Cable Co.	NPDES # MA0032832	SEGMENT MA34-28
Berkshire Electric Cable Co. is authorized to discharge contact and non-contact cooling water from their facility in Leeds 0.017MGD (daily maximum) via Outfall #001 into a swamp area adjacent to the Mill River.. Stormwater flows into Fire Pond, which is also adjacent to the Mill River. It should be noted that Berkshire installed a closed loop contact cooling water system so that it no longer discharges industrial wastewater according to a letter received June 2007. The TRC concentration reported in the whole effluent toxicity report in June 2004 was <0.05 mg/L (n=1).		

PERMITTEE Bioshelters, Inc.	NPDES # MA0110281	SEGMENT Tributary to MA34-25
Bioshelters, Inc. is authorized (MA0110281 issued in December 2002) to discharge from their facility in Amherst a maximum daily flow of 0.0864 MGD of fish culture effluent via Outfall #001 to Great Swamp to an unnamed tributary of the Mill River Hadley. The facility is engaged in farming of Tilapia (capacity to produce 6000,000 lbs annually). The facility raises fish and hydroponic produce in a recirculation aquaculture and hydroponic system. The wastewater from the fish is used to grow plants, and plants are used to clean the water for the fish. Water is supplied to the facility by an on-site well.		

PERMITTEE Boston and Maine Corporation	NPDES # MA0000272	SEGMENT Tributary to MA34-04
Boston and Maine Corporation (B&M) is authorized to discharge from the East Deerfield Rail Yard facility (NPDES # MA0000272 issued September 2005 and modified with an effective date of 1 July 2006) for the discharge of stormwater and process wastewater treated by a Dissolved Air Flotation system via Outfall #004 to an unnamed brook to the Connecticut River. The flow limit is 0.015 MGD average monthly and 0.045 MGD daily maximum. The facility is required to submit the results of modified acute and chronic whole effluent toxicity tests conducted once a year in March with both <i>C. dubia</i> and <i>P. promelas</i> on grab samples of the discharge. No acute whole effluent toxicity was detected by either test species in March 2006 or 2007 (i.e., $LC_{50} > 100\%$ effluent). Some chronic toxicity was detected (CNOEC = 50% effluent to <i>P. promelas</i> in 2006 and CNOEC = 50% effluent to <i>C. dubia</i> in 2007). Survival of both test organisms exposed to river water collected in the unnamed tributary downstream from the 004 discharge was $\geq 80\%$. Dilution water sampling location will be corrected to a site upstream from the discharge in subsequent whole effluent toxicity tests. A Stormwater Pollution Prevention Plan (SWPPP) that includes monitoring requirements is also an integral part of this permit.		

PERMITTEE Chang Farms, Inc.	NPDES # MA0040207	SEGMENT MA34-04
Chang Farms, Inc. is authorized (MA0040207 issued in September 2006) to discharge from their facility in Whately a monthly average flow of 0.15 MGD of treated effluent via Outfall #001 to the Connecticut River. The farm is an agricultural enterprise that produces bean sprouts in different varieties for the retail market. Water is drawn from an on-site wellfield for irrigation (including sprout soaking), washing sprout plants, and equipment cleaning. On average 0.12 MGD is used to irrigate and wash/rinse harvested plants and an average of 0.03 MGD is used to clean and sanitize process equipment. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit is 1.0mg/L (monthly average and daily maximum) year round. The permit authorizes this discharge via Outfall 002 to Sugarloaf Brook, a tributary to the Connecticut River, until the direct discharge to the river via Outfall 001 is completed. The permittee agreed to install a UV disinfection system to treat coliform bacteria in the effluent. The TRC monitoring is required because of cleaning products.		

PERMITTEE City of Chicopee	NPDES # MA0101508	SEGMENT MA34-05
The City of Chicopee is authorized (MA0101508 issued in May 2005) to discharge from the Chicopee Water Pollution Control Facility an average monthly flow of 15.5 MGD of treatment plant effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 100\%$ effluent using <i>P. promelas</i> as a test species on a quarterly basis. The TRC limit between 1 April and 31 October is 0.89 and 1.0 mg/L (average monthly and daily maximum limits, respectively). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from 0.04 to 24mg/L (n=31) (note most measurements were >10 mg/L) while TRC concentrations ranged from <0.05 to 2.2 mg/L (n=32) although there was only one reported exceedance of the TRC limit. It should also be noted that construction was completed for the facility's "Secondary Bypass Disinfection Facility" in mid 2006. The permit also authorizes the discharge of stormwater/wastewater via combined sewer overflows during wet weather via nine outfalls to the Connecticut River as follows: 001 Britton Street in front of house #171 (30" pipe). Fairview sewer separation (32 Million Gallons/Year) in construction to be completed in 2009. 003 Power line right of way south of James Street (30" pipe) 004 Riverview Place Sewage Pumping Station (21" pipe) 005 Leslie Street Sewage Pumping Station (36" pipe) 006 Call Street Sewage Pumping Station (60" pipe) 007-I Jones Ferry Road Sewage Pumping Station (70X69 rectangle). Major project in construction to be completed in 2009 - 173 Million Gallons/Year. 007-II Jones Ferry Road Sewage Pumping Station (36" pipe) 008 Easement south of Jones Ferry Road Sewage (48" pipe) 009 Paderewski Street Sewage Pumping Station (60" pipe). This discharge was eliminated in late 2006.		

PERMITTEE Commonwealth of Massachusetts Division of Fisheries and Wildlife	NPDES # MA0110035	SEGMENT Tributary to MA34-04
The Massachusetts Division of Fisheries and Wildlife is authorized (MA0110035 issued in September 2007) to discharge from the Sunderland State Fish Hatchery a flow of 1.17 MGD average monthly and 1.68 daily maximum of treated effluent via Outfall #001 to Russellville Brook, a tributary to the Connecticut River. The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ and $C-NOEC \geq 100\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis when formalin is used. These monitoring requirements were also a condition of the prior permit. The facility has reportedly not used formalin since 1993, so they have not conducted any whole effluent toxicity tests.		

PERMITTEE Commonwealth of Massachusetts Division of Fisheries and Wildlife	NPDES # MA0110051	SEGMENT Tributary to MA34-04
The Massachusetts Division of Fisheries and Wildlife is authorized (MA0110051 issued in December 2001) to discharge from the Montague (Bitzer) State Fish Hatchery a flow of 1.4 MGD average monthly and 1.55 daily maximum of treated effluent via Outfall #001 to an unnamed tributary of the Connecticut River. The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ and $C-NOEC \geq 100\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis when formalin is used. The facility has reportedly not used formalin for the last 15 years, so they have not conducted any whole effluent toxicity tests.		

PERMITTEE Consolidated Edison Energy of Massachusetts, Inc. (CEEMI)	NPDES # MA0004707	SEGMENT MA34-05
CEEMI is authorized (MA0004707 issued in November 2004) to discharge the following from the West Springfield Station (coal/oil fired power plant) to the Connecticut River: Outfall #001: 1.1 MGD daily maximum of once through cooling water for the two combustion turbine generator (CTG) unit's lube oil cooling systems combined with the CTG's sandfilter backwash water. The maximum daily temperature shall not exceed 91°F, and the temperature rise from the inlet shall not exceed 20°F. Outfall #002A: 69 MGD of once through condenser cooling water for Unit 3 steam turbine generator combined with Unit 3's sandfilter backwash water and the hydrogen booster pumps cooling water from 15 April to 31 October. The maximum daily temperature shall not exceed 112°F, and the temperature rise from the inlet shall not exceed 37°F. The TRC limit is 0.13 and 0.2 mg/L (average monthly and daily maximum, respectively during chlorination events). Outfall #002B: 69 MGD of once through condenser cooling water for Unit 3 steam turbine generator combined with Unit 3's sandfilter backwash water and the hydrogen booster pumps cooling water from 1 November to 14 April. The maximum daily temperature shall not exceed 100°F, and the temperature rise from the inlet shall not exceed 48°F. The TRC limit is 0.13 and 0.2 mg/L (average monthly and daily maximum, respectively during chlorination events). Outfall #005: intake screen wash. Outfall #006: stormwater from electric control room roof drains and yard areas (including parking lot, Outfall #010: CTG's sandfilter backwash water, and Outfall #020: Unit 3's sandfilter backwash water. Annual reports must be submitted detailing hourly intake and discharge temperature monitoring, net heat load, amount of water discharged. Biological and thermal monitoring studies to evaluate the effects of West Springfield Station's discharge on the balanced, indigenous population of shellfish, fish and wildlife in an on the Connecticut River and the effectiveness of location, design, construction, and capacity of the cooling water intake structure to minimize adverse environmental effects are also required. Ichthyoplankton (fish eggs and larvae) occurrence and abundance of species entrained and in a transect of the Connecticut River upstream from the Station, and finfish occurrence and abundance of species impinged		

PERMITTEE Town of Deerfield	NPDES # MA0101648	SEGMENT MA34-04
The Town of Deerfield is authorized (MA0101648 issued in January 2007) to discharge from the South Deerfield Wastewater Treatment Plant a flow of 0.85 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L (daily maximum). (These same limits and monitoring requirements were in the August 2000 permit.) Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from <0.1 to 9.6 mg/L while TRC concentrations were all <0.050 mg/L (n=16).		

PERMITTEE Town of Easthampton	NPDES # MA0101478	SEGMENT MA34-04
The Town of Easthampton is authorized (MA0101478 issued in September 2007) to discharge from the Easthampton Wastewater Treatment Plant (WWTP) a flow of 3.8 MGD average monthly of treated sanitary and industrial wastewater via Outfall #001 and #002 to the Connecticut River and the Manhan River, respectively. In the recently issued permit the facility's whole effluent toxicity limits are as follows: Outfall 001: $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> in June and September. The TRC limit between 1 April and 30		

November is 1.0 mg/L (average monthly and daily maximum).

Outfall 002: $LC_{50} \geq 100\%$ effluent and CNOEC report only using *C. dubia* in March and December. The TRC limit between 1 April and 30 November is 0.05 mg/L (average monthly and daily maximum).

Ammonia-nitrogen concentrations reported for Outfall 001 in the whole effluent toxicity reports submitted between June 2000 and December 2006 ranged from 0.462 to 19mg/L (n=15), while TRC concentrations were ≤ 0.32 mg/L (n=15). According to the fact sheet of the NPDES permit "The main effluent pipe is approximately 2.1 miles long and discharges to the Connecticut River by gravity. The outfall is located near shore, just downstream of the confluence of the Connecticut and Manhan Rivers. During periods when discharge flows exceed the capacity of Outfall #001, flow is discharged to the Manhan River through Outfall #002. The hydraulic capacity of Outfall #001 varies based on the hydraulic regime in the Connecticut River. For example, the permittee estimates that the peak capacity is 3.1 MGD at normal river level (101 ft.), 2.7 MGD at the ten-year flood level and 1.2 MGD at the 50-year flood level (124 ft.)...during the summer months with no discharges from Outfall #002, the maximum daily flows (as opposed to the peak capacities listed above), as measured by the plant's influent flow meter, are about 2 MGD, indicating that the maximum daily flow capacity of Outfall #001 at normal river stage is about 2 MGD".

PERMITTEE FirstLight Hydro Generating Company	NPDES # MA0035521	SEGMENT MA34-03
Cabot Station (hydropower project): The FirstLight Hydro Generating Company (formerly the NE Hydro Generating Company and the Northeast Generation Company (NGC) is authorized (MA0035521 issued in September 1996) to discharge from the Cabot Station, sump pump discharge via Outfall #001; groundwater drain pipe discharge via Outfall #002; transformer cooling pit discharge via Outfall #003; six pit drain discharge via Outfall #004; three floor drain discharge via Outfall #005; two sump discharges via Outfall #006; and generator water seal leakage via Outfall #007 to the Connecticut River.		

PERMITTEE FirstLight Hydro Generating Company	NPDES # MA0035530	SEGMENT MA34-02
Northfield Mountain Station (a pump storage hydropower project): The FirstLight Hydro Generating Company (formerly the NE Hydro Generating Company and the Northeast Generation Company - NGC) is authorized (MA0035530 issued in September 1996) to discharge the following from the Northfield Mountain Station to the Connecticut River: Outfall #001: floor and associated drain water; Outfall #002: non-contact cooling water in heat exchanger for transformer, bearing cooling, liquid rheostat cooling, oil coolers, and generator coolers.		

PERMITTEE Town of Hadley	NPDES # MA0100099	SEGMENT MA34-04
The Town of Hadley is authorized (MA0100099 issued in April 2006) to discharge from the Hadley Wastewater Treatment Plant (WWTP) a flow of 0.54 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's acute whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L daily maximum. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and June 2006 ranged from <0.1 to 13 mg/L (n=12) while TRC concentrations were all <0.05 mg/L (n=12).		

PERMITTEE Hampden Papers, Inc.	NPDES # MAG250881	SEGMENT MA34-05
Hampden Papers, Inc. is authorized (MAG250881 issued September 2000) to discharge 0.22 MGD (maximum daily) of non-contact cooling water via Outfalls 002 and 003 to the Connecticut River. The facility reports the maximum daily temperature doesn't exceed 79°C while pH is in the range of 7.3 to 7.9 SU. The source of water for the facility is municipal. TRC concentrations in the discharge ranged from 0.24 to 1.0 mg/L according to DMRs submitted in 2007.		

PERMITTEE Town of Hatfield	NPDES # MA0101290	SEGMENT MA34-04
The Town of Hatfield is authorized (MA0101290 issued in April 2006) to discharge from the Hatfield Wastewater Treatment Plant a flow of 0.5 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L (daily maximum). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between May 2001 and October 2006 ranged from 5.2 to 45 mg/L (n=12) while TRC concentrations ranged from 0.01 to 0.42 mg/L (n=12).		

PERMITTEE Hazen Paper Company	NPDES # MAG250872	SEGMENT MA34-05
Hazen Paper Company is authorized (MAG250872 issued September 2000) to discharge an average monthly flow of 0.258 MGD of non-contact cooling water via Outfall #001 and 0.09 MGD of non-contact cooling water via Outfall #002 to the Connecticut River. The facility DMR reports for 2007 that the maximum daily temperature didn't exceed 71.2°C while pH was in the range of 7.5 to 7.9 SU. The source of water for the facility is four private wells.		

PERMITTEE Hercules, Inc.	NPDES # MAG250848	SEGMENT MA34-05
Hercules, Inc. is authorized (MAG250848 issued in January 2001) to discharge 0.2 MGD (maximum daily) of non-contact cooling water to the Connecticut River via Outfall 001. The facility reports the maximum daily temperature doesn't exceed 77°C while pH is in the range of 7.1 to 8.2 SU. The source of water for the facility is municipal. TRC concentrations in the discharge ranged from 0.49 to 0.56 mg/L according to DMRs submitted in 2007.		

PERMITTEE City of Holyoke	NPDES # MA0101630	SEGMENT MA34-05, MA34-04
The City of Holyoke is authorized (MA0101630 issued in September 2000) to discharge treated effluent from the Holyoke Department of Public Works an average monthly flow of 17.5 MGD via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 100\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis. The TRC limit between 1 April and 31 October 31 is 0.74 and 1.00 mg/L (average monthly and daily maximum, respectively). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from 1.13 to 12.7 mg/L (n=29). The permit also authorizes the discharge of stormwater/wastewater via combined sewer overflows during wet weather into the Connecticut River and the Holyoke Canal as described below: Connecticut River upstream from the Holyoke Dam (Segment MA34-04) Outfall 021: River Terrace. Note this discharge reduced to 28 Million Gallons/year from 58 MGY by the Green Brook Separation Project completed late 2001/early 2002. Outfall 020: Cleveland Street. Outfall 023: Jefferson Street to a "dingle" at this site, which doesn't appear to reach the Connecticut River. Outfall 019: Yale Street. Outfall 018: Walnut Street Combined sewer overflows to the Connecticut River downstream from the Holyoke Dam (Segment MA34-05) Outfall 014: Mosher Street. Note this outfall was eliminated in 2005. The Mosher Street Sewer Separation Project eliminated an estimated 31 Million Gallons/year. Outfall 013: Appleton Street. Outfall 011: Jackson Street Outfall 009: Berkshire Street. The Berkshire Street Screening and Disinfection Facility Project was completed in October 2007 (treating an estimated 270 Million Gallons/year). Outfall 008: Springdale Park. Outfall 007: Northampton Street/Glen Street. Outfall 003: Jones Ferry Road Outfall 002: Providence Hospital Combined sewer overflows to the Holyoke Canal: Outfall 016: Front Street/Appleton Street - First Level Canal		

PERMITTEE Holyoke Gas and Electric Department (HG&E)	NPDES # MA0001520, MA0035866, MA0035882, MA0035874, MA0035564	SEGMENT Holyoke Canal System to MA34-05
The Holyoke Gas & Electric Department (HG&E) is authorized (MA0001520 issued in December 2005) to discharge the following from the Cabot Street Station (gas/oil fired power plant) to the Holyoke Canal System: Outfall #001 - 10.8 MGD average monthly and 23.0 MGD daily maximum of condenser cooling water from Units 6, 8, and 9, the maximum daily temperature shall not exceed 102°F, and the temperature rise from the inlet shall not exceed 30°F. The permit also requires that a modified acute and chronic whole effluent toxicity test be conducted once during the permit cycle using both <i>C. dubia</i> and <i>P. promelas</i> as test species. The facility operates a full depth fish excluder system (FES) located near the headgates of the canal system to minimize impacts from the cooling water intake structure (CWIS). The permit also requires rotation and inspection of the CWIS intake screens and reports to the Department in the event of a fish kill/impingement event. Thermal sampling in the canal and Connecticut River in July/August during a four-hour period of electricity production on one day was also required. Outfall #002 – 0.025 MGD average monthly (0.1 MGD daily maximum) of neutralization tank wastewater. The permit also authorizes the discharge of two internal outfalls (004 and 005) to outfalls 001 and/04 002. HG&E is also authorized (MA0035564, MA0035882, MA0035866, and MA0035874 issued September 1996) to discharge from four stations (hydropower projects) to the Holyoke Canal. These permits were transferred to HG&E from Holyoke Water Power Company in December 2001. <u>Riverside Station:</u> Outfall #001 bearing cooling water, Outfall #002 flood water pump, Outfall #004 sump pump, and Outfall #005 bearing cooling water for Unit 7. <u>Hadley Falls Station:</u> Outfall #002 generator cooler for Unit 1, Outfall #003 thrust bearing oil cooler, Outfall #004 wheel pit sump, Outfall #005 station service pump for Unit 1, Outfall #006 dewatering sump, Outfall #007 wheel pit sump with oil/water separator, and Outfall #008 generator cooler for Unit 2. <u>Chemical Station:</u> Outfall #001 turbine bearing cooling water. <u>Boatlock Station:</u> Outfall #001 bearing cooling water, and Outfall #002 thrust bearing cooling water. Note: there are two additional stations, Skinner and Beebe-Holbrook, with unpermitted waterwheels prior to the Riverside Station which should be permitted.		

PERMITTEE Intelicoat Technologies, LLC	NPDES # MAG250968	SEGMENT MA34-05
Intelicoat Technologies, LLC in South Hadley is authorized (MAG250968 issued June 2001 formerly permitted to Rexam Image Products) to discharge 0.082 MGD average monthly of non-contact cooling water to Buttery Brook. The source of water for the facility is the Water Department Fire District 1. The facility conducted modified acute and chronic toxicity tests on two flow weighted composite samples of their ten outfalls (reported as Outfall 001 "upstream" and Outfall 002 "downstream"). No acute or chronic toxicity to <i>C. dubia</i> was detected in the tests conducted in July 2001. Survival of <i>C. dubia</i> exposed (7-day) to water collected from Buttery Brook was 100%.		

PERMITTEE JP Elastomerics Corporation	NPDES # MA0001503	SEGMENT MA34-15
JPS Elastomerics – Stevens Urethane, Hampshire Plant MA0001503 issued September 2004 for the discharge of contact and non-contact cooling water via Outfall #001 a wetland to Wilton Brook. The flow limit is 0.020 MGD daily maximum. The facility was required to conduct a whole effluent toxicity test in September (limits are $LC_{50} \geq 100\%$ and $C-NOEC \geq 100\%$ effluent) using <i>C. dubia</i> as a test species. The TRC limit is 0.011 mg/L average monthly and 0.019 mg/L daily maximum.		

PERMITTEE Town of Montague	NPDES # MA0100137	SEGMENT MA34-04, MA34-03
The Town of Montague is authorized (MA0100137 issued in November 2000) to discharge from the Montague Water Pollution Control Facility a flow of 1.83 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis. The TRC limit between April 1 and October 31 is 1.0 mg/L daily maximum. The maximum TRC measurement reported in the whole effluent toxicity reports between August 2000 and September 2006 was 0.15 mg/L (n=15). Ammonia-nitrogen concentrations in the effluent during this time ranged from 0.16 to 2.9 mg/L (n=15). The facility also has two regulators that remain. Outfall #01 is located near Greenfield Road. Outfall #02 reportedly discharges to the Connecticut River Segment MA34-03 and receives overflows from two regulator structures located in Avenue A and at 7 th and L Streets in Turners Falls. A long-term CSO control plan was approved in March 2005. Work should be completed by the end of 2008 which will reduce or eliminate the CSO discharges.		

PERMITTEE Mt. Tom Generating Company, LLC	NPDES # MA0005339	SEGMENT MA34-04
The Mt. Tom Generating Company, LLC is authorized (MA0005339 issued in September 1992) (formerly permitted to the Holyoke Water Power Company prior to 1 November 2006) to discharge the following to the Connecticut River from the Mt. Tom Station (coal fired power plant): Outfall #001 - 133.2 MGD average monthly/daily maximum for two pump operation, or 70.0 MGD average monthly/ daily maximum for one pump operation of once through cooling water with a maximum total residual oxidant (TRO) of 0.15 mg/L (both chlorine and bromine are used for biofouling) when in use, and a maximum temperature of 39°C(102°F). The temperature rise from the inlet during two pump operation shall not exceed 11.1°C(20°F) and during one pump operation shall not exceed 17.7°C(32°F). Outfall #002 - 0.216 MGD average monthly (0.36 MGD daily maximum) of wastewater treatment plant effluent; Outfalls #003, 004, 007, and 009A – stormwater runoff; Outfall #005 - 0.71 MGD (normal) daily maximum or 1.074 MGD (with intermittent fire pump uses) daily maximum of screen wash and service water tank overflow; Outfall #006 - 0.144 MGD daily maximum reflecting pool overflow; Outfalls #008 and #009 – 0.25 MGD average monthly (0.30 MGD daily maximum) bottom ash transport water; Outfalls #010 and #011 - 1.0 MGD average monthly (1.2 MGD daily maximum) fly ash transport water No biological monitoring was required in the permit other than to report any unusual numbers (twice the average) of fish impinged on the intake.		

PERMITTEE City of Northampton	NPDES # MA0101818	SEGMENT MA34-04
The City of Northampton is authorized (MA0101818 issued in May 2002) to discharge from the Northampton Wastewater Treatment Plant a flow of 8.6 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River and #002 to the Mill River bed when the Connecticut River is in high flow stage. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L average monthly and daily maximum. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between November 2000 and September 2007 ranged from 0.81 to 23 mg/L (n=15) while TRC concentrations ranged from <0.02 to 0.39 mg/L (n=14).		

PERMITTEE City of Northampton	NPDES # MAG640034	SEGMENT MA34056
The City of Northampton is authorized (MAG640034 issued in May 2003) to discharge from the Northampton Water Treatment Facility 0.82 MGD average monthly of treated filter backwash water as supernate overflow from settling lagoons into Mountain Street Reservoir. This facility was supposed to go on-line in August 2005.		

PERMITTEE Town of Northfield	NPDES # MA0100200	SEGMENT MA34-01
The Town of Northfield is authorized (MA0100200 issued in May 2002) to discharge from the Town of Northfield Wastewater Treatment Facility a flow of 0.275 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis (testing required in May and August each year). The Total Residual Chlorine (TRC) limit between 1 April and 31 October is 1.0 mg/L (both average monthly and daily maximum). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and August 2007 ranged from <0.100 mg/L to 21.400 mg/L (n=15). TRC concentrations reported in the whole effluent toxicity reports between August 2000 and August 2007 are <0.050 mg/L to 0.360 mg/L (n=15).		

PERMITTEE Northfield Mount Hermon School	NPDES # MA0032573	SEGMENT MA34-02
The Northfield Mount Hermon School is authorized (MA0032573 issued in September 2005) to discharge from their facility in Gill a flow of 0.45 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on an annual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L average monthly and daily maximum. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from 0.47 to 21mg/L (n=14) while TRC concentrations ranged from 0.02 to 0.42 mg/L (n=14).		

PERMITTEE Omniglow Corporation	NPDES # MAG250010	SEGMENT MA34-05
Omniglow Corporation of West Springfield is authorized (MAG250010 issued February 2001) to discharge 500 gallons per day of non-contact cooling water to the Connecticut River. The source of water for the facility is municipal.		

PERMITTEE Pro Corporation - PMC	NPDES # MAG250741	SEGMENT MA34-28
Pro Corporation – PMC of Florence is authorized (MAG250741 issued November 2002) to discharge 0.108 MGD of non-contact cooling water to Mill River - Northampton. The source of water for the facility is municipal.		

PERMITTEE Raytor Compounds, Inc.	NPDES # MAG250960	SEGMENT MA34-28
Raytor Compounds, Inc. (formerly Perstorp Compounds, Inc.) in Florence is authorized (NPDES permit #MAG250960 issued January 2006) to discharge 0.05 MGD (daily maximum) of non-contact cooling water to Mill River - Northampton. The source of water for the facility is municipal or an on-site well.		

PERMITTEE Red Wing Meadow Trout Hatchery	NPDES # MA0027880	SEGMENT MA34-41
The Red Wing Meadow Trout Hatchery was authorized (MA0027880 issued in April 2002) to discharge from the facility a flow of 1.44 MGD daily maximum of treated effluent via Outfall #001 to Sawmill River. The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ and $C-NOEC \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis when formalin is used. The limit for TRC is 0.022 and 0.038 mg/L (average monthly and daily maximum, respectively). According to EPA the permit was terminated in January 2005 because the facility went out of business.		

PERMITTEE South Deerfield Water Supply District	NPDES # MAG640005	SEGMENT Tributary to MA34-24
South Deerfield Water Supply District (MAG640005 issued April 2002) discharges approximately 0.04 MGD of effluent from the Roaring Brook Reservoir Water Treatment Facility to the Roaring Brook Reservoir outlet stream a tributary to the Mill River - Hatfield. Because of their low dilution factor, the facility was required to conduct a whole effluent toxicity test using <i>C. dubia</i> in September 2002.		

PERMITTEE Town of South Hadley	NPDES # MA0100455	SEGMENT MA34-05, MA34-19
The Town of South Hadley is authorized (MA0100455 issued in June 2006) to discharge from the South Hadley Wastewater Treatment Plant (WWTP) a average monthly flow of 4.2 MGD of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>C. dubia</i> as a test species on a biannual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L average monthly and 1 daily maximum. The facility is also authorized to discharge stormwater/wastewater from combined sewer overflows during wet weather via Outfall 004 at Main Street South Hadley to the Connecticut River, from Outfall 010 at the Stonybrook Pump Station to Stony Brook (MA34-19), and via Outfall 012 at Gaylord Street to Buttery Brook. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from 0.45 to 31.7 mg/L (n=15) while TRC concentrations ranged from <0.02 to 0.28 mg/L (n=15).		

PERMITTEE Southworth Company Turners Falls Mill	NPDES # MA0005011	SEGMENT MA34-03
The Southworth Company Turner Falls Mill (formerly Esleek Manufacturing Company, Inc.) is authorized (MA0005011 issued in September 2007) to discharge from their Turner Falls Mill facility on Canal Street. The permit authorizes the discharge of treated process wastewater to the Turners Falls Power Canal via Outfall #001 and power generation water (pass through from the Turners Falls Power Canal) and non-contact cooling water via Outfall #002 to the Connecticut River. The new permit requires quarterly whole effluent toxicity testing ($LC_{50} \geq 50\%$ effluent limit) using <i>C. dubia</i> as a test species on the treated process wastewater discharge. The prior permit required testing three times per year with an $LC_{50} \geq 50\%$ effluent limit and a chronic report only requirement. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between July 2000 and October 2007 ranged from <0.1 to 4.7 mg/L (n=25) while TRC concentrations ranged from 0.02 to 0.08 mg/L (n=26) with only one measurement >0.05 mg/L. The new permit requires that Best Technology Available for Cooling Water Intake Structure (CWIS) be implemented to minimize adverse environmental effects, all live fish and other aquatic organisms impinged, entrained, or trapped on or in the CWIS shall be returned to the power canal or Connecticut River by means to maximize their survival. Additionally, a CWIS Monitoring Program shall be implemented and an Annual CWIS Biological Monitoring Report shall be submitted to EPA and MassDEP.		

PERMITTEE Springfield Water and Sewer Commission	NPDES # MA0101613	SEGMENT MA34-05
The Springfield Water and Sewer Commission is authorized (MA0101613 issued in December 2000) to discharge an average monthly of 67 MGD of treated effluent from the Regional Waste Water Treatment Facility via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 100\%$ effluent using <i>C. dubia</i> as a test species on a quarterly basis. The TRC limit between 1 April and 31 October is 0.22 mg/L average monthly and 0.38 mg/L average weekly. Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from <0.1 to 2.8 mg/L (n=28).		

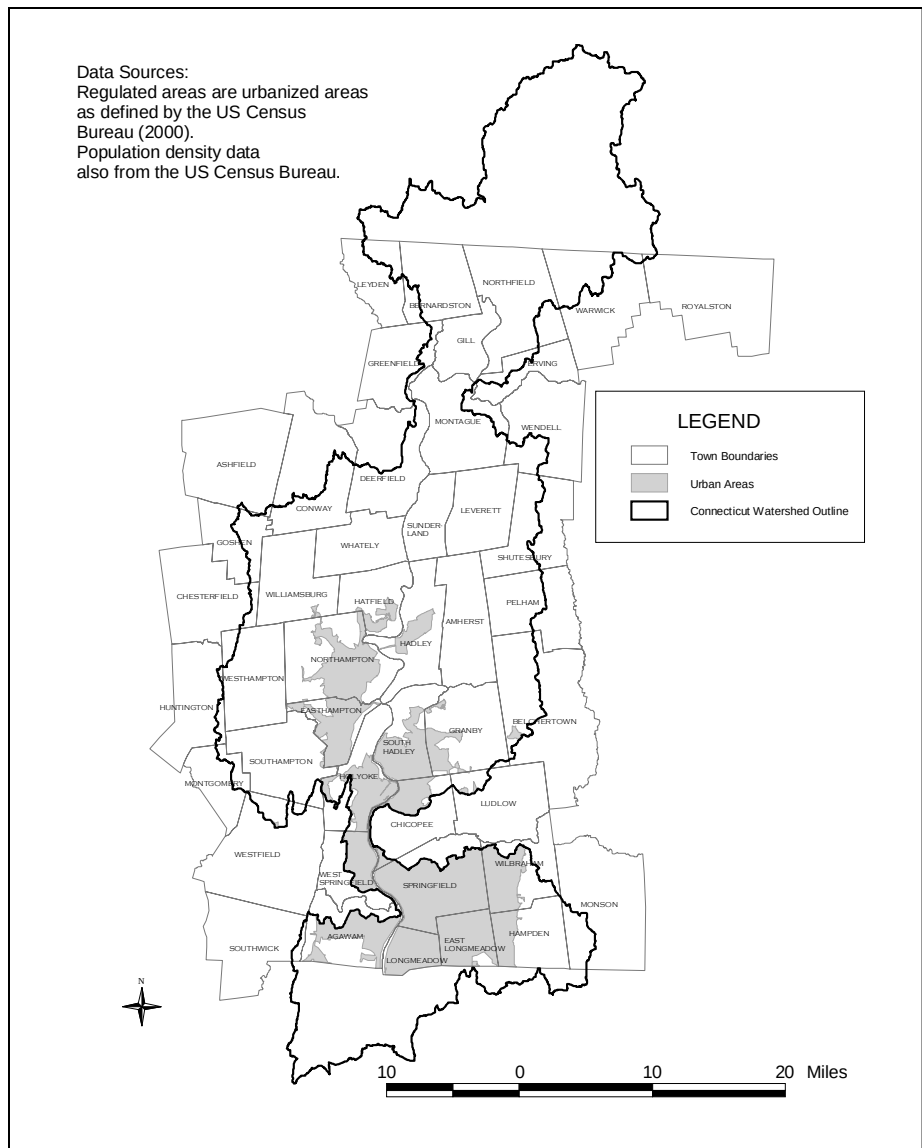
PERMITTEE Springfield Water and Sewer Commission	NPDES # MA0103331	SEGMENT MA34-29/34-05
The Springfield Water and Sewer Commission is authorized (MA0103331 issued in June 2003) to discharge from their facility, combined sewer overflow discharges to the following receiving waters: Connecticut River (MA34-05) outfalls: #007 (Rowland Street), #008 (Washburn Street), #010 (Clinton Street), #011 (Liberty Street), #012 (Worthington Street), #013 (Bridge Street), #014 (Elm Street), #015 (Union Street), #016 (York Street), #018 (Longhill Street), and #049 (Springfield Street). The North End sewer separation project (CSOs 007 and 049) to eliminate an estimated 65 Million Gallon/year is currently in the design phase and is anticipated to be completed in 2011. Mill River- Springfield (MA34-29) outfalls: #017 (Fort Pleasant Ave. and Blake Hill), #019 (Mill, Orange, and Locust Streets), #024 (Rifle and Central Streets), #025 (Allen and Oakland Streets), #045 (Fort Pleasant Avenue), #046 (Belmont Street), and #048 (Allen and Rifle Streets). Mill River Project completed in December 2003 eliminating an estimated 60 Million Gallons/Year.		

PERMITTEE Town of Sunderland	NPDES # MA0101079	SEGMENT MA34-04
The Town of Sunderland is authorized (MA0101079 issued in June 2006) to discharge from the Sunderland Wastewater Treatment Plant (WWTP) a flow of 0.5 MGD average monthly of treated effluent via Outfall #001 to the Connecticut River. The facility's whole effluent toxicity limit is $LC_{50} \geq 50\%$ effluent using <i>Pimephales promelas</i> as a test species on a biannual basis. The TRC limit between 1 April and 31 October is 1.0 mg/L (daily maximum). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and September 2007 ranged from 0.37 to 23mg/L (n=15) while TRC concentrations ranged from <0.05 to 0.6 mg/L (n=15).		

PERMITTEE University of Massachusetts	NPDES # MA0032689	SEGMENT Tributary to MA34-27
The University of Massachusetts is authorized (MA0032689 issued in December 2003) to discharge from the Coal Storage and Handling Facility a flow of 50 GPM daily maximum of stormwater treatment of runoff from coal pile via Outfall #001 to Taylor Brook. The facility is required to update and implement their stormwater pollution prevention plan (SWPPP). Ammonia-nitrogen concentrations reported in the whole effluent toxicity reports between August 2000 and April 2005 ranged from <0.01 mg/L to 0.260 mg/L (n=15). TRC concentrations ranged from <0.020 to 0.12 mg/L (n=15), however only one measurement was above the minimum quantification level of 0.05 mg/L. <u>Ambient</u> The University of Massachusetts staff collected water approximately 100 yards above where the ditch runs into Taylor Brook, which flows into Fort River, for use as dilution water in the facility's whole effluent toxicity tests. Between August 2000 and April 2005, survival of <i>C. dubia</i> exposed (48 hours) to Taylor Brook ranged from 90 to 100% (n=15). Between August 2000 and April 2005, survival of <i>P. promelas</i> exposed (48 hours) to the Taylor Brook water ranged from 98 to 100% (n=15). Hardness ranged from 25 to 80mg/L (n=15).		

STORMWATER

The NPDES Phase II General Permit program requires NPDES permit coverage for stormwater discharges from small municipal separate storm sewer systems (MS4s), and construction activity disturbing one acre or more of land in a mapped "urbanized area" defined and delineated by the US Bureau of Census in 2000 (<http://www.epa.gov/npdes/pubs/fact2-2.pdf>). Large and medium MS4s (populations over 100,000) were permitted during Phase I of the NPDES stormwater program. Under EPA's Phase II Program, the definition of "municipal" includes Massachusetts communities, U.S. military installations, state or federal owned facilities such as hospitals, prison complexes, state colleges or universities and state highways. An MS4 is a system that: discharges at one or more point sources; is a separate storm sewer system (not designed to carry combined stormwater and sanitary waste water); is operated by a public body; discharges to the Waters of the United States or to another MS4; and, is located in an "Urbanized Area". The NPDES Phase II General Permit requires operators of regulated MS4s to develop and implement a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system which is subsequently discharged into local waterbodies. The NPDES Stormwater Phase II General Permit requires operators of regulated small municipal separate storm sewer systems (MS4s) to develop a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system, and then discharged into local waterbodies. Certain Massachusetts communities were automatically designated (either in full or part) by the Phase II rule based on the urbanized area delineations from the 2000 U.S. Census.



As a result of the census mapping, 19 communities in the Connecticut River Watershed were located either totally or partially in the regulated Urbanized Area (see Table H5). All of these communities applied to EPA and MassDEP for coverage under the Phase II stormwater general permit, issued on 1 May 2003, with the exception of the Town of Williamsburg, which received a waiver of the Phase II stormwater requirements on May 16, 2003 since the area subject to jurisdiction has a population under 1,000 and otherwise satisfies the criteria identified at 40 CFR 123.35(d) 1. Municipalities that are totally regulated must implement the requirements of the Phase II permit in the entire town, while communities that are partially regulated need to comply with the Phase II permit only in the mapped Urbanized Areas. Phase II stormwater general permits will expire on 1 May 2008 (Domizio 2004). For detailed community maps see <http://www.epa.gov/region01/npdes/stormwater/ma.html>.

Table H5. NPDES Phase II stormwater permit information for the Connecticut River Watershed communities.

Community	Permit #	Permit Issued	Mapped Regulatory area in community
Agawam	MAR041001	8/22/2003	Partial
Belchertown	MAR041002	9/12/2003	Partial
Chicopee	MAR041003	9/4/2003	Partial
EastLongmeadow	MAR041005	10/16/2003	Partial
Easthampton	MAR041110	9/12/2003	Partial
Granby	MAR041007	10/2/2003	Partial
Hadley	MAR041008	9/3/2003	Partial
Hampden	MAR041009	9/12/2003	Partial
Hatfield	MAR041010	9/15/2003	Partial
Holyoke	MAR041011	10/2/2003	Partial
Longmeadow	MAR041013	10/31/2003	Total
Ludlow	MAR041014	10/16/2003	Partial
Northampton	MAR041016	9/12/2003	Partial
South Hadley	MAR041020	9/19/2003	Partial
Southampton	MAR041021	10/3/2003	Partial
Springfield	MAR041023	9/12/2003	Total
West Springfield	MAR041024	9/18/2003	Total
Wilbraham	MAR041025	10/7/2003	Partial
Williamsburg	waiver10		

Information about other general stormwater NPDES permittees are available online at:
<http://cfpub.epa.gov/npdes/stormwater/noi/noisearch.cfm>.

LITERATURE CITED

Domizio, L. 2004. *Stormwater permitting information Phase II Communities*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA. Personal Communication.

APPENDIX G

MassDEP DWM 2002 Fish Toxics Monitoring in the Connecticut River Watershed

INTRODUCTION

Fish contaminant monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection (MassDEP) Divisions/Offices (Watershed Management (DWM), Environmental Analysis, and Research and Standards), the Massachusetts Department of Fish and Game, and the Massachusetts Department of Public Health (MA DPH). Fish contaminant monitoring is designed to screen the edible fillets of several species of fish desired by the angling public for consumption, as well as species representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals (Pb, Cd, Se, Hg, As), polychlorinated biphenyls (PCBs), and organochlorine pesticides. These data are used by the MA DPH in assessing human health risks associated with the consumption of freshwater fishes.

In the Connecticut River Watershed fish contaminant monitoring surveys were conducted by MassDEP DWM staff in Lower Mill Pond in Easthampton in 2002. The objective of these surveys was to screen the edible fillets of fishes for potential contaminants (e.g., selected metals, PCBs and organochlorine pesticides). All results were submitted to the MA DPH for review.

Project Objectives

Fish contaminant monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority and, therefore, fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom-dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, PCBs and chlorinated pesticides.

Fish toxics monitoring conducted in 2002 followed guidance in the Quality Assurance Project Plan (QAPP) for Fish Toxics Monitoring (MassDEP 2003). Data quality objectives are presented in the above-mentioned QAPP.

METHODS

Field Methods

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish (MassDEP 2003 and MassDEP 2005). The characteristics of each site determine the method(s) of sample collection. Lower Millpond was sampled by DWM using boat electrofishing and trot line collection methods. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody and collecting most fish shocked. Fish collected by electrofishing were stored in a live well filled with site water until the completion of sampling. Fish to be included in the sample were stored on ice and transported to the DWM laboratory in Worcester.

DWM Laboratory Methods (Sample processing)

Fish brought to the MassDEP DWM laboratory in Worcester were processed using protocols designed to assure accuracy and prevent cross-contamination of samples (MassDEP 2003 and MassDEP 2005). Specimen lengths and weights were recorded along with notes on tumors, lesions, or other anomalies noticed during an external visual inspection. Species, length, and weight data can be found in Table G1. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR high density polyethylene (HDPE) cups with covers. Composite samples were composed of three fillets from like-sized individuals of the same species (occasionally the same genus). Samples were tagged and frozen for subsequent delivery to the MassDEP's Wall Experiment Station (WES).

WES Laboratory Methods (Analytical)

Mercury analysis were conducted using EPA Method 245.1. This is a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. All analyses for cadmium, lead and selenium were conducted using EPA Method 200.7. Cadmium and lead were analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emission Spectrophotometer. Arsenic and selenium were analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption

Spectrophotometer. PCB arochlor, PCB congener, and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector “according to the modified AOAC 983.21 procedure for the analysis of PCB arochlors, congeners, and organochlorine pesticides” (Maietta *et al.* 2004). Additional information on analytical techniques used at WES is available from the laboratory.

RESULTS

Electrofishing at Lower Mill Pond in East Hampton on 6/6/02 resulted in the collection of three largemouth bass, three yellow perch, and three bluegill. Trotlines set overnight and retrieved on 6/7/02 resulted in the collection of three yellow bullhead. Additional species observed included pumpkinseed, chain pickerel, American eel, white perch, white sucker, and bowfin *Amia calva*.

All fish tissue data met DWM data quality objectives and passed quality control acceptance limits of the WES laboratory unless otherwise noted below (Maietta *et al.* 2004).

“Fish tissue data passed the QC acceptance limits of the WES laboratory. WES reported a number of lab-validated data with “qualification”. All but one of these “qualified” data points were for very low concentrations of either PCBs (Congeners and Arochlors) and/or organochlorine pesticides. One data point for arsenic at the detection limit was also qualified. The lab fortified matrix spike recovery for toxaphene was 50% resulting in “J” (estimated) qualification by WES. These QC data suggest potential poor recovery of toxaphene in samples. Lab accuracy estimates for metals (all analytes) using lab-fortified matrix samples were acceptable ranging from 80-112 % recovery except for two selenium samples at 126 and 128 % recovery and one lead sample at 130% recovery. QC sample recoveries were acceptable ranging from 83-117%. Lab accuracy estimates for metals (all analytes) using lab fortified blanks were acceptable ranging from 82 to 111 % recovery except for one lead sample at 128% recovery.

All quality assurance and quality control data are available from the laboratory upon request.

Fish toxics monitoring survey data can be found below in Table G1 (excerpted from Maietta *et al.* 2004).

Table G1. Analytical Results for 2002 Lower Millpond Fish Toxics Monitoring Survey. Results reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code ¹	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
Lower Mill Pond, Easthampton, Connecticut River Watershed													
LMF02-1	6/6/02	LMB	31.9	400	2002020 (L2002192-1)	<0.040	<0.20	0.33	<0.060	0.18	0.05	A1254-0.020J A1260-0.038J BZ#180-0.0048	DDE-0.0076J
LMF02-2	6/6/02	LMB	33.4	470	(L2002196-1)							BZ#170-0.0022J	
LMF02-3	6/6/02	LMB	32.3	420									
LMF02-4	6/6/02	YP	26.1	220	2002021 (L2002192-2)	<0.040	<0.20	0.12	<0.060	0.34	0.21	BZ#118-0.0012J	ND
LMF02-5	6/6/02	YP	25.6	200	(L2002196-2)								
LMF02-6	6/6/02	YP	25.7	210									
LMF02-7	6/6/02	B	20.4	160	2002022 (L2002192-3)	<0.040	<0.20	0.08	<0.060	0.22	0.12	A1260-0.025J BZ#118-0.0015J BZ#180-0.0042	DDE-0.0064J
LMF02-8	6/6/02	B	20.1	160	(L2002196-3)							BZ#170-0.0019J	
LMF02-9	6/6/02	B	19.4	150									
LMF02-10	6/7/02	YB	29.2	340	2002023 (L2002192-4)	<0.040	<0.20	0.12	<0.060	0.14	0.79	A1260-0.10 BZ#118-0.0035J BZ#180-0.020	Chlor ² -0.064J DDE-0.015J
LMF02-11	6/7/02	YB	24.7	220	(L2002196-4)							BZ#170-0.0034J	
LMF02-12	6/7/02	YB	27.0	260									

¹ Species Code Common Name Scientific name
 (B) bluegill *Lepomis macrochirus*
 (LMB) largemouth bass *Micropterus salmoides*
 (YB) yellow bullhead *Ameiurus natalis*
 (YP) yellow perch *Perca flavescens*

² - Chlordane

ND - not detected or the analytical result is at or below the established method detection limit (MDL).

J-estimated value, concentration <RDL or certain QC criteria not met

RDL = reporting detection limit

< = result not detected above method detection limit, unless otherwise noted

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Maietta, R. J., J. Ryder, and R.F. Chase. 2004. CN099.0. *2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.