83-AC-2

SHAWSHEEN RIVER WATERSHED

2000 WATER QUALITY ASSESSMENT REPORT

Bend in the river near Ballardvale

View from the Steven's Street Bridge in Andover

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
ELLEN ROY HERZFELDER, SECRETARY
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
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SHAWSHEEN RIVER WATERSHED

2000 WATER QUALITY ASSESSMENT REPORT

Prepared by:

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Department of Environmental Protection
Division of Watershed Management

Report Number:

83-AC-2

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Massachusetts Department of Environmental Protection
Division of Watershed Management
Worcester, Massachusetts

July 2003

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Data and information used in this report was provided in part by the following agencies and organizations:

State

- Massachusetts Executive Office of Environmental Affairs Shawsheen River Watershed Team
- Massachusetts Department of Environmental Protection (MADEP):
  - Division of Watershed Management (DWM)
  - Bureau of Resource Protection
  - Bureau of Strategic Policy and Technology, Wall Experiment Station
- Massachusetts Department of Public Health (MDPH)
- Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE)
  - Division of Fisheries and Wildlife
  - Riverways Program
- Massachusetts Department of Environmental Management (DEM)

Federal

- United States Environmental Protection Agency (EPA)
- United States Army Corps of Engineers (ACOE)
- United States Geological Survey (USGS)
  - Water Resources Division

Much appreciation is also extended to several MADEP employees for their contributions: Mark Casella, Jane Colonna-Romano, Ken Dominick, Laurie Kennedy, Rick McVoy, and Arthur Screpetis.

It is impossible to thank everyone who contributed to the assessment report process: field, laboratory, data management, writing, editing, and graphics, as well as meetings, phone calls, and many e-mails. All of these contributions are very much appreciated.

Cover photo credit: KD Talbot Photography Inc.

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ACOE	Army Corps of Engineers
ADB	Assessment Database
BMP	Best Management Practice
BPJ	Best Professional Judgment
CMR	Code of Massachusetts Regulations
CNOEC	Chronic No Observed Effect Concentration
CWA	Clean Water Act
DFWELE	Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement
DMR	Discharge Monitoring Report
DO	dissolved oxygen
DWM	Division of Watershed Management
DWP	Drinking Water Program
EPA	United States Environmental Protection Agency
HAFB	Hanscom Air Force Base
LC_{50}	lethal concentration to 50% of the test organisms
GIS	Geographical Information System
L-EL	Low effect level
MADEP	Massachusetts Department of Environmental Protection
MassGIS	Massachusetts Geographic Information System
MDL	Method detection limit
MDPH	Massachusetts Department of Public Health
MRWC	Merrimack River Watershed Council
MVPC	Merrimack Valley Planning Commission
NPDES	National Pollutant Discharge Elimination System
ORW	Outstanding Resource Waters
PALIS	Pond and Lake Information System
PCB	polychlorinated biphenyls
PWS	public water supply
QA/QC	quality assurance/ quality control
RBP	rapid bioassessment protocol
SARIS	Stream and River Inventory System
S-EL	severe effect level
SWQS	Surface Water Quality Standards
TMDL	total maximum daily load
TOC	total organic carbon
TOXTD	MADEP DWM Toxicity Testing Database
TRC	total residual chlorine
USGS	United States Geological Survey
WBID	Waterbody Identification Code
WBS	Waterbody System Database
WMA	Water Management Act
WWTP	waste water treatment plant

LIST OF UNITS

cfs	cubic feet per second
CFU	colony forming unit
gpd	gallons per day
MGD	million gallons per day
MPN	Most probable number
µg/kg	microgram per kilogram
mg/L	milligram per liter
ng	nanogram
NTU	nephelometric turbidity units
PPB	parts per billion
PPM	parts per million
SU	standard units

EXECUTIVE SUMMARY
SHAWSHEEN RIVER WATERSHED 2000
WATER QUALITY ASSESSMENT REPORT

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which surface waters in the Commonwealth 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 not assessed, as well as basic information needed to focus resource protection and remediation activities later in the watershed management planning process.

This assessment report presents a summary of current water quality data/information in the Shawsheen 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 1*)* ***support*** or 2) ***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 and ponds are currently ***unassessed***; 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 Assessment Database (ADB).

There are a total of 13 rivers, streams, brooks or creeks (the term "rivers" will hereafter be used to include all) assessed in this report in the Shawsheen River Watershed. These include the Shawsheen River and Kiln, Elm, Spring, Vine, Long Meadow, Sandy, Content, Strong Water, Meadow, Pinnacle, Rogers brooks, and one unnamed tributary. These assessments represent approximately 99% (59.3 miles) of the estimated total of 60.1 "named" river miles (including the unnamed tributary) in the watershed. The remaining rivers are small and they are currently unassessed. This report also includes information on 15 of the 20 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) in the Shawsheen River Watershed. The 15 lakes assessed in this report represent 438 acres of the 495 total lake acreage (or 88% of the lake acreage) in the Shawsheen River Watershed.

The status of the designated uses for these waterbodies is summarized in a segment format, which includes 16 river segments and 15 lake segments in the Shawsheen River Watershed.

AQUATIC LIFE USE

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* (impaired) may result from anthropogenic stressors that include point and/or nonpoint source(s) of pollution and hydrologic modification.

SHAWSHEEN RIVER WATERSHED:
***Aquatic Life Use* assessment for rivers**
(total length assessed in report – 59.3 miles)
- **Support – 5.7 miles (10%)**
- **Impaired – 6.7 miles (11%)**
- **Not Assessed – 46.9 miles (79%)**

***Shawsheen River Watershed – Aquatic Life Use* Summary**:
Only one river segment (Shawsheen River, MA83-17), representing 5.7 miles of the 59.3 river miles in the Shawsheen River Watershed included in this report, is assessed as supporting the *Aquatic Life Use* (Figure 1). The *Aquatic Life Use* is assessed as impaired for 11% (6.7 miles) of the total river miles. These impaired waterbodies include the following: the upper two segments of the mainstem Shawsheen River (MA83-08 and MA83-01; totaling 3.8 miles), the lower 2.3 miles of Elm Brook, and the middle 0.6 miles (culverted portion) of Rogers Brook. These impairments are a result of anthropogenic substrate alterations. The main source of impairment was attributed to hydromodification (channelization) although post development erosion, sedimentation and industrial/commercial site stormwater discharges are suspected. The majority (79%) of the river miles in the watershed included in this report are currently not assessed for this use.

Few lakes in the Shawsheen River Watershed have recently been surveyed for variables used to assess the status of the *Aquatic Life Use* (i.e., DO, pH, nutrients, macrophytes and plankton/chlorophyll *a*). None of the lakes in the Shawsheen River Watershed are assessed as support for the *Aquatic Life Use*. A majority (53%) of the lake acreage assessed for the *Aquatic Life Use* is impaired (Figure 1). The *Aquatic Life Use* is assessed as impaired for five lakes (Fosters, Gravel Pit, Long, Lowell Junction, and Pomps ponds) because of low DO saturation, high phosphate and chlorophyll a levels, excess algal growth, and/or presence of non-native aquatic vegetation including *Potamogeton crispus* (curly pondweed) and/or *Cabomba caroliniana* (fanwort). These two non-native aquatic plant species are particularly invasive and reproduce vegetatively. Therefore, they may spread readily downstream on currents or by mechanical transport. Low DO saturation occurred in two of the five impaired lakes (Long and Fosters ponds) and the excess algal growth and high phosphate and chlorophyll *a* levels occurred in only one (Long Pond) of the five impaired lakes. Ten lakes, representing 47% of the lake acreage in the Shawsheen River Watershed, are currently not assessed for the *Aquatic Life Use*.

SHAWSHEEN RIVER WATERSHED:
***Aquatic Life Use* assessment for Lakes**
(total acreage assessed in report 438 acres)
- **Impaired – 233 acres (53%)**
- **Not Assessed – 205 acres (47%)**

FISH CONSUMPTION USE

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 marketable fish or for the recreational 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, MDPH, Bureau of Environmental Health Assessment (MDPH 2002a). The MDPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species poses a health risk for human consumption; hence the *Fish Consumption Use* is assessed as non-support in these waters. In July 2001, MDPH issued new consumer advisories on fish consumption and mercury contamination (MDPH 2001). Because of these statewide advisories, no waters can be assessed as either support or partial support for the *Fish Consumption Use*; these waters default to "not assessed". The statewide advisories read as follows:

> The MDPH "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, MDPH 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 (MDPH 2001)." Additionally, MDPH "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 (MDPH 2001)." MDPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially.

***Fish Consumption Use* Summary**:

Because of elevated levels of mercury in edible portions of fish, MDPH has issued fish consumption advisories for three ponds and one portion of the mainstem in the Shawsheen River Watershed because of health concerns related to mercury (Figure 2). These waterbodies include: a portion of the Shawsheen River; Lowell Junction, Ames, Fosters, and Pomps ponds (a total of 271 acres and 1.1 river miles) (MDPH 2002a). Because of the statewide advisory (see previous page), the majority of the rivers and lakes in the Shawsheen River Watershed default to not assessed for the *Fish Consumption Use*. Sources of mercury in this area are currently unknown, although atmospheric deposition is suspected.

SHAWHSEEN RIVER WATERSHED:
***Fish Consumption Use* assessment for rivers**
(total length assessed in report – 59.3 miles)

- **Impaired – 1.1 miles (2%)**
- **Not Assessed – 58.2 miles (98%)**

***Fish Consumption Use* assessment for lakes**
(total area assessed in report 438 acres)

- **Impaired – 271 acres (62%)**
- **Not Assessed – 167 acres (38%)**

DRINKING WATER USE

The term *Drinking Water Use* has been 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.state.ma.us/dep/brp/dws/dwshome.htm). These waters are subject to stringent regulation in accordance with the Massachusetts Drinking Water Regulations. MADEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act. DWP has also initiated work on its Source Water Assessment Program (SWAP), 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 SWAP 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, MDPH and MADEP.

PRIMARY & SECONDARY CONTACT RECREATIONAL* AND *AESTHETIC USES

The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, pH, temperature, turbidity and aesthetics meet the SWQS) 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. 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, macrophyte cover and/or transparency (Secchi disk depth) data are assessed to evaluate the status of the recreational uses. 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.

Shawsheen River Watershed – Primary and Secondary Contact Recreational and Aesthetic Use
Summary:

The majority of the river miles (53%) are assessed as impaired for the *Primary Contact Recreational Use* (Figure 3). The entire length of Kiln, Vine, Spring, Strong Water, and Rogers brooks; the lower 2 miles of Elm Brook; and the lower 1.1 miles of Pinnacle Brook are all assessed as impaired for this use. The upper 5.9 miles of the Shawsheen River mainstem (from the headwaters in Bedford to Billerica) and the lower 5.8 miles of the Shawsheen River (before its confluence with the Merrimack River, Lawrence) are also assessed as impaired for the *Primary Recreational Contact Use.* These impairments are a result of elevated fecal coliform bacteria levels. The main source of impairment is attributed to stormwater discharges and municipal separate storm sewer systems.

SHAWSHEEN RIVER WATERSHED:
***Recreational* and *Aesthetic* Uses assessment for rivers**
(total length assessed in report – 59.3 miles)
Primary Contact Recreational Use
- **Support – 24.1 miles (41%)**
- **Impaired – 31.7 (53%)**
- **Not Assessed – 3.5 miles (6%)**

Secondary Contact Recreational Use
- **Support – 51.3 miles (86%)**
- **Impaired – 4.5 (8%)**
- **Not Assessed – 3.5 miles (6%)**

Aesthetics Use
- **Support – 0.5 miles (1%)**
- **Not Assessed – 58.8 miles (99%)**

A total of 24.1 river miles (41%) support this use. The upper 3 miles of Elm Brook and the entire length of Content Brook, Meadow Brook and an unnamed tributary all support this use. Additionally, the middle 16.2 miles of the Shawsheen River support the *Primary Contact Recreational Use*. A total of 3.5 miles are currently not assessed for this use.

The majority of the river miles (86%) are assessed as support for the *Secondary Contact Recreational Use* (Figure 4). The lower 1.1 miles of Pinnacle Brook, all of Rogers Brook and the upper 2.1 miles of the Shawsheen River (headwaters in Bedford) are assessed as impaired. Sources of impairment were primarily caused by elevated levels of fecal coliform bacteria. A total of 3.5 miles are currently not assessed for the *Secondary Recreational Use*. Only 0.5 miles of Rogers Brook was assessed as support for this use. The majority of the river miles (99%) are not assessed for the *Aesthetics Use* (Figure 5).

Due to a lack of fecal coliform bacteria data , 60% of the lake acreage was not assessed for the *Primary* and *Secondary Contact Recreational and Aesthetic* uses (Figures 3, 4 and 5). None of the lakes in the Shawsheen River Watershed are assessed as support for the *Primary* and *Secondary Contact Recreational and Aesthetic* uses. Two ponds (Long Pond, Tewksbury, and Fosters Pond, Andover), approximately 40% (174 acres) of the 438 acres in the Shawsheen River Watershed included in this report, are assessed as impaired for the *Primary* and *Secondary Contact Recreational and Aesthetic* uses. Causes of impairment include excess algal growth, overabundance of non-native aquatic plants, and Secchi disk depth measurement violations. Although sources are currently unknown, nutrient enrichment from stormwater runoff; failing, substandard, or inappropriately sited sewage disposal systems; and/or drainage from agricultural lands is likely to contribute to organic enrichment and algal blooms, resulting in impairments to these uses.

SHAWSHEEN RIVER WATERSHED:
***Recreational* and *Aesthetic* Uses assessment for lakes**
(total lake area assessed in report – 438 acres)
***Primary and Secondary Contact Recreational and Aesthetics* Uses**
- **Impaired – 174 acres (40%)**
- **Not Assessed – 264 acres (60%)**

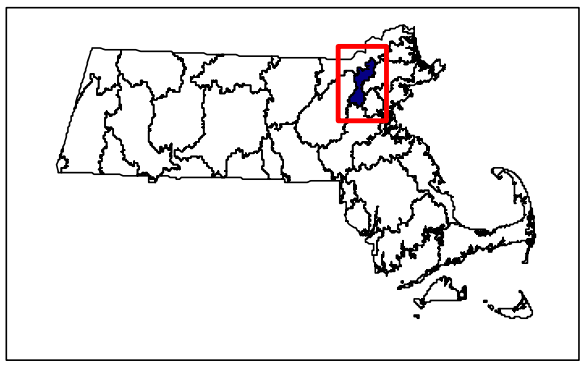
RECOMMENDATIONS

In addition to specific issues for the individual segments, the evaluation of current water quality conditions in the Shawsheen River Watershed has revealed the need for the following.

- Habitat quality evaluations should be conducted along streams/rivers to assess streamflow conditions as related to water withdrawals and/or flow management practices (e.g., outlet control operations). Collect additional data, where necessary, to determine the frequency, duration, and spatial extent of the low-flow conditions.
- Habitat quality evaluations should be conducted along streams/rivers to document areas of erosion and sedimentation. Develop and implement best management practices (BMPs) to control stormwater runoff.
- Work with the members of stream teams to conduct stream cleanups and encourage/strengthen local stewardship.
- Work with DFWELE to designate Cold Water Fishery resources in the Shawsheen River Watershed and incorporate them into the next revision of the Massachusetts SWQS.
- Continue to conduct biological and water quality monitoring to evaluate the effect(s), if any, of National Pollutant Discharge Elimination System (NPDES) discharges, water withdrawals, power plant operations, and nonpoint sources of pollution and to document any changes in water quality conditions as a result of infrastructure improvements/pollution abatement controls.
- Develop and reissue NPDES permits for surface water discharges in the Shawsheen River Watershed.
- As part of the Water Management Act (WMA) 5-year review process, MADEP should continue to evaluate compliance with registration and/or permit limits for withdrawals in the Shawsheen River Watershed. Work with water suppliers to optimize and implement water conservation measures to maintain and/or reduce water withdrawals as well as encourage the development and implementation of local watershed and wellhead protection plans.
- Coordinate with the DEM and/or other groups conducting lake and watershed surveys to generate quality assured lakes data. As part of any lake water quality evaluation, include identification of non-native species and mapping of macrophyte cover in order to evaluate the status of the *Aquatic Life*, *Recreational* and *Aesthetic* uses.
- Review data from "Beaches Bill" required water quality testing (bacteria sampling at all formal bathing beaches) to assess the status of the recreational uses.
- Review recommendations for long-term restoration/preservation from lake diagnostic/feasibility studies and watershed management plans and effect their implementation. Implement recommendations from the nutrient TMDL analysis currently being prepared by MADEP.
- Continue to implement recommendations from the Shawsheen Bacteria TMDL.
- Review and implement recommendations from EOEA's wetland restoration plan.
- Monitor and control the spread and growth of non-native aquatic and wetland vegetation. Determine the effectiveness of the herbicide treatment on the non-native, aquatic plant infestations. Prevent the further spread of these plants to unaffected areas (within this pond as well as to other ponds) by alerting pond-users to the problem and responsibility of spreading these non-native species. This should include posting of boat access points with educational warning signs.
- Implement the recommendations of the USAF Habitat TMDL.

SHAWSHEEN RIVER WATERSHED

Aquatic Life Use Assessment Summary – Rivers and Lakes



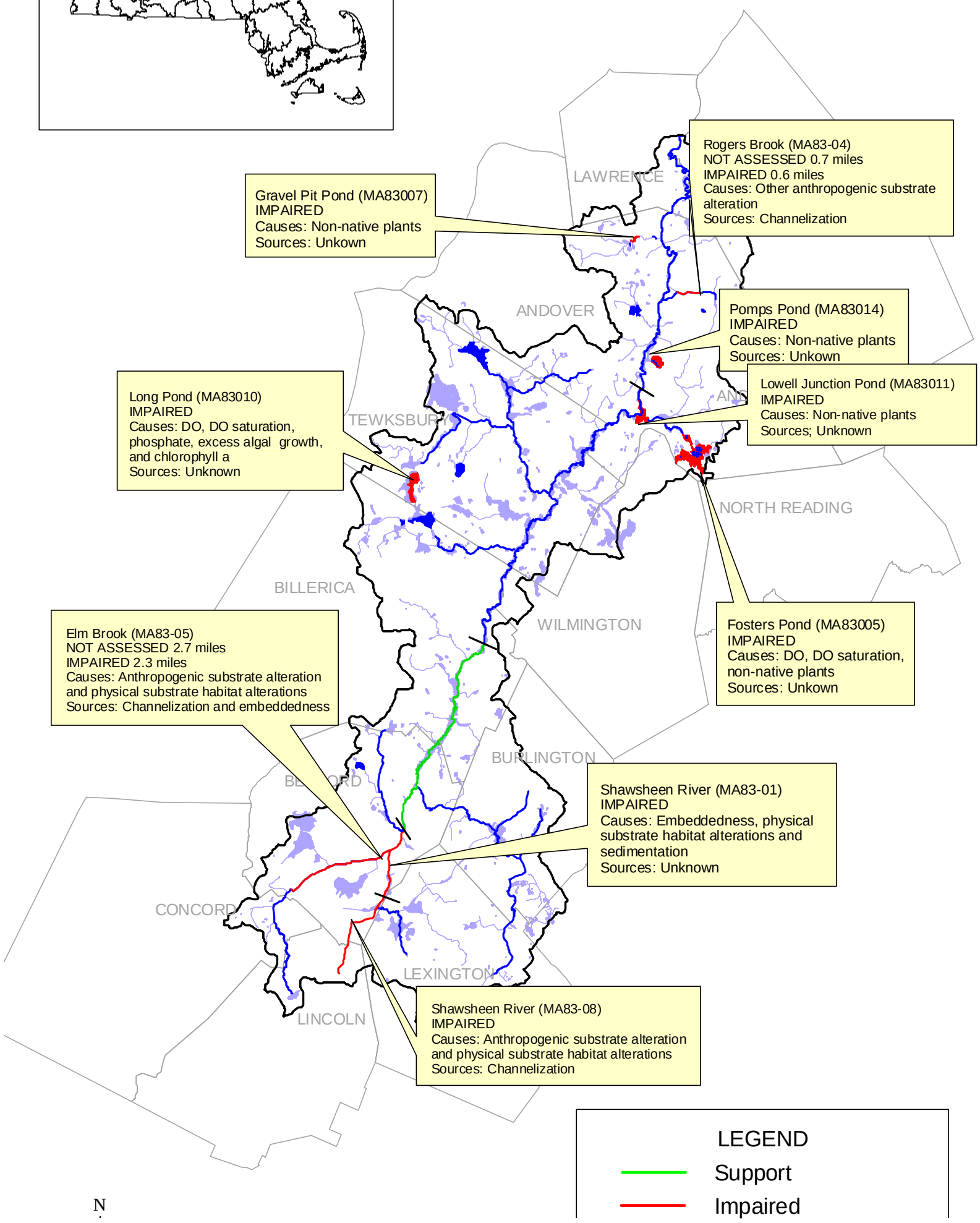


Figure1. *Shawsheen River Watershed Aquatic Life Use Assessment Summary* – Rivers and Lakes.

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SHAWSHEEN RIVER WATERSHED
Fish Consumption Use Assessment Summary – Rivers and Lakes

NOTE: MDPH STATEWIDE ADVISORY
In June 2002, MDPH issued new consumer advisories on fish consumption and mercury contamination. The MDPH "…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, MDPH 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 (MDPH 2001)." Additionally, MDPH "…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 (MDPH 2001)." MDPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially. The advisory encompasses all freshwaters in Massachusetts and, therefore, the *Fish Consumption Use* for lakes in the Shawsheen River Watershed cannot be assessed as support.

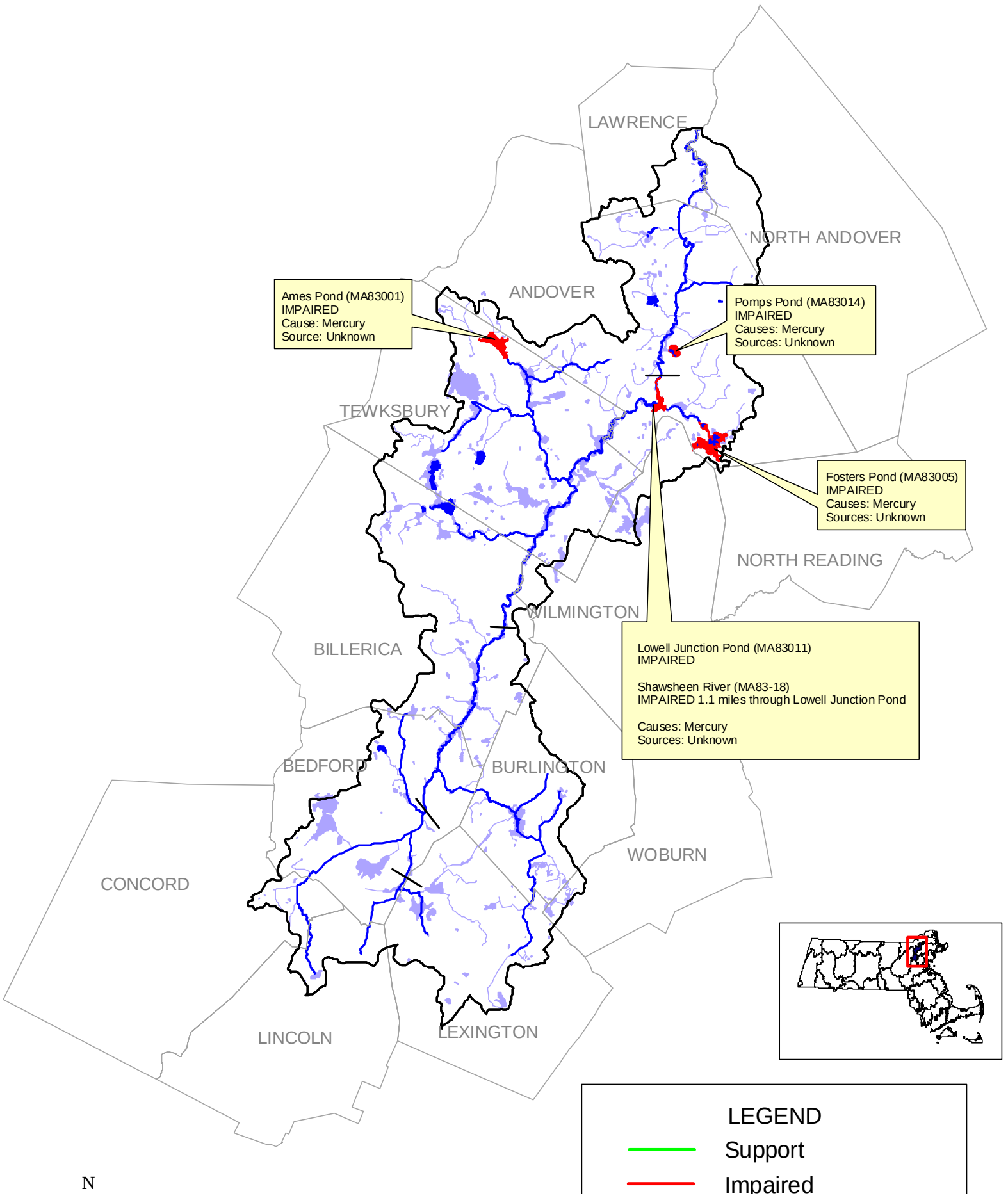

Figure 2. Shawsheen River Watershed *Fish Consumption Use* Assessment Summary – Rivers and Lakes.

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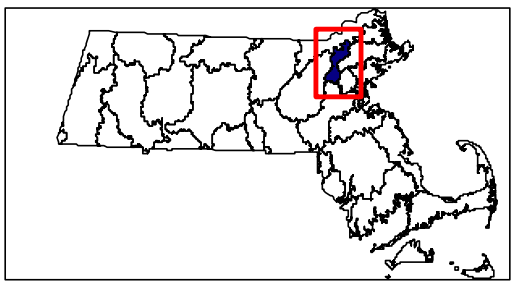
SHAWSHEEN RIVER WATERSHED

Primary Contact Recreational Use Assessment Summary – Rivers and Lakes



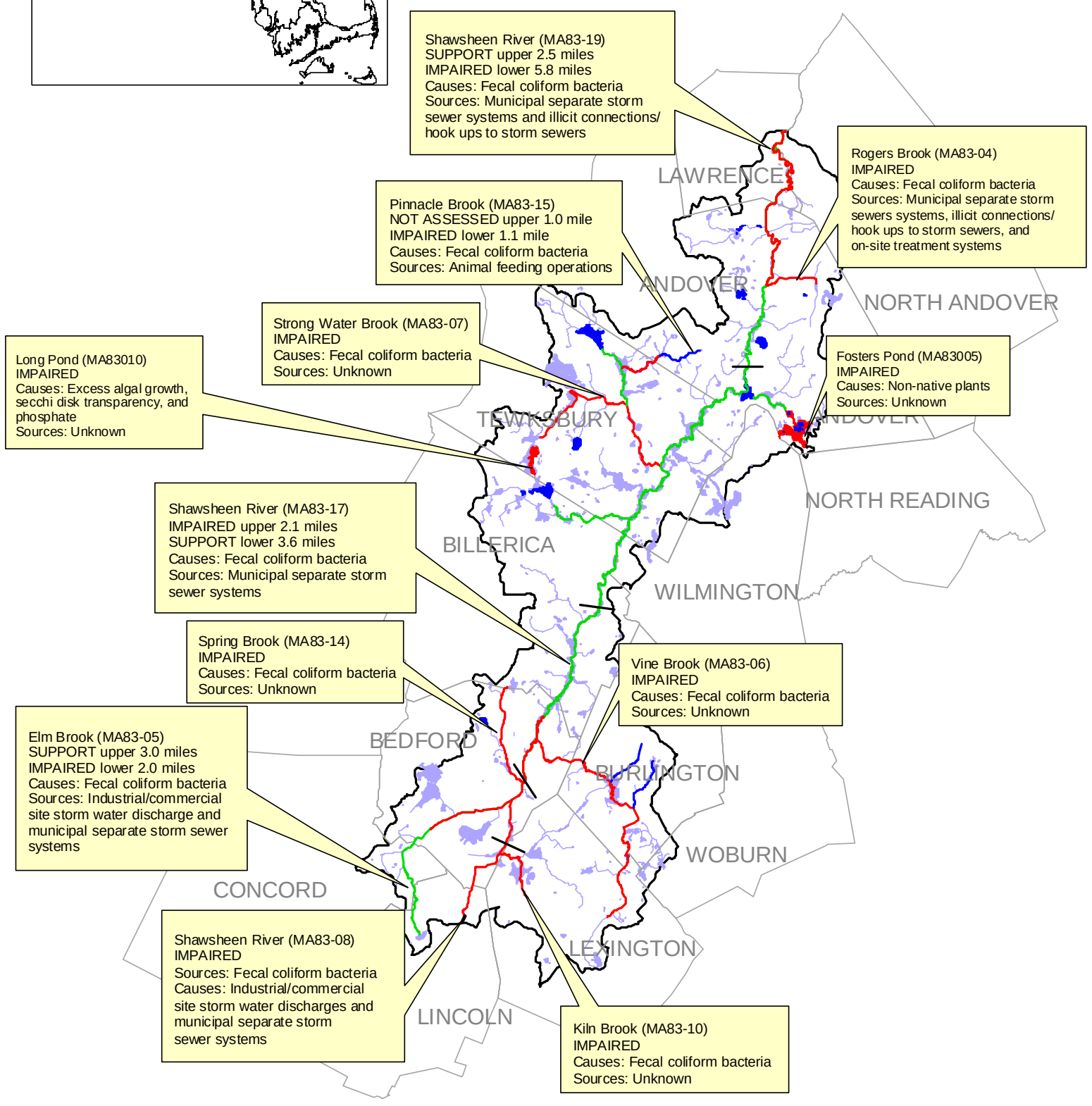


Figure 3. Shawsheen River Watershed *Primary Contact Recreational Use* Assessment Summary – Rivers and Lakes.

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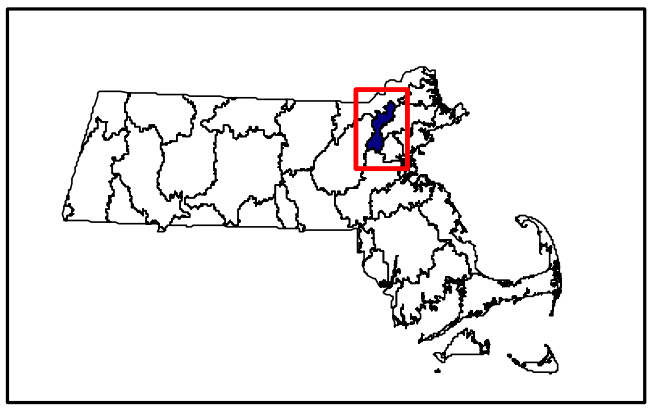
SHAWSHEEN RIVER WATERSHED

Secondary Contact Recreational Use Assessment Summary – Rivers and Lakes



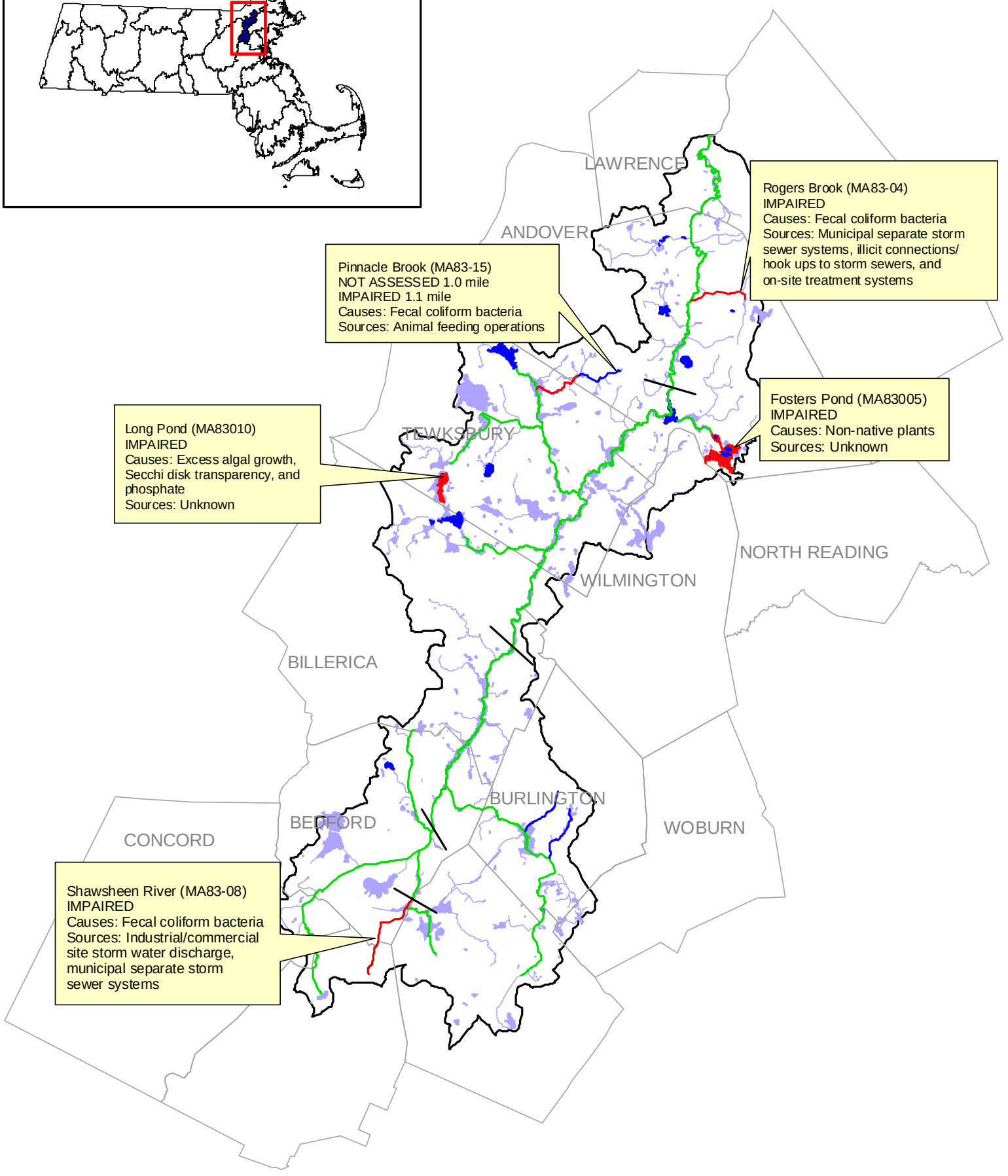


Figure 4. Shawsheen River Watershed *Secondary Contact Recreational* Use Assessment Summary – Rivers and Lakes.

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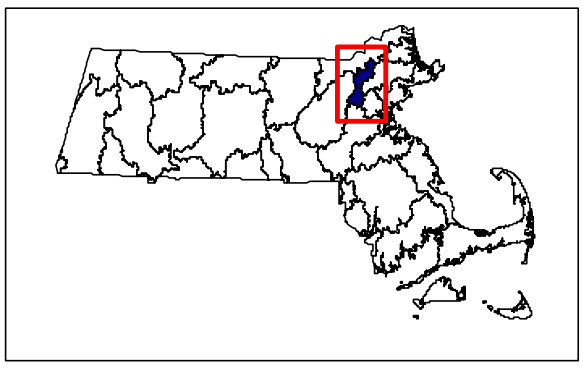
SHAWSHEEN RIVER WATERSHED
Aesthetics Use Assessment Summary – Rivers and Lakes



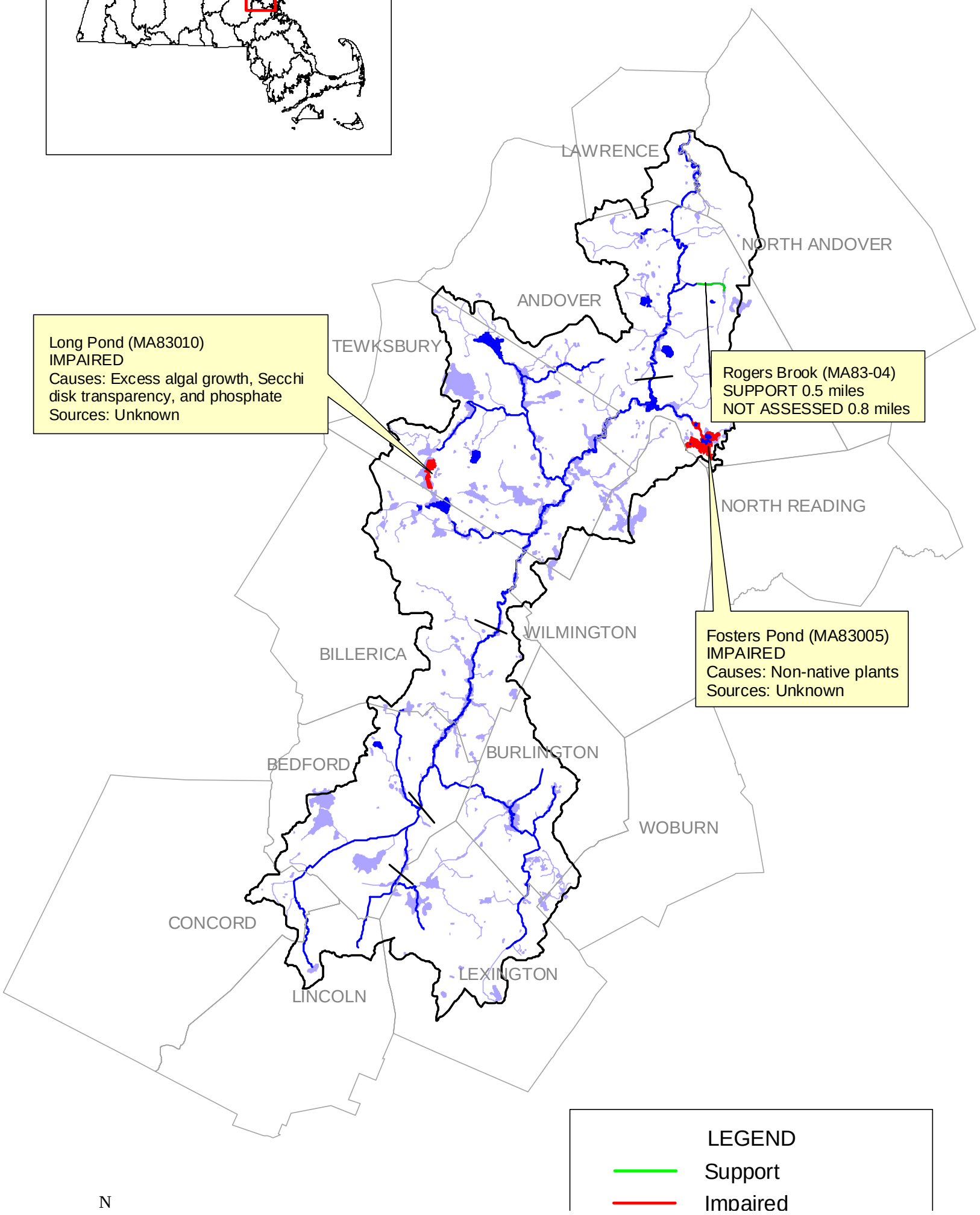


Figure 5. Shawsheen River Watershed *Aesthetics Use* Assessment Summary – Rivers and Lakes.

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INTRODUCTION

The Massachusetts Watershed Approach is a collaborative effort between state and federal environmental agencies, municipal agencies, citizens, non-profit groups, businesses and industries in the watershed. The mission is to improve water quality conditions and to provide a framework under which the restoration and/or protection of the watershed's natural resources can be achieved. Figure 6 illustrates the management structure to carry out the mission. This report presents the current assessment of water quality conditions in the Shawsheen River Watershed. The assessment is based on information that has been researched and developed by the Massachusetts Department of Environmental Protection (MADEP) through the first three years (information gathering, monitoring, and assessment) of the five-year cycle in partial fulfillment of MADEP's federal mandate to report on the status of the Commonwealth's waters under the Federal Water Pollution Control Act (commonly known as the Clean Water Act [CWA]).

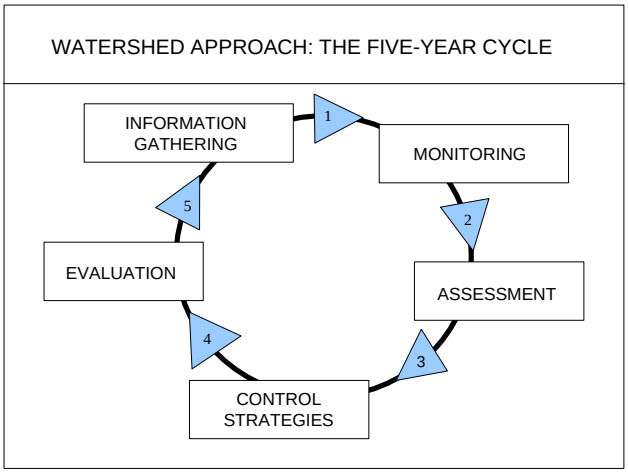


Figure 6. Five-year cycle of the Watershed Approach.

The goal of the 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 United States Environmental Protection Agency (EPA), the United States Congress, and the public. Together, these agencies are responsible for implementation of the CWA mandates. Under Section 305(b) of the Federal CWA, every two years MADEP must submit a statewide report (to the EPA) that describes the status of water quality in the Commonwealth. Up 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 recommended that the states combine elements of the statewide 305(b) Report and the section 303(d) list of impaired waters into one "Integrated List of Waters". This statewide list is based on the compilation of information for the Commonwealth's 27 watersheds. Massachusetts has opted to write individual watershed 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. Instream 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 as described below (Assessment Methodology). Once the use assessments have been completed the segments are categorized for the Integrated List.

ASSESSMENT METHODOLOGY

WATER QUALITY CLASSIFICATION

The Massachusetts Surface Water Quality Standards (SWQS) designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected; prescribe minimum water quality criteria required to sustain the designated uses; and include provisions for the prohibition of discharges (MADEP 1996). These regulations should undergo public review every three years. The surface waters are segmented and each segment is assigned to one of the six classes described below. Each class is identified by the most sensitive, and therefore, governing, water uses to be achieved and protected. Surface waters may be suitable for other beneficial uses, but shall be regulated by the Department of Environmental Protection to protect and enhance the designated uses.

Inland Water Classes

1. ***Class A*** *– These waters are designated as a source of public water supply. To the extent compatible with this use they shall be an excellent habitat for fish, other aquatic life and wildlife, and suitable for primary and secondary contact recreation. These waters shall have excellent aesthetic value. These waters are designated for protection as Outstanding Resource Waters (ORWs) under 314 Code of Massachusetts Regulations (CMR) 4.04(3).*
2. ***Class B*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.*
3. ***Class C*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife, and for secondary contact recreation. These waters shall be suitable for the irrigation of crops used for consumption after cooking and for compatible industrial cooling and process uses. These waters shall have good aesthetic value.*

Coastal and Marine Classes

4. ***Class SA*** *– These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary recreation. In approved areas they shall be suitable for shellfish harvesting without depuration (Open Shellfishing Areas). These waters shall have excellent aesthetic value.*
5. ***Class SB*** *– These waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfishing Areas). These waters shall have consistently good aesthetic value.*
6. ***Class SC*** *– These waters are designated as a habitat for fish, other aquatic life, and wildlife and for secondary contact recreation. They shall also be suitable for certain industrial cooling and process uses. These waters shall have good aesthetic value.*

The 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. In so doing, the States report on waterbodies within the context of meeting their designated uses (described above in each class). 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 standards: Cold Water Fishery (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).

The SWQS, summarized in Table 1, prescribes minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be applied (MADEP 1996). 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 artificially regulated waters, the lowest flow conditions at which aquatic life criteria must be applied are the flow equal or exceeded 99% of the time on a yearly basis or another equivalent flow that has been agreed upon. In coastal and marine waters and for lakes the most severe hydrological condition for which the aquatic life criteria must be applied shall be determined by MADEP on a case-by-case basis.

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 organization 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, MADEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by MADEP are of known and documented quality and are suitable for their intended use. For external sources of information, MADEP requires 1) an appropriate *Quality Assurance Project Plan* including a laboratory Quality Assurance /Quality Control (QA/QC) plan, 2) use of a state certified lab (or as otherwise approved by MADEP for a particular analysis), and 3) sample data, QA/QC and other pertinent sample handling information are documented in a citable report.

EPA provides guidelines to the States for making their use support determinations (EPA 1997 and 2002a, 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 only 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 1) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance in the 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 standards.

Each designated 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***. In this report, however, if there is some indication that water quality impairment may exist, which is not "naturally occurring", the use is identified with an "Alert Status". Detailed guidance for assessing the status of each use follows in the Designated Uses Section of this report. It is important to note that not all waters are assessed. Many small and/or unnamed ponds, rivers, and estuaries are currently ***unassessed***; 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 1. Summary of Massachusetts Surface Water Quality Standards (MADEP 1996 and MDPH 2002b).

Dissolved Oxygen	Class A, Class B Cold Water Fishery (BCWF), and Class SA: ≥6.0 mg/L and ≥75% saturation unless background conditions are lower Class B Warm Water Fishery (BWWF) and Class SB: ≥5.0 mg/L and ≥60% saturation unless background conditions are lower Class C: Not ≤5.0 mg/L for more than 16 of any 24-hour period and not ≤3.0 mg/L anytime unless background conditions are lower; levels cannot be lowered below 50% saturation due to a discharge Class SC: Not ≤5.0 mg/L for more than 16 of any 24-hour period and not ≤4.0 mg/L anytime unless background conditions are lower; and 50% saturation; levels cannot be lowered below 50% saturation due to a discharge
Temperature	Class A: ≤68°F (20°C) and Δ1.5°F (0.8°C) for Cold Water and ≤83°F (28.3°C) and Δ1.5°F (0.8°C) for Warm Water. Class BCWF: ≤68°F (20°C) and Δ3°F (1.7°C) due to a discharge Class BWWF: ≤83°F (28.3°C) and Δ3°F (1.7°C) in lakes, Δ5°F (2.8°C) in rivers Class C and Class SC: ≤85°F (29.4°C) nor Δ5°F (2.8°C) due to a discharge Class SA: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) Class SB: ≤85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C) and Δ1.5°F (0.8°C) between July through September and Δ4.0°F (2.2°C) between October through June
pH	Class A, Class BCWF and Class BWWF: 6.5 - 8.3 SU and Δ0.5 outside the background range. Class C: 6.5 - 9.0SU and Δ1.0 outside the naturally occurring range. Class SA and Class SB: 6.5 - 8.5SU and Δ0.2 outside the normally occurring range. Class SC: 6.5 - 9.0SU and Δ0.5 outside the naturally occurring range.
Solids	All Classes: *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.*
Color and Turbidity	All Classes: *These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use.*
Oil and Grease	Class A and Class SA: *Waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.* Class SA: *Waters shall be free from oil and grease and petrochemicals.* Class B, Class C, Class SB and Class SC: *Waters shall be free from oil* and *grease, 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.*
Taste and Odor	Class A and Class SA: *None other than of natural origin.* Class B, Class C, Class SB and Class SC: *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.*
Aesthetics	All Classes: *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.*
Toxic Pollutants	All Classes: *All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife… The division shall use the recommended limit published by EPA pursuant to 33 USC 1251, 304(a) as the allowable receiving water concentrations for the affected waters unless a site-specific limit is established*.
Nutrients	*Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.*

Note: *Italics are direct quotations.*

Δ criterion (referring to a change from natural background conditions) is applied to the effects of a permitted discharge.

Table 1 (Continued). Summary of Massachusetts Surface Water Quality Standards (MADEP 1996 MDPH 2002b)

Bacteria (MDPH 2002b) Minimum Standards for Bathing Beaches State Sanitary Code and MADEP 1996 Class A criteria apply to the *Drinking Water Use*. Class B and SB criteria apply to *Primary Contact Recreation Use* while Class C and SC criteria apply to *Secondary Contact Recreation Use*.	Class A: • Fecal coliform bacteria: An arithmetic mean of <20 CFU/100 mls in any representative set of samples and <10% of the samples >100 CFU/100 mls. Class B: • At public bathing beaches, as defined by MDPH, where *E. coli* is the chosen indicator: No single *E. coli* sample shall exceed 235 *E. coli* /100 mls and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 *E. coli* / 100 mls. • At public bathing beaches, as defined by MDPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 61 *Enterococci* /100 mls and the geometric mean of the most recent five *Enterococci* samples within same bathing season shall not exceed 33 *Enterococci* /100 mls. • Current standards for other waters (not designated as bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 CFU/100 mls in any representative set of samples, nor shall more than 10% of the samples exceed 400 CFU/100 mls. (This criterion may be applied on a seasonal basis at the discretion of the MADEP.) Class C: • Fecal coliform bacteria: Shall not exceed a geometric mean of 1000 CFU/100 mls, nor shall 10% of the samples exceed 2000 CFU/100 mls. Class SA: • Fecal coliform bacteria: Waters approved for open shellfishing shall not exceed a geometric mean (most probable number (MPN) method) of 14 MPN/100 mls, nor shall more than 10% of the samples exceed 43 MPN/100 mls. • At public bathing beaches, as defined by MDPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 mls and the geometric mean of the five most recent *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 mls. • Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 CFU/100 mls in any representative set of samples, nor shall more than 10% of the samples exceed 400 CFU/100 mls. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) Class SB: • Fecal coliform bacteria: In waters approved for restricted shellfish, a fecal coliform median or geometric mean (MPN method) of <88 MPN/100 mls and <10% of the samples >260 MPN/100 mls. • At public bathing beaches, as defined by MDPH, where *Enterococci* are the chosen indicator: No single *Enterococci* sample shall exceed 104 *Enterococci* /100 mls and the geometric mean of the most recent five *Enterococci* levels within the same bathing season shall not exceed 35 *Enterococci* /100 mls. • Current standards for other waters (not designated as shellfishing areas or public bathing beaches), where fecal coliform bacteria are the chosen indicator: Waters shall not exceed a geometric mean of 200 CFU/100 mls in any representative set of samples, nor shall more than 10% of the samples exceed 400 CFU/100 mls. (This criterion may be applied on a seasonal basis at the discretion of the MA DEP.) Class SC: • Fecal coliform bacteria: Shall not exceed a geometric mean of 1000 CFU/100 mls, nor shall 10% of the samples exceed 2000 CFU/100 mls.

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 (MA DEP1996).

- *AQUATIC LIFE* - suitable habitat for sustaining a native, naturally diverse, community of aquatic flora and fauna. 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, and *Warm Water Fishery* - waters that are not capable of sustaining a year-round population of cold water aquatic life.
- *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 in approved areas (Open Shellfish Areas) shellfish harvested without depuration shall be suitable for consumption. Class SB waters in approved areas (Restricted Shellfish Areas) shellfish harvested with depuration shall be suitable for consumption.
- *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, boating and limited contact incident to shoreline activities.
- *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 Contact Recreation, Secondary Contact Recreation* and *Aesthetics Uses* follows.

AQUATIC LIFE USE

This use is suitable for sustaining a native, naturally diverse, community of aquatic flora and fauna. The results of biological (and habitat), toxicological, and chemical data are integrated to assess this use. The nature, frequency, and precision of the MADEP'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 1) 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 et al. 2002)	No/minimal loss, BPJ	Moderate/severe loss, BPJ
Macrophytes	BPJ	Exotic 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)/percent saturation (MADEP 1996, EPA 1997)	Infrequent excursion from criteria (Table 1), BPJ (minimum of three samples representing critical period)	Frequent and/or prolonged excursion from criteria [river and shallow lakes: exceedances >10% of measurements; deep lakes (with hypolimnion): exceedances in the hypolimnetic area >10% of the surface area].
pH (MA DEP 1996, EPA 19 November 1999)	Infrequent excursion from criteria (Table 1)	Criteria exceeded >10% of measurements.
Temperature (MADEP 1996,EPA 1997)	Infrequent excursion from criteria (Table 1)[1]	Criteria exceeded >10% of measurements.
Toxic Pollutants (MADEP 1996, EPA 19 November 1999)	Infrequent excursion from criteria (Table 1)	Frequent and/or prolonged excursion from criteria (exceeded >10% of measurements).
Ammonia-N (MADEP 1996, EPA 1999)	Ammonia is pH and temperature dependent[2]	
Chlorine (MADEP 1996, EPA 19 November 1999)	0.011 mg/L (freshwater) or 0.0075 mg/L (saltwater) total residual chlorine (TRC)[3]	
CHEMISTRY-SEDIMENT**		
Toxic Pollutants (Persaud et al. 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 04 November 1999)	≤14.0 μg/kg wet weight	BPJ
PCB in aquatic tissue (Environment Canada 04 November 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. [1]Maximum daily mean T in a month (minimum six measurements evenly distributed over 24-hours) less than criterion. [2] Saltwater is temperature dependent only. [3] The minimum quantification level for TRC is 0.05 mg/L. [4]For 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 (MDPH), Bureau of Environmental Health Assessment (MDPH 2002a). The MDPH 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 non-support in these waters.

In July 2001, MDPH issued new consumer advisories on fish consumption and mercury (Hg) contamination (MDPH 2001).

1. The MDPH "…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, MDPH 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 (MDPH 2001)."
2. Additionally, MDPH "…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 (MDPH 2001)."

Other statewide advisories that MDPH has previously issued and are still in effect are as follows (MDPH 2001):

1. Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCBs) 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
MDPH Fish Consumption Advisory List (MDPH 2002a, MDPH 2001)	Not applicable, precluded by statewide advisory (Hg)	Waterbody on MDPH Fish Consumption Advisory List

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

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). MA DEP'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 status of the supplies is currently reported to MADEP and EPA by the suppliers 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*** – No closures or advisories (no contaminants with confirmed exceedances of maximum contaminant levels, conventional treatment is adequate to maintain the supply).	***Impaired*** – 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 and from the Shawsheen River Watershed's public water suppliers.

SHELLFISH HARVESTING USE

This use is assessed using information from the Department of Fisheries, Wildlife and Environmental Law Enforcement'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, which 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, so they are closed for the harvest of shellfish.

Variable	***Support*** – SA Waters—Approved[1] SB Waters— Approved[1], Conditionally Approved[2] or Restricted[3]	***Impaired*** – 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 (DFWELE 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.state.ma.us/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 (MDPH 2002b) Minimum Standards for Bathing Beaches State Sanitary Code and MADEP 1996	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). Other waters: Samples* collected during the primary contact season must meet criteria (Table 1). 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). Other waters: Samples* collected during the primary contact season do not meet the criteria (Table 1).
Aesthetics (MA DEP 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 (MDPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 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 or dense/very dense biovolume of non-native macrophytes) that render the water aesthetically objectionable or unusable*, BPJ.	Overabundant growths (i.e., blooms or dense/very dense biovolume of non-native macrophytes) rendering the water aesthetically objectionable and/or unusable*, BPJ.

*Data sets to be evaluated for assessment purposes must be representative of a sampling location (minimum of five samples per station recommended) over the course of the primary contact season. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use. An impairment decision will not be based on a single sample (i.e., the geometric mean of five samples is <200 CFU/100mL but one of the five samples exceeds 400 cfu/100mL). 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/100mL if the result is reported as <20 cfu/100mL). 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.

SECONDARY CONTACT RECREATIONAL 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
Fecal Coliform Bacteria (MA DEP 1996)	Other waters: Samples* collected must meet the Class C or SC criteria (see Table 1).	Other waters: Samples* collected do not meet the Class C or SC criteria (see Table 1).
Aesthetics (MA DEP 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.
Nuisance organisms	No overabundant growths (i.e., blooms or dense/very dense biovolume of non-native macrophytes) that render the water aesthetically objectionable or unusable*, BPJ.	Overabundant growths (i.e., blooms or dense/very dense biovolume of non-native macrophytes) rendering the water aesthetically objectionable and/or unusable*, BPJ.

*Data sets to be evaluated for assessment purposes must be representative of a sampling location (minimum of five samples per station recommended) over time. 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
Aesthetics (MA DEP 1996) Visual observations	Narrative "free from" criteria met, BPJ (≤10% extent of spatial and temporal degradation).	Narrative "free from" criteria not met, BPJ (>10% extent of spatial and temporal degradation).

SHAWSHEEN RIVER WATERSHED DESCRIPTION AND CLASSIFICATION

DESCRIPTION

The Shawsheen River Watershed is located in northeastern Massachusetts where it is bordered by the Merrimack, Ipswich, Boston Harbor, Charles and Concord watersheds (see Figure 7). The watershed includes 60.1 miles of named streams and encompasses 78 square miles of drainage area. Approximately 4.5% of the watershed area is covered by wetland or open water. Fosters Pond (135 acres) in Andover/Wilmington and Ames Pond (82 acres) in Tewksbury are the two largest of the 18 ponds, which comprise a total of 438 acres, in the watershed.

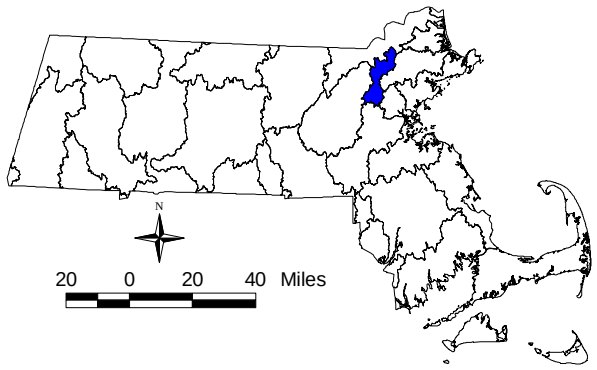


Figure 7. Location of Shawsheen River Watershed

The mainstem Shawsheen River flows for 25 miles, dropping 70 feet in elevation, from its headwaters at Hanscom Field in Bedford to its confluence with the Merrimack River in Lawrence. The main-stream channel depth generally ranges between one-half and five feet. It is impounded by dams at Ballardvale Village and at Stevens Street, both in Andover. Elsewhere, the relatively narrow channel, comprised primarily of coarse sand and gravel substrates, meanders generally on a northeasterly course through broad floodplains and extensive freshwater wetlands that provide excellent habitat for beaver, mink, muskrat and several species of waterfowl. The USGS maintains two streamflow gaging stations on the Shawsheen River. One gage (01100600), located in Wilmington, measures flow from an area of 36.5 square miles. A second gage (01100568), located at Hanscom Air Force Base (HAFB), Bedford, records drainage from an area of 2.09 square miles (Socolow *et al*. 2002).

Portions of 12 cities or towns, representing both Middlesex and Essex counties, lie within the Shawsheen watershed. These are Andover, Bedford, Billerica, Burlington, Concord, Lawrence, Lexington, Lincoln, North Andover, Tewksbury, Wilmington, and Woburn. While portions of Andover, Lawrence and Lexington are the most urban in character, almost all of these municipalities are densely populated. This places demand on the water resources in the drainage basin for water supply even though several municipalities actually derive their water supply from surface or groundwater sources outside of the Shawsheen River Watershed. The Town of Burlington maintains the only direct withdrawal of surface water from the Shawsheen River. Bedford, Burlington, and Tewksbury pump water from wells situated near the Shawsheen River or its tributaries for at least a portion of their public water supply. High population density has also led to the need for sound wastewater management practices. Over one third (38%) of the land area in the watershed is residential, mostly zoned for house lots between 1/4 and 1/2 acre. Some of these residential areas are served by municipal wastewater collection systems, which deliver sewage to publicly owned treatment works (POTWs) located in neighboring watersheds. However, many residences continue to rely on individual, on-site septic systems for sewage disposal. Other than these, few, if any, wastewater discharges occur to ground or surface waters in the Shawsheen River Watershed.

CLASSIFICATION

Consistent with the National Goal Uses of “fishable and swimmable waters”, the classification of waters in the Shawsheen River Watershed according to the SWQS, include the following (MADEP 1996):

> “Class B – These waters are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Where designated they shall be suitable as a source of water supply with appropriate treatment. They shall be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.” In the Shawsheen River Watershed, the following waters are classified as B, Warm Water Fisheries (other restrictions as noted):

- Shawsheen River source to water withdrawal point in Billerica -approximately Cook Street and Alexander Road (Treated Water Supply)
- Shawsheen River water withdrawal point in Billerica to confluence with Merrimack River

The designation of ORW is applied to those waters with exceptional socio-economic, recreational, ecological and/or aesthetic values. ORWs have more stringent requirements than other waters because the existing use is so exceptional or the perceived risk of harm is such that no lowering of water quality is permissible. ORWs include certified vernal pools (CVPs) and all designated Class A Public Water Supplies, and may include surface waters found in National Parks, State Forests and Parks, Areas of Critical Environmental Concern and those protected by special legislation (DEM 1993). Wetlands that border ORWs are designated as ORWs to the boundary of the defined area.

Within the Shawsheen River Watershed, there are approximately 39 CVPs (NHESP 2002). These are located in the towns of Andover, Tewksbury, Bedford, Burlington, Wilmington, Concord, Lincoln, and Lexington. Obligate vernal pool species observed included the spotted salamander (*Ambystoma maculatum*), Blandings turtle (*Emydoidea blandingi*), freshwater clams (*Corbicula fulminea*), fairy shrimp (*Branchinecta conservatio*), wood frog (*Rana sylvatica*), and the American toad (*Bufo americanus*) (NHESP 2002). Numerous facultative species of frogs, newts (a form or lifestage of the spotted salamander), turtles, and a variety of benthic macroinvertebrates were also documented in vernal pools in the Shawsheen River Watershed.

Unlisted waters in the Shawsheen River Watershed not otherwise designated in the SWQS, are designated *Class B, High Quality Waters* for inland waters. According to the SWQS, where fisheries designations are necessary, they shall be made on a case-by-case basis.

SUMMARY OF EXISTING CONDITIONS AND PERCEIVED PROBLEMS

In the earliest summary of water quality of the Shawsheen River, Screpetis (1975) concluded that the water quality in the Shawsheen River did not meet the criteria for its Class B designation. The general topography of the watershed with its many marshy areas coupled with several point and nonpoint sources of pollution were determined to account for the degradation in water quality conditions. High coliform bacteria and low DO concentrations were the major violations. The majority of the direct discharges to the Shawsheen River as of 1974 were already planned for elimination through connections with the municipal sewer systems.

The 1995 MADEP water quality results indicated that bacterial contamination was predominant throughout the watershed. The entire mainstem Shawsheen River appears on the 1998 303(d) List due to bacteria violations. Additionally, three tributaries to the Shawsheen River - Rogers Brook, Vine Brook, and Elm Brook - are also listed for pathogen violations.

The 2002 Bacteria TMDL (LimnoTech 2002) indicated that there were 151 failing septic systems throughout the watershed. The report indicated that the majority of the failing septic systems were within the towns of Billerica and Tewksbury. The Town of Tewksbury recently filed an Environmental Notification Form to Massachusetts Environmental Policy Act for an extensive sewer extension program. The Town has appropriated $80 million for approximately 95 miles of sewers. An Environmental Impact Report will need to be developed for this project and it will be subject to public and agency review (Brander 2003a). In 1999, MADEP Northeast Regional Office (NERO) identified and removed wastewater from a storm drain on Dunham Road in Billerica. The town required nearby commercial and industrial facilities to connect to the sewer system.

The EPA designates uncontrolled waste sites by placing them on a priority list. This list, the National Priority List (NPL), defines national priorities among the known or threatened releases of hazardous substances and pollutants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation. There are eleven NPL sites (described in the individual segments) throughout the Shawsheen Watershed (EPA 25 March 2003).

The CWA, section 303(d), requires states to identify those waterbodies that are not meeting standards and prioritize the development of TMDLs for these waterbodies. Table 2 identifies the waterbodies in the Shawsheen River Watershed on the most recent, EPA - approved, 1998 Massachusetts Section 303(d) List (MADEP 1999a).

Table 2. 1998 303(d) List of Waters in the Shawsheen River Watershed.

Name	Waterbody Identification Code (WBID)	Location	Cause of Impairment
Ames Pond	MA83001	Tewksbury	Noxious aquatic plants
Bakers Meadow Pond	MA83002	Andover	Noxious aquatic plants
Butterfield Pond	MA83003	Burlington	Noxious aquatic plants, turbidity
Fawn Lake	MA83004	Bedford	Noxious aquatic plants
Fosters Pond	MA83005	Andover/Wilmington	Noxious aquatic plants
Gravel Pit Pond	MA83007	Andover	Noxious aquatic plants
Hussey Brook Pond	MA83008	Andover	Noxious aquatic plants
Hussey Pond	MA83009	Andover	Noxious aquatic plants
Long Pond	MA83010	Tewksbury	Nutrients, noxious aquatic plants
Lowell Junction Pond	MA83011	Andover	Metals, noxious aquatic plants
Pomps Pond	MA83014	Andover	Noxious aquatic plants
Rabbit Pond	MA83015	Andover	Turbidity
Round Pond	MA83018	Tewksbury	Noxious aquatic plants
Richardson Pond	MA83020	Billerica	Noxious aquatic plants
Pond Street Pond	MA83021	Billerica	Noxious aquatic plants
Shawsheen River	MA83-08	Headwater, north of Folly Pond and North Great Road, Lincoln to Summer Street, Bedford	Other habitat alterations, pathogens
	MA83-01	Summer Street, Bedford to confluence with Spring Brook, Bedford	Unknown toxicity, organic enrichment/low DO, pathogens
	MA83-02	Confluence with Spring Brook, Bedford to Central Street, Andover	Unknown toxicity, organic enrichment/low DO, pathogens
	MA83-03	Central Street, Andover to confluence with the Merrimack River, Lowell	Unknown toxicity, pathogens
Rogers Brook	MA83-04	Outlet of first unnamed pond, Andover (to confluence with Shawsheen River, Andover	Pathogens, turbidity
Vine Brook	MA83-06	Headwaters near Grant Street, Lexington to confluence with Shawsheen River, Bedford	Pathogens
Elm Brook	MA83-05	Headwaters, Lincoln to confluence with Shawsheen River, Bedford	Pathogens, turbidity

Within the last decade, the northeastern United States has been identified as receiving elevated rates of mercury deposition from the atmosphere and high levels of mercury contamination in non-commercial freshwater fish (Tatsutani 1998). Mercury is a trace metal that exists in the earth's crust. It is a toxicant that, once mobilized in the environment, can be transformed into methylmercury -- a particularly toxic form that can bioaccumulate. The primary source of mercury exposure in people is through the consumption of freshwater fish contaminated with methylmercury. As a result of this risk, the MDPH, as well as the other New England States, has issued a statewide fish consumption advisory (MDPH 2001).

Additionally, there are three lakes in the Shawsheen River Watershed and a portion of the mainstem Shawsheen River (Ballardvale Impoundment) for which MDPH has issued site-specific fish consumption advisories due to elevated levels of mercury. The most recent MDPH Fish Consumption List recommends the following for waterbodies in the Shawsheen River Watershed (MDPH 2002a):

Shawsheen River at Ballardvale Impoundment (Andover):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass or black crappie from this water body."
2. "The general public should limit consumption of largemouth bass and black crappie to two meals per month."

Ames Pond (Tewksbury):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat largemouth bass from this waterbody."
2. "The general public should limit consumption of largemouth bass to two meals per month."

Fosters Pond (Andover/Wilmington):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body."
2. "The general public should limit consumption of all fish from this water body to two meals per month."

Pomps Pond (Andover):

1. **"**Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody."
2. "The general public should not eat largemouth bass from this waterbody."
3. "The general public should limit consumption of non-affected fish from this water body to two meals per month."

SOURCES OF INFORMATION

Multiple local, private, state and federal agencies provided information used in the water quality assessment of the Shawsheen River Watershed. Within MADEP, information was obtained from three programmatic bureaus: Bureau of Resource Protection (BRP, see below), Bureau of Waste Prevention (industrial wastewater discharge information) and the Bureau of Waste Site Cleanup (hazardous waste site cleanup information). Specifically, water quality and lake data were provided by MADEP DWM's Watershed Planning Program. Water withdrawal and wastewater discharge permit information was provided by members of the Shawsheen River Watershed Team in the MADEP Northeastern Regional Office and the DWM Watershed Permitting Program.

The Shawsheen River Watershed has facilities that discharge to the mainstem of the river and to its tributaries (Appendix E, tables E1 and E2). The following types of NPDES discharges occur in the Shawsheen River Watershed.

- *Institutional Discharges:* There is one facility that discharges domestic wastewater in the watershed. Battle Road Farm Condominiums, Old Bedford Road in Lincoln (owned by Lincoln House Associates Limited Partnership), was permitted (MA0031658) on 24 June 1988 to discharge treated sanitary wastewater. The discharge from this facility, operational since 1989, is to an isolated channelized wetland. The existing permit expired on 22 May 2002 and was administratively continued. In 2000, 2001 and 2002, there were minor violations to the permit (fecal bacteria counts were above the 400 counts/100 mls limit), (Cashins 2003).

- *Industrial non-process discharges*: Several industries have general permits issued to the facilities by the EPA for the discharge of non-contact cooling water and stormwater. While these discharges are authorized and controlled under general permits, the associated impacts from these facilities are minimal and do not get significant review from MADEP.

Two NPDES dischargers, Battle Road Wastewater Treatment Plant (MA0031658) and HAFB in Bedford (MA0090697) which has been terminated, submit toxicity testing reports to EPA and MADEP as required by their NPDES permit. Data from these toxicity reports are maintained by DWM in a database entitled "Toxicity Testing Data - TOXTD". Information from the reports includes: survival of test organisms exposed to ambient river water (used as dilution water), physicochemical analysis (e.g., hardness, alkalinity, pH, total suspended solids) of the dilution water, and the whole effluent toxicity test results. Data were reviewed and

summarized for use in the assessment of current water quality conditions in the Shawsheen River Watershed.

Phase II NPDES stormwater permits are general permits developed by EPA with input from MADEP. All 12 communities in the Shawsheen River Watershed are "Phase II" communities. The final version of the Phase II stormwater permit was issued on 1 May 2003. Permit applications from the towns must be submitted to EPA by 30 July 2003 and coverage begins with the permit application (Scarlet 2003). There are no Federal Energy Regulatory Commission (FERC) licensed hydroelectric power plants in the Shawsheen River Watershed nor any FERC-exempt power-generating facilities.

A list of registered and permitted WMA withdrawals (both public water suppliers and other industrial users) is provided in Appendix E, Table E3 (LeVangie 2002). In cases where water withdrawal information was available, it was included in the segment assessment.

The EPA, Office of Environmental Measurement and Evaluation, assisted the MADEP in evaluating the water and sediment quality at nine locations within the Shawsheen River Watershed (EPA 1998). Nine sediment samples, along with water quality data (pH, DO, temperature, and specific conductance) were collected and analyzed during January 1997. The sediment samples were analyzed for metals, acid volatile sulfides (AVS) / simultaneously extracted metals (SEM), semi-volatile organic carbons (SVOCs), PCBs, pesticides, TOC, toxicity, and grain size. The results of the chemical analyses revealed the detection of several inorganic and organic contaminants in the majority of the sediment samples. However, the concentrations of all chemicals were below the S-EL biological effects guidelines developed by the Ontario Ministry of the Environment (Environment Canada. 04 November 1999). The results of the 10-day exposure to all of the sediment samples for the freshwater invertebrates (test organisms) indicated a lack of acute toxicity for those organisms with respect to the test endpoints, survival and growth (EPA 1998).

Other state agencies contributing information to this report include: the MDPH, the DFWELE, and the DEM. Contributing federal agencies include EPA, USGS, and the United States Air Force (USAF).

In addition to state and federal agencies, regional, local and citizen monitoring groups provided valuable data/information, which may be used (depending on data quality) to indicate areas of degraded water quality, as well as causes and sources of contamination.

The Massachusetts Wetlands Restoration Program (MWRP) has initiated an effort to restore wetlands in the Shawsheen River Watershed. MWRP is working with communities and advocacy groups to identify impacted wetlands and potential restoration locations within the watershed. The goal of the MWRP is to develop and implement a Watershed Wetlands Restoration Plan that will improve the condition of wetlands within the Shawsheen River Watershed (Durey 2001).

The Merrimack River Watershed Council (MRWC) is a 23-year old nonprofit membership organization whose mission is to…"*protect and restore the Merrimack River Watershed for the enjoyment of people, the benefit of its communities, and the health of the ecosystem*" (MRWC 2000a). MRWC has a growing constituency of individuals, businesses, municipalities and community groups seeking to protect the natural resources of the watershed. Working in partnership with these diverse interests, MRWC acts as a catalyst to improve the watershed environment through its advocacy center and research work (Goodno 2001). The Shawsheen River Watershed has been a focus of study for the MRWC since 1995 (MRWC 2000a).

MRWC works with citizens, organizations and agencies to adopt the "Watershed Approach" in making wise land and water use decisions, protecting and preserving drinking water, providing recreation opportunities, and watershed advocacy. In 1996, the MRWC received a grant from the Massachusetts EOEA to implement a Shawsheen River Watershed Project, which spurred the formation of the Shawsheen River Watershed Association (MRWC 2000b). Local communities participated in education forums, eventually forming stream teams to conduct shoreline surveys, collect samples and analyze water quality, assess in-stream habitat conditions, and collect data on benthic macroinvertebrates. MRWC and the Massachusetts Riverways Adopt-A-Stream Program aided volunteers in both organization and team training. The River Watch Network in Vermont trained volunteers to assess habitat conditions throughout the watershed.

Supported by MRWC, stream teams were formed in the upper, middle, and lower sections of the watershed to conduct shoreline surveys and collect water quality data. The stream team volunteers sampled water

quality stations bi-weekly during the summer months from 1996 to 1998. The stream teams documented impairments in the watershed and prioritized action items (MRWC 2000b). Additionally, MRWC worked with local towns to compile data on storm drain outlets in the watershed. Storm drains were mapped and their conditions were documented by walking and canoeing the entire mainstem (MRWC 2000a). This information was used to create a Geographical Information System (GIS) datalayer for stormwater runoff coverage in the watershed.

Under a Massachusetts Watershed Initiative Grant, Environmental Science Services, Inc. conducted habitat quality assessments at six stream reaches in August 2001 (ESS 2002).

A New England Coastal Basin (NECB) Mercury Study was initiated by USGS in 1999 when the results of their National Mercury Pilot Study showed some of the highest mercury concentrations in the country were in the NECB study area (USGS 13 June 2001). The dominant source of mercury identified in the NECB study area was atmospheric deposition. In collaboration with USGS's Toxics Substances Hydrology Program (an extension of the National Mercury Pilot Study), Urban Land Use Gradient Study (part of the National Water-Quality Assessment program) and the MADEP Merrimack Valley Fish Study (described below), USGS collected, sediment, water, and/or fish tissue for total and/or methyl mercury analysis from 22 streams north of Boston in 1999 and 30 sites in the NECB in 2000. Total and methyl mercury samples from the water column and the sediment were collected by USGS on 20 July 1999 from the Shawsheen River near Tewksbury. These data, however, are not yet available (2003).

A directed study of fish in lakes in northeastern Massachusetts was performed by the MADEP Office of Research and Standards (ORS) during 1999 in order to examine possible spatial patterns in the occurrence of higher fish mercury concentrations and to compare the fish contamination situation in this localized geographic region to statewide and regional data. The objectives of the study were to:

1) sample fish from many lakes in northeastern MA where fishing takes place in order to determine if fish consumption advisories are needed for those lakes;

2) determine whether the frequency of advisories is greater in this area than across the state as a whole;

3) determine if there are any spatial patterns in fish mercury concentrations within the study area related to the locations of the major point sources of mercury emissions;

4) determine how well measured mercury concentrations match those predicted by a fish tissue mercury prediction model developed by MADEP;

5) compare mercury concentrations in fish from the region with those from other parts of Massachusetts.

The lakes sampled in this study were chosen on the basis of the following: size of lake (4 hectares minimum size), availability of fish species, fishing pressure, access, and proximity to other lakes. Two ponds selected for inclusion in this study in the Shawsheen River Watershed were sampled by Normandeau and Associates (under contract to MADEP ORS):

- Ames Pond (Tewksbury)
- Pomps Pond (Andover)

In August 2001, the Massachusetts "Beach Bill" was enacted by the legislature and signed by the Governor (MGL. C111. S5S). This act created minimum standards for public bathing waters adjacent to any public or semi-public bathing beach in the Commonwealth. A "public bathing beach" is defined as a beach open to the general public, whether or not any entry fee is charged, that permits access to bathing waters. A "semi-public bathing beach" is defined as a bathing beach used in connection with a hotel, motel, trailer park, campground, apartment house, condominium, country club, youth club, school, camp, or similar establishment where the primary purpose of the establishment is not the operation of the bathing beach and where admission to the use of the bathing beach is included in the fee paid for use of the premises. A semi-public bathing beach shall also include a bathing beach operated and maintained solely for the use of members and guests of an organization that maintains such bathing beach. Under the Beach Bill, the MDPH was directed to establish minimum uniform water quality standards for coastal and inland beach

waters as well as determining the frequency and location of testing, reporting requirements, and requirements for notifying the public of threats to human health or safety. *105 CMR 445.000: Minimum Standards for Bathing Beaches (State Sanitary Code, Chapter VII)* outlines MDPH's guidelines for the Beach Bill and is available online at http://www.state.ma.us/dph/dcs/bb4_01.pdf. Additionally, under the Beach Bill and MDPH guidelines local boards of health and state agencies are responsible for collecting samples from public beaches using testing procedures consistent with the American Public Health Association's *Standard Methods for Examination of Water and Waste Water* or methods approved by EPA. Operators of semi-public beaches are responsible for the costs of testing their beaches. Results of testing, monitoring, and analysis of public and semi-public beaches must be submitted in an annual report to MDPH by 31 October of each year (MDPH 2002b).

Site specific evaluations of other water quality issues in the Shawsheen River Watershed related to either wastewater discharges and/or water withdrawals were conducted either through field investigations (where resources could be allocated) or through the review of DMRs and annual water withdrawal reports submitted by the permittees.

Projects funded through various MADEP grant and loan programs also provide valuable information that may be used in the water quality assessment report. A summary of these projects for the Shawsheen River Watershed is provided in Appendix F.

TOTAL MAXIMUM DAILY LOADS (TMDL)

As part of the Federal CWA, states are required to develop TMDLs for lakes, rivers and coastal waters that do not meet SWQS as indicated by the 303(d) List of Waters (see Table 2). A TMDL is the greatest amount of a pollutant that a waterbody can accept and still meet water quality standards. Further information on the 303(d) List and the TMDL program are available on the MADEP website at: http://www.dep.state.ma.us/dep/brp/wm/wmpubs.htm.

RIVERS

The Shawsheen River and three tributaries to the river (Vine Brook, Rogers Brook, and Elm Brook) were placed on the 1998 303(d) List of Waters for bacteria. A bacteria TMDL for the Shawsheen River Watershed was completed by LimnoTech in August 2002 for MADEP and the MRWC (LimnoTech 2002). This report was developed by LimnoTech, Inc. through a contract with the MRWC and funded by a grant from the National Wildlife Federation. Data were collected and coordinated through the MRWC and the Merrimack River Watershed Team. The purpose of this TMDL was to establish a fecal coliform TMDL for segments of the Shawsheen River and tributaries that are currently not meeting Massachusetts' standards. Additionally, the bacteria TMDL for this watershed has outlined an implementation strategy to abate fecal coliform sources so bacteria standards can be obtained (LimnoTech 2002). Data that were analyzed as part of this TMDL include fecal coliform data collected by the MRWC in 1996, 1997 and 1998 and fecal coliform data collected by the MADEP in 1989, and 1995-1996 (LimnoTech 2002).

A Shawsheen Bacteria TMDL Implementation Plan was developed to further identify the sources of bacteria in the watershed and to isolate storm drains with high bacteria counts. Fecal coliform bacteria were collected by MRWC and ESS, Inc. during 2001 and 2002 from storm drain locations in the Shawsheen River Watershed (01-01/MWI, see Appendix F), (MRWC 2003a).

A Draft TMDL for aquatic life impairment in the Shawsheen Headwaters was prepared by MRWC in October 2002. This segment of the Shawsheen River is listed on the 1998 303(d) List for habitat alterations between river miles 27.0 and 25.0. The objective of this TMDL was to specify reductions in stormwater pollutant loads and other associated stressors so that aquatic life uses could eventually be met. The Draft TMDL recommends achieving BMPs designed to enhance ground water recharge and reduce high stormwater flows and pollutant loads will be necessary(MRWC 2002).

LAKES

There are 15 lakes in the Shawsheen River Watershed on the 1998 303(d) List for which the most common cause of impairment is noxious aquatic plants (Table 2). The updated list is expected to be finalized in 2003. Lakes, which are on the updated list, are expected to have TMDLs developed for them within five to 10 years (Mattson 2002).

OBJECTIVES

This report summarizes information generated in the Shawsheen River Watershed through *Year 1* (information gathering in 1999) and *Year 2* (environmental monitoring in 2000) activities established in the "Five-Year Cycle" of the Watershed Initiative. Data collected by DWM (including QA/QC analyses) in 2000 are provided in Appendix A, B, and C of this report. Additionally, water quality data collected by DWM in 1995, but never published, are provided in Appendix D. Using these and other sources of information (identified in each segment assessment), the status of water quality conditions of lakes and rivers in the Shawsheen River Watershed was assessed in accordance with EPA's and MADEP's use assessment methods. Not all waters in the Shawsheen River Watershed are included in the MADEP/EPA WBS database or this report.

The objectives of this water quality assessment report are to:

1. evaluate whether or not surface waters in the Shawsheen River Watershed, defined as segments in the WBS database, currently support their designated uses (i.e., meet SWQS),
2. identify water withdrawals (habitat quality/water quantity) and/or major point (wastewater discharges) and nonpoint (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, and
5. recommend additional monitoring needs and/or remediation actions in order to better determine the level of impairment or to improve/restore water quality.

REPORT FORMAT

RIVERS

The rivers assessed in the Shawsheen River Watershed are presented in the *River Segment Assessments* section of this report. The order of river segments have been assigned Stream and River Information System (SARIS) code numbers (Halliwell *et al*. 1982). River segments are organized hydrologically (from most upstream to downstream) and tributary segments follow after the river segment into which they discharge. Each river segment assessment is formatted as follows.

SEGMENT IDENTIFICATION

Name, water body identification number (WBID), location, length, classification.

Sources of information: coding system (waterbody identification number such as MA51-01) used by MADEP to reference the stream segment in databases such as 305(b) and 303(d), the Massachusetts SWQS (MADEP 1996), and other descriptive information.

SEGMENT DESCRIPTION

Major land-use estimates (the top three uses for the subwatershed, excluding "open water", and other descriptive information.

Sources of information: descriptive information from USGS topographical maps, base geographic data from Massachusetts Geographic Information System (MassGIS), land use statistics from a GIS analysis using the MassGIS land use coverage developed at a scale of 1:25,000 and based on aerial photographs taken in 1999 (UMass Amherst 1999).

SEGMENT LOCATOR MAP

Sub-basin map, major river location, segment origin and termination points, and segment drainage area (gray shaded).

Sources of information: MassGIS quadrangle maps data layers and stream segments (MassGIS 2002).

WATER WITHDRAWALS AND WASTEWATER DISCHARGE PERMIT INFORMATION

Water withdrawal, NPDES wastewater discharge

Sources of information: WMA Database Printout (LeVangie 2002); open permit files located in the Worcester and Northeast Regional DEP Offices.

USE ASSESSMENT

Aquatic Life, Fish Consumption, Drinking Water (where applicable – see note below), Primary Contact, Secondary Contact, and Aesthetics.

Sources of information include: MADEP DWM Survey data (Appendix A, B, C, and D); MADEP DWM Toxicity Testing Database "TOXTD". The MDPH Freshwater Fish Consumption Advisory Lists (MDPH 2001 and MDPH 2002a) were used to assess the *Fish Consumption Use*. Where other sources of information were used to assess designated uses citations are included.

[Note: Although the *Drinking Water Use* itself was not assessed in this water quality assessment report, the Class A waters were identified.]

SUMMARY

Use summary table (uses, status, causes and sources of impairment).

RECOMMENDATIONS

Additional monitoring and implementation needs.

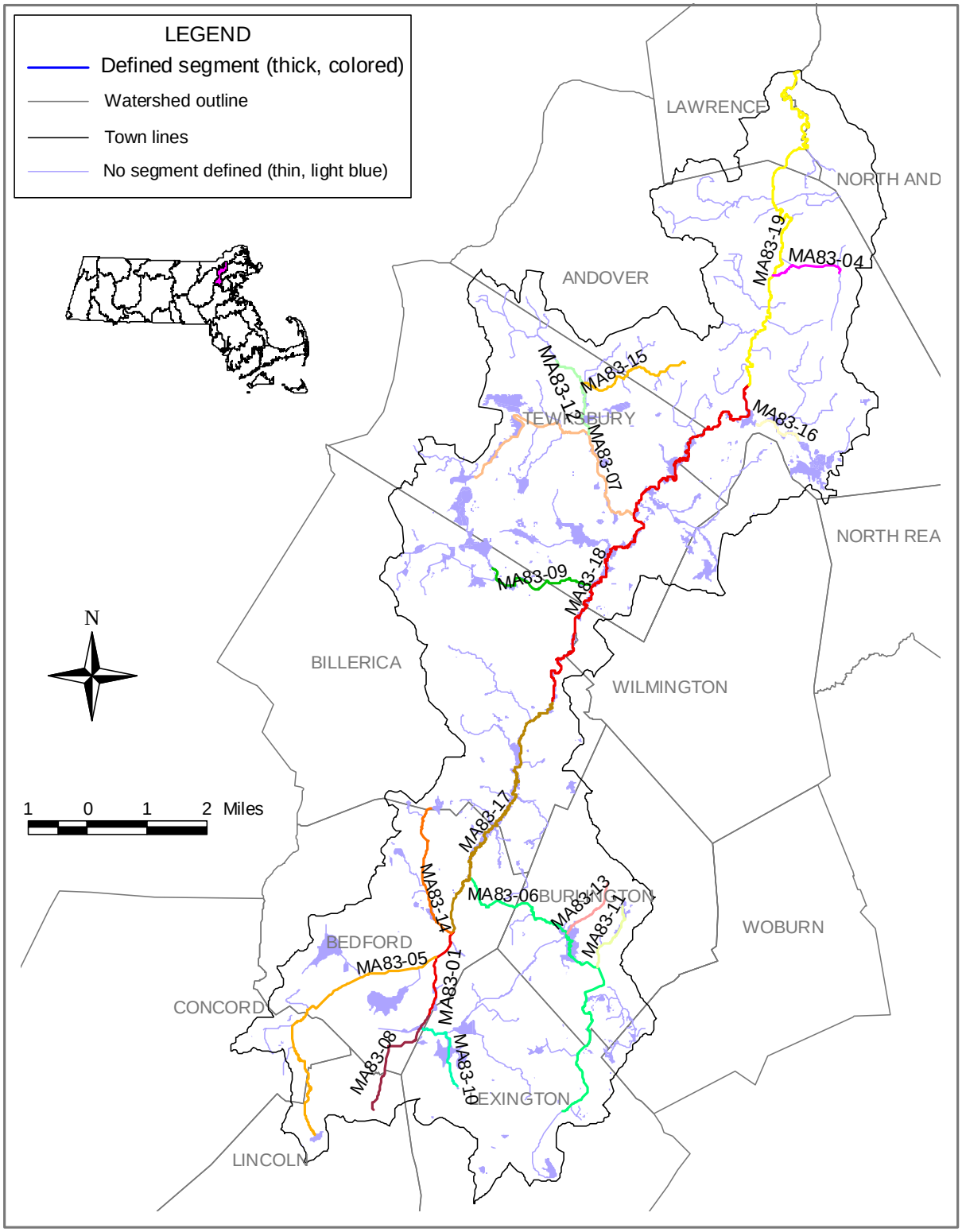
LAKES

The assessed lakes, identified with their WBID code numbers, are listed alphabetically in the *Lake Assessment* section of this report (Table 22). The status of the individual uses is summarized for these lakes for each watershed. The location, acreage, trophic status, use assessments, and causes of impairment are then summarized for each individual lake.

SHAWSHEEN RIVER WATERSHED - RIVER SEGMENT ASSESSMENTS

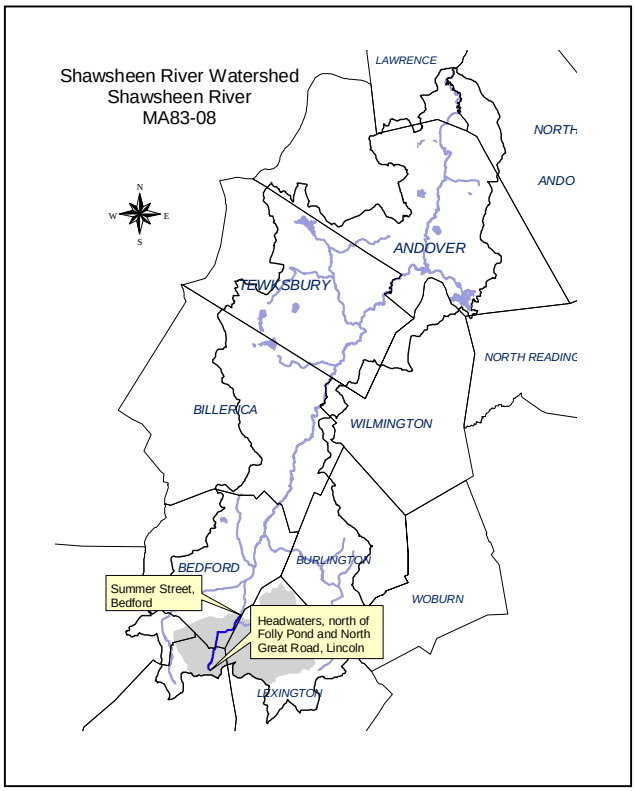
There are a total of 13 freshwater rivers assessed in this report (Figure 8). These include the Shawsheen River and Kiln, Elm, Spring, Vine, Long Meadow, Sandy, Content, Strong Water, Meadow, Pinnacle, Unnamed tributary and Rogers brooks. These rivers represent approximately 99% (59.3 of the estimated 60.1) river miles in the watershed. The remaining rivers are small and/or unnamed, and they are currently unassessed.

Figure 8. Shawsheen River Watershed – River Segment Locations identified by WBID



SHAWSHEEN RIVER (SEGMENT MA83-08)

Location: Headwaters, north of Folly Pond and North Great Road, Lincoln, to Summer Street, Bedford
Segment Length: 2.1 miles
Classification: Class B, Warm Water Fishery, Treated Water Supply



The drainage area of this segment is approximately 6.59 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	37%
Forest	22%
Transport	15%

This segment is on the 1998 303(d) List of Waters for other habitat alterations and pathogens (Table 2).

The MRWC and the Upper Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (eight sampling events) from two sites along this segment (MRWC 1998).

SEGMENT DESCRIPTION

Prior to the construction of Hanscom Field in 1947, the Shawsheen River originated in a small wetland located just north of Great Road (between Virginia Road and Massachusetts Avenue) in Lincoln and flowed in a north then northeasterly direction to be joined by two small unnamed tributaries prior to its confluence with Kiln Brook in Bedford. The United States Geological Survey (USGS) 7.5 Minute Series Topographic Concord Quadrangles published after the development of Hanscom Field depict the segment as an intermittent stream that disappears just north of Hanscom School and reappears as a perennial unnamed tributary between the airfield runway and the Boston & Maine Railroad line near Wood Road in Bedford. The Shawsheen River will be recognized as a named stream according to its original stream channel.

The drainage area for the Shawsheen River headwaters area encompasses the southwest portion of the watershed, which is comprised primarily by Hanscom Field The Hanscom properties total approximately 1,300 acres. The property encompasses parts of Bedford, Concord, Lexington, and Lincoln. The majority of the base is owned and operated by the Massachusetts Port Authority (Massport) as a civilian airfield and tenant areas, while the remainder of the base is operated by the USAF.

The drainage area for the HAFB portion of Hanscom Field is approximately 584 acres (Rizzo Associates, Inc., 1996). The base activities provide command, control and communication systems to USAF operations. Open channels and a closed storm drainage system convey runoff generated by Massport and HAFB directly and indirectly into the Shawsheen River, Elm Brook, and nearby wetlands. The storm drainage system consists of two series of parallel catch basins placed along the edges of most runways, taxiways, and apron areas. Pervious catch basins and perforated/open-jointed pipes were intended to drain groundwater as well as convey surface water away from the airfield's paved surface areas and infield areas (Rizzo Associates, Inc., 1996). Both HAFB and Massport have NPDES stormwater permits (applications submitted to EPA in October 1992).

Direct discharges to this segment of the Shawsheen River include drainage from approximately 330 acres conveyed by five pipes that collect runoff from land occupied by Massport tenants and three fuel farms (of four in the headwaters area). The 22-acre civil portion of the airfield drains into the Shawsheen River via three 72-inch storm drains. The pipes also collect runoff from a tributary area, which includes the Digital Equipment Corporation's hangar, the Raytheon Aircraft Services hangars, and a fourth fuel farm. The Shawsheen River Headwaters also receives runoff from a small, mostly vegetated area of approximately 2.7 acres. Two

additional 24-inch pipes also discharge directly to the Shawsheen River from the runway and infield area, which measures approximately 47 acres. Runoff via overland flow from the runways and vegetated infield land areas also discharges to the Shawsheen River (Rizzo Associates, Inc., 1996).

The USGS maintains one gaging station (01100568) on the mainstem Shawsheen River in Bedford (on the HAFB property). This gage has provided continuous daily discharge records since 1995. The mean annual flow of the Shawsheen River at this gage (drainage area is 2.09 square miles) is 4.86 cfs (Socolow *et al*. 2002). In addition to collecting flow measurements at the gage, the USGS also collected chemical, and microbiological data to document effects of remediation activities on the Hanscom properties. Due to funding problems, the USGS discontinued the chemical and microbiological data collection in 2001 (Girouard 2002).

A bacteria TMDL for the Shawsheen River Watershed was completed by LimnoTech in August 2002 for MADEP and the MRWC (LimnoTech 2002). Data were collected and coordinated through the MRWC and the Merrimack River Watershed Team. The purpose of this TMDL was to establish a bacteria TMDL for segments of the Shawsheen River and tributaries that are currently not meeting Massachusetts' standards. Additionally, the bacteria TMDL outlined an implementation strategy to abate fecal coliform sources so bacteria criteria can be attained (MADEP 2002).

A Shawsheen Bacteria TMDL Implementation Plan was developed to further identify the sources of bacteria in the watershed and to isolate storm drains with high bacteria counts. Fecal coliform bacteria were collected by MRWC and ESS, Inc. during 2001 and 2002 from storm drain locations in the Shawsheen River Watershed (01-01/MWI, see Appendix F; MRWC 2003a). As part of this implementation plan, two storm drain mapping projects (99-06/MWI and 00-06/MWI, see Appendix F) were completed in this portion of the Shawsheen River by MRWC in 2000. In Phase I, MRWC worked with local town managers and stream team volunteers to develop criteria for mapping the location and describing the condition of 250 storm drains along the mainstem (MRWC 2000a). In Phase II, a storm drain map was created using GIS technology for the Shawsheen River Watershed (MRWC 2001b). These data are useful in understanding the extent of non-point source pollution in the watershed and flooding potential for local communities (MRWC 2000a).

Excerpted from the EPA New England National Priorities List (NPL) website (EPA 25 March 2003):

> Hanscom Air Force Base/Hanscom Field site (EPA ID #: MA8570024424) covers approximately 1,120 acres in a light industrial area of eastern Massachusetts. A total of 22 possible sources of contamination have been identified on the land the Air Force has owned or leased. Since the spring of 1991, contaminated groundwater located within the vicinity of the airfield on Hanscom Field has been extracted and treated; however, investigations conducted, both by the Air Force and the Town of Bedford, have been inconclusive in terms of identifying a specific source of contamination that is the cause for the production well shutdown. Excavation of contaminated oil and drums, removal of contaminated soil and underground storage tanks, and operation of an SVE and groundwater collection system have reduced immediate threats to the public and the environment at the Hanscom Field/Hanscom Air Force Base site.

WMA WATER WITHDRAWAL

Based on the available information, there are no WMA regulated water withdrawals in this subwatershed.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLES E1 AND E2):

Jet Aviation, a current Massport tenant, under the terms of a MADEP mandated consent order, was required to initiate groundwater pumping and treatment and petroleum recovery. Groundwater recovery operations began 25 September 1989. Recovery was conducted at a rate of approximately 3 gpm and treatment was achieved by a dual granular activated carbon system. Jet Aviation applied for a NPDES permit (MA0032271) to discharge treated groundwater and treated precipitation runoff from a concrete loading pad (treatment via oil/water separator and holding tanks). Runoff collected in the second holding tank was treated by a carbon adsorption system prior to discharge to the unnamed tributary. Remediation operations were terminated in 1998 and the permit was terminated on 2 June 1999.

Battle Road Farm Condominiums, Old Bedford Road in Lincoln (owned by Lincoln House Associates Limited Partnership), was permitted (MA0031658) on 24 June 1988 to discharge treated sanitary wastewater (Outfall # 001, current average daily flow of 0.019 million gallons per day (MGD), design flow of 0.033 MGD) from the sanitary wastewater treatment facility. The discharge from this facility, operational since 1989, is to an isolated channelized wetland in this subwatershed. The existing permit expired on 22 May 2002 and was administratively continued. The permit renewal application was submitted to the EPA

and is currently being prepared for public comment. The existing permit includes monitoring requirements for two stormwater outfalls on the property. It has been determined that these outfalls were never built and, therefore, the new permit will not include outfalls 002 and 003 (Hill 2003). In 2000, 2001 and 2002, there were minor violations to the permit (fecal bacteria counts were above the 400 counts/100 mls limit; Cashins 2003).

The Massport property of Hanscom Field also discharges runoff from 188 acres of land consisting of runway and infield areas. Federal Express PMX in Lexington has a general stormwater permit (MAR05C148) that allows them to discharge to this subwatershed. This general permit was issued by the EPA in October 2001 and will expire in October 2005.

Since Bedford, Concord, Lexington, and Lincoln are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

In support of the stormwater permit development for the HAFB the USGS was contracted by the USAF to install an automatic (phone dial-up) continuous record stream flow gage in the Shawsheen River approximately 0.3 miles downstream from the multipipe outlet structure of Massport and HAFB drainage systems. The gage has a drainage area of 2.09 square miles and is capable of providing flow data every ten minutes, 24 hours per day, on a year round basis. The gage, operational since October 1995, provides streamflow data necessary to gain a better understanding of how streamflow conditions in the Shawsheen River are influenced by climatological events and the effects of stormwater runoff from Hanscom Field. Quarterly water quality monitoring of the Shawsheen River, initiated in September 1995, is also being conducted by USGS at the gage to provide additional instream data.

A Draft TMDL for aquatic life impairment in the Shawsheen Headwaters was prepared by MRWC in October 2002. The objective of this TMDL was to specify reductions in stormwater pollutant loads and other associated stressors so that aquatic life uses could be met. Based on past studies in the watershed (Rizzo Associates, Inc. 1996), the stressors impacting aquatic life/habitat in the headwaters of the Shawsheen include contaminants associated with stormwater runoff, hydrologic modifications, riparian corridor encroachment, and channel alteration (MRWC 2002). The Draft TMDL recommends implementing BMPs designed to enhance ground water recharge and reduce high stormwater flows and pollutant loads (MRWC 2002). The following actions are currently underway:

- USAF contracted MRWC to identify BMPs to be installed on the HAFB property to meet the TMDL surrogate target. The recommendations of BMPs are scheduled to be presented to USAF by December 2002.
- Massport Authority is working on identifying solutions to reduce runoff from the runways.

DWM conducted a habitat assessment in this segment of the Shawsheen River in September 2000. The habitat assessment revealed a channelized waterway with no instream cover for fish other than a small amount of aquatic macrophytes. The streambanks were stable and canopy cover was adequate, however, riparian landuse away from the immediate streambank was predominantly paved (airport service roads) and industrial (base facilities). Epifaunal substrate was poor, consisting almost entirely of sand. There was very little variability in habitat types with a shallow run predominating. There appeared to be an iron floc covering most all surfaces throughout the reach (Maietta 2001).

Biology

In September 2000 DWM conducted fish population sampling in this segment of the Shawsheen River downstream from three large culverts on the HAFB in Bedford using a backpack shocker. A total of 36 fish (19 being young of the year white suckers) were collected. Four species were represented. The fish community was dominated by white sucker and redfin pickerel. Other fish present included two American eels and one pumpkinseed (Maietta 2001). It should be noted that downstream of the sampled reach there are a number of beaver dams which may be acting as barriers to migrating fish, especially under low flow conditions. In addition, these beaver dams, are creating large areas of deeper pool habitats more favorable to “pond species” (Maietta 2001).

Toxicity

Effluent

Battle Road Farm Condominiums has conducted whole effluent toxicity tests on an annual basis between August 1999 and June 2002 on two test organisms (*C. dubia and P. promelas*). No acute whole effluent toxicity has been detected (i.e., the LC_{50} have all been $\geq$ 100% effluent). Based on these results and current permitting requirements the draft permit has increased the frequency of monitoring to two times per year and reduced the whole effluent toxicity testing requirements to one test organism, *C. dubia* only (Hill 2003).

Sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation assisted the MADEP in evaluating the sediment quality from two sampling locations (SH01C – at the outfall pipes on the HAFB property and MP01- at the USGS gage on the HAFB property in Bedford) within this segment of the Shawsheen River (EPA 1998). Whole sediment toxicity tests were performed according to EPA guidance. The results of the 10-day exposure tests (Table 3) indicated a lack of toxicity for the freshwater invertebrates (*Chironomus tentans and Hyallela azteca*) with respect to the test endpoints, survival and growth (EPA 1998). Artificial sediment was utilized as a control.

Table 3. EPA sediment toxicity data, Shawsheen River (Segment MA83-08)

Station Name	Survival *H. azteca* (average)	Survival *C. tentans* (average)
Control	83%	81%
SH01C	96%	93%
MP01	98%	93%

Chemistry – water

The USGS conducted water quality sampling in the Shawsheen River between September 1995 and September 2001 (for the purpose of this report data from 11 surveys conducted between October 1997 and September 2001 have been reviewed) at their gaging station (01100568). These data are published in the Water Resources Data Massachusetts and Rhode Island Water Year 1998, 1999, 2000, and 2001 reports (Socolow *et al.* 1999, Socolow *et al.* 2000, Socolow *et al*. 2001, and Socolow *et al*. 2002).

DO

Instream DO ranged between 6.9 and 10.9 mg/L, however, these data do not represent worse-case (pre-dawn) conditions.

Temperature

The maximum water temperature (11 September 1999) was 19.5°C.

pH

Instream pH ranged between 6.2 and 7.0 SU with 1 of the 11 measurements (9%) <6.5 SU.

Ammonia-Nitrogen

The ammonia-nitrogen concentrations ranged between 0.23 and 1.2 mg/L as N. All of these measurements were below 4.15 mg/L as N (chronic instream criterion for ammonia at pH of 7.0 and temperature of 20°C) (EPA 1999).

Phosphorus

Total phosphorus concentrations ranged between 0.010 to 0.092 mg/L with a mean of 0.04 mg/L.

Chemistry – sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation assisted the MADEP in evaluating the sediment quality at two locations (SH01C and MP01) within this segment (EPA 1998). Two sediment samples were collected with a petit ponar dredge (upper six inches of aquatic substrate) and analyzed for metals, AVS/SEM, SVOCs, PCB, pesticides, TOC, toxicity, and grain size. The first sediment sample (SH01C) was located at the outfall pipes on the HAFB property in Bedford, MA. The TOC at SH01C was 0.52%. DDE (a breakdown product and an impurity in DDT), DDD (an insecticide and DDT breakdown product), DDE (a DDT breakdown product), and dieldrin (an insecticide) measured

in quantities that exceeded the L-EL guidelines but were below the S-EL guidelines (Persaud *et al*. 1993). The second sediment sample (MP01) was located at the USGS gage station on the HAFB property in Bedford, MA. The TOC at MP01 was 0.26%. DDD and dieldrin measured in quantities that exceeded the L-EL guidelines, but were below the S-EL guidelines (Persaud *et al*. 1993). There were no metals concentrations at either sample location that exceeded the L-EL guidelines. In the two sediment samples collected there were no exceedances of the S-EL guidelines in any analyte.

While no water column and/or sediment quality problems were detected, the habitat assessment revealed a channelized waterway with little to no instream cover for fish and poor epifaunal substrates. Physical alteration (underground/culverted) of the stream channel in this segment of the Shawsheen River has also resulted in a reduction of habitat available for aquatic life. The *Aquatic Life Use* is, therefore, assessed as impaired for the entire length of this segment.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data (Table 4) during the months of June through September 1998 (eight sampling events) from two sites along this segment (MRWC 1998). Two of the eight sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 4. MRWC 1998 fecal coliform bacteria data, Shawsheen River (Segment MA83-08)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH 0.3 (Shawsheen River, at the Hanscom Airfield outfalls, Bedford)	46 – 1,110	173
SH 0.6 (Shawsheen River, upstream side of Westview, Bedford)	82 – 2,000	407

In August and September 2000 DWM collected fecal coliform bacteria samples at one station on this segment of the Shawsheen River (Appendix A, Table A4):

- SH01A-US, drainage culvert from HAFB, Bedford, MA.

The fecal coliform bacteria counts at SH01A-US were 360 cfu/100 mls in August and 500 cfu/100 mls in September.

Fecal coliform and *E. coli* bacteria samples were collected (only during the primary contact season) at the USGS gage (01100568) in Bedford, MA in support of the stormwater permit development for the HAFB property (Socolow *et al.* 1999, Socolow *et al.* 2000, Socolow *et al*. 2001, and Socolow *et al*. 2002).

- 1998 the fecal coliform bacteria counts ranged from 54 cfu/100 mls to 220 cfu/100 mls (n=3);
- 1999 the counts ranged 1900cfu/100 mls to 3,900 cfu/100 mls (n=3);
- 2000 the counts ranged from 150cfu/100 mls to 6,900 cfu/100 mls (n= 3);
- 2001 the counts were 40cfu/100 mls and 290cfu/100 mls (n=2).

Of the eleven fecal coliform samples collected by USGS between April 1998 and July 2001, four samples exceeded 2,000 cfu/100 mls. These elevated bacteria counts were all associated with wet weather conditions.

Fecal coliform bacteria were collected during July, October, and November 2002 from five storm drain locations in this segment of the Shawsheen River by MRWC as part of the Shawsheen TMDL Implementation Plan project (01-01/MWI, see Appendix F; MRWC 2003a). This part of the project (Part II) focused on the Shawsheen River headwaters on the HAFB property and documented bacteria levels in the end-of-pipe effluents. The data presented in this report are not representative of stream habitat conditions, but do represent source identification of pollutant loadings. Bacteria samples were collected during dry and wet weather conditions. The fecal coliform bacteria counts ranged from 4cfu/100 mls (sample collected during a dry weather event – 0.0 inches of rain) to 1,423cfu/100 mls (sample collected during a wet weather event – 0.68 inches of rain) (MRWC 2003a).
The storm drains sampled in this segment primarily drain the HAFB property.

Based on elevated fecal coliform bacteria levels and best professional judgment, the *Primary Contact Recreational Use* is assessed as impaired for the entire length of this segment. Although the geometric

mean from the MRWC 1998 bacteria data did not exceed 1,000 cfu/100 mls, 36% of the samples collected by USGS (representative of wet weather conditions) exceeded 2,000 cfu/100 mls. The *Secondary Contact Recreational Use* is, therefore, also assessed as impaired.

AESTHETICS

An overriding objectionable condition (channelized/underground) is not an aesthetic issue according to the use assessment guidance but, rather an aquatic life issue related to habitat quality.

No information is available to assess the Aesthetics Use for this segment of the Shawsheen River.

Shawsheen River (MA83-08) Use Summary Table

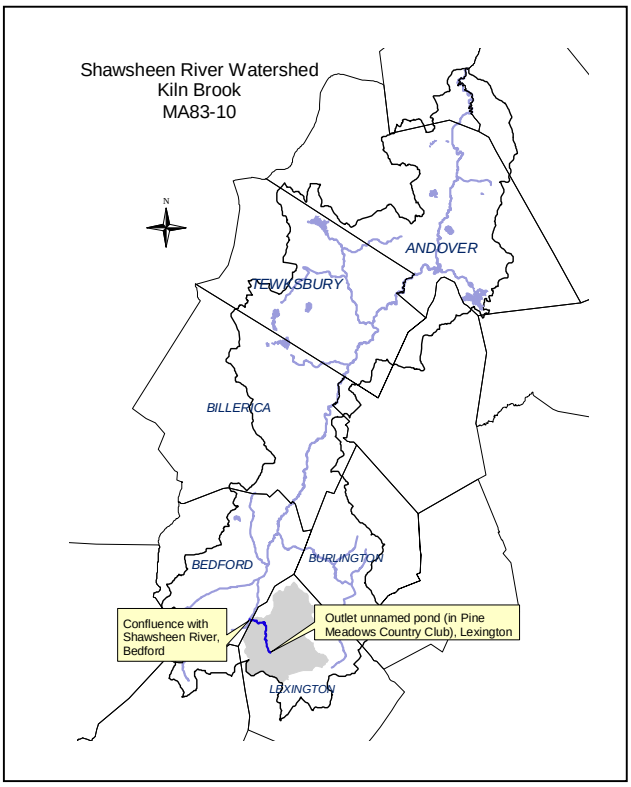
Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		IMPAIRED	Anthropogenic substrate alteration, physical substrate habitat alterations	Channelization	Post development erosion and sedimentation , industrial/commercial site stormwater discharge (permitted)
Fish Consumption		NOT ASSESSED			
Primary Contact		IMPAIRED	Fecal coliform bacteria	Industrial/commercial site stormwater discharge (permitted), municipal separate storm sewer systems	
Secondary Contact		IMPAIRED	Fecal coliform bacteria	Industrial/commercial site stormwater discharge (permitted), municipal separate storm sewer systems	
Aesthetics		NOT ASSESSED			

RECOMMENDATIONS SHAWSHEEN RIVER (SEGMENT MA83-08)

- Review and implement recommendations of the USAF Habitat TMDL and the Shawsheen Bacteria TMDL (i.e., implementing BMPs designed to enhance groundwater recharge and reduce high stormwater flows and pollutant loads; assess the feasibility of potential restorative actions along the riparian corridor, including the river itself; and develop and implement an instream habitat restoration/improvement project to improve habitat quality and support aquatic life).
- A shoreline survey should be conducted to document aesthetic quality of this segment of the Shawsheen River.
- Follow-up with EPA on the status of remediation activities at the Hanscom Air Force Base/Hanscom Field NPL site (EPA ID # MA8570024424).

KILN BROOK (SEGMENT MA83-10)

Location: Outlet of unnamed pond (located in Pine Meadows Country Club), Lexington, to confluence with Shawsheen River, Bedford
Segment Length: 1.5 miles.
Classification: Class B, Warm Water Fishery



The drainage area of this segment is approximately 4.2 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	46%
Forest	24%
Open Land	12%

The MRWC and the Upper Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (eight sampling events) from one site along this segment (MRWC 1998).

A portion of Kiln Brook drains a large wetland area. In this area there is an old (abandoned) town of Lexington landfill, which has been under suspicion that the leachate affects the water quality in the area of Kiln Brook (Dunn 2003a).

WMA WATER WITHDRAWAL

Based on the available information, there are no regulated water withdrawals in this tributary system.

NPDES WASTEWATER DISCHARGE SUMMARY:

Based on the available information, there are no discharges to this tributary system. It should be noted, however, that Lexington and Bedford are Phase II Stormwater communities; they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE USE

Biology

DFWELE conducted fish population sampling at one location in this segment - downstream of Maguire Street Bridge in Bedford - using a backpack shocker in July 2000. A total of 24 fish, representing four species, were collected. Redfin pickerel dominated the fish community. Other species present (American eel, chain pickerel, and swamp darter) were represented by a few individuals. The fish assemblage consisted of macrohabitat generalists (Richards 2003).

Too little information is available to assess the *Aquatic Life Use*.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data during the months of June through September 1998 (eight sampling events) from one station along this segment (MRWC 1998). A total of eight bacteria samples were collected and the fecal coliform counts ranged from 100 cfu/100 mls to 5,800 cfu/100 mls. The geometric mean of the fecal coliform bacteria data is 464 cfu/100 mls. Fifty percent of the samples exceeded 400 cfu/100 mls and one sample exceeded 2,000 cfu/100 mls. Two of the eight sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Based on elevated fecal coliform bacteria levels, the *Primary Contact Recreational Use* is assessed as impaired for the entire length of this segment. The *Secondary Contact Recreational Use* is assessed as support. However, it is identified with an Alert Status because of one elevated fecal coliform bacteria count (2,000 cfu/100 mls).

Kiln Brook (Segment MA83-10) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Primary Contact		IMPAIRED	Fecal coliform bacteria	unknown	stormwater
Secondary Contact		SUPPORT*			
Aesthetics		NOT ASSESSED			

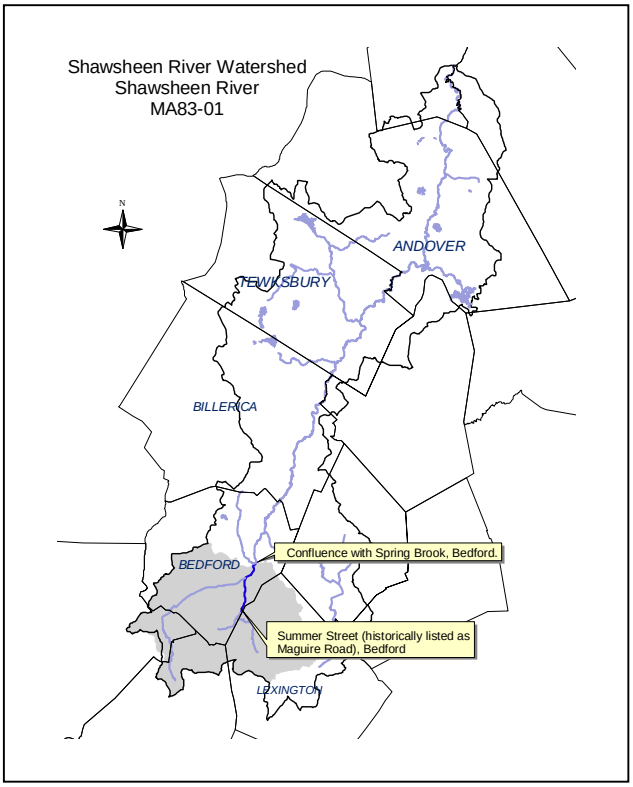
*"Alert Status" issue identified, see details in the text above

RECOMMENDATIONS KILN BROOK (SEGMENT MA83-10)

- Continue to monitor bacteria levels in Kiln Brook to identify and remediate sources of contamination.
- A shoreline survey should be conducted to document aesthetic quality of Kiln Brook.
- Conduct groundwater and surface water monitoring to study the potential affects from the abandoned landfill in Lexington.

SHAWSHEEN RIVER (SEGMENT MA83-01)

Location: Summer Street, Bedford, to the confluence with Spring Brook, Bedford
Segment Length: 1.7 miles.
Classification: Class B, Warm Water Fishery, Treated Water Supply



The drainage area of this segment is approximately 13.87 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	34%
Forest	32%
Transport	10%

This segment is on the 1998 303(d) List of Waters for unknown toxicity, organic enrichment/low DO and pathogens (Table 2).

The MRWC and the Upper Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (six sampling events) from two sites along this segment (MRWC 1998).

A bacteria TMDL for the Shawsheen River Watershed was completed by Limno-Tech in August 2002 for MADEP and the MRWC (LimnoTech 2002). Data were collected and coordinated through the MRWC and the Merrimack River Watershed Team. The purpose of this TMDL was to establish a fecal coliform TMDL for segments of the Shawsheen River and tributaries that are currently not meeting Massachusetts standards. Additionally, the bacteria TMDL outlined an implementation strategy to abate fecal coliform sources so bacteria criteria can be attained (MADEP 2002).

A Shawsheen Bacteria TMDL Implementation Plan was developed to further identify the sources of bacteria in the watershed, and to isolate storm drains with high bacteria counts. Fecal coliform bacteria were collected by MRWC and ESS, Inc. during 2001 and 2002 from storm drain locations in the Shawsheen River Watershed (01-01/MWI, see Appendix F; MRWC 2003a). As part of this implementation plan, two storm drain mapping projects (99-06/MWI, see Appendix F) were completed in this portion of the Shawsheen River by MRWC in 2000. In Phase I, MRWC worked with local town managers and stream team volunteers to develop criteria for mapping the location and describing the condition of 250 storm drains along the mainstem (MRWC 2000a). In Phase II, a storm drain map was created using GIS technology for the Shawsheen River Watershed (MRWC 2001b). These data are useful in understanding the extent of non-point source pollution in the watershed and flooding potential for local communities (MRWC 2000a).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E3):

Facility	PWS ID#	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)				
					1998	1999	2000	2001	2002
Bedford Department of Public Works*	3023000	31502301	023-02G 023-08G 023-09G	0.66 reg 0.00 per 0.66 total	0.19	0.27	0.26	0.17	N/A

* indicates system-wide withdrawal; all sources are not within this segment
N/A = Data not available for 2002

The Town of Bedford has one well (#6) and one wellfield (Shawsheen Road Wellfield, #2, 4, & 5) along this segment of the Shawsheen River. Currently, the Shawsheen Road Wellfield is listed as the only indigenous

supply source in Bedford. Occasionally iron and manganese levels are of concern. Well #6 has been off-line since 1984 due to limited yield and suspected water quality problems.

NPDES WASTEWATER DISCHARGE SUMMARY:
Based on the available information, there are no discharges to this segment. It should be noted, however, that Bedford is a Phase II Stormwater community, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Habitat quality was evaluated at six stations in this segment of the Shawsheen River by ESS, Inc. in August 2001 as part of the Shawsheen River Watershed Storm Drain Assessment Project (01-08/MWI, see appendix F; ESS 2002). While the instream habitat quality variables (i.e., epifaunal substrate, embeddedness, sediment deposition, riparian vegetative zone width, and frequency of riffles) generally scored low, the riparian zone was well vegetated and the streambanks were stable. No objectionable deposits, odors, or oils were documented.

Biology

DFWELE conducted fish population sampling at one location in this segment of the Shawsheen River - upstream of Route 4, Bedford - using a backpack shocker in September 1998. A total of 55 fish, representing nine species, were collected. The samples were dominated by American eel and redfin pickerel, while banded sunfish, golden shiner, and pumpkinseed were abundant. Other species present, including white sucker, chain pickerel, bluegill, and swamp darter, were represented by few individuals. The fish assemblage was dominated by macrohabitat generalists (Richards 2003).

Toxicity

Ambient

Samples were collected by members of the MVPC in June 2002 as part of the *Chronic Toxicity Testing* Project (00-06/104, see Appendix F). The EPA, Office of Environmental Measurement and Evaluation assisted the MVPC in evaluating the surface water from one sampling location (SH-1 located at Page Road in Bedford) within this segment (EPA 2002b). Initial samples were collected on 19 June 2002. Two additional samples were collected on 22 June and 24 June 2002 for use on days three and five of testing to provide fresh samples for test renewals. The results of the 7-day, short-term chronic toxicity tests indicated a lack of acute toxicity for both species with respect to the survival and growth endpoints (survival of *C. dubia* = 100% and survival of *P. promelas* = 95%; EPA 2002b). Lab water was utilized as a test control (survival of *C. dubia* = 100%, survival of *P. promelas* = 75%).

The habitat evaluations conducted by ESS, Inc. indicated poor epifaunal substrates in this segment of the Shawsheen River. Embeddedness and lack of riffle habitat were noted. The riparian zone, however, was well vegetated and the streambanks were stable. The *Aquatic Life Use* is, therefore, assessed as impaired for the entire length of this segment. It should also be noted, however, that no instream chronic toxicity was detected (unknown toxicity was identified as an impairment cause on the 1998 303(d) List).

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data (Table 5) during the months of June through September 1998 (six sampling events) from two sites along this segment (MRWC 1998). Two of the six sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 5. MRWC 1998 fecal coliform bacteria data, Shawsheen River (Segment MA83-01)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH 1.8 (Great Road, Bedford)	1 – 192	10
SH 2.3 (Page Road, Bedford)	55 - 400	131

In August and September 2000 DWM collected fecal coliform bacteria samples at two stations on this segment of the Shawsheen River (Appendix A, Table A4):

- SH01, Summer Street, Bedford, MA.
- SH02, at Page Road (upstream from center cement bridge structure), Bedford, MA.

The fecal coliform bacteria data at SH01 were 89 cfu/100 mls in August and 180 cfu/100 mls in September. The counts at SH02 were 600 cfu/100 mls in August and 330 cfu/100m in September.

Fecal coliform and *E. coli* bacteria were collected during August, September, and October 2001 from six storm drain locations in this segment of the Shawsheen River by ESS as part of the Shawsheen River Watershed Storm Drain Assessment project (01-08/MWI, see Appendix F; ESS 2002). The storm drain study documented end-of-pipe effluents before any mixing occurred within the receiving waterbody. The data presented in the ESS report is not representative of instream water quality conditions, but does represent source identification of pollutant loadings (ESS 2002). A total of 13 wet weather bacteria samples were collected. The fecal coliform bacteria counts ranged from 110cfu/100 mls to 260,000cfu/100 mls and the *E. coli* bacteria counts ranged from 110cfu/ml to 260,000cfu/100 mls (ESS 2002). A total of two dry weather samples were collected; the fecal coliform bacteria counts were 2cfu/100 mls and 1,900cfu/100 mls and the *E. coli* bacteria counts were 1cfu/ml and 1,300cfu/100 mls (ESS 2002). The storm drains sampled in this segment primarily drained large, impervious areas, residential areas, and recreational areas.

Fecal coliform, *E.coli*, and Enterococci bacteria samples were collected by members of the MVPC in April-June 2002 from one station at Page Road, Bedford (station SH-1) as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). A total of seven bacteria samples were collected. The fecal coliform counts ranged from 370 cfu/100 mls to 2,600 cfu/100 mls. The geometric mean over the three months of sampling for the fecal coliform bacteria data is 761 cfu/100 mls. Only one sample exceeded 2, 000 cfu/100 mls.

Based on elevated fecal coliform bacteria levels, the *Primary Contact Recreational Use* is assessed as impaired for the entire length of this segment. Although the geometric mean from the MRWC 1998 bacteria data did not exceed 200 cfu/100 ml, more recent bacteria sampling data (DWM and MVPC) do exceed 200 cfu/100 ml. Furthermore, storm drain discharges to this segment of the Shawsheen River are confirmed sources of bacteria. The *Secondary Contact Recreational Use* is assessed as support. However, it is identified with an Alert Status because of one elevated fecal coliform bacteria count.

Shawsheen River (Segment MA83-01) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life*		IMPAIRED	Embeddedness , physical substrate habitat alterations, sedimentation		Post development erosion and sedimentation, industrial/commercial site stormwater discharge (permitted), highway/road/bridge runoff non construction related
Fish Consumption		NOT ASSESSED			
Primary Contact		IMPAIRED	Fecal coliform bacteria	Municipal separate storm sewer systems	Municipal (urbanized high density area), residential districts
Secondary Contact		SUPPORT*			
Aesthetics		NOT ASSESSED			

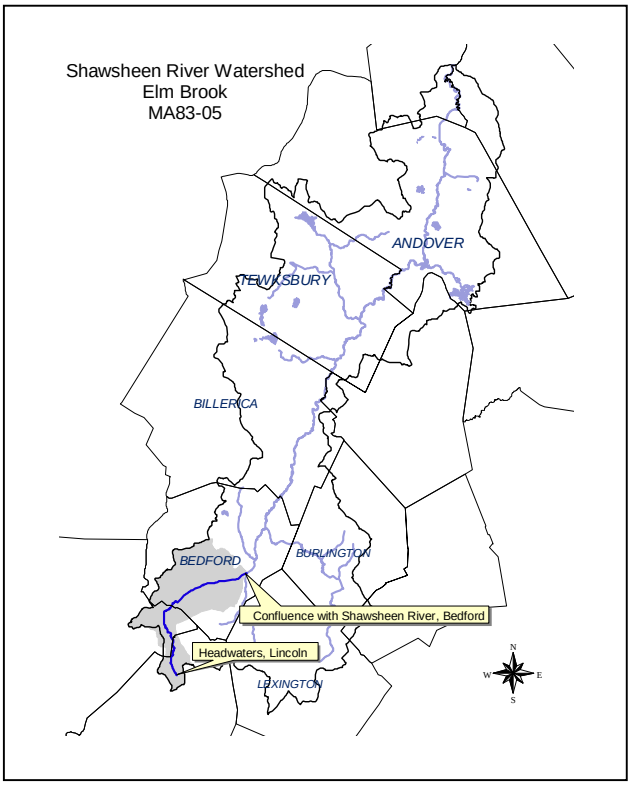
* "Alert Status" issues identified, see details in the text above

RECOMMENDATIONS SHAWSHEEN RIVER (SEGMENT MA83-01)

- Continue efforts of the watershed team toward finding bacteria sources and remediating problems.
- Develop and implement an instream habitat restoration/improvement project to improve habitat quality and support aquatic life.
- Implement the recommendations of the Shawsheen Bacteria TMDL
    - septic tank control (identify and remediate local community septic problems)
    - urban runoff (collect additional monitoring data to isolate sources of bacteria and implement a control plan)
- A shoreline survey should be conducted to document aesthetic quality of this segment of the Shawsheen River.

ELM BROOK (SEGMENT 83-05)

Location: Headwaters, Lincoln, to confluence with the Shawsheen River, Bedford
Segment Length: 5.0 miles.
Classification: Class B.



The drainage area of this segment is approximately 6.0 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	44%
Residential	31%
Transport	7%

This segment is on the 1998 303(d) List Waters because of pathogens and turbidity (Table 2).

The MRWC and the Upper Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (seven sampling events) from six sites along this segment (MRWC 1998).

There are two NPL sites located in this subwatershed. The site descriptions were excerpted from the EPA New England National Priorities List (NPL) website (EPA 25 March 2003):

The Naval Weapons Industrial Reserve Plant (NWIRP) site (*EPA ID #:* MA6170023570) is a 46-acre facility that is part of a larger industrial complex located immediately north of Hanscom Air Force Base, which is also on the NPL. NWIRP is operated by Raytheon Co. and was established in 1952 when a missile and radar development laboratory was built. Between 1959 and 1977, the Navy obtained about 43 additional acres from the Air Force. Wastes generated at NWIRP include various volatile organic compounds (VOCs), photographic fixer, waste oil and coolants, lacquer thinner, unspecified solvents and thinners, Stoddard solvent, waste paint, and chromic, sulfuric, nitric, hydrochloric, and phosphoric acids. The Hartwell Road Well Field, part of the municipal water supply for the Town of Bedford, is located less than .5 miles from NWIRP. The three wells in this field were closed in 1984 after VOCs contamination was discovered. The Town of Bedford conducted an investigation that determined that NWIRP was a likely source of the well field contamination. Hanscom Air Base is also a potential contributor to the groundwater contamination in this area. Approximately 11,000 people rely on drinking water wells located within 4 miles of the site. The Shawsheen River, 7 miles downstream of NWIRP, is a source of drinking water for approximately 12,800 people. Nine residential areas and wetlands are located to the east and northeast of the site. There are extensive wetlands and several species of rare plants and wildlife along the Shawsheen River and the Elm Brook, both located downstream of NWIRP. Draft Proposed Plans for the TCE and BTEX plume have been deferred for the time being. In 2003 an insitu thermal treatment system will undergo a pilot test at the TCE plume and a source soil removal will be conducted at the BTEX plume. Documentation of the treatment of chlorinated solvents at the south end of NWIRP Bedford by the adjacent Hanscom Air Force Base groundwater extraction and treatment system through a Memorandum of Understanding with the Air Force is in routing for signature. A monitoring plan has been developed and will commence in the fall of 2002.

The Raytheon Missile Systems Division (Raytheon) site (EPA ID #: MAD981214992) is located at 180 Hartwell Road in Bedford, Middlesex County, Massachusetts. Raytheon began operations on the property in 1958. Raytheon uses a variety of chemicals, including acids, alkali cleaners, copper plating solutions, photographic developers and fixers, epoxy coating solutions [containing volatile organic compounds (VOCs) such as toluene, xylenes, and methyl ethyl ketone], and solvents (including acetone, propanol, 1,1,1-trichloroethane, trichloroethylene, methylene chloride, and Freon). Raytheon handles liquid wastes in satellite storage areas. Wastes in the satellite storage areas were regularly transferred to drums stored in an on-site hazardous waste storage building. Raytheon is licensed by U.S. Environmental Protection Agency (EPA) to handle small quantities of hazardous waste (RCRA ID No. MAD019165406). A number of environmental investigations have been performed at the Raytheon property and its vicinity. Several spills of fuel and hazardous substances have been reported to and remediated under the supervision of the Massachusetts Department of Environmental Quality Engineering (MA DEQE) and its successor, the Massachusetts Department of Environmental Protection (MA DEP). Investigations have documented the release

of VOCs and metals to groundwater beneath the Raytheon property. Runoff from the former Raytheon property flows westward to Elm Brook, which discharges to the Shawsheen River.

WMA WATER WITHDRAWAL SUMMARY:
Based on the available information, there are no regulated water withdrawals in this tributary system.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E2):
An unnamed tributary in this subwatershed received treated groundwater discharge via the HAFB Treatment Plant (Outfall # 001), NPDES MA0090697. The permit was issued on 1 October 1990 for the groundwater recovery and treatment system designed to remove volatile organic compound (VOC) contamination in the overburden and bedrock aquifer at HAFB. The system was designed to operate 24 hours per day, 7 days per week, for up to 20 years. The maximum flow to the system was expected to be 0.468 MGD, of which up to 0.144 MGD was to be discharged to the surface receiving water while the remainder was to be recharged to the ground through a soil flushing system in accordance with MADEP permit 0-439. The HAFB has been conducting chronic toxicity tests of this discharge as part of the requirements of their NPDES permit. Whole effluent toxicity testing limits in the NPDES permit are $LC_{50} \geq 100\%$, and CNOEC = 100%. Hanscom has been listed as a NPL site since 1994 and has been subject to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) oversight since that time. Since all responsible parties (HAFB, EPA Region I, and MADEP) for the site have agreed with the cleanup and oversight of the Ground Water Extraction and Treatment System under CERCLA, this NPDES permit was terminated on 22 March 2002.

The Raytheon Corporation permit (MA0001406), in Bedford, was terminated on 5 December 1997. There is one discharge from a groundwater remediation facility (MA0033529) that discharges to Elm Brook.

Stormwater runoff from the Massport property at Hanscom field discharges through two direct and two indirect outfalls to Elm Brook. The drainage from a 242 acre vegetated area discharges via overland flow into Elm Brook. Drainage from approximately 50 acres of runway and infield area discharges indirectly into Elm Brook through a 36-inch reinforced concrete pipe located approximately 900 feet away from the main channel of the brook. Another drainage area contributes runoff from a 211-acre area comprised mainly of the runways and infield grass areas as well as Massachusetts Institute of Technology Lincoln Laboratory through a 54-inch reinforced concrete pipe at a location 500 feet from Elm Brook. All stormwater discharges from Massport property will be regulated under the NPDES permit currently in development co-signed by all Massport tenants.

The Millipore Corporation, in Bedford, had a NPDES permit (MA0025828) authorizing them to discharge non-contact cooling water (0.03 MGD) to this segment. The permit was issued on 30 September 1983 and was terminated on 9 April 1999. The discharge was eliminated via connection to Massachusetts Water Resource Authority (MWRA) sewer system (Casella 2003).

The Amoco Oil Company in Bedford, NPDES permit (MA0035441), was issued for a groundwater remediation project that was completed in 2002. The permit was terminated on 3 January 2003.

The following general stormwater permits were issued by the EPA in October 2001 and will expire in October 2005.

- Raytheon Company permit No. MAR05C148
- Laurence G. Hanscom Field permit Nos. MAR05C227, MAR05C135, MAR05C133, MAR05C262, MAR05C132, MAR05C261, MAR05C134, AND MAR05C263
- Millipore Corporation permit No. MAR05C254, MAR05B728, and MAR05B729

Since Bedford, Concord, and Lincoln are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT
AQUATIC LIFE
Habitat and Flow

DWM conducted a habitat assessment in this segment, upstream of Hartwell Road in Bedford, in September 2000. The habitat assessment revealed a channelized waterway, which runs through an extensive wetland of loosestrife and red maple, with instream cover consisting primarily of aquatic

macrophytes. Epifaunal substrate was poor consisting of mostly mud, silt and sand. Habitat types included a shallow run with a few deeper pools. Approximately 50 meters down the sampling reach there was a small beaver dam, which created a slightly impounded area for approximately fifty meters to the base of a larger beaver dam (Maietta 2001).

Habitat quality of Elm Brook near Railroad Avenue and Washington Street, Bedford (station SW7/SW8) was evaluated by ESS, Inc. in August 2001 (ESS 2002). While the instream habitat quality variables (i.e., epifaunal substrate, embeddedness, frequency of riffles, and riparian vegetative zone width) generally scored low, the riparian zone was generally well vegetated and the streambanks were stable. The streambed was comprised of sand and gravel (60 and 35%, respectively). Although no major objectionable conditions were noted, there was some trash observed in the stream.

Biology

DFWELE conducted fish population sampling at two locations in this segment - at Hartwell Road and off Route 62 near Bedford Center, Bedford - using a backpack shocker in June 2000. A total of 107 fish, representing eight species, were collected. The samples were dominated by redfin pickerel and white sucker, while golden shiner, banded sunfish, and American eel were abundant. Other species present, including creek chubsucker, pumpkinseed, and swamp darter, were represented by few individuals (Richards 2003). The fish assemblage was dominated by macrohabitat generalists and also included a mix of fluvial specialists/dependants (Richards 2003).

DWM conducted fish population sampling in this segment upstream of Hartwell Road in Bedford using a backpack shocker in September 2000. A total of 45 fish were collected. Nine species were represented in the sample. The fish community was dominated by redfin pickerel, banded sunfish, and pumpkinseed. It appeared that banded sunfish were more prevalent downstream of the first beaver dam with pumpkinseed taking over in between the two beaver dams. Fish were pooled throughout the entire reach and, therefore, fish assemblage distinctions between the two habitat types could not be made. Other species collected included creek chubsucker, golden shiner, brown bullhead, chain pickerel, American eel, and darter (Maietta 2001).

Toxicity

Ambient

Surface water samples were collected by members of the MVPC in June 2002 as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). The EPA, Office of Environmental Measurement and Evaluation, assisted the MVPC in evaluating the surface water from one sampling location (EBRf – located at Great Road in Bedford) within this segment (EPA 2002b). Initial samples were collected on 19 June 2002, two additional samples were collected on 22 June and 24 June 2002 from each location for use on days three and five of testing to provide fresh samples for test renewals. The results of the 7-day, short-term chronic toxicity tests indicated a lack of acute toxicity for the freshwater invertebrates (survival of *C. dubia* = 100% and survival *of P. promelas* = 93%) with respect to the test endpoints, survival and growth (EPA 2002b). Lab water was utilized as a control (survival of survival *C. dubia* = 100% and survival of *P. promelas* = 75%).

Toxicity

Effluent

HAFB conducted 24 whole effluent toxicity tests using *C. dubia* and *P. promelas* between February 1996 and November 2001 on their treated effluent (Outfall #001) discharge. No acute toxicity (i.e., the LC_{50} have all been $\geq$ 100% effluent) has been detected by either test species (*C. dubia, P. promelas*) in any of the 24 toxicity tests results submitted since February 1996. However, chronic toxicity to both test organisms has been detected in eight (*C. dubia*) and four (*P. promelas*) test events since February 1996. The chronic no observed effect concentrations (CNOEC) to both species ranged from <6.25 to 50%. Neither test organism was consistently more sensitive and chronic toxicity was detected in 46% of the test events.

Sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation assisted the MADEP in evaluating the sediment quality from one sampling location (EB02 – 0.5 miles upstream of its confluence with the Shawsheen River) within this segment (EPA 1998). Whole sediment toxicity tests were performed according to EPA guidance (EPA 1994). The results of the 10-day exposure tests

indicated no acute toxicity to the freshwater invertebrates (survival of *C. tentans* = 89% and survival of *H.azteca* = 100%) with respect to the test endpoints, survival and growth (EPA 1998). Artificial sediment was utilized as a control (survival of *H. azteca*. = 83% and survival of *C. tentans* = 81%).

Chemistry – sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation assisted the MADEP in evaluating the sediment quality at one location (EB02) within this segment (EPA 1998). The sediment sample was collected and analyzed for metals, AVS/SEM, SVOCs, PCB, pesticides, TOC, toxicity, and grain size. The TOC at EB02 was 0.21%. There were no detections of chlorinated pesticides or PCB. Additionally, there were no metals concentrations that exceeded the L-EL guidelines. In the sediment sample collected there was no exceedances of the S-EL guidelines in any analyte.

The upper 2.7 miles of Elm Brook are not assessed for the Aquatic Life Use. Channelization of Elm Brook begins just downstream from the Concord/Bedford town lines. In this reach, the habitat assessments indicated poor epifaunal substrates. Embeddedness and lack of riffle habitat were noted. The riparian zone, however, was well vegetated and the streambanks were stable. The *Aquatic Life Use* is, therefore, assessed as impaired for the lower 2.3 miles of this segment. It should also be noted, however, that no instream chronic toxicity or sediment toxicity was detected.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data (Table 6) during the months of June through September 1998 (seven sampling events) from six sites along this segment (MRWC 1998). Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 6. MRWC 1998 fecal coliform bacteria data, Elm Brook (Segment MA83-05)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
EB 0.5 (Route 2A, Lincoln)	54 – 1,000	203
EB 1.5 (Virginia Road, Concord)	2 – 460	79
EB 2.5 (Hartwell Road, Bedford)	2 – 220	48
EB 3.3 (Washington Street, Bedford)	112 – 2,480	457
EB 3.4 (South Road, Bedford)	130 – 1,500	467
EB 4.0 (Great Road, Bedford)	170 – 1,500	590

In August and September 2000 DWM collected fecal coliform bacteria samples at one station from Elm Brook (Appendix A, Table A4):

- EB02, upstream from Great Road bridge, Bedford, MA.

The fecal coliform bacteria counts at EB02 were 470 cfu/100 mls in August and 380 cfu/100 mls in September.

Fecal coliform and *E. coli* bacteria were collected during September and October 2001 from two storm drain locations in this segment of Elm Brook by ESS as part of the Shawsheen River Watershed Storm Drain Assessment project (01-08/MWI, see Appendix F; ESS 2002). The storm drain study documented end-of-pipe effluents before any mixing occurred within the receiving waterbody. The data presented in the ESS report is not representative of stream habitat conditions, but does represent source identification of pollutant loadings (ESS 2002). A total of four bacteria samples were collected during wet weather conditions. The fecal coliform bacteria counts ranged from 1,200cfu/100 mls to 5,200cfu/100 mls and the *E. coli* bacteria counts ranged from 800cfu/ml to 4,400cfu/100 mls (ESS 2002). The storm drains sampled in this segment primarily drained industrial and residential areas (ESS 2002).

Fecal coliform, *E.coli*, and Enterococci bacteria samples were collected by members of the MVPC in April-June 2002 from a one station in Elm Brook near Great Road, Bedford (station EB-RF) in this segment as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). A total of seven bacteria samples were collected. The fecal coliform counts ranged from 78 cfu/100 mls to 13,000

cfu/100 mls. The geometric mean over the three months of sampling for the fecal coliform bacteria data was 661cfu/100 mls.

The upper 3.0 miles of Elm Brook are assessed as support for the *Primary Contact Recreational Use.* However, it is identified with Alert Status because the most upstream station had one elevated bacteria count. Downstream from Hartwell Road, Bedford, the *Primary Contact Recreational Use* is assessed as impaired as a result of elevated fecal coliform bacteria levels and best professional judgment (the lower 2.0 miles of this segment). The *Secondary Contact Recreational Use* is assessed as support but it is identified with an Alert Status because of one elevated fecal coliform bacteria count.

Elm Brook (Segment MA83–05) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED upper 2.7 miles IMPAIRED lower 2.3 miles	Anthropogenic substrate alteration , physical substrate habitat alterations	Channelization, Embeddedness	Post development erosion and sedimentation, Industrial/commercial site stormwater discharge (permitted)
Fish Consumption		NOT ASSESSED			
Primary Contact		SUPPORT* upper 3.0 miles IMPAIRED lower 2.0 miles	Fecal coliform bacteria	Industrial/commercial site stormwater discharge (permitted), Municipal separate storm sewer systems	
Secondary Contact		SUPPORT*			
Aesthetics		NOT ASSESSED			

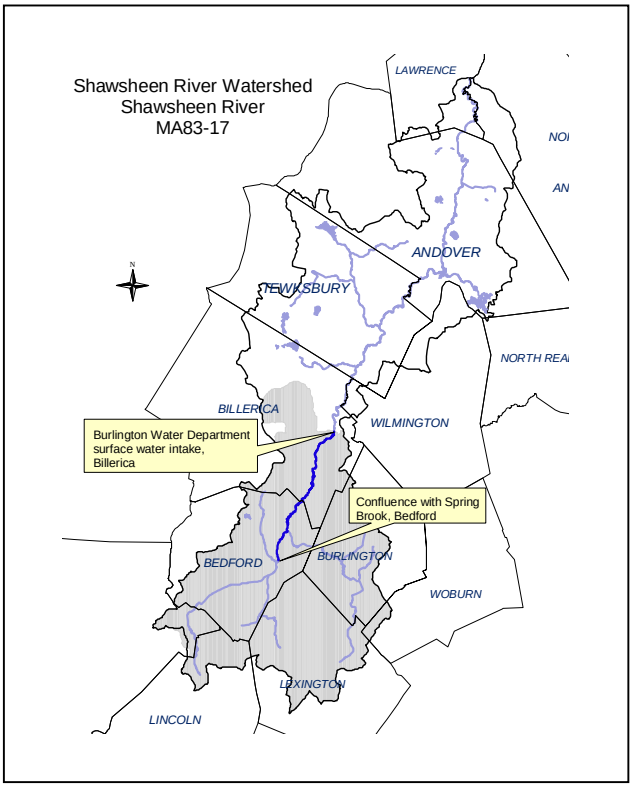
* "Alert Status" issues identified, see details in the text above

RECOMMENDATIONS ELM BROOK (SEGMENT MA83–05)

- Additional monitoring of storm drain discharges to Elm Brook are needed to confirm sources of bacteria.
- Assess the feasibility of potential restorative actions along the riparian corridor, including the river itself.
- Develop and implement an instream habitat restoration/improvement project to improve habitat quality and support aquatic life.
- Continue to monitor bacteria levels to document effectiveness of bacteria source reduction activities.
- Since NPDES discharges to Elm Brook have ceased, additional monitoring of water quality (including turbidity – an impairment identified on the 1998 303(d) List) should be conducted.
- A shoreline survey should be conducted to document aesthetic quality of Elm Brook.
- Follow-up with EPA on the status of remediation activities at the NPL sites that are located in this subwatershed.

SHAWSHEEN RIVER (SEGMENT MA83-17)

Location: Confluence with Spring Brook, Bedford, to the Burlington Water Department's surface water intake, Billerica
Segment Length: 5.7 miles.
Classification: Class B, Warm Water Fishery, Treated Water Supply



The drainage area of this segment is approximately 35.31square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	41%
Forest	29%
Open Land	10%

This segment (formerly part of segment MA83-02) of the Shawsheen River is on the 1998 303(d) List Waters because of unknown toxicity, organic enrichment/low DO and pathogens (Table 2).

The MRWC and the Upper and Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 from seven sites along this segment (MRWC 1998).

A bacteria TMDL for the Shawsheen River Watershed was completed by Limno-Tech in August 2002 for MADEP and the MRWC (LimnoTech 2002). Data were collected and coordinated through the MRWC and the Merrimack River Watershed Team. The purpose of this TMDL was to establish a fecal coliform TMDL for segments of the Shawsheen River and tributaries that are currently not meeting Massachusetts standards. Additionally, the bacteria TMDL outlined an implementation strategy to abate fecal coliform sources so bacteria criteria can be attained (MADEP 2002).

A Shawsheen Bacteria TMDL Implementation Plan was developed to further identify the sources of bacteria in the watershed and to isolate storm drains with high bacteria counts. Fecal coliform bacteria were collected by MRWC and ESS, Inc. during 2001 and 2002 from storm drain locations in the Shawsheen River Watershed (01-01/MWI, see Appendix F; MRWC 2003a). As part of this implementation plan, two storm drain mapping projects (99-06/MWI and 00-06/MWI, see Appendix F) were completed in this portion of the Shawsheen River by MRWC in 2000. In Phase I, MRWC worked with local town managers and stream team volunteers to develop criteria for mapping the location and describing the condition of 250 storm drains along the mainstem (MRWC 2000a). In Phase II, a developed storm drain map was created using GIS technology for the Shawsheen River Watershed (MRWC 2001b). These data are useful in understanding the extent of non-point source pollution in the watershed and flooding potential for local communities (MRWC 2000a).

WMA WATER WITHDRAWAL

There are currently no WMA withdrawals along this segment of the Shawsheen River. The Town of Bedford's Well #1 has been off-line since 1983 due to high coliform bacteria, low yield, and poor condition. Their Turnpike Wellfield (wells #7, 8, & 9) has been inactive since 1978 due to volatile and nonvolatile organic contamination.

NPDES WASTEWATER DISCHARGE SUMMARY:

Based on the available information, there are no discharges to this tributary system. It should be noted, however, that Bedford and Billerica are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a

stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE

Habitat and Flow

Habitat quality of the Shawsheen River downstream from Boston Road/Route 3A (near Ackerson Playground), Billerica (station SW9) was evaluated by ESS, Inc. in August 2001 (ESS 2002). None of the instream habitat quality variables scored low, although the epifaunal substrate was marginal. The streambed was comprised primarily of gravel (80%). No objectionable conditions were noted.

Habitat quality of the Shawsheen River near Churchill Street, Billerica (station SW10) was evaluated by ESS, Inc. in August 2001 (ESS 2002). None of the instream habitat quality variables scored low. The streambed was comprised of cobble, gravel, and boulder (40, 30, 20%, respectively). No objectionable conditions were noted.

Biology

DFWELE conducted fish population sampling at two locations in this segment of the Shawsheen River (downstream of the Middlesex Turnpike, Bedford, and upstream of Route 62, Bedford) using a backpack shocker in September 1998 and July 2002. A total of 197 fish, represented by 14 species, were collected. The samples were dominated by redfin pickerel and American eel. Other species present, including largemouth bass, brown bullhead, bluegill, banded sunfish, brown trout, creek chubsucker, chain pickerel, rainbow trout, swamp darter, white sucker, pumpkinseed, and redbreast sunfish were represented by few individuals. The fish assemblage was dominated by macrohabitat generalists and also included a mix of fluvial specialists/dependants (Richards 2003). In addition, there was one tributary (Webb Brook) to this segment of the river that was sampled; three American eels were observed in July 2002.

Toxicity

Ambient

Surface water samples were collected by members of the MVPC in June 2002 as part of the *Chronic Toxicity Testing* project (00-06/104, See Appendix F). The EPA, Office of Environmental Measurement and Evaluation assisted the MVPC in evaluating the ambient surface water from one sampling location (SH-2 – located at Route 3A in Billerica) within this segment (EPA 2002b). The initial sample was collected on 19 June 2002 and two additional samples were collected on 22 June and 24 June 2002 for use on days three and five of testing to provide fresh samples for test renewals. The results of the 7-day, short-term chronic toxicity tests indicated a lack of toxicity for both species with respect to the survival and growth endpoints (survival of *C. dubia* = 90% and survival of *P. promelas* = 93%; EPA 2002b). Lab water was utilized as a test control (survival of *C. dubia* = 100%, survival of *P. promelas* = 75%).

Sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation assisted the MADEP in evaluating the sediment quality from three sampling locations (Table 7; EPA 1998). Whole sediment toxicity tests were performed according to EPA guidance (EPA 1994). Although no significant toxicity to either test organism was detected (either survival or growth) compared to the artificial sediment control (Table 7), survival of *C. tentans* exposed to sediment collected from the river near Route 3A and near the Burlington Pump Station was only 64 and 63%, respectively (EPA 1998).

Table 7. EPA sediment toxicity data, Shawsheen River (Segment MA83-17)

Station Name	Survival *H. azteca* (average)	Survival *C. tentans* (average)
Control	83%	81%
VB01 Shawsheen River 0.2 miles downstream of its confluence with Vine Brook in Bedford	94%	75%
SH06 downstream of Boston Road/Route 3A, Billerica	79%	64%
SH06A upstream of Burlington Pump Station, Billerica	83%	63%

Chemistry – sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation, assisted the MADEP in evaluating the sediment quality at two locations (VB01, SH06, and SH06A) within this segment (EPA 1998). Three sediment samples were collected and analyzed for metals, AVS/SEM, SVOCs, PCB, pesticides, TOC, toxicity, and grain size. The first sample (VB01) was located below the confluence with Vine Brook, Bedford, MA. The TOC at VB01 was 3.9%. The second sample (SH06) was located near the Paul F. Newman Bridge, Billerica, MA. The TOC at SH06 was 2.8%. The third sample collected (SH06A) was located near the Burlington Pump Station, Billerica. The TOC at SH06A was 4.13%. Several pesticides and organic compounds were measured in quantities that exceed the L-EL guidelines from all three sites (VB01, SH06 and SH06A). Several metals (Cr, Cu, Ni, Pb, and/or Zn) were measured from both VB01 and SH06 in quantities that exceed the L-EL guidelines, but they were below the S-EL guidelines (Persaud *et al*. 1993). There were no exceedances of the S-EL guidelines in any analyte measured in any of the three sediment samples.

Instream habitat quality in this segment of the Shawsheen River was generally good. With the exception of two sediment toxicity tests (survival of *C. tentans* was slightly less than 75%), no other instream or sediment toxicity was detected. The *Aquatic Life Use* is therefore assessed as support for the entire length of this segment. It is identified with an Alert Status because of the slightly low survival of test organisms exposed to Shawsheen River sediments. It should also be noted that unknown toxicity was identified as an impairment cause on the 1998 303(d) List.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper and Middle Shawsheen Stream Team collected fecal coliform bacteria data (Table 8) during the months of June through September 1998 from seven sites along this segment (MRWC 1998). Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 8. MRWC 1998 fecal coliform bacteria data, Shawsheen River (Segment MA83-17)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH 3.1 (Meadowbrook Road, Bedford)	200 – 400	300
SH 3.7 (Middlesex Turnpike, Bedford)	128 – 2,000	312
SH 3.8 (Middlesex Turnpike, Bedford)	60 – 2,000	327
SH 4.2 (Dunham Road, Billerica)*	1,000 – 101,000	10,402
SH 5.0 (Route 3A, Billerica)	10 - 380	135
SH 5.5 (Sachem Street, Billerica)	98 - 450	298
SH 6.1 (behind Shawsheen Tech High school, Billerica)	270 - 310	289

Note: In 1999, MADEP NERO identified and removed wastewater from a storm drain on Dunham Road in Billerica. The town required nearby commercial and industrial facilities to connect to the sewer system.

In August and September 2000 DWM collected fecal coliform bacteria samples at one station on this segment of the Shawsheen River (Appendix A, Table A4).

- SH06, downstream from Route 3A bridge, Billerica, MA.

The fecal coliform bacteria data at SH06 was 380 cfu/100 mls in August and 200 cfu/100 mls in September.

Fecal coliform and *E. coli* bacteria were collected during September 2001 from two storm drain locations in this segment of the Shawsheen River by ESS as part of the Shawsheen River Watershed Storm Drain Assessment Project (01-08/MWI, see Appendix F; ESS 2002). The storm drain study documented end-of-pipe effluents before any mixing occurred within the receiving waterbody. The data presented in the ESS report is not representative of stream habitat conditions, but does represent source identification of pollutant loadings (ESS 2002). A bacteria sample was collected from each storm drain location during wet weather conditions; the fecal coliform bacteria counts were 24,000cfu/100 mls and 60,000/100 mls and the *E. coli* bacteria counts were 16,000cfu/ml and 54,000cfu/100 mls (ESS 2002). The storm drains sampled in this segment primarily drained industrial and residential areas (ESS 2002).

Fecal coliform, *E.coli*, and Enterococci bacteria samples were collected by members of the MVPC in April-June 2002 from a three stations (SH-1A – located at Route 3, Bedford, SH1B –Middlesex Turnpike, Bedford, and SH2 –Route 3A, Billerica) in this segment as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). A total of seven bacteria samples were collected from each site; the fecal coliform counts are summarized in Table 9:

Table 9. MVPC 2002 fecal coliform bacteria data, Shawsheen River (Segment MA83-17)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH-1A (Shawsheen River, Route 3, Bedford)	20 – 2,400	231 (25% of the samples exceeded 400 cfu/100 mls)
SH-1B (Shawsheen River, Middlesex Turnpike, Bedford)	5 - 20	11
SH-2 (Shawsheen River, Route 3A, Billerica)	20 - 540	128

Based on elevated fecal coliform bacteria levels, the upper 2.1 mile reach of this segment is assessed as impaired for the *Primary Contact Recreational Use* while the lower 3.6 miles is assessed as support. The *Secondary Contact Recreational Use* is assessed as support for the entire segment. Because of an elevated bacteria count (exceeding 2000 cfu/100 mls) and elevated fecal coliform bacteria counts from storm drains into this segment of the Shawsheen River the recreational uses are also identified with an Alert Status.

Shawsheen River (Segment MA83-17) Use Summary Table

Designated Uses		Status	Causes	Sources
			Known	Known
Aquatic Life		SUPPORT*		
Fish Consumption		NOT ASSESSED		
Primary Contact		IMPAIRED upper 2.1mile reach SUPPORT* lower 3.6 mile reach	Fecal coliform bacteria	Municipal separate storm sewer systems
Secondary Contact		SUPPORT*		
Aesthetics		NOT ASSESSED		

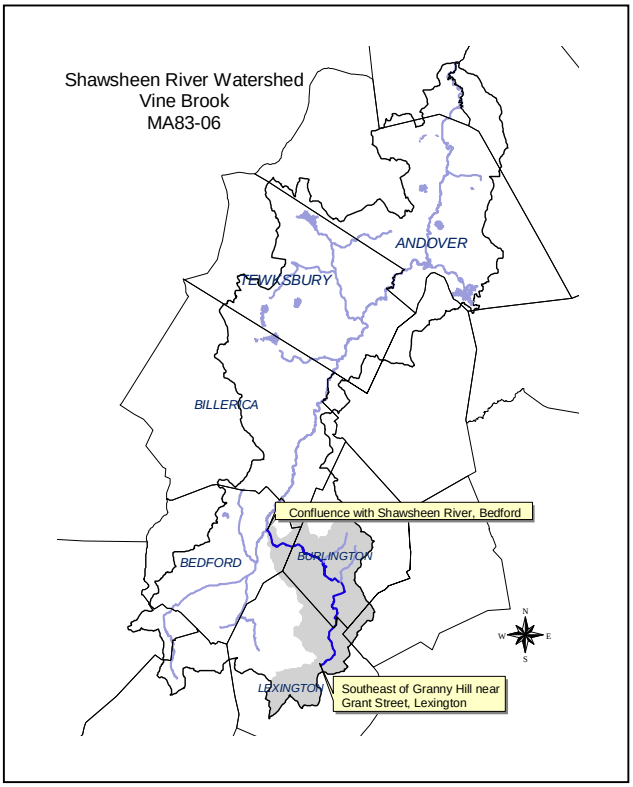
* "Alert Status" issues identified, see details in the text above

RECOMMENDATIONS SHAWSHEEN RIVER (SEGMENT MA83-17)

- Implement the recommendations of the Shawsheen Bacteria TMDL.
  - septic tank control (identify and remediate local community septic problems)
  - urban runoff (collect additional monitoring data to isolate sources of bacteria and implement a control plan)
- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- A shoreline survey should be conducted to document aesthetic quality of this segment of the Shawsheen River.

VINE BROOK (SEGMENT MA83–06)

Location: Headwaters southeast of Granny Hill, near Grant Street, Lexington, to confluence with the Shawsheen River, Bedford
Segment Length: 6.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 10.05 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	42%
Forest	25%
Open Land	9%

This segment is on the 1998 303(d) List of Waters because of pathogens (Table 2).

Butterfield Pond (MA83003) is located within this subwatershed and the use assessment for Butterfield Pond (MA83003) is provided in the lake assessment section of this report.

The MRWC and the Upper Shawsheen Stream Team carried out shoreline surveys along this segment in 1998 (MRWC 1998). They also collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (eight sampling events) from seven sites along this segment (MRWC 1998).

Excerpted from the EPA New England National Priorities List (NPL) website (EPA 25 March 2003).

The Microwave Associates Communications Company (MACC) site (EPA ID #: MAD980522601), along with several other parcels, was used for pig farming, agriculture, and sand and gravel mining prior to 1959. From 1987 to the present, the building has been occupied by several computer software development companies. MACC reportedly generated such wastes as trichloroethylene (TCE), 1,1,1-trichloroethane (TCA), methanol, acetone, methylene chloride, cadmium, nickel, chromium, selenium, lead, hydrogen fluoride, acetic acid, hydrogen sulfide, nitric acid, and hydrochloric acid during on-site operations. Solvent wastes were reportedly transported off site by a licensed waste hauler while the remaining wastes were treated at two on-site waste water treatment plants prior to being discharged to the municipal sewer system. In 1979, approximately 175 gallons of TCA were reportedly spilled due to a rupture in a line to a 275-gallon aboveground storage tank. Approximately 35 cubic yards of TCA-contaminated soil were reportedly excavated and treated prior to off-site disposal. Overland surface water flow on the MACC property is toward an unnamed stream located to the west of the property. The unnamed stream flows easterly and discharges to Vine Brook. Historical sediment sampling conducted along the unnamed stream indicates that the surface water pathway has been impacted by a release of pesticides, polychlorinated biphenyls (PCBS) and inorganic elements from the MACC property.

The former RCA Corp. (RCA) *site (EPA ID #:* MAD001060698) is located at 183 Bedford Street (formerly 163 Bedford Street), in the Town of Burlington, Massachusetts. Between 1958 and 1994, the property was used as an industrial facility, primarily for manufacturing and testing military electronics equipment. Prior to 1958, the property was used for agricultural purposes, which included a piggery and a small quarry for sand and gravel, located in the southwestern portion of the property. The hazardous waste generated at RCA resulted from a variety of manufacturing activities. Numerous studies, including groundwater monitoring reports, a Phase I Environmental Assessment, and Phase I and II Site Investigation Reports, have been conducted on the RCA property. As part of these studies, groundwater data has been collected from 63 monitoring wells and 22 subsurface points on the RCA property between 1986 and 1994. Surface water and sediment samples have also been collected. Eighteen possible source areas were identified as a result of these studies, consisting of material storage areas or waste disposal areas associated with past on-site processes. Volatile organic compounds (VOCs), including: 1,1,1-trichloroethane (1,1,1-TCA); trichloroethene (TCE); toluene; ethylbenzene; and xylenes; were detected at concentrations significantly above background in groundwater samples collected in a former paint disposal area located on the eastern side of the property, and metals, including: chromium, copper, arsenic, nickel and zinc were detected at concentrations significantly above background in sediment samples collected from Vine Brook downstream of this area. In addition, VOCs (1,1,1-TCA, TCE, ethylbenzene and xylene) and metals (chromium, copper, arsenic and

zinc) were detected at concentrations significantly above background in subsurface soil samples collected from the former paint disposal area and a former acid disposal area located on the southwest portion of the property. Response Action Outcome Statements, a Risk Characterization, and Phase a IV investigation are currently being prepared by IT Corporation in accordance with MA DEP directives.

The former Tech Weld Corp. (Tech Weld) site (EPA ID #: MAD021721105) is located at 70 Blanchard Road in Burlington, Massachusetts. Operations consisted of manufacturing and repair of vehicle storage tanks for the chemical and petroleum industries. Cleaning wastewater was discharged into a subsurface leaching bed or an oil/water separator, and then discharged into an intermittent stream located on the eastern side of the property. In 1975, the Burlington Department of Public Works and Board of Health, and the Massachusetts Water Resources Commission ordered that Tech Weld cease direct discharging to the leach bed, and remove contaminated soils in the area. Subsequent actions regarding these directives are unknown. Continued groundwater monitoring at the property identified the following contaminants: 1,1-dichloroethane; trans 1,2-dichloroethylene; tetrachloroethylene; trichloroethylene; 1,1-dichloroethylene; acetone; and benzene. During 1986 and 1987, the Tech Weld building was demolished, and the current office complex was constructed on the property.

The former U. S. Windpower site (EPA ID #: MAD101186419) is located at 160 Wheeler Road in Burlington, Massachusetts. In 1989 and 1990, the former manufacturing building was demolished and replaced with a six-story office complex (approximately 26,000 square feet). The building is currently occupied by Siemens-Nixdorf Corporation, and the address of the property has changed to 200 Wheeler Road. During manufacturing operations conducted by the various on-site companies, chlorinated solvents were reportedly discharged into several wash sinks located within the building. The sinks were connected to a storm and roof drainage system, which discharged to leaching beds located on the eastern portion of the property. The actual quantities of wastes that were disposed and dates of disposal are unknown. In 1999, MA DEP approved installation of a soil gas and groundwater recovery and treatment system, which is currently located on the property. Results of the recovery and treatment system are reported to MA DEP every 6 months as part of Phase IV investigations currently on-going on the property.

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E3):

Facility	PWS ID#	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)				
						1998	1999	2000	2001	2002
Lexington Golf Club	--	--	31515501	Irrigation pond Irrigation well Irrigation well	0.07	0.03	0.04	0.03	0.04	0.04
Burlington Water Department*	3048000	9P31504801	31504801	3048000-11G 3048000-12G 3048000-05G 3048000-08G 3048000-07G	3.9 reg 0.0 per 3.9 total	3.46	3.23	3.31	3.32	N/A

* indicates system-wide withdrawal; all sources are not within this segment
N/A = Data not available for 2002.

The Lexington Golf Club, 55 Hill Street in Lexington is registered (31515501) to withdraw 0.07 MGD during 214 days of operation from one surface water and two-groundwater points. The Town of Burlington is registered to withdraw groundwater from five locations in the Vine Brook subwatershed.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E2):

The Burlington Groundwater Treatment Plant was permitted (MA0102911) on 7 April 1986 to discharge treated groundwater from three wells used for water supply. This discharge was operated for two years (1985-1987) and the permit was terminated on 15 May 2002 as the system was converted to a closed loop system.

E.H. Perkins Construction, Inc. (formerly Quinn-Perkins Sand and Gravel Co.), in Burlington has a NPDES permit (MA0004081) to discharge rock washing/grinding process water treated through a series of two detention basins for solids removal prior to entering into Vine Brook. The discharge averages 20,000 - 30,000 gpd during the construction season.

The Wakefield Sand & Gravel, located just off the Middlesex Turnpike on the south side of Route 128, covers approximately 50 acres. It is under a consent judgment by the MADEP for numerous wetlands violations. Both process and stormwater are believed to discharge into Vine Brook, which flows through the property.

MITRE Corporation, in Bedford, was authorized (MA0027197) to discharge non-contact cooling water and stormwater to Vine Brook. The facility has been routed to the MWRA sewer system as of April 1996 and the permit was terminated on 18 February 1997.

The Bellofram Site in Burlington is an inactive site under a commitment to the MADEP to perform groundwater remediation (airstripping for VOCs). The groundwater is being treated utilizing a low profile air stripper and the treated effluent water is being discharged (MA0036641) to Vine Brook under an emergency exclusion. The facility's permitted average flow is 53.6 gpm; the total volume of discharge as of January 2003 was 10 million gallons (permit limits for 1,1 dichloethylene = 7 ug/l, TCE = 5 ug/l, 1,1,1 trichloroethane – 5 ug/l, perchloroethylene = 5 ug/l, and carbon tetrachloride = 5 ug/l).

A sewer overflow that occurs in the town of Burlington at the Pump Station discharges (during periods of extreme wet weather) directly into Vine Brook. The last overflow event on record with MADEP was March 21, 2001 (event associated with rain and snow melt). On January 15, 2003, the Town submitted a Sewer System Evaluation Survey Report, pursuant to an Administrative Consent Order (ACO-NE-01-1004), that presents the findings from their evaluation of the sewer system in regard to identifying and eliminating sources of extraneous flow (i.e., infiltration and inflow). The recommendations in the report include $1.2 million in system rehabilitation, including manhole and sewer system rehabilitation, sewer system replacement, sewer service connection rehabilitation, and redirection of inflow sources. This work, when implemented, will serve to reduce flows and mitigate overflows and their impacts during wet weather events (Brander 2003b).

Since Bedford, Burlington, and Lexington are Phase II Stormwater communities they must apply for permit coverage for their municipal drainage systems and are required by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data (Table 10) during the months of June through September 1998 (seven sampling events) from five sites along this segment (MRWC 1998). Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 10. MRWC 1998 fecal coliform bacteria data, Vine Brook (Segment MA83-06)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
VB 1.5 (Vine Brook near Hayes Lane/Grant Road, Lexington)	390 – 3,900	983 (29% samples exceed 2,000 cfu/100 mls)
VB 2.3 (Vine Brook near East Street, Lexington)	80 – 2,000	376
VB 4.3 (Lexington Street, Burlington)	68 – 4,880	331 (one sample exceeds 2000 cfu/100 mls)
VB 5.0 (Vine Brook, Terrace Hall Road, Burlington)	34 – 1,330	156 (one sample exceeds 400 cfu/100 mls)
VB 6.5 (Vine Brook, off of Meadow Brook Road near Route 62, Burlington)	60 - 270	150

In August and September 2000 DWM collected fecal coliform bacteria samples at one station from Vine Brook (Appendix A, Table A4).

- VB01, upstream from Route 62 bridge, Bedford, MA.

The fecal coliform bacteria counts at VB01 were 20 cfu/100 mls in August and 130 cfu/100 mls in September.

Because of elevated fecal coliform bacteria levels (particularly in the upper drainage area and upper reach of this segment) and best professional judgment (sewer overflow that occurs in the town of Burlington near Terrace Hall Road) the *Primary Contact Recreational Use* is assessed as impaired for the entire length of this segment. The *Secondary Contact Recreational Use* is assessed as support, although it is identified with an Alert Status because the most upstream sampling location did exceed 2,000 cfu/100 mls in 29% of the samples.

Vine Brook (Segment MA83–06) Use Summary Table

Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Primary Contact		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems, Sanitary Sewer Overflow
Secondary Contact		SUPPORT*			
Aesthetics		NOT ASSESSED			

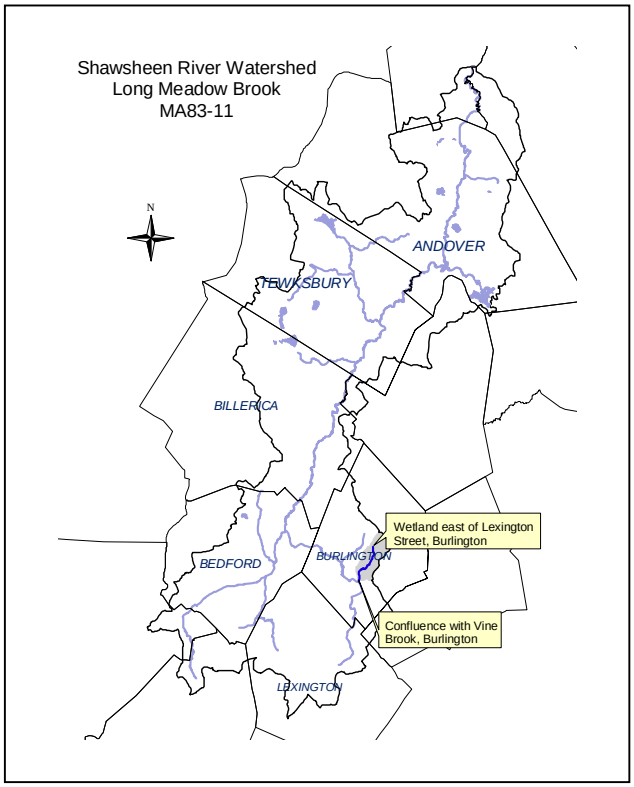
* “Alert Status” issues identified, see details in the text above

RECOMMENDATIONS VINE BROOK (SEGMENT MA83–06)

- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- Monitoring should be conducted to assess the status of the *Aquatic Life Use*.
- A shoreline survey should be conducted to document aesthetic quality of Vine Brook.
- Follow-up with EPA on the status of remediation activities at the NPL sites located in this subwatershed.
- Follow-up with North East Regional Office of the MADEP on the status of the Wakefield Sand & Gravel discharge and wetland violations.

LONG MEADOW BROOK (SEGMENT MA83-11)

Location: Wetland east of Lexington Street, and north of Independence Drive, Burlington, to confluence with Vine Brook, Burlington
Segment Length: 1.3 miles.
Classification: Class B.



The drainage area of this segment is approximately 0.75 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	48%
Forest	22%
Open Land	18%

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY:
Based on the available information, there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

It should be noted, however, that Burlington is Phase II Stormwater community, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT SUMMARY:
Too little data are available to assess the designated uses of Long Meadow Brook.

Long Meadow Brook (Segment MA83-11) Use Summary Table

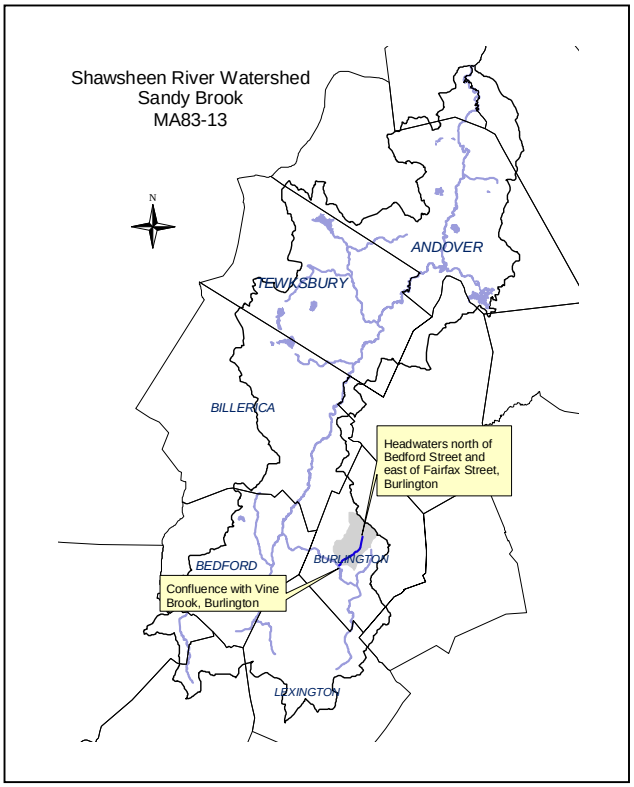
Aquatic Life	Fish Consumption	Primary Contact	Secondary Contact	Aesthetics
				
NOT ASSESSED				

RECOMMENDATIONS LONG MEADOW BROOK (SEGMENT MA83-11)

- Establish a Stream Team to obtain additional data and to foster local stewardship.

SANDY BROOK (SEGMENT MA83-13)

Location: Headwaters north of Bedford Street and east of Fairfax Street, Burlington, to confluence with Vine Brook, Burlington
Segment Length: 1.2 miles.
Classification: Class B.



The drainage area of this segment is approximately 1.1 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	70%
Forest	17%
Open Land	7%

NPDES WASTEWATER DISCHARGE SUMMARY:
Based on the available information, there are no discharges to this tributary system.

It should be noted, however, that Burlington is a NPDES Phase II community. Burlington must apply for permit coverage for their municipal storm drainage system by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E3):

Facility	PWS ID#	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)				
						1998	1999	2000	2001	2002
Burlington Water Department*	3048000	9P31504801	31504801	3048000-01G 3048000-02G	3.9 reg 0.0 per 3.9 total	3.46	3.23	3.31	3.32	N/A

* indicates system-wide withdrawal; all sources are not within this segment.
N/A = Data not available for 2002.

The Town of Burlington is registered to withdraw groundwater from two locations in the Sandy Brook subwatershed.

USE ASSESSMENT
Too little data are available to assess the designated uses of Sandy Brook. However, the *Aquatic Life Use* is identified with an Alert Status because of the small drainage area of the watershed and the presence of water withdrawals.

Sandy Brook (Segment MA83-13) Use Summary Table

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

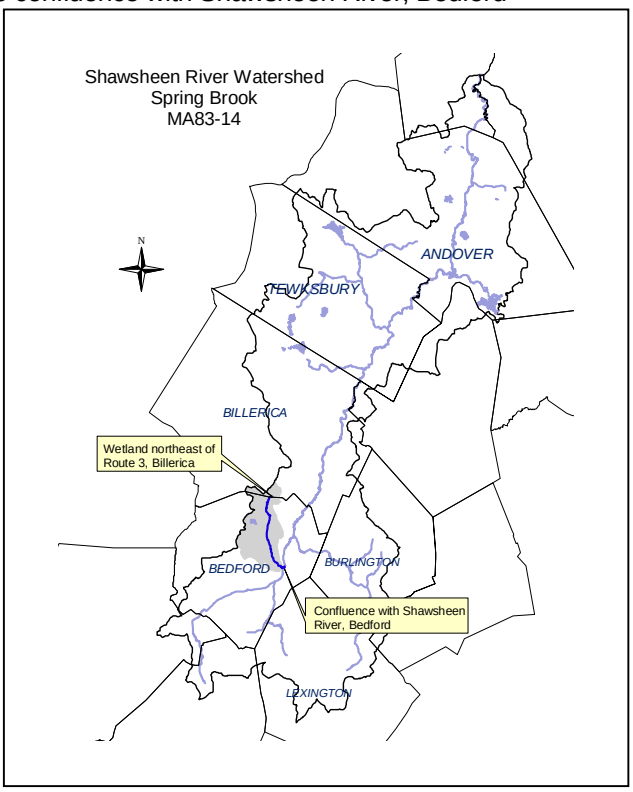
* "Alert Status" issues identified, see details in the text above

RECOMMENDATIONS SANDY BROOK (MA83-13)

- Establish a Stream Team to obtain additional data and to foster local stewardship.
- Biological monitoring (i.e., benthic macroinvertebrate, fish population, habitat assessment) should be conducted to evaluate whether or not there are any instream impacts associated with water withdrawals. If deemed necessary, conduct an inflow/outflow analysis for Sandy Brook.

SPRING BROOK (SEGMENT MA83-14)

Location: Wetland northeast of Route 3, Billerica, to confluence with Shawsheen River, Bedford
Segment Length: 2.5 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.3 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	42%
Forest	31%
Open Land	15%

The MRWC and the Upper Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (seven sampling events) from two sites along this segment (MRWC 1998).

Fawn Lake (MA83004) is located within this segment's subwatershed. The use assessment for Fawn Lake is provided in the lake assessment section of this report.

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY:

Based on the available information, there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

It should be noted, however, that Bedford is a Phase II Stormwater community, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE USE

Biology

DFWELE conducted fish population sampling at one location in this segment - downstream of Route 62 Bridge in Bedford - using a backpack shocker in July 2000. A total of 87 fish, representing six species, were collected. The samples were dominated by redfin pickerel and golden shiner, while American eel, and banded sunfish were abundant. Two other species, largemouth bass and swamp darter were represented by a few individuals. The fish assemblage was a mix of macrohabitat generalists and fluvial specialists/dependants (Richards 2003).

Too little data are available to assess the status of the *Aquatic Life Use*, therefore, it is not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data (Table 11) during the months of June through September 1998 from two sites along this segment (MRWC 1998). Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 11. MRWC 1998 fecal coliform bacteria data, Spring Brook (Segment MA83-14)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SB 0.8 (Alcott Road, Bedford)	132 – 1,360	420
SB 2.3 (Route 62, Bedford)	2 - 400	58

Based on elevated fecal coliform bacteria levels (geometric mean greater than 200 cfu/100 mls and 43% of the samples exceeded 400 cfu/100 mls at the upstream sampling station) the *Primary Contact Recreational Use* is assessed as impaired for the entire length of this segment. It should be noted, however, that the downstream sampling station location (SB 2.3, Route 62, Bedford) did not have elevated fecal coliform bacteria levels. The *Secondary Contact Recreational Use* is assessed as support.

Spring Brook (Segment MA83-14) Use Summary Table

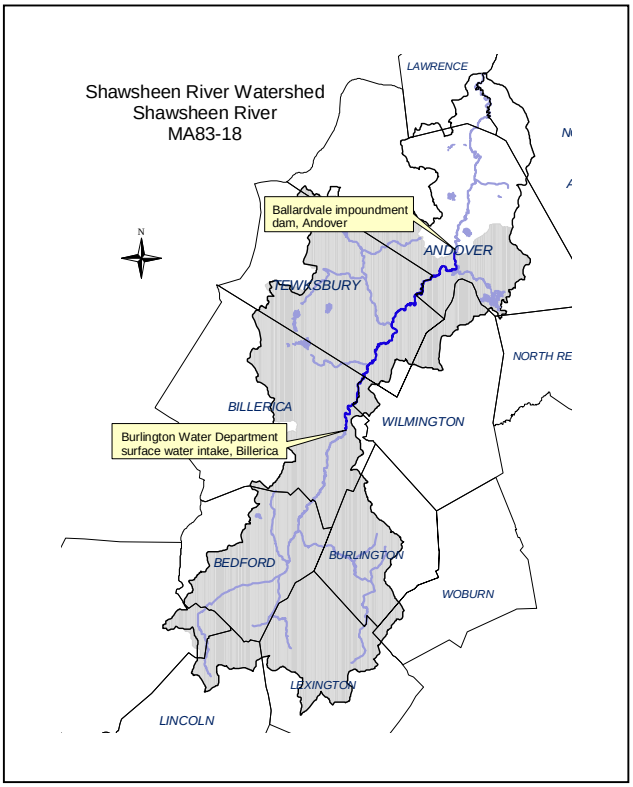
Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Primary Contact		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems
Secondary Contact		SUPPORT			
Aesthetics		NOT ASSESSED			

RECOMMENDATIONS SPRING BROOK (SEGMENT MA83-14)

- Additional monitoring (e.g., habitat quality) should be conducted to assess the status of the *Aquatic Life Use*.
- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- A shoreline survey should be conducted to document aesthetic quality of Spring Brook.

SHAWSHEEN RIVER (SEGMENT MA83-18)

Location: From the Burlington Water Department's surface water intake, Billerica, to the Ballardvale impoundment dam, Andover
Segment Length: 10.1 miles.
Classification: Class B, Warm Water Fishery.



The drainage area of this segment is approximately 65.38 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	40%
Forest	31%
Open Land	9%

This segment of the Shawsheen River (formerly part of segment MA83-02) is on the 1998 303(d) List of Waters because of unknown toxicity, organic enrichment/low DO and pathogens (Table 2).

Lowell Junction Pond (Ballardvale Impoundment), Andover (MA83010), is located within this segment's subwatershed. The use assessments for this impoundment are provided in the lake assessment section of this report.

The MRWC and the Upper and Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 from four sites along this segment (MRWC 1998).

A bacteria TMDL for the Shawsheen River Watershed was completed by Limno-Tech in August 2002 for MADEP and the MRWC (Limno-Tech 2002). Data were collected and coordinated through the MRWC and the Merrimack River Watershed Team. The purpose of this TMDL was to establish a fecal coliform TMDL for segments of the Shawsheen River and tributaries that are currently not meeting Massachusetts standards. Additionally, the bacteria TMDL outlined an implementation strategy to abate fecal coliform sources so bacteria criteria can be attained (MADEP 2002).

A Shawsheen Bacteria TMDL Implementation Plan was developed to further identify the sources of bacteria in the watershed and to isolate storm drains with high bacteria counts. Fecal coliform bacteria were collected by MRWC and ESS, Inc. during 2001 and 2002 from storm drain locations in the Shawsheen River Watershed (01-01/MWI, see Appendix F; MRWC 2003a). As part of this implementation plan, two storm drain mapping projects (99-06/MWI, see Appendix F) were completed in this portion of the Shawsheen River by MRWC in 2000. In Phase I, MRWC worked with local town managers and stream team volunteers to develop criteria for mapping the location and describing the condition of 250 storm drains along the mainstem (MRWC 2000a). In Phase II, a developed storm drain map was created using GIS technology for the Shawsheen River Watershed (MRWC 2001b). These data are useful in understanding the extent of non-point source pollution in the watershed and flooding potential for local communities (MRWC 2000a).

A USGS gaging station (01100600) on the Shawsheen River, located at Route 129 on the Billerica/Wilmington border, has been in operation since 1963. The drainage area at the gage is 36.5 square miles. The highest daily mean flow at the gage was recorded at 1850 cfs on 22 October 1996 and the lowest daily mean flow was 0.7 cfs on 19 August 1983 (Socolow *et al.* 1999, Socolow *et al.* 2000, Socolow *et al*. 2001, and Socolow *et al*. 2002).

Excerpted from the EPA New England National Priorities List (NPL) website (EPA 25 March 2003).

The Roy Bros Haulers (Roy Bros) site (EPA ID #: MAD009870643) is a 4.4-acre active chemical hauler operation located at 764 Boston Road in Billerica, Massachusetts. Since 1948, Roy Bros has operated as a transporter of liquid and dry industrial chemicals, which include chromium, benzene, toluene, methyl ethyl ketone (MEK), and 1,1,1-trichloroethane (TCA). Land use prior to 1948 is unknown. Prior to 1967, Roy Bros discharged wash water from the rinsing of the tanker trucks to a 1,000-gallon septic dry well located north of the building. Sludge and other residues collected from the rinsing of tanker trucks were disposed of in an unlined lagoon area located east of the building. Due to problems with wastewater disposal, chemical spillage, and storage tanks with inadequate containment features, Roy Bros was ordered by the Massachusetts Department of Environmental Quality Engineering (MA DEQE) [currently Massachusetts Department of Environmental Protection (MA DEP)] to begin cleanup, to upgrade the subsurface disposal system, and to construct a pretreatment facility. During a 1981 MA DEQE inspection, MA DEQE personnel noted that sludge from the pretreatment facility was either stored in tanker trucks or disposed of on the property. In 1981, Roy Bros was permitted by MA DEQE to connect to the Billerica sewer system. Surface water runoff on the Roy Bros property flows easterly toward the abutting wetland area which discharges into the Shawsheen River. Historical sediment sampling conducted along the Shawsheen River indicates that the surface water pathway has been impacted by a release of VOCs, SVOCs, and metals from the Roy Bros property. The property is currently in Phase I of the five phase Massachusetts Contingency Plan (MCP) process.

The Sutton Brook Disposal Area (EPA ID #: MAD980520696), which is roughly synonymous with the Rocco's Disposal Area site, is located off South Street on the eastern boundary of Tewksbury, Middlesex County, Massachusetts. Waste disposal activities at the Sutton Brook Disposal Area can be traced back to at least 1957, when an area of the site was used as a "burning dump." In 1966, the Town of Tewksbury was ordered by the Commonwealth of Massachusetts (the Commonwealth) Commissioner of Public Health to operate the landfill using the sanitary landfill method. However, after 1966, there were documented occurrences of landfill burning, uncovered waste areas, the filling in of on-site wetlands, wastes disposed below the water table, and landfill slopes which exceeded operation plans. Due to these violations, the Commonwealth ordered the closure of the landfill in 1979. At the time of its closure, the landfill was accepting in excess of 250 tons of waste per day. Despite the closure order, landfill operations continued until 1982, when official landfill operations were suspended, yet waste acceptance continued through 1988. Numerous investigations of the site by local, state, and federal organizations have revealed the presence of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and inorganic elements in on-site and off-site ground water, surface water, sediment, soil, and VOCs and SVOCs in air samples. During the Winter of 2000-2001, EPA installed 14 groundwater monitoring wells, and obtained samples from 22 monitoring wells in the vicinity of the Rocco Landfill in order to get a current assessment of the condition of groundwater, which may be leaving the site. In addition to the analytical samples, groundwater level measurements were taken at a total of 43 wells. The groundwater analytical data suggest that there is contamination discharging to groundwater from the northern and southern lobes of the Rocco Landfill. It appears that the affected groundwater flows towards Sutton Brook from the south(from the southern lobe, and towards Sutton Brook from the north(from the northern lobe).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E3):

Facility	PWS ID#	WMA Permit #	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)				
						1998	1999	2000	2001	2002
Burlington Water Department*	3048000	9P31504801	31504801	048-01S	3.9 reg 0.0 per 3.9 total	3.46	3.23	3.31	3.32	N/A

* indicates system-wide withdrawal; all sources are not within this segment
N/A = Data not available for 2002.

The Tewksbury Water Department has five wells near the Shawsheen River (in the vicinity of the confluence with Strong Water Brook). None are currently active. Tewksbury uses water exclusively from the Merrimack River Watershed (LeVangie 2002).

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E2):

BTL Specialty Resins Corporation, in Andover, discharged uncontaminated cooling water via three outfalls to the Shawsheen River. Site visit notes indicate that this facility's discharges have been connected to the Greater Lawrence Sanitary District wastewater treatment facility. This permit (MA0004952) was terminated on 22 October 1998.

Praxair, Inc. (formerly Liquid Carbonic Bulk Gases), in Tewksbury, was permitted (MA0002135) to discharge (0.03 MGD) treated non-contact cooling water to an unnamed tributary in this subwatershed. After an inspection on 7 May 2002, the MADEP NERO reported that the facility will be applying for an industrial holding

tank (for less than the 225 gallons they discharge) if the facility were operating at peak. Currently, there is no flow discharging via an outfall to the settling basin. EPA is in the process of closing the NPDES permit (Casella 2003).

There are three general stormwater permitees in this subwatershed. The following general permits were issued by the EPA in October 2001, and will expire in October 2005:

- Shawsheen Rubber Co. permit No. MAR05B966
- Praxair Inc. permit No. MAR05B622
- Wing's Used Auto Parts permit No. MAR05B739

Since Billerica, Tewksbury, Woburn, and Wilmington are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE

Biology

DFWELE conducted fish population sampling at three locations in this segment of the Shawsheen River (downstream of Route 129, Billerica, opposite of Mohawk Drive to Bridge Street, Tewksbury, and Bridge Street crossing, Tewksbury) using a backpack shocker in September 1998 and July 2002. A total of 229 fish, representing 13 species, were collected. The samples were dominated by American eel, redbreast sunfish and redfin pickerel. Other species present, including bluegill, banded sunfish, fallfish, largemouth bass, pumpkinseed, rainbow trout, white sucker, creek chubsucker, chain pickerel, and yellow bullhead, were represented by a few individuals. The fish assemblage was dominated by macrohabitat generalists (Richards 2003).

Toxicity

Ambient

Samples were collected by members of the MVPC in June 2002 as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). The EPA, Office of Environmental Measurement and Evaluation, assisted the MVPC in evaluating the ambient surface water from two sampling locations (SH-3 – located at Route 129 in Wilmington and SH-4 – located at Mill Street in Tewksbury) within this segment (EPA 2002b). Initial samples were collected on 19 June 2002 and two additional samples were collected on 22 June and 24 June 2002 from each location for use on days three and five of testing to provide fresh samples for test renewals. The results of the 7-day, short-term chronic toxicity tests indicated no toxicity for both species with respect to the survival and growth endpoints (Table 12) (EPA 2002b). Lab water was utilized as a test control (survival of *C. dubia* = 100%, survival of *P. promelas* = 75%).

Table 12. EPA 2002 ambient toxicity data, Shawsheen River (Segment MA83-18)

Station Name	Survival *C. dubia* (average)	Survival *P. promelas* (average)
Control	100%	75%
SH-3	100%	98%
SH-4	100%	98%

Sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation, assisted the MADEP in evaluating the sediment quality from one sampling location (SH08 – Shawsheen River upstream of the Ballardvale Dam, Andover) within this segment (EPA 1998). Whole sediment toxicity tests were performed according to EPA guidance (EPA 1994). The results of the 10-day exposure tests indicated a lack of toxicity for both species tested (survival of *C. tentans* = 76% and survival of *H.azteca* = 80%) with respect to the test endpoints, survival and growth (EPA 1998). Artificial sediment was utilized as a control (survival of *H. azteca*. = 83% and survival of *C. tentans* = 81%).

Chemistry – sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation, assisted the MADEP in evaluating the sediment quality at one location (SH08) within this segment (EPA 1998). The sediment sample was collected and analyzed for metals, AVS/SEM, SVOCs, PCB, pesticides, TOC,

toxicity, and grain size. The TOC at SH08 was 3.69%. There was only one L-EL exceedance of a chlorinated pesticide and PCB were not detected. Additionally, several metal concentrations (Cd, Cu, Pb, and Zn) exceeded the L-EL guidelines. None of the analytes measured exceeded the S-EL guidelines.

Although no instream or sediment toxicity was detected, too little data are available to assess the status of the *Aquatic Life Use*, therefore, it is not assessed.

FISH CONSUMPTION

In 1995 fish toxics monitoring was conducted by DWM at the Ballardvale Impoundment in Andover. The mercury data triggered a site-specific advisory against the consumption of fish from Lowell Junction Pond (locally known as the Ballardvale Impoundment) and the MDPH issued the following fish consumption advisory.

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat largemouth bass and black crappie from this water body."
2. "The general public should limit consumption of largemouth bass and black crappie from this water body to two meals per month."

Because of elevated mercury levels in fish tissue, which resulted in a DPH fish consumption advisory, the Fish Consumption Use is assessed as impaired for the lower 1.1 mile reach of the Shawsheen River through the Lowell Junction Pond (Ballardvale Impoundment), Andover.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper and Middle Shawsheen Stream Teams collected fecal coliform bacteria data (Table 13) during the months of June through September 1998 from four sites along this segment (MRWC 1998). One of the seven sampling events was conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 13. MRWC 1998 fecal coliform bacteria data, Shawsheen River (Segment MA83-18)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH 7.1 (Route 129, Billerica/Wilmington)	64 - 450	215
SH 8.5 (Route 38, Tewksbury)	10 – 2,000	112
SH 9.5 (Mill Street/Shawsheen Street, Tewksbury)	36 - 720	137
SH 12.2 (Above the Ballardvale Dam, Andover)	40 - 190	86

In August and September 2000 DWM collected fecal coliform bacteria samples at five stations on this segment of the Shawsheen River (Appendix A, Table A4).

- SH06A, at the Burlington water intake off of Alexander Road, Billerica, MA.
- SH07, at USGS gage, downstream from Salem Road/Route129 bridge, Billerica/Wilmington, MA.
- SH07A, downstream from Route 38 bridge, Tewksbury, MA.
- SH07B, approximately 350 meters /southwest from Route 93, Andover/Tewksbury, MA.
- SH08, off the upstream side of Ballardvale Dam, Andover, MA.

The fecal coliform bacteria data at SH06A were 50 cfu/100 mls in August and 86 cfu/100 mls in September. The counts at SH07 were 490 cfu/100 mls in August and 4,000 cfu/100 mls in September. The counts at SH07A were 120 cfu/100 mls in August and 110 cfu/100 mls in September. The counts at SH07B were 150 cfu/100 mls in August and 110 cfu/100 mls in September. The counts at SH08 were 99 cfu/100m in August and 140 cfu/100 mls in September.

Fecal coliform, *E.coli*, and Enterococci bacteria samples were collected by members of the MVPC in April-June 2002 from three stations in this segment of the Shawsheen River as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). A total of seven bacteria samples were collected from each site. The fecal coliform counts are summarized in Table 14.

Table 14. MVPC 2002 fecal coliform bacteria data, Shawsheen River (Segment MA83-18)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH-3 (Route 129, Billerica/Wilmington)	<20 - 800	78 (one sample exceeded 400 cfu/100 mls)
SH-4 (Mill Street, Tewksbury)	20 - 600	113
SH-5 (Andover Street, Andover)	39 - 290	96

The entire length of this segment is assessed as support for both the *Primary* and *Secondary Contact Recreational* uses. The *Primary Contact Recreational Use*, however, is identified with an Alert Status because of occasional elevated fecal coliform bacteria counts in the vicinity of Route 129, Billerica/Wilmington.

Shawsheen River (Segment MA83-18) Use Summary Table

Designated Uses		Status	Causes	Sources
			Known	Suspected
Aquatic Life		NOT ASSESSED		
Fish Consumption		NOT ASSESSED upper 9.0 miles IMPAIRED lower 1.1 miles	Mercury	Atmospheric deposition toxics
Primary Contact		SUPPORT*		
Secondary Contact		SUPPORT		
Aesthetics		NOT ASSESSED		

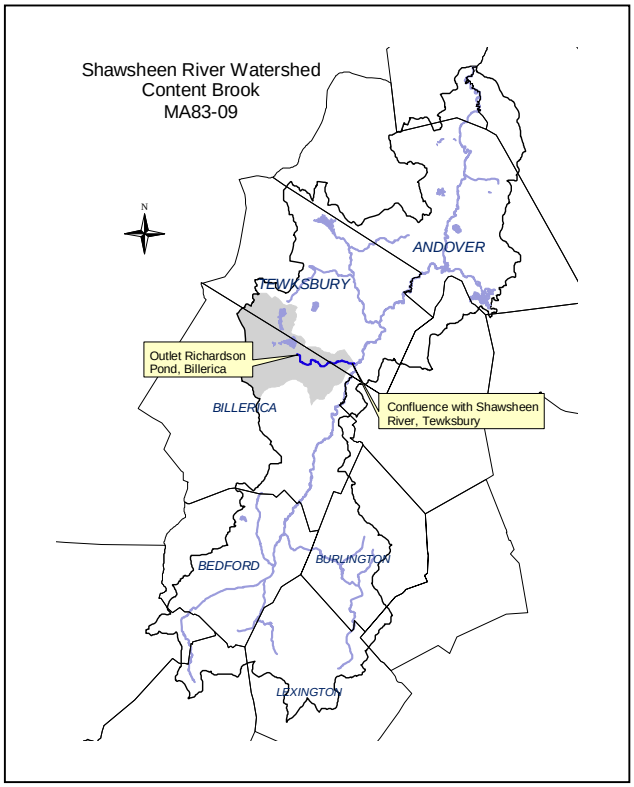
* "Alert Status" issues identified, see details in the text above

RECOMMENDATIONS SHAWSHEEN RIVER (SEGMENT MA83-18)

- Additional monitoring (e.g., habitat quality) should be conducted to assess the status of the *Aquatic Life Use*.
- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- A shoreline survey should be conducted to document aesthetic quality of this segment of the Shawsheen River.
- Follow-up with EPA on the status of remediation activities at the NPL sites located in this subwatershed.

CONTENT BROOK (SEGMENT MA83-09)

Location: Outlet of Richardson Pond, Billerica, to confluence with Shawsheen River, Tewksbury
Segment Length: 2.2 miles.
Classification: Class B.



The drainage area of this segment is approximately 5.8 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	45%
Forest	30%
Open Land	8%

Long Pond (MA83010), Pond Street Pond (MA83021), and Richardson Pond (MA83020) are located within this segment's subwatershed. The use assessments for both ponds are provided in the lake assessment section of this report.

DFWELE has proposed that Content Brook be reclassified in the SWQS as a cold water fishery (MassWildlife 2001). In 1988, DFWELE sampled one station west of Whipple Road, Billerica and found four young of the year brown trout (Richards 2003).

The MRWC and the Northern Middlesex Council of Governments presented a planning level, environmental impacts analysis that was conducted for three subwatersheds in the Shawsheen Watershed - Strong Water Brook, Content Brook, and Pinnacle Brook. The goal of the study was to evaluate potential impacts to water quality and quantity based on expected future development and to recommend BMPs to minimize future impacts and maximize protection of watershed functions. A watershed model was used to evaluate potential water-related impacts that are expected with future development (MRWC 2001a). Based on the current conditions of the subwatersheds and results of the watershed modeling, MRWC proposed that future developments meet the following watershed goals: reduce stormwater pollutant loads, maintain groundwater recharge and quality, protect stream channels, prevent increased overbank flooding, and safely convey extreme floods.

The MRWC and the Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (seven sampling events) from two sites along this segment (MRWC 1998).

Excerpted from the EPA New England National Priorities List (NPL) website (EPA 25 March 2003).

> The Iron Horse Park site (EPA ID #: MAD051787323), a 553-acre industrial complex, includes manufacturing and rail yard maintenance facilities, open storage areas, landfills, and wastewater lagoons. A long history of activities at the site, beginning in 1913, has resulted in the contamination of soil, groundwater, and surface water. Middlesex Canal runs along the length of the northern boundary and is drained by Content Brook, which runs through residential areas into the Shawsheen River east of the site. Richardson Pond lies north of the site and is also drained by Content Brook. An unnamed brook, which runs northerly through the site near wastewater lagoons, drains into a marshland near the asbestos landfill. On-site groundwater and surface water are sporadically contaminated with organic and inorganic chemicals, asbestos, and heavy metals including arsenic, cadmium, lead, and selenium. The soil at the site is contaminated with polychlorinated biphenyls (PCBs), petrochemicals, and the same heavy metals as those found in the groundwater. The majority of surface water contamination is located in the vicinity of the now-closed Shaffer Landfill. Environmentally sensitive marshland and wetlands are located near the site and could be subject to contamination. A settlement for Remedial Action for Shaffer Landfill has been completed.

WMA WATER WITHDRAWAL

The Tewksbury Water Department's 15 wells in this subwatershed have been abandoned (LeVangie 2002).

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E2):
Iron Horse Park, High Street, North Billerica is a federal Superfund site where sludge, asbestos and other wastes are released at an industrial landfill from a lagoon or pit both to the groundwater release and to the surface water.

The NPDES permit (MA0030147) for the Penn Culvert Co. Iron Horse Park property, in North Billerica, was terminated on 13 February 2003. The discharge was for stormwater that went into a wetland near the Middlesex Canal.

The NPDES permit (MA0030805) for the Eastern Terminals Inc. Iron Horse Park property, in North Billerica, was administratively continued. The discharge goes to the Middlesex Canal.

Since Billerica and Tewksbury are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT
AQUATIC LIFE
Biology

DFWELE conducted fish population sampling at two locations in this segment - 50 meters upstream and 150 meters downstream of Beech Street in Tewksbury and at 150 meters on both sides of Whipple Road in Billerica/Tewksbury - using a backpack shocker in July 2000. A total of 81 fish, representing 11 species, were collected. The samples were dominated by redfin pickerel and fallfish, while banded sunfish, American eel, and pumpkinseed were abundant. Other species present, including bluegill, black crappie, creek chubsucker, chain pickerel, golden shiner, and white sucker, were represented by a few individuals. The fish assemblage was a mix of macrohabitat generalists and fluvial specialists/dependants (Richards 2003).

Too little data are available to assess the status of the *Aquatic Life Use*, therefore, it is not assessed. Other potential Aquatic Life Use concerns, however, relate to the Superfund and hazardous waste sites in the headwaters of Content Brook. A Feasibility Study (FS) is expected to be final in early 2003 to evaluate potential alternatives for the remediation of the Shaffer Landfill area (EPA 25 March 2003).

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Middle Shawsheen Stream Team collected fecal coliform bacteria data (Table15) during the months of June through September 1998 (seven sampling events) from two sites along this segment (MRWC 1998). Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 15. MRWC 1998 fecal coliform bacteria data, Content Brook (segment MA83-09)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
COB 1.7 (Gray Street, Billerica)	40 – 430	133
COB 2.8 (Beech Street, Tewksbury)	124 – 2,000	277

In August and September 2000 DWM collected fecal coliform bacteria samples at one station from Content Brook (Appendix A, Table A4).

- CB01, upstream/west at Beech Street, Tewksbury, MA.

The fecal coliform bacteria counts at CB01 were 190 cfu/100 mls in August and 110 cfu/100 mls in September.

Although one fecal coliform bacteria count was elevated (2,000 cfu/100 mls) in 1998 near Beech Street, Tewksbury, it is best professional judgment that both the *Primary and Secondary Contact Recreational* uses for Content Brook are supported (geometric mean for the other samples was less than 200 cfu/100 mls). However, the *Primary Contact Recreational Use* is identified with an Alert Status because of the one elevated bacteria count.

Content Brook (Segment MA83-09) Use Summary Table

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

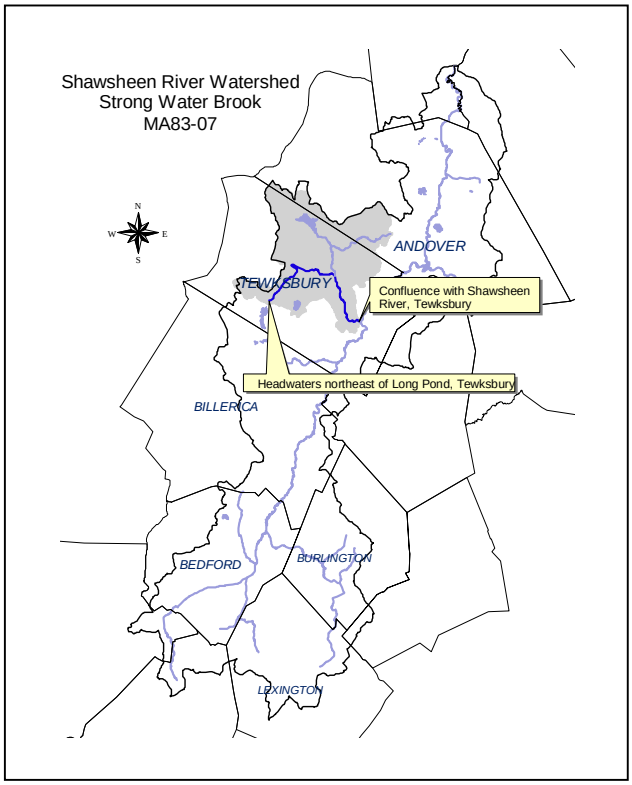
* “Alert Status” issues identified, see details in the text above

RECOMMENDATIONS CONTENT BROOK (SEGMENT MA83-09)

- Additional information (i.e., temperature, habitat quality, etc.) is needed for Content Brook in order to evaluate the proposed designation as a cold water fishery.
- Review recommendations from the environmental impacts analysis final report presented by the MRWC (MRWC 2001a).
- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- Additional monitoring (e.g., habitat quality) should be conducted to assess the status of the *Aquatic Life Use*.
- A shoreline survey should be conducted to document aesthetic quality of Content Brook.
- Follow-up with EPA on the status of remediation activities at the Iron Horse Park site *(*EPA ID #: MAD051787323).

STRONG WATER BROOK (SEGMENT MA83-07)

Location: Headwaters northeast of Long Pond, Tewksbury, to confluence with the Shawsheen River, Tewksbury
Segment Length: 4.8 miles.
Classification: Class B.



The drainage area of this segment is approximately 9.75 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Forest	35%
Residential	31%
Open Land	11%

Ames Pond (MA83001) and Round Pond (MA83018) are located within this subwatershed. The use assessments for these ponds are provided in the lake assessment section of this report.

The MRWC and the Northern Middlesex Council of Governments presented a planning level, environmental impacts analysis that was conducted for three subwatersheds in the Shawsheen Watershed - Strong Water Brook, Content Brook, and Pinnacle Brook. The goal of the study was to evaluate potential impacts to water quality and quantity, based on expected future development, and to recommend BMPs to minimize future impacts and maximize protection of watershed functions. A watershed model was used to evaluate potential water-related impacts that are expected with future development (MRWC 2001a). Based on the current conditions of the subwatersheds and results of the watershed modeling MRWC proposed that future developments meet the following watershed goals: reduce stormwater pollutant loads, maintain groundwater recharge and quality, protect stream channels, prevent increased overbank flooding, and safely convey extreme floods.

The MRWC and the Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (eight sampling events) from two sites along this segment (MRWC 1998).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E3):

Facility	PWS ID#	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)				
					1998	1999	2000	2001	2002
Tewksbury Hospital	3295001	31529501	3295001-01G 3295001-03G	0.3	0.24	0.26	0.21	0.13	N/A

* indicates system-wide withdrawal; all sources are not within this segment
N/A = Data not available for 2002

The Tewksbury State Hospital is registered (3295001) to withdraw 0.297 MGD of water from two groundwater points.

NPDES WASTEWATER DISCHARGE SUMMARY (APPENDIX E, TABLE E2):

Getty Petroleum Corp., 869 Main Street, Tewksbury applied for a permit (MA0036846) in 1996. This permit was issued for a carbon absorption treatment program and was terminated in 2001.

The Tewksbury Hospital NPDES permit (MA0030040) for non-contact cooling water and boiler blowdown was terminated on 11 June 2001.

There is a general stormwater permittee in this subwatershed. The Raytheon Company, located in Tewksbury, is permitted (MAR05C203) to discharge stormwater in this subwatershed. This general permit was issued by the EPA in October 2001 and will expire in October 2005.

Since Andover and Tewksbury are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE

Biology

DFWELE conducted fish population sampling at two locations in this segment - upper end of Mohawk Drive and Birchwood Road and 200 meters upstream of Mohawk Drive in Tewksbury - using a backpack shocker in July 2000. A total of 137 fish, representing nine species, were collected. The samples were dominated by fallfish and American eel, while redbreast sunfish, pumpkinseed, and redfin pickerel were abundant. Other species present, including bluegill, chain pickerel, largemouth bass, and white sucker, were represented by few individuals. The fish assemblage was a mix of macrohabitat generalists and fluvial specialists/dependants (Richards 2003).

Too little data are available to assess the status of the *Aquatic Life Use*, therefore, it is not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Middle Shawsheen Stream Team collected fecal coliform bacteria data (Table16) during the months of June through September 1998 (seven sampling events for station SWB2.0 and eight sampling events for station SWB3.3) from two sites along this segment (MRWC 1998). Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 16. MRWC 1998 fecal coliform bacteria data, Strong Water Brook (Segment MA83-07)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SWB 2.0 (East/Maple Streets, Tewksbury)	116 – 2,000	337
SWB 3.3 (Shawsheen Street, Tewksbury)	106 – 2,000	275

In August and September 2000 DWM collected fecal coliform bacteria samples at one station from Strong Water Brook (Appendix A, Table A4):

- SW01 is located upstream from Shawsheen Street bridge, Tewksbury, MA.

The fecal coliform bacteria counts at SW01 were 50 cfu/100 mls in August and 90 cfu/100 mls in September.

Based on elevated fecal coliform bacteria levels (geometric means greater than 200 cfu/100 mls and >25% of the samples exceeded 400 cfu/100 mls at the upstream sampling station) the *Primary Contact Recreational Use* is assessed as impaired for the entire length of this segment. The *Secondary Contact Recreational Use* is assessed as support. Although sources are currently unknown, land-use practices in this subwatershed include some agricultural activity and the town of Tewksbury is currently serviced primarily by on-site septic systems (MADEP 2002).

Strong Water Brook (Segment MA83-07) Use Summary Table

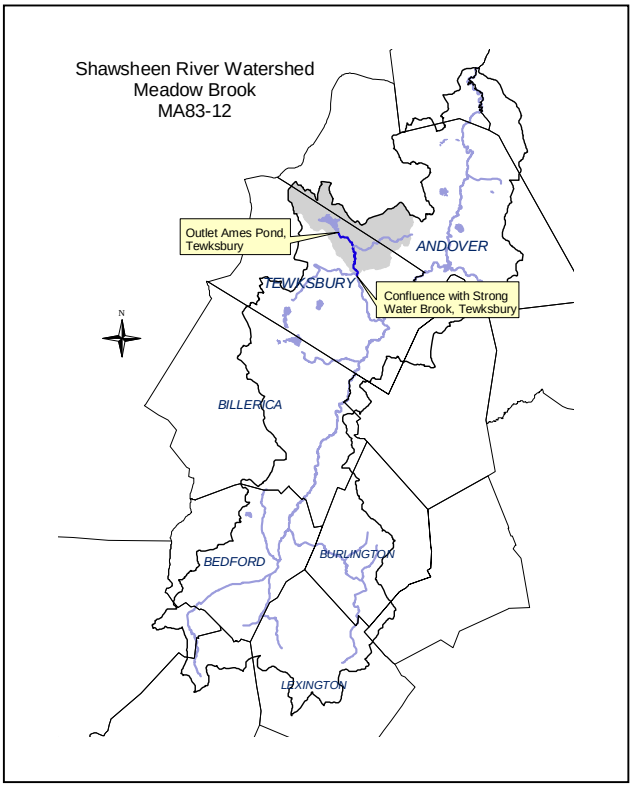
Designated Uses		Status	Causes	Sources	
			Known	Known	Suspected
Aquatic Life		NOT ASSESSED			
Fish Consumption		NOT ASSESSED			
Primary Contact		IMPAIRED	Fecal coliform bacteria	Unknown	Municipal separate storm sewer systems, On-site treatment systems (septic systems), non-irrigated crop production
Secondary Contact		SUPPORT			
Aesthetics		NOT ASSESSED			

RECOMMENDATIONS STRONG WATER BROOK (SEGMENT MA83-07)

- Review recommendations from the environmental impacts analysis final report presented by the MRWC (MRWC 2001a).
- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- Additional monitoring (e.g., habitat quality) should be conducted to assess the status of the *Aquatic Life Use*.
- A shoreline survey should be conducted to document aesthetic quality of Strong Water Brook.

MEADOW BROOK (SEGMENT MA83-12)

Location: Outlet of Ames Pond, Tewksbury, to confluence with Strong Water Brook, Tewksbury
Segment Length: 1.7 miles.
Classification: Class B.



The drainage area of this segment is approximately 4.6 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	39%
Forest	31%
Open Land	9%

The MRWC and the Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (seven sampling events) from one site along this segment (MRWC 1998).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY:
Based on the available information, there are no regulated water withdrawals in this tributary system.

Based on the available information, there are no discharges to this tributary system. It should be noted, however, that Tewksbury is a NPDES Phase II community. Tewksbury must apply for permit coverage for their municipal storm drainage system by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Middle Shawsheen Stream Team collected fecal coliform bacteria data during the months of June through September 1998 (seven sampling events) from Meadow Brook near Pinnacle Street, Tewksbury (station MDB 2.6; MRWC 1998). The fecal coliform counts ranged from 20 cfu/100 mls to 2,000 cfu/100 mls with a geometric mean of 122 cfu/100 mls. Only one sample exceed 400 cfu/100 mls. Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Although one fecal coliform bacteria count was elevated (2,000 cfu/100 mls) in 1998 near Pinnacle Street, Tewksbury, it is best professional judgment that both the *Primary and Secondary Contact Recreational* uses for Meadow Brook are supported (geometric mean for the other samples was less than 200 cfu/100 mls). However, the *Primary Contact Recreational Use* is identified with an Alert Status because of the one elevated bacteria count.

Meadow Brook (Segment MA83-12) Use Summary Table

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

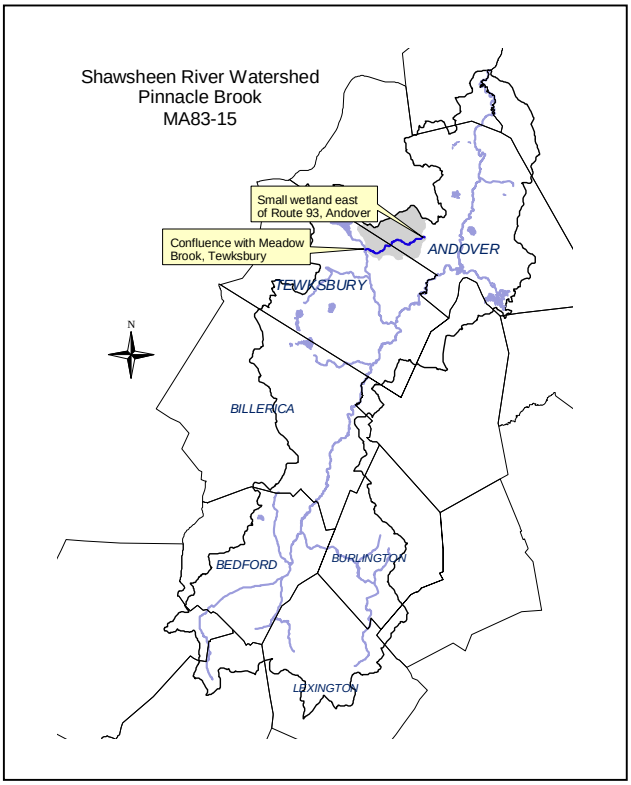
* “Alert Status” issue identified, see details in the text above

RECOMMENDATIONS MEADOW BROOK (SEGMENT MA83-12)

- Continue to monitor bacteria levels to identify sources and remediate problems.

PINNACLE BROOK (SEGMENT MA83-15)

Location: Small wetland east of Interstate 93, Andover, to confluence with Meadow Brook, Tewksbury
Segment Length: 2.1 miles.
Classification: Class B.



The drainage area of this segment is approximately 2.0 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	38%
Forest	33%
Open Land	11%

The MRWC and the Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (seven sampling events) from one site along this segment (MRWC 1998).

Numerous complaints since the early 1990s regarding odor problems and potential water quality concerns related to a piggery/manure operation in Andover have been received by the Shawsheen Watershed Team and the Andover Board of Health. The Board of Health is currently working with the property owner to address the issues of concern (Dunn 2003b).

The MRWC and the Northern Middlesex Council of Governments presented a planning level, environmental impacts analysis that was conducted for three subwatersheds in the Shawsheen Watershed - Strong Water Brook, Content Brook, and Pinnacle Brook. The goal of the study was to evaluate potential impacts to water quality and quantity, based on expected future development, and to recommend BMPs to minimize future impacts and maximize protection of watershed functions. A watershed model was used to evaluate potential water-related impacts that are expected with future development (MRWC 2001a). Based on the current conditions of the subwatersheds and results of the watershed modeling, MRWC proposed that future developments meet the following watershed goals: reduce stormwater pollutant loads, maintain groundwater recharge and quality, protect stream channels, prevent increased overbank flooding, and safely convey extreme floods.

WMA WATER WITHDRAWAL

Based on the available information, there are no regulated water withdrawals in this tributary system.

NPDES WASTEWATER DISCHARGE SUMMARY:

There is one general stormwater permittee in this subwatershed. The Raytheon Company, located in Andover, is permitted (MAR05C162) to discharge stormwater in this subwatershed. This general permit was issued by the EPA in October 2001 and will expire in October 2005.

Tewksbury is a Phase II community and must apply for permit coverage for their municipal storm drainage system by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Middle Shawsheen Stream Team collected fecal coliform bacteria data during the months of June through September 1998 (seven sampling events) near Pinnacle Street, Tewksbury near Andover town line (PB 1.3; MRWC 1998). The fecal coliform counts ranged from 3,600 cfu/100

mls to 20,000 cfu/100 mls. The geometric mean for the fecal coliform bacteria data is 8,726 cfu/100 mls. Two of the seven sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

The lower 1.1 mile reach of the brook is assessed as impaired for both the *Primary and Secondary Contact Recreational* uses because of the extremely high bacteria counts. Based on best professional judgment, the upper 1.0 mile of Pinnacle Brook (upstream of the Piggery operation) is currently not assessed.

Pinnacle Brook (Segment MA83-15) Use Summary Table

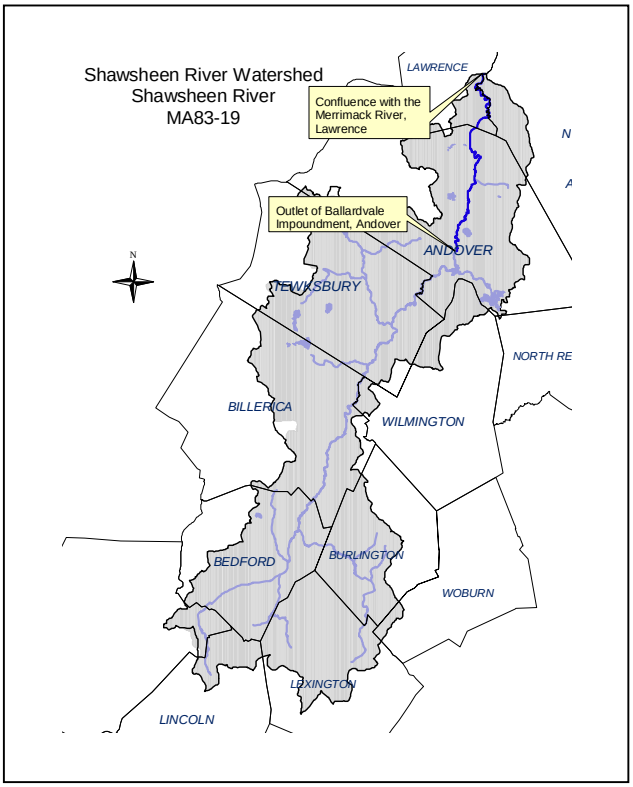
Designated Uses		Status	Causes	Sources
			Known	Known
Aquatic Life		NOT ASSESSED		
Fish Consumption		NOT ASSESSED		
Primary Contact		NOT ASSESSED upper 1.0 mile IMPAIRED lower 1.1 mile	Fecal coliform bacteria	Animal feeding operations
Secondary Contact		NOT ASSESSED upper 1.0 mile IMPAIRED lower 1.1 mile	Fecal coliform bacteria	Animal feeding operations
Aesthetics		NOT ASSESSED		

RECOMMENDATIONS PINNACLE BROOK (SEGMENT MA83-15)

- Follow-up with the Board of Health on the status of remediation activities at the piggery/manure operation.
- Review recommendations from the environmental impacts analysis final report presented by the MRWC (MRWC 2001a).
- Additional monitoring (e.g., habitat quality) should be conducted to assess the status of the *Aquatic Life Use*.
- A shoreline survey should be conducted to document aesthetic quality of Pinnacle Brook.

SHAWSHEEN RIVER (SEGMENT MA83-19)

Location: Outlet of Ballardvale impoundment, Andover, to the confluence with the Merrimack River, Lawrence
Segment Length: 8.3 miles.
Classification: Class B, Warm Water Fishery.



The drainage area of this segment is approximately 77.93 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	42%
Forest	30%
Open Land	10%

This segment of the Shawsheen River (formerly part of segments MA83-02 and MA83-03) is on the 1998 303(d) List of Waters (MA83-02 because of unknown toxicity, organic enrichment/low DO and pathogens and segment MA83-03 because of unknown toxicity and pathogens; Table 2).

Several ponds are located within this segment's subwatershed: The use assessments for Pomps Pond (MA83014), Bakers Meadow Pond (MA83002), Gravel Pit Pond (83007), Hussey Brook Pond (MA83008), and Hussey Pond (MA83009) are provided in the lake assessment section of this report.

The MRWC and the Upper and Middle Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 from 6 sites along this segment (MRWC 1998).

A bacteria TMDL for the Shawsheen River Watershed was completed by Limno-Tech in August 2002 for MADEP and the MRWC (LimnoTech 2002). Data were collected and coordinated through the MRWC and the Merrimack River Watershed Team. The purpose of this TMDL was to establish a fecal coliform TMDL for segments of the Shawsheen River and tributaries that are currently not meeting Massachusetts standards. Additionally, the bacteria TMDL outlined an implementation strategy to abate fecal coliform sources so bacteria criteria can be attained (MADEP 2002).

A Shawsheen Bacteria TMDL Implementation Plan was developed to further identify the sources of bacteria in the watershed and to isolate storm drains with high bacteria counts. Fecal coliform bacteria were collected by MRWC and ESS, Inc. during 2001 and 2002 from storm drain locations in the Shawsheen River Watershed (01-01/MWI, see Appendix F; MRWC 2003a). As part of this implementation plan, two storm drain mapping projects (99-06/MWI and 00-06/MWI, see Appendix F) were completed in this portion of the Shawsheen River by MRWC in 2000. In Phase I, MRWC worked with local town managers and stream team volunteers to develop criteria for mapping the location and describing the condition of 250 storm drains along the mainstem (MRWC 2000a). In Phase II, a developed storm drain map was created using GIS technology for the Shawsheen River Watershed (MRWC 2001b). These data are useful in understanding the extent of non-point source pollution in the watershed and flooding potential for local communities (MRWC 2000a).

Excerpted from the EPA New England National Priorities List (NPL) website (EPA 25 March 2003).

> The Reichold Chemicals Inc. site (EPA ID #: MAD001000165) is located at 77 Lowell Junction Road in Andover, Essex County, Massachusetts. The current status of the property is unknown. In November 1930, Watson Park Company purchased the property and began production of phenolic and urea formaldehyde resins on site. Reichold purchased the property in 1953 and continued to produce phenolic and urea formaldehyde resins as well as epoxy resins, hardeners, and other chemicals. In 1986, Reichold sold the property to BTL. BTL continued to produce

phenolic resins on the property until the facility closed in February 1990. Prior to 1972, untreated wastewater was discharged into unlined leaching ponds located adjacent to the Shawsheen River and the on-site septic system. According to former Reichold employees, Reichold formerly disposed of drums of process wastes, fill material, gelled resins, and solid filter cake in an on-site landfill from approximately 1963 to approximately 1972. In April 1979, Donald Reed conducted a Hydrogeological Investigation, which documented the presence of phenol in groundwater beneath the Reichold property. The property was classified as a Tier II site under the Massachusetts Contingency Plan (MCP) in March 1986. In 1987, Geraghty & Miller Inc. performed a Hydrogeologic investigation of the Reichold property, which documented the presence volatile organic compounds (VOCs) and phenol in groundwater and soil. Surface water runoff from the property flows directly into the Shawsheen River, which passes through the property. Samples collected from the surface water pathway indicated the presence of six VOCs, 16 SVOCs, and 4 metals. Based on these results, a release of substances to the surface water pathway impacting a wetlands and a fishery has occurred. No other sensitive environments are known to be impacted. Actions taken to address the release to surface water include discontinuing the use of the unlined leaching ponds, and removal and off-site disposal of contaminated soil. The Reichold property is currently in Phase V of the five-phase MCP. Remedial activities, including continued bioremediation of on-site groundwater and periodic groundwater sampling are ongoing under the direct supervision of a Licensed Site Professional (LSP).

WMA WATER WITHDRAWAL SUMMARY (APPENDIX E, TABLE E3):

Facility	WMA Registration #	Source	Authorized Withdrawal (MGD)	Average Withdrawal (MGD)				
				1998	1999	2000	2001	2002
Indian Ridge Country Club	31500902	Irrigation pond Irrigation well	0.08	0.07	0.09	0.04	0.09	0.07
Andover Country Club	31500901	Irrigation pond	0.09	0.09	0.10	0.05	0.15	0.11

* indicates system-wide withdrawal; all sources are not within this segment

The Andover Water Department has three wells, which are all currently inactive. The town uses water exclusively from the Merrimack River Watershed (LeVangie 2002).

NPDES WASTEWATER DISCHARGE SUMMARY(APPENDIX E, TABLE E2):

Tyer Industries, Inc., in Andover, discharged non-contact cooling water to the Shawsheen River. The NPDES permit (MA0026972) was terminated on 9 October 2001.

Powerhouse Property at 10 Tantallon Road in Andover discharged under NPDES Permit Exclusion for Construction Dewatering issued 7 November 1995. The treated construction dewatering discharge (primarily to remove petroleum product) commenced 15 November 1995. The exclusion states that the discharge was to a storm drain, which then discharges to the Shawsheen River. It is unclear when the discharge was ceased (potentially operational for only a few weeks).

Since Andover, North Andover, and Lawrence are Phase II Stormwater communities, they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

AQUATIC LIFE

Biology

DFWELE conducted fish population sampling at seven locations in this segment of the Shawsheen River (downstream of Ballardvale Dam, Andover, north of Route 28 bridge, downstream of reservation Road, Andover, upstream of Route 114, South Lawrence, and Loring Street, Lawrence) using a backpack shocker in September and October 1998 and July 2002. A total of 738 fish, representing 13 species, were collected. The samples were dominated by American eel, bluegill, and redbreast sunfish, while fallfish, pumpkinseed, and tessellated darter were abundant. Other species present, including brown trout, chain pickerel, redfin pickerel, largemouth bass, sea lamprey, white sucker, and yellow bullhead were represented by few individuals. The fish assemblage was dominated by macrohabitat generalists and also included fluvial specialists (Richards 2003).

Toxicity

Ambient

Samples were collected by members of the MVPC in June 2002 as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). The EPA, Office of Environmental Measurement and Evaluation, assisted the MVPC in evaluating the ambient surface water from two sampling locations (SH-6 –Route 28, Andover and SH-7 – Merrimack Street, Lawrence) within this segment (EPA 2002b). Initial samples were collected on 19 June 2002 and two additional samples were collected on 22 June and 24 June 2002 from each location for use on days three and five of testing to provide fresh samples for test renewals. The results of the 7-day, short-term chronic toxicity tests indicated no toxicity for both species with respect to the survival and growth endpoints (Table 17; EPA 2002b). Lab water was utilized as a test control (survival of *C. dubia* = 100%, survival of *P. promelas* = 75%).

Table 17. EPA ambient toxicity data, Shawsheen River (Segment MA83-19)

Station Name	Survival *C. dubia* (average)	Survival *P. promelas* (average)
Control	100%	75%
SH-6	100%	93%
SH-7	100%	90%

Sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation, assisted the MADEP in evaluating the sediment quality from one sampling location (SS01 – located at Stevens Street in Andover) within this segment (EPA 1998). Whole sediment toxicity tests were performed according to EPA guidance (EPA 1994). The results of the 10-day exposure tests indicated a lack of toxicity for the freshwater invertebrates (survival of *C. tentans* = 88% and survival of *H. azteca* = 75%) with respect to the test endpoints, survival and growth (EPA 1998). Artificial sediment was utilized as a control (.survival of *C. tentans* = 83% and survival of *H. azteca* = 81%).

Chemistry – sediment

In January 1997, the EPA, Office of Environmental Measurement and Evaluation assisted the MADEP in evaluating the water and sediment quality at on location (SS01) within this segment (EPA 1998). One sediment sample was collected and analyzed for metals, AVS/SEM, SVOCs, PCB, pesticides, TOC, toxicity, and grain size. The TOC at SS01 was 0.75%. DDE was measured at 8.4mg/kg, this exceeded the L-EL guidelines, but was below the S-EL guidelines (Persaud *et al*. 1993). None of the analytes measured exceeded the S-EL guidelines.

Although no instream or sediment toxicity was detected, too little data are available to assess the status of the *Aquatic Life Use*, therefore, it is not assessed.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Lower Shawsheen Stream Team collected fecal coliform bacteria data (Table 18) during the months of June through September 1998 (six sampling events) from seven sites along this segment (MRWC 1998). Two of the six sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 18. MRWC 1998 fecal coliform bacteria data, Shawsheen River (Segment MA83-19)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH 14.4 (Shawsheen River near Gradall Lane, Andover)	108 - 340	215
SH 14.5 (Shawsheen River off of Railroad Avenue, Andover)	2 - 400	77
SH 14.6 (Shawsheen River, off of Stevens Street, Andover)	240 – 1,100	522 (4 of 6 samples over 400 cfu/100 mls – 67%)
SH 15.5 (Shawsheen River, Route 133 Bridge, Andover)	80 - 510	175
SH 17.3 (Shawsheen River, Greene Street bridge, North Andover)	2 - 650	112
SH 18.25 (Shawsheen River, Merrimack Street, North Andover/Lawrence)	10 – 2,000	222 (one sample over 400 cfu/100 mls)

In August and September 2000 DWM collected fecal coliform bacteria samples at six stations on this segment of the Shawsheen River (Appendix A, Table A4).

- SH09, upstream from Central Street bridge Andover, MA.
- SH09A, upstream from Brook Street bridge, Andover, MA.
- SH10, downstream from Route 28 bridge, Andover, MA.
- Pipe at SH10, downstream from Route 28, Andover, MA (sampled once in September).
- SH11, downstream from Route 114 bridge, North Andover/Lawrence, MA.
- SH12, at Merrimack Street (upstream side of culvert entering Merrimack River), Lawrence, MA.

The fecal coliform bacteria counts at SH09 were 89 cfu/100 mls in August and 110 cfu/100 mls in September. The counts at SH09A were 180 cfu/100 mls in August and 110 cfu/100 mls in September. The counts at SH10 were 300 cfu/100 mls in August and 670 cfu/100 mls in September. The bacteria data from the pipe discharging at SH10 was 9,800 cfu/100 mls in September. The counts at SH11 were 970 cfu/100 mls in August and 15,000 cfu/100 mls in September. The counts at SH12 were 680 cfu/100 mls in August and 190 cfu/100 mls in September.

Fecal coliform bacteria were collected during July, September, and October 2002 from five storm drain locations in this segment of Shawsheen River by MRWC as part of the Shawsheen TMDL Implementation Plan Project (01-01/MWI, see Appendix F; MRWC 2003b). This part of the project (Part I) focused on the Lower Shawsheen River Watershed in the towns of Andover, North Andover, and Lawrence, MA. This study documented bacteria levels in the end-of-pipe effluents. The data presented in this report are not representative of stream habitat conditions, but do represent source identification of pollutant loadings. Bacteria samples were collected during dry and wet weather conditions and the fecal coliform bacteria counts ranged from 196cfu/100 mls (sample collected during a dry weather event - 0.0 inches of rainfall) to 38,000cfu/100 mls (sample collected during a wet weather event, approximately 1.12 inches of rainfall; MRWC 2003b).

Fecal coliform, *E.coli*, and Enterococci bacteria samples were collected by members of the MVPC in April-June 2002 from a two stations in this segment of the Shawsheen River as part of the *Chronic Toxicity Testing* project (00-06/104, see Appendix F). A total of seven bacteria samples were collected from each site and the fecal coliform counts are summarized in Table 19:

Table 19. MVPC 2002 fecal coliform bacteria data, Shawsheen River (Segment MA83-19)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
SH-6 (Shawsheen River, Route 28, Andover)	29 - 730	159 (one sample exceeded 400 cfu/100mls)
SH-7 (Shawsheen River, Sutton Street, North Andover)	78 – 1,100	292 (one sample exceeded 400 cfu/100mls)

The upper 2.5 mile reach of this segment of the Shawsheen River is assessed as support for the *Primary Contact Recreational Use*, although it is also identified with an Alert Status because of elevated fecal coliform bacteria counts. Downstream from the confluence with Rogers Brook, fecal coliform bacteria counts frequently exceeded a geometric mean of 200 cfu/100 mls and, therefore, the *Primary Contact Recreational Use* is assessed as impaired. The *Secondary Contact Recreational Use* is assessed as support for the entire segment. However, this use is also identified with an Alert Status because of the extremely high count in the Shawsheen River (DWM September 2000 sample station SH11 was 15,000 cfu/100 mls) and elevated fecal coliform bacteria counts from storm drains into this segment.

Shawsheen River (Segment MA83-19) Use Summary Table

Designated Uses		Status	Causes	Sources
			Known	Known
Aquatic Life		NOT ASSESSED		
Fish Consumption		NOT ASSESSED		
Primary Contact		SUPPORT* upper 2.5 miles IMPAIRED lower 5.8 miles	Fecal coliform bacteria	Municipal separate storm sewer systems, illicit connections/hookups to storm sewers
Secondary Contact		SUPPORT*		
Aesthetics		NOT ASSESSED		

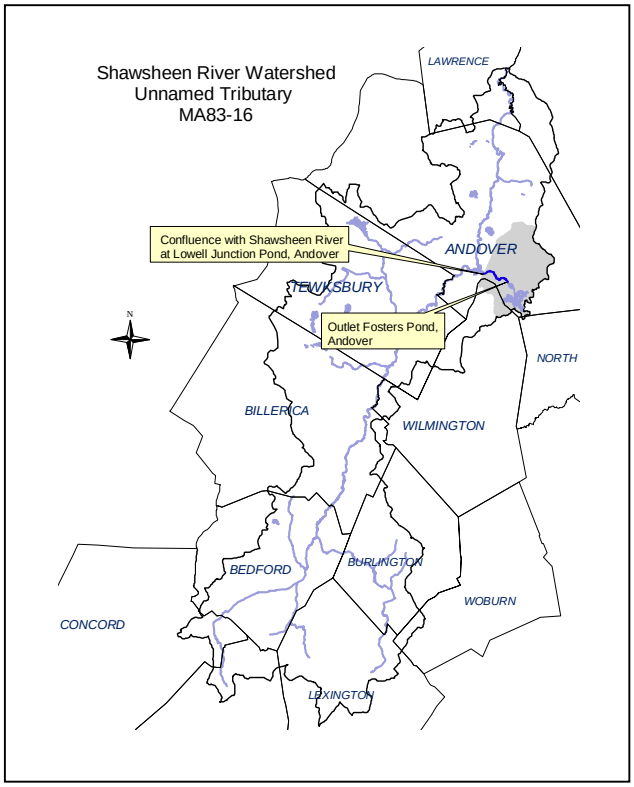
* “Alert Status” issues identified, see details in the text above

RECOMMENDATIONS SHAWSHEEN RIVER (SEGMENT MA83-19)

- Additional monitoring (e.g., habitat quality) should be conducted to assess the status of the *Aquatic Life Use*.
- A shoreline survey should be conducted to document aesthetic quality of this segment of the Shawsheen River.
- Implement the recommendations of the Shawsheen Bacteria TMDL.
    - septic tank control (identify and remediate local community septic problems)
    - urban runoff (collect additional monitoring data to isolate sources of bacteria and implement a control plan)
- Continue to monitor bacteria levels to help implement Phase II stormwater requirements.
- Follow-up with EPA on the status of remediation activities at the NPL site located in this subwatershed.

UNNAMED TRIBUTARY (SEGMENT MA83-16)

Location: Outlet of Fosters Pond, Andover, through River Street Pond to confluence with Shawsheen River at Lowell Junction Pond, Andover
Segment Length: 1.0 mile.
Classification: Class B.



The drainage area of this segment is approximately 3.5 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	46%
Forest	41%
Open Land	3%

Fosters Pond (MA83005) is in this subwatershed area. The use assessment for Fosters Pond is provided in the lake assessment section of this report.

The MRWC and the Lower Shawsheen Stream Team collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (seven sampling events) from one site along this segment (MRWC 1998).

WMA WATER WITHDRAWAL AND NPDES WASTEWATER DISCHARGE SUMMARY:
Based on the available information, there are no WMA regulated water withdrawals or NPDES regulated surface wastewater discharges in this subwatershed.

It should be noted, however, that Andover is a Phase II community. Andover must apply for permit coverage for their municipal storm drainage system by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Lower Shawsheen Stream Team collected fecal coliform bacteria data during the months of June through September 1998 (seven sampling events) from the unnamed tributary at River Street, Andover (station FPR 2.1; MRWC 1998). The fecal coliform counts ranged from 8 cfu/100 mls to 340 cfu/100 mls with a geometric mean of 53 cfu/100 mls.

Based on the low fecal coliform bacteria counts both the *Primary and Secondary Contact Recreational* uses for this unnamed tributary of the Shawsheen River are supported.

Unnamed tributary (Segment MA83-16) Use Summary Table

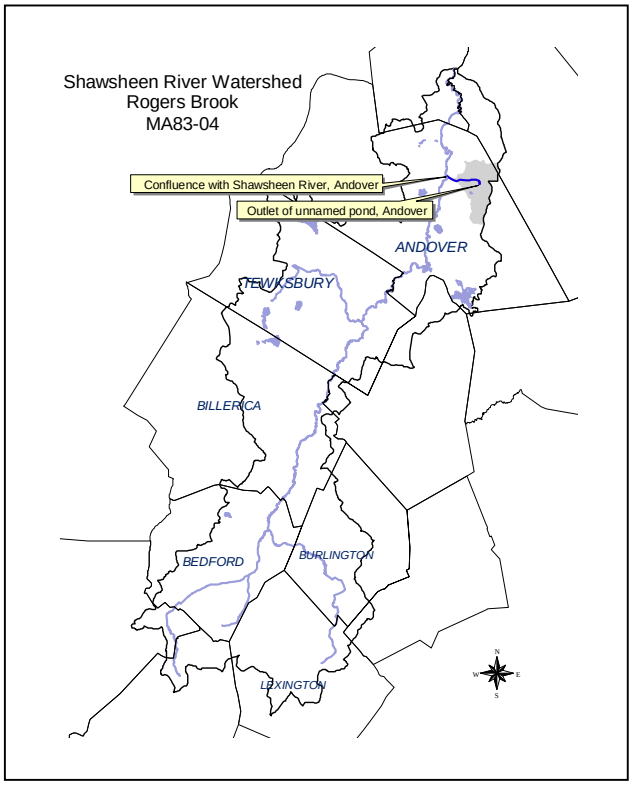
Designated Uses		Status
Aquatic Life		NOT ASSESSED
Fish Consumption		NOT ASSESSED
Primary Contact		SUPPORT
Secondary Contact		SUPPORT
Aesthetics		NOT ASSESSED

RECOMMENDATIONS UNNAMED TRIBUTARY (SEGMENT MA83-16)

- The Stream Team should continue to foster local stewardship and protect this brook.

ROGERS BROOK (SEGMENT MA83-04)

Location: Outlet of first unnamed pond, Andover, to confluence with the Shawsheen River, Andover
Segment Length: 1.3 miles.
Classification: Class B.



The drainage area of this segment is approximately 1.48 square miles. Land-use estimates (top three) for the subwatershed (map inset, gray shaded area):

Residential	52%
Forest	23%
Open Land	19%

This segment is on the 1998 303(d) List of Waters because of pathogens and turbidity (Table 2).

Rabbit Pond (MA83015) is in this subwatershed area. The use assessment for Rabbit Pond is provided in the lake assessment section of this report.

The MRWC and the Lower Shawsheen Stream Team carried out a shoreline survey along this segment in 1998 (MRWC 1998). They also collected water quality data (DO, fecal coliform bacteria, *E.coli*, and turbidity) during the months of June through September 1998 (eight sampling events) from two sites along this segment (MRWC 1998).

WMA WATER WITHDRAWAL SUMMARY:
Based on the available information, there are no regulated water withdrawals in this tributary system.

NPDES WASTEWATER DISCHARGE SUMMARY:
The NPDES permit (MA0034631) for the Citgo Service Station property in North Andover was terminated on 24 June 1999. This permit was issued for a gasoline remediation project (treatment from October 1991 to June 1993).

Since Andover and North Andover are Phase II Stormwater communities they must apply for permit coverage for their municipal drainage systems by July 2003 and develop, implement and enforce a stormwater management program, to reduce the discharge of pollutants from their system, over the five-year permit term (Domizio 2003).

USE ASSESSMENT
AQUATIC LIFE USE
Habitat and flow

A 0.6-mile reach of Rogers Brook is culverted under the downtown section of Andover.

The physical alteration (underground/culverted) of the stream channel has resulted in a reduction of habitat available for aquatic life. The *Aquatic Life Use* is, therefore, assessed as impaired for a 0.6-mile reach of this segment. The remaining 0.7-mile reach of Rogers Brook is not assessed for the *Aquatic Life Use*.

PRIMARY AND SECONDARY CONTACT RECREATION

The MRWC and the Upper Shawsheen Stream Team collected fecal coliform bacteria data (Table 20) during the months of June through September 1998 (eight sampling events) from two sites along this segment (MRWC 1998). Two of the eight sampling events were conducted during wet weather conditions (Note: high bacteria concentrations were associated with these wet weather conditions).

Table 20. MRWC 1998 fecal coliform bacteria data, Rogers Brook (Segment MA83-04)

Station Name (upstream to downstream)	Fecal Coliform data range (cfu/100 mls)	Geometric Mean (cfu/100 mls)
ROB 0.0 (Highland Avenue, Andover)	120 – 1,500	317
ROB 1.5 (just upstream of confluence with Shawsheen River, Andover)	2 – 1,440	231

In August and September 2000 DWM collected fecal coliform bacteria samples at two stations from Rogers Brook (Appendix A, Table A4):

- RB02A, downstream from Morton Street, Andover, MA.
- RB01A, approximately 550 feet upstream of confluence with Shawsheen River, Andover, MA.

The fecal coliform bacteria counts at RB02A were < 10 cfu/100 mls in August and 9,600 cfu/100 mls in September. The fecal coliform bacteria counts at RB01A were 7,500 cfu/100 mls in August and 10,000 cfu/100 mls in September.

Fecal coliform bacteria were collected during September and October 2002 from two storm drain locations in Rogers Brook by MRWC as part of the Shawsheen TMDL Implementation Plan project (01-01/MWI, see Appendix F; MRWC 2003b). This part of the project (Part I) focused on the Lower Shawsheen River Watershed in the towns of Andover, North Andover, and Lawrence, MA. This study documented bacteria levels in the end-of-pipe effluents. The data presented in this report are not representative of stream habitat conditions, but do represent source identification of pollutant loadings. Bacteria samples were collected during wet weather conditions. The fecal coliform bacteria counts ranged from 430cfu/100 mls (sample collected during a wet weather event – 1.12 inches of rain) to 21,000cfu/100 mls (sample collected during a wet weather event – 0.68 inches of rain) (MRWC 2003b).

The Andover Department of Public Works discovered that stormdrains in the Rogers Brook subwatershed had high coliform counts possibly caused by illegal wastewater connections (Brander 2002). The Town of Andover currently has a contract to provide sewer service to portions of South Andover. These areas include Rogers Brook, Ballardvale Road and portions of South Main Street, which are all located in this subwatershed (MRWC 2003b).

Because of elevated fecal coliform bacteria levels and best professional judgment (illicit sewer connections), the *Primary* and *Secondary Contact Recreational uses* are assessed as impaired for the entire length of this segment.

AESTHETICS

The MRWC conducted a shoreline survey in the summer 1998 between Phillips Academy and Dundee Park in Andover, MA. There were no odors, scum, foam or oily sheens observed by the team. The stream team observed some bank erosion and algae growth on the surface of the water. The stream team did not note any storm drains, however, runoff was observed from roadways and lawns (MRWC 1998).

No objectionable conditions were documented during the 1998 shoreline survey in the upper 0.5 mile reach of Rogers Brook, therefore, the *Aesthetics Use* is assessed as support. The lower 0.8 mile (including the 0.6 mile culverted portion of the brook) reach of the segment is not assessed for this use.

Rogers Brook (Segment MA83–04) Use Summary Table

Designated Uses		Status	Causes	Sources
			Known	Known
Aquatic Life		NOT ASSESSED upper 0.5 mile reach IMPAIRED 0.6 mile culverted reach NOT ASSESSED lower 0.2 mile reach	Other anthropogenic substrate alteration (318)	Channelization (20)
Fish Consumption		NOT ASSESSED		
Primary Contact		IMPAIRED	Fecal coliform bacteria	Municipal separate storm sewer systems (34), illicit connections/hookups to storm sewers (55), on-site treatment systems (septic systems 92)
Secondary Contact		IMPAIRED	Fecal coliform bacteria	Municipal separate storm sewer systems (34), illicit connections/hookups to storm sewers (55), on-site treatment systems (septic systems 92)
Aesthetics		SUPPORT upper 0.5 mile reach NOT ASSESSED lower 0.8 mile reach		

RECOMMENDATIONS ROGERS BROOK (SEGMENT MA83–04)

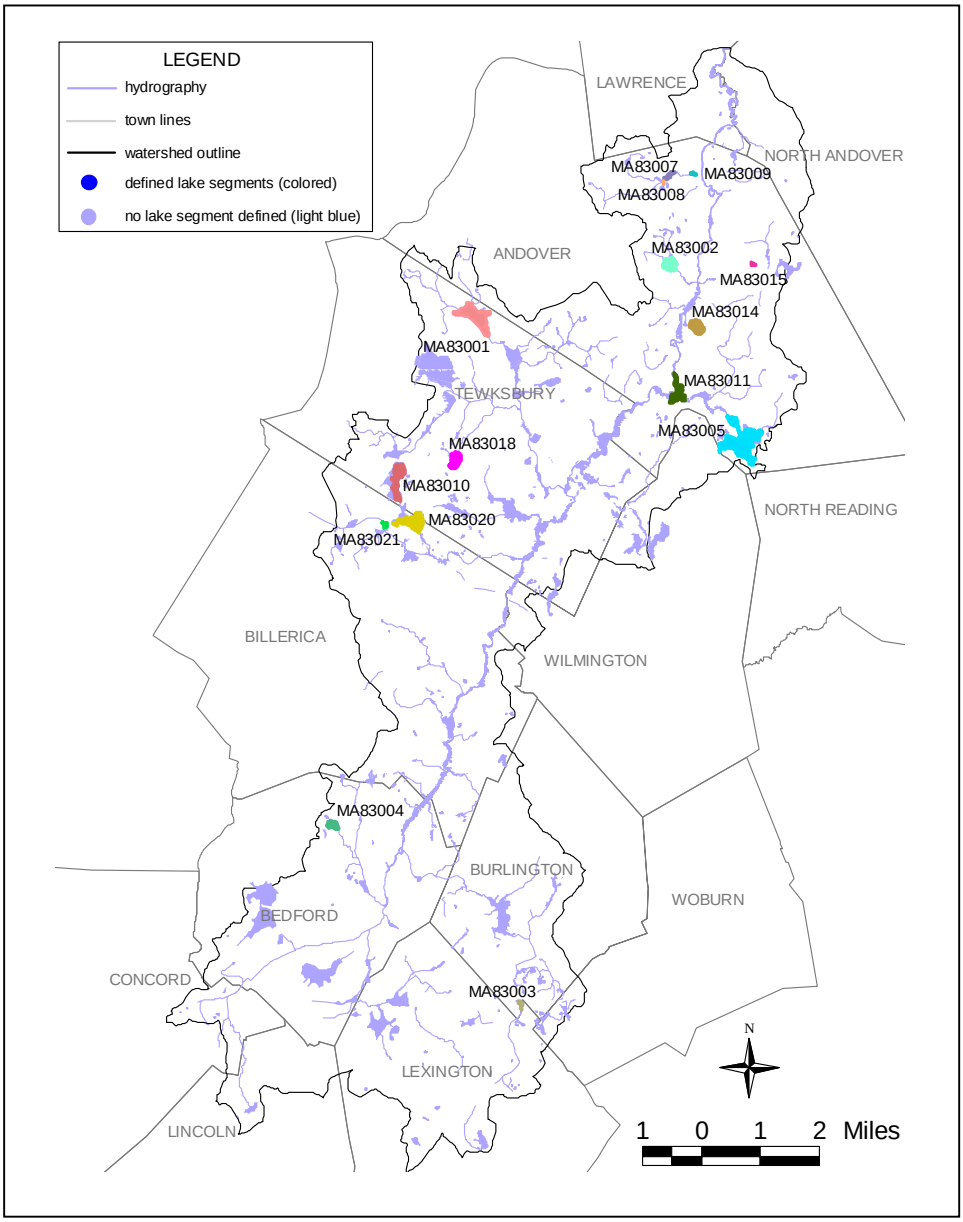
- Continue to monitor bacteria levels to identify sources and remediate them.
- Develop and implement an instream habitat restoration/improvement project to improve habitat quality and support aquatic life.
- Follow-up with the Andover Department of Public Works regarding the remediation activities concerning illegal wastewater connections. Follow-up on the progress of sewer service provided by the Town of Andover to portions of South Andover. These areas include Rogers Brook, Ballardvale Road and portions of South Main Street, which are all located in this subwatershed (MRWC 2003b).

SHAWSHEEN RIVER WATERSHED - LAKE ASSESSMENTS

A total of 20 lakes, ponds or impoundments (the term "lakes" will hereafter be used to include all) have been identified and assigned PALIS code numbers in the Shawsheen River Watershed (Ackerman 1989 and MADEP 2001). The total surface area of the Shawsheen River Watershed lakes is 495 acres. They range in size from two to 135 acres; 18 lakes are less than 50 acres and one is greater than 100 acres. This report presents information on 15 of these lakes that are in the WBS database (Figure 9). Five lakes, which total 57 acres, are unassessed and they are not currently included as segments in the WBS database.

Eighteen of these lakes had previously been assigned PALIS code numbers (Pond and Lake Information System, Ackerman et al., 1989) and two (2) additional lakes had codes assigned to them as a result of the 1995 MADEP surveys. The total surface acreage of the Shawsheen Watershed lakes is 495. Of that total, 88%, was assessed during the 1995 surveys. The 15 lakes assessed in this report represent 438 acres, or 88%, of the acreage in the Shawsheen River Watershed. They lie wholly or partly within six of the watershed's eight communities (Figure 9). Baseline lake surveys were conducted on two of these lakes (TMDL sampling) in the summer of 2000 (Appendix B, Tables B1, B2, and B3). Synoptic surveys were conducted by DWM in 44 of these lakes in 1995 (Appendix D, Table D4).

Figure 9. Shawsheen River Watershed – Lake Segments Locations identified by WBID



TROPHIC STATUS EVALUATION

Lakes are dynamic ecosystems that undergo a process of succession from one trophic state to another. Under natural conditions most lakes move from a nutrient poor (oligotrophic) condition, through an intermediate (mesotrophic) stage of nutrient availability and biological productivity, to a nutrient-rich or highly productive (eutrophic) state. For the purposes of this report trophic status was estimated primarily using visual observations of macrophyte cover and phytoplankton populations observed in 1995 and/or 2000 by MADEP DWM (Appendix D, Table D4). A more definitive assessment of trophic status requires more extensive collection of water quality and biological data than is currently available. As available data become more than five years old, trophic status estimates are generally listed as undetermined. This is particularly true if the lake was previously estimated to be oligo- or mesotrophic, since conditions may have moved to a more productive status in the interim.

The trophic status estimates for the lakes assessed in the Shawsheen River Watershed are presented in Table 21; all but two of the 15 lakes (93% of the assessed lake acreage) were eutrophic, one lake (25 acres) was hypereutrophic. Trophic status was undetermined in one lake (1% of the assessed lake acreage).

Table 21. Shawsheen River Watershed lake trophic status evaluation. (**Bold indicates waterbody on the 1998 303(d) List**).

Lake Name (local name), Location	Waterbody Identification Code (WBID)	Class	Size (Acres)	Trophic Status Estimate
Ames Pond, Tewksbury	MA83001	B	82	Eutrophic
Bakers Meadow Pond, Andover	MA83002	B	18	Eutrophic
Butterfield Pond, Burlington/Lexington	MA83003	B	7	Eutrophic
Fawn Lake, Bedford	MA83004	B	11	Eutrophic
Fosters Pond, Andover/Wilmington	MA83005	B	135	Eutrophic
Gravel Pit Pond (Hussey Brook Pond East), Andover	MA83007	B	5	Eutrophic
Hussey Brook Pond (West), Andover	MA83008	B	5	Undetermined
Hussey Pond, Andover	MA83009		2	Eutrophic
Long Pond, Tewksbury	MA83010	B	39	Eutrophic
Lowell Junction Pond (Ballardvale Impoundment), Andover	MA83011	B	40	Eutrophic
Pomps Pond, Andover	MA83014	B	14	Eutrophic
Pond Street Pond, Billerica	MA83021	B	4	Eutrophic
Rabbit Pond, Andover	MA83015	B	5	Eutrophic
Richardson Pond (North), Billerica/Tewksbury	MA83020	B	46	Eutrophic
Round Pond, Tewksbury	MA83018	B	25	Hypereutrophic

LAKE USE ASSESSMENTS

Lake assessments are based on information gathered during DWM surveys (recent and historic) as well as pertinent information from other reliable sources (e.g., abutters, herbicide applicators, diagnostic/feasibility studies, MDPH, etc.). The 1995 DWM synoptic surveys focused on visual observations of water quality and quantity (e.g., water level, sedimentation, etc.), the presence of native and non-native aquatic plants (both distribution and aerial cover) and presence/severity of algal blooms (Appendix D, Table D4). During 2000, more intensive in-lake sampling was conducted by DWM in two lakes in the Shawsheen River Watershed as part of the TMDL program. This sampling included in-lake measurements of DO, pH, temperature, Secchi disk transparency, nutrients, and chlorophyll *a*, and detailed macrophyte mapping (Appendix B, Tables B1, B2, and B3). While these surveys provided additional information to assess the status of the designated uses fecal coliform bacteria data were unavailable and, therefore, the *Primary Contact Recreational* Use was usually not assessed. In the case of the *Fish Consumption Use*, fish consumption advisory information was obtained from the MDPH (MDPH 2002a). Although the *Drinking Water Use* was not assessed in this water quality assessment report, the Class A waters were identified. Information on drinking water source

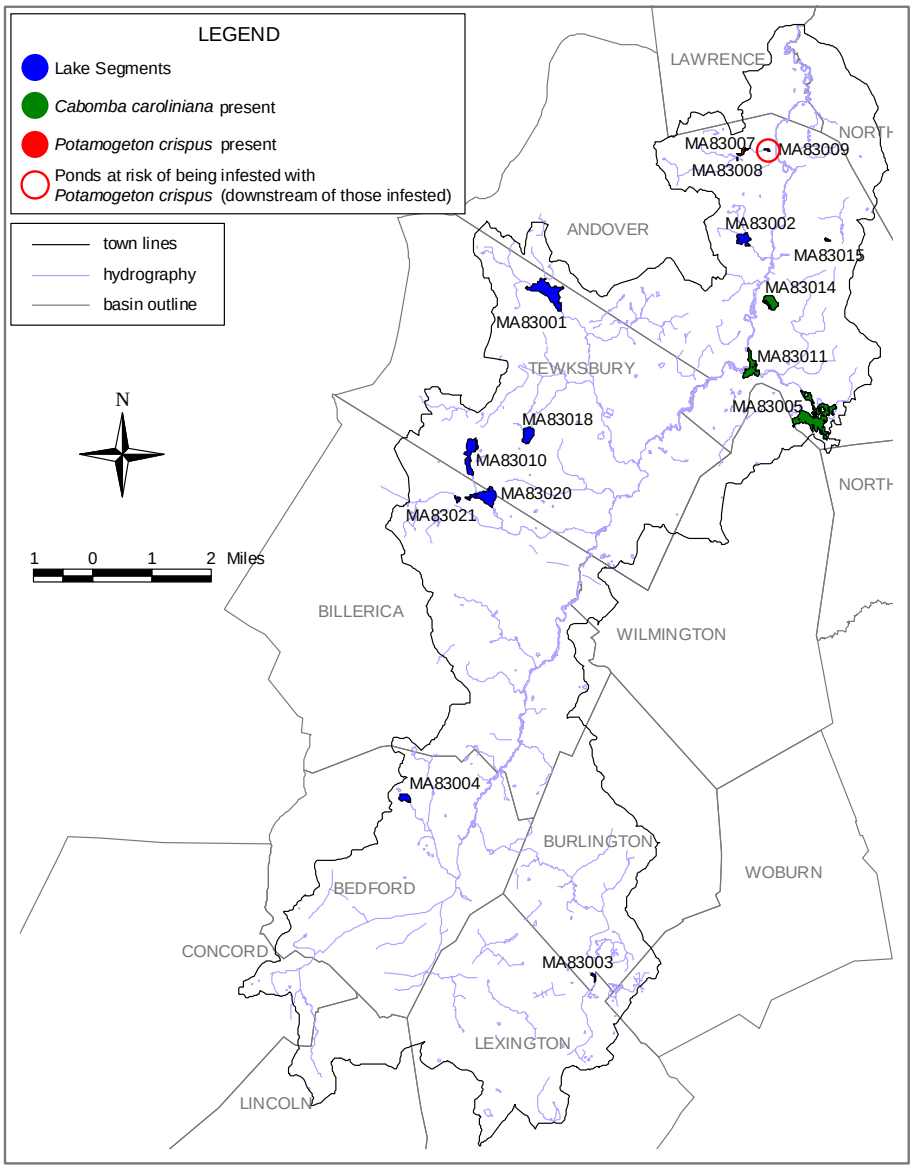
protection and finish water quality is available at http://www.state.ma.us/dep/brp/dws/dwshome.htm and from the Shawsheen River Watershed's public water suppliers.

The use assessments and supporting information were entered into the EPA Waterbody System database. Data on the presence of non-native plants were entered into the MADEP DWM informal non-native plant tracking database.

AQUATIC LIFE

Non-native aquatic macrophytes were observed in 4 of the 15 lakes surveyed by DWM in 1995 (Appendix D, Table D4). The two non-native aquatic species observed in the Shawsheen River Watershed lakes were *Potamogeton crispus* (curly leaf pondweed) and *Cabomba caroliniana* (fanwort). These species have high potential for spreading and are likely to have established themselves in downstream lake and river segments in the Shawsheen River Watershed, which may not have been surveyed. Figure 10 indicates where these non-native aquatic species were observed during the DWM 1995 surveys and the likely, or potential, avenues of downstream spreading. .

Figure 10. Shawsheen River Watershed – presence of non-native aquatic vegetation and potential for downstream spreading



Additionally, *M. heterophyllum* is suspected to be present in Ames Pond (Tewksbury). At the time of the 1995 DWM synoptic survey the plants had not matured sufficiently to be positively identified. Because *M. heterophyllum* is suspected, the *Aquatic Life Use* for this lake is identified with an "Alert Status".

It should also be noted that at least one non-native wetland species, either *Lythrum Salicaria* (purple loosestrife) or *Phragmites australis* (common reed grass), were observed at all but one of the 15 lakes surveyed by DWM in 1995 and/or 2000 (Appendix D, Table D4). These two non-native wetland species were co-located at Richardson Pond North (Billerica/Tewksbury) and Round Pond (Tewksbury). Although the presence of these species is not generally a cause of impairment to lakes, their invasive growth habit can result in the impairment of wetland habitat associated with lakes.

Oxygen depletion occurred below 1.5 m during August and 0.5 m in September 2000 at Fosters Pond (Appendix B, Table B1). Because oxygen depletion occurs at such a shallow depth, the entire pond is assessed as impaired for the *Aquatic Life Use* as a result of organic enrichment/low DO, as well as the exotic species.

Oxygen depletion occurred below 0.5 meters in July and August and less than 1.0 m in September 2000 at Long Pond (Appendix B, Table B). The surface water was densely covered with duckweed and algae. Very high total phosphorus concentrations and elevated chlorophyll *a* measurements were also documented (Appendix B, Table B2). Based on these data the *Aquatic Life Use* is assessed as impaired.

The *Aquatic Life Use* was assessed as impaired in three lakes (Gravel Pit, Lowell Junction, and Pomps ponds) with confirmed non-native macrophyte(s). Two additional lakes, Fosters and Long ponds, were impaired for both organic enrichment/low DO and non-native macrophytes. The remaining 10 lakes in the Shawsheen River Watershed were not assessed for the *Aquatic Life Use* because of the cursorial nature of the synoptic surveys and/or the lack of DO data observations.

FISH CONSUMPTION

In June 2002, MDPH issued new consumer advisories on fish consumption and mercury contamination. The MDPH "…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, MDPH 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 (MDPH 2001)."

Additionally, MDPH "…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 (MDPH 2001)."

MDPH's statewide advisory does not include fish stocked by the state Division of Fisheries and Wildlife or farm-raised fish sold commercially. The advisory encompasses all freshwaters in Massachusetts and, therefore, the *Fish Consumption Use* for lakes in the Shawsheen River Watershed cannot be assessed as support.

In August and September 2000 fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in Fosters Pond, Andover and Round Pond, Tewksbury, respectively, at the request of the Shawsheen Watershed Team for human consumption considerations. PCB was not detected in any of the samples analyzed (Appendix C, Table C1). Mercury concentrations were above the MDPH action level of 0.5 PPM in fish from Fosters Pond. Because of elevated mercury concentrations MDPH issued a fish consumption advisory in May 2001 due to mercury contamination for Fosters Pond in Andover/Wilmington (MDPH 2002a). The advisory recommends the following.

Fosters Pond (Andover/Wilmington):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body."
2. "The general public should limit consumption of all fish from this water body to two meals per month."

The mercury concentration in the individual largemouth bass collected from Round Pond, Tewksbury was at the MDPH action level of 0.5 PPM (Appendix C, Table C1). While no advisory was issued (sample size too limited), additional sampling of predatory fishes from this waterbody was recommended (Appendix C).

In 1999 fish toxics monitoring in Ames Pond (Tewksbury) and Pomps Pond (Andover) was conducted by Normandeau and Associates as part of the MADEP ORS mercury study. Based on the results of this survey DPH issued the following advisories.

Ames Pond (Tewksbury):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat largemouth bass from this waterbody."
2. "The general public should limit consumption of largemouth bass to two meals per month."

Pomps Pond (Andover):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this waterbody."
2. "The general public should not eat largemouth bass from this waterbody."
3. "The general public should limit consumption of all other fish species to two meals per month."

In September 1995 fish toxics monitoring (metals, PCB, and organochlorine pesticide in edible fillets) was conducted by DWM in Lowell Junction Pond (Ballardvalle Impoundment) in response to the request of the Shawsheen Watershed Team. These data can be found in Appendix C, Table C2. Because of elevated mercury concentrations, MDPH issued a fish consumption advisory which recommends following.

Shawsheen River at Lowell Junction Pond (also known as Ballardvale Impoundment, Andover):

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any largemouth bass or black crappie from this water body."
2. "The general public should limit consumption of largemouth bass and black crappie to two meals per month."

Four lakes, Ames Pond (Tewksbury), Fosters Pond (Andover/Wilmington), Pomps Pond (Andover), and Ballardvale Impoundment (also known as Lowell Junction Pond)(Andover) are impaired (non-support due to mercury contamination) for the *Fish Consumption Use* (Table 22). [NOTE: The MDPH fish consumption advisory list contains the status of each water body for which an advisory has been issued. If a water body is not on the list, it may be because either an advisory was not warranted or the water body has not been sampled. MDPH's most current Fish Consumption Advisory list is available online at http://www.state.ma.us/DPH/beha/fishlist.htm.] One additional lake, Round Pond, Tewksbury is identified with an Alert Status for the Fish Consumption Use. While no advisory was issued (sample size too limited), additional sampling of predatory fishes from this waterbody was recommended (Appendix C).

PRIMARY AND SECONDARY CONTACT RECREATION AND AESTHETICS

Two ponds, Long Pond in Tewksbury, and Fosters Pond, Andover, were assessed as impaired for the *Recreational* and *Aesthetics* uses. In Long Pond all of the Secchi disk depth measurements violated the bathing beach guidance of four feet (Appendix B, Table B2). Because of the presence of algae and duckweed blooms the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are assessed as impaired. Only 13% of the lake biovolume, however, has dense/very dense vegetation.

Approximately 77% of Fosters Pond biovolume (the 3-dimensional space available for biological growth) has dense/very dense vegetation dominated by *Cabomba caroliniana*. Because of this high percentage of biovolume of a non-native aquatic plant the *Primary* and *Secondary Contact Recreational* and *Aesthetic* uses are assessed as impaired. None of the Secchi disk depth measurements in Fosters Pond violated the bathing beach guidance of four feet (Appendix B, Table B2).

While Pomps Pond in Andover was not assessed for the *Recreational* and *Aesthetics* uses these uses were identified with an Alert Status because of documented blue-green blooms (Carifio 2002). The Town of Andover, Department of Public Works, collects weekly fecal coliform and *E.coli* bacteria samples from the swimming beach at Pomps Pond between the months of June and August. Since 1998, the beach was closed once for three days because of elevated bacteria concentrations (Carifio 2002). There are not enough data (i.e., lack of transparency data) available to assess these uses.

The *Primary* and *Secondary Contact Recreational* and *Aesthetics* uses are not assessed in the remaining 13 lakes in the Shawsheen River Watershed because of a lack of bacteria, transparency and in-lake survey data.

SUMMARY

A total of six of the 15 lakes in the Shawsheen River Watershed assessed in this report were impaired for one or more uses. Causes of impairment included noxious (overabundant) plant growth (including both native and non-native vegetation), mercury contamination, organic enrichment/low DO, excess algal growth, and Secchi disk transparency. None of the uses were supported in any of the lakes assessed in this report. Nine lakes are currently not assessed for any of the uses and all of these lakes are on the 1998 303(d) List of Waters.

Due to the focus of the lake surveys conducted for the TMDL program, the major causes for use impairment were organic enrichment/low DO and non-native aquatic vegetation. Mercury contamination, excess algal growth, and Secchi disk transparency were also causes for impairment. Low DO is likely a symptom of lake eutrophication, a process of enrichment from excessive, anthropogenic introductions of plant nutrients. Site-specific sources of impairment to the lakes in the Shawsheen River Watershed are largely unknown. However, nutrient enrichment from stormwater runoff, failing, substandard, or inappropriately sited sewage disposal systems, and/or drainage from agricultural lands are likely to have increased macrophyte productivity, resulting in impairments to the *Aquatic Life Use.*

Table 22 presents the use assessments for the lakes in the Shawsheen River Watershed.

Table 22. Shawsheen River Watershed lake assessments.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Ames Pond, Tewksbury	MA83001	82	NOT ASSESSED	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4). Fish toxics monitoring conducted in 1999 as part of ORS mercury study.							
Bakers Meadow Pond, Andover	MA83002	18	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4).							
Butterfield Pond, Burlington/Lexington	MA83003	7	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4).							
Fawn Lake, Bedford	MA83004	11	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4). Note: Diagnostic/Feasibility study available for Fawn Lake - completed by Alliance Technologies Corporation in 1989 (ACT 1989). Subsequent to the 1989 Diagnostic/Feasibility Study, the Town of Bedford has applied for a 319 grant to fund a lake restoration project. The Town has proposed to support the implementation of low impact development stormwater controls to help restore and protect water quality in the lake. The objective is to restore the water quality and recreational value of Fawn Lake through the implementation of a watershed management plan. The current improvements underway in Fawn Lake include in-lake measures to control noxious aquatic plants and nutrient recycling.							
Fosters Pond, Andover/Wilmington	MA83005	135	IMPAIRED (DO, DO saturation, non-native plants)	IMPAIRED (Mercury)	IMPAIRED (Non-native plants)	IMPAIRED (Non-native plants)	IMPAIRED (Non-native plants)
Low DO/saturation occurred at depths greater than 0.5m during the 2000 summer survey (Appendix B, Table B1). None of the Secchi disk depth measurements violated the bathing beach guidance of four feet (Appendix B, Table B2). Non-native aquatic plant (*Cabomba caroliniana*) and non-native wetland plant (*Lythrum Salicaria*) documented in 1995 and 2000 (Appendix D, Table D4). Fish toxics monitoring conducted in 2000 by DWM (Appendix C, Table C1).							
Gravel Pit Pond (Hussey Brook Pond East), Andover	MA83007	5	IMPAIRED (Non-native plants)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native aquatic plant (*Potamogeton crispus*) and non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4).							

Table 22 (Continued). Shawsheen River Watershed lake assessments.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Hussey Brook Pond (West), Andover	MA83008	5	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Hussey Pond, Andover	MA83009	2	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4).							
Long Pond, Tewksbury	MA83010	39	IMPAIRED (DO, DO saturation, phosphate, excess algal growth, chlorophyll *a*)	NOT ASSESSED	IMPAIRED (Excess algal growth, Secchi disk transparency, phosphate)	IMPAIRED (Excess algal growth, Secchi disk transparency, phosphate)	IMPAIRED (Excess algal growth, Secchi disk transparency, phosphate)
Low DO/saturation occurred at depths greater than 0.5m during the 2000 summer survey (Appendix B, Table B1). The surface water was densely covered with duckweed and algae. Very high total phosphorus concentrations and chlorophyll *a* measurements were also documented (Appendix B, Table B2). All of the Secchi disk depth measurements violated the bathing beach guidance of four feet in Long Pond (Appendix B, Table B2). Non-native wetland plant (*Lythrum Salicaria*) documented in 1995 and 2000 (Appendix D, Table D4). Long Pond in Tewksbury had a surface TP concentration of 0.4 mg/l (extremely high) during the 2000 baseline lake survey. Potential nutrient sources around this lake were further investigated and a trailer park with a failing septic system was identified as a potential source of nutrients (Appendix B, Table B2).							
Lowell Junction Pond (Ballardvale Impoundment), Andover	MA83011	40	IMPAIRED (Non-native plants)	IMPAIRED (Mercury)	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native aquatic plant (*Cabomba caroliniana*) and non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4).							
Pomps Pond, Andover	MA83014	14	IMPAIRED (Non-native plants)	IMPAIRED (Mercury)	NOT ASSESSED*	NOT ASSESSED*	NOT ASSESSED*
Non-native aquatic plant (*Cabomba caroliniana*) and non-native wetland plant (*Lythrum Salicaria)* documented in 1995 (Appendix D, Table D4). The Town of Andover collects weekly bacteria samples during the months of June through August from the public swimming beach at Pomps Pond. Herbicides were applied to control a blue-green bloom in 2002 (Carifio 2002). While bacteria counts have been low no Secchi disc depth data are available and because of the documented algae bloom the primary contact recreational use is not assessed. However, these uses were identified with an *Alert Status because of documented blue-green blooms (Carifio 2002). Note: Pomps Pond was awarded a DEM Lake and Ponds Grant in 1995. This grant- funded project controlled invasive, non-native plants (fanwort and coontail) through the use of a mechanical harvester at Pomps Pond. Also included in the project was new sand for the public beach and signs/printed material about the pond.							

Table 22 (Continued). Shawsheen River Watershed lake assessments.

Lake, Location	WBID	Size (Acres)	Aquatic Life (Impairment Cause)	Fish Consumption (Impairment Cause)	Primary Contact (Impairment Cause)	Secondary Contact (Impairment Cause)	Aesthetics (Impairment Cause)
Pond Street Pond, Billerica	MA83021	4	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plant (*Lythrum Salicaria*) identified during the 1995 synoptic survey (Appendix D, Table D4).							
Rabbit Pond, Andover	MA83015	5	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Richardson Pond (North), Billerica/Tewksbury	MA83020	46	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Non-native wetland plants (*Lythrum Salicaria* and *Phragmites australis*) identified during the 1995 synoptic survey (Appendix D, Table D4).							
Round Pond, Tewksbury	MA83018	25	NOT ASSESSED	NOT ASSESSED*	NOT ASSESSED	NOT ASSESSED	NOT ASSESSED
Fish toxics monitoring conducted in 2000 (Appendix C, Table C1). Round Pond is identified with an Alert Status for the Fish Consumption Use. While no advisory was issued (sample size too limited), additional sampling of predatory fishes from this waterbody is recommended (Appendix C). Non-native wetland plants (*Lythrum Salicaria* and *Phragmites australis*) identified during the 1995 synoptic survey (Appendix D, Table D4).							

RECOMMENDATIONS – LAKES

- Coordinate with DEM and/or other groups conducting lake surveys to generate quality-assured lakes data. Conduct more intensive lake surveys to better determine the lake trophic and use support status and identify causes and sources of impairment. As sources are identified within lake watersheds they should be eliminated or, at least, minimized through the application of appropriate point or non-point source control techniques.

- Implement recommendations identified in the TMDLs and lake Diagnostic/Feasibility studies, including lake watershed surveys to identify sources of impairment.

- Additional monitoring at Pomps Pond should be conducted that includes transparency and nutrient data (determine cause for blue-green blooms). Mechanical harvesting to control *Cabomba caroliniana* and *Ceratophyllum* sp. is not recommended since they spread vegetatively.

- Review data from the "Beaches Bill" required water quality testing (bacteria sampling at all formal bathing beaches) to assess the status of the recreational uses (e.g., Pomps Pond, Andover).

- Quick action is necessary to manage non-native aquatic or wetland plant species that are isolated in one or a few location(s) in order to alleviate the need for costly and potentially fruitless efforts to do so in the future. Two courses of action should be pursued concurrently. More extensive surveys need to be conducted, particularly downstream from these recorded locations, to determine the extent of the infestation. And, "spot" treatments (refer to the draft Generic Environmental Impact Report for Eutrophication and Aquatic Plant Management in Massachusetts [MADEP and DEM 1998] for advantages and disadvantages of each) should be undertaken to control populations at these sites. These treatments include careful hand-pulling of individual plants in small areas. In larger areas, other techniques, such as selective herbicide application, may be necessary. In either case, the treatments should be undertaken prior to fruit formation and with a minimum of fragmentation of the individual plants. These actions will minimize the spreading of the populations. This draft aquatic plant report (MADEP and DEM 1998) should be consulted prior to the development of any lake management plan to control non-native aquatic or wetland plant species.

- Where non-native plant infestations are more extensive, conduct additional monitoring to determine the extent of the problem. The draft Generic Environmental Impact Report for Eutrophication and Aquatic Plant Management in Massachusetts (MADEP and DEM 1998) should be consulted prior to the development of any lake management plan to control non-native aquatic plant species. Plant control options can be selected from several techniques (e.g., bottom barriers, drawdown, herbicides, etc.) each of which has advantages and disadvantages that need to be addressed for the specific site. However, methods that result in fragmentation (such as cutting or raking) should be discouraged because of the propensity for some invasive species of these plants to reproduce and spread vegetatively (from cuttings).

- Prevent spreading of invasive plants. Once the extent of the problem is determined and control practices are exercised, vigilant monitoring needs to be practiced to guard against infestations in unaffected areas and to ensure that managed areas stay in check. A key portion of the prevention program should be posting of boat access points with signs to educate and alert lake-users to the problem and responsibility of spreading these species.

LITERATURE CITED

Ackerman, M.T., 1989. *Compilation of Lakes, Ponds, Reservoirs* and *Impoundments Relative to the Massachusetts Lake Classification Program.* Publication: #15901-171-50-4-89-c.r. Technical Services Branch, Massachusetts Division of Water Pollution Control, Department of Environmental Quality Engineering, Westborough, MA.

ACT. 1989. *Fawn Lake, Final Report.* Alliance Technologies Corporation, Inc., Bedford, MA.

Brander, K. 2002. *Storm drain issues in Rogers Brook.* Massachusetts Department of Environmental Protection, Northeast Regional Office, Wilmington, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 12 September 2002.

Brander, K. 2003a. *Sewer systems within the Shawsheen River Watershed.* Massachusetts Department of Environmental Protection, Northeast Regional Office, Wilmington, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 13 march 2003.

Brander, K. 2003b. *Stormwater Sewer Overflows in Vine Brook.* Massachusetts Department of Environmental Protection, Northeast Regional Office, Wilmington, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 27 February 2003.

Carifio, A. 2002. *Pomps Pond Bacteria Data.* Town Of Andover, Department of Public Works. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 13 August 2002.

Casella, M. 2003. *NPDES permit status in the Shawsheen River Watershed.* Massachusetts Department of Environmental Protection, Northeast Regional Office, Wilmington, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 10 May 2003.

Cashins, W. 2003. *Battle Road Farm Condos, 2002 inspections.* Wilmington, MA. Massachusetts Department of Environmental Protection, Northeast Regional Office, Wilmington, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 20 February 2003.

Chalmers, A. T. 2003. *Toxics Substances Hydrology Program Sampling in the Shawsheen River Watershed*. Communication with USGS, Montpelier, VT. E-mail to Stella Kiras, MADEP dated 6 March 2003.

Coles, J.C. 1998.*Organochlorine Compounds in Fish Tissue from the Connecticut, Housatonic and Thames River Basins Study Unit, 1992-94.* National Water-Quality Assessment Program. U.S. Department of the Interior, U.S. Geological Survey. Marlborough, MA.

DEM. 1993. *Areas of Critical Environmental Concern (ACEC) Program Guide June 1993.* Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Department of Environmental Management, ACEC Program, Boston, MA.

DFW. 2001. *Draft April 2001 Coldwater Fisheries Resource List*. Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement, Division of Fisheries and Wildlife, Westborough, MA.

DFWELE. 2000. *Designated Shellfish Growing Areas Datalayer – July 2000.* Published by MassGIS in October 2000 (MA Office of Geographic and Environmental Information). Executive Office of Environmental Affairs for the Department of Fisheries, Wildlife, and Environmental Law Enforcement, Division of Marine Fisheries. Boston, MA.

Domizio, L. 2003. Personal Communication. *Shawsheen River Watershed: Phase II Communities stormwater permit requirements*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Dunn, W. 2003a. Personal Communication. *Kiln Brook - Landfill Status.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Dunn, W. 2003b. Personal Communication. *Pinnacle Brook - Piggery Operation Status.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Durey. H. 2001. *Shawsheen River Watershed Wetlands Restoration Plan: preliminary Report, February 2001*. Massachusetts Wetlands Restoration Program, Executive Office of Environmental Affairs, Boston, MA.

Environment Canada. 04 November 1999. Canadian Environmental Quality Guidelines. [Online]. Environment Canada. http://www.ec.gc.ca/ceqg-rcqe/tistbl_e.doc [28 September 1998].

Environmental Law Reporter. 1988. *Clean Water Deskbook*. Environmental Law Institute, Washington, D.C.

EPA. 1994. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates*. U.S. Environmental Protection Agency. Office of Research and Development, Washington, DC

EPA. 1997. *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Report Contents.* U.S. Environmental Protection Agency. Assessment and Watershed Protection Division (4503F). Office of Wetlands, Oceans, and Watersheds. Office of Water, Washington D.C.

EPA 1998. *Shawsheen River Ecological Assessment Report.* U.S. Environmental Protection Agency. Office of Environmental Measurement and Assessment. Office of Wetlands, Oceans, and Watersheds. Office of Ecosystem Assessment, Region I, New England

EPA. 1999. *1999 Update of Ambient Water Quality Criteria for Ammonia.* U.S. Environmental Protection Agency, Office of Water and Office of Science and Technology. Washington, D.C. and Office of Research and Development, Duluth, MN.

EPA. 19 November 1999. Federal Register Document. [Online]. United States Environmental Protection Agency. http://www.epa.gov/fedrgstr/EPA-WATER/1998/December/Day-10/w30272.htm.

EPA. 2002a. *Consolidated Assessment and Listing Methodolgy – toward a compendium of best practices*. United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. Washington, DC.

EPA. 2002b. *Toxicity Test results: June 2002, Ambient Surface Water Samples from the Shawsheen River, eastern Massachusetts, Memorandum dated 8 October 2002. .* U.S. Environmental Protection Agency. Office of Environmental Measurement and Evaluation. Region I, New England, North Chelmsford, MA.

EPA. 25 March 2003. Waste Site Cleanup & Reuse in New England. [Online]. http://yosemite.epa.gov/r1/npl_pad.nsf/SelectedByState?OpenForm&View=Massachusetts.

Environment Canada. 04 November 1999. Canadian Environmental Quality Guidelines. [Online]. Environment Canada. http://www.ec.gc.ca/ceqg-rcqe/tistbl_e.doc [28 September 1998].

ESS 2002. *Shawsheen River Watershed Storm Drain Assessment, Towns of Bedford & Billerica, Massachusetts*. Environmental Science Services, Inc., Wellesley, MA.

Girouard G. 2002. Personal Communication. *Status of the USGS gage (01100568) at Hanscom AFB.* United States Geological Survey, Water Resources Division, Northborough, MA.

Goodno, R. 2001. Personal Communication. *Merrimack River Basin information*. Merrimack River Watershed Council, Lawrence, MA. 16 August 2001.

Grubbs, G.H. and R.H. Wayland III. 2000. Letter to Colleague dated 24 October 2000. *EPA recommendations on the use of fish and shellfish consumption advisories and certain shellfish growing area classifications in determining attainment of water quality standards and listing impaired waterbodies under section 303(d) of the Clean Water Act*. United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. Washington, DC.

Halliwell, D.B., W.A. Kimball and A.J. Screpetis. 1982. *Massachusetts Stream Classification Program Part I: Inventory of Rivers and Streams.* Massachusetts Division of Fisheries and Wildlife, Department of Fisheries, Wildlife, and Recreational Vehicles and Massachusetts Division of Water Pollution Control, Department of Environmental Quality Engineering. Westborough, MA.

Hill, D. 2003. (dana.hill@state.ma.us). *Battle Road Farm Condos permit status.* Boston, MA. Massachusetts Department of Environmental Protection, Boston, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 20 February 2003.

Howes, B., D. White, R. Samimy, M. Rapacz. 2002. *The Massachusetts Estuaries Project Embayment Water Quality Assessment Interim Report Priority Embayments 1-20 dated September 30, 2002.* University of Massachusetts-Dartmouth, School of Marine Science and Technology, Dartmouth, MA.

LeVangie, D. 2002. *Water withdrawal registration and permit information.* Water Management Act Database. Massachusetts Department of Environmental Protection, Division of Watershed Management, Database Manager. Boston, MA.

LimnoTech, Inc. 2002. *Bacteria TMDL for the Shawsheen River Basin: Report MA83-01-2002-24*. [This report was developed by through a contract with the Merrimack River Watershed Council and funded by a grant from the National Wildlife Federation.]. LimnoTech, Inc., Ann Arbor, MI.

MADEP. 1996. (Revision of 1995 report). *Massachusetts surface water quality standards.* Massachusetts Department of Environmental Protection, Division of Water Pollution Control, Technical Services Branch. Westborough, MA 114p. (Revision of 314 CMR 4.00, effective June 23, 1996.)

MADEP and DEM. 1998. *Eutrophication and Aquatic Plant Management in Massachusetts Draft Generic Environmental Impact Report.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA and Massachusetts Department of Environmental Management, Boston, MA.

MADEP. 1999a. *Final Massachusetts Section 303(d) List of Waters 1998.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MADEP. 2001. Open File. *PALIS updates.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassGIS. 2002. *Hydrography - statewide 1:25000.* MassGIS (MA Office of Geographic and Environmental Information), Executive Office of Environmental Affairs, Boston, MA.

MassWildlife 2001. *Draft April 2001 Coldwater Fisheries Resource List*. Massachusetts Department of Fisheries, Wildlife, and Environmental law Enforcement, Division of Fisheries and Wildlife, Westborough, MA.

Maietta, R. 2001. *2000 Shawsheen River and Elm Brook Fish Survey, Memorandum dated 29 May 2001.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Mattson, M. 2002. Personal Communication. *Shawsheen River Basins Lake TMDL Status.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MDPH. 1969. *Article 7 Regulation 10.2B of the State Sanitary Code.* Commonwealth of Massachusetts. Department of Public Health. Boston, MA.

MDPH. 2001. *Public Health Statewide Fish Consumption Advisory issued July 2001.* The Commonwealth of Massachusetts, Bureau of Environmental Health Assessment, Boston, MA.

MDPH. 2002a. *Freshwater Fish Consumption Advisory List – June 2002.* Massachusetts Department of Public Health, Bureau of Environmental Health Assessment. Boston, MA.

MDPH. 2002b. *105 CMR 445.000: Minimum Standards For Bathing Beaches, State Sanitary Code, Chapter VII*. Massachusetts Department of Public Health, Division of Community Sanitation Regulations and Statues {Online} http://www.state.ma.us/dph/dcs/csanregs.htm. 19 September 2002.

MRWC. 1998. *Shawsheen River Watershed 1998 Volunteer Water Quality Monitoring Report, Andover.* Prepared by the Merrimack River Watershed Council 1997.

MRWC. 2000a. *Final Report, GIS Data Layer of Storm Drain Outlets, Project 99-06/MWI (Part I) Shawsheen River, July 2000.* Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, July 2000.

MRWC. 2000b. *The Ongoing Story of the Shawsheen Watershed Project, January 2000.* Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, January 2000.

MRWC. 2001a. *Final Report*, *Minimizing Environmental Impacts of Buildout: A Subwatershed Approach in the Shawsheen*. Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, July 2001.

MRWC. 2001b. *Final Report, GIS Data Layer of Storm Drain Outlets, Project 00-06/MWI (Part II) Shawsheen River, June 2001.* Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, June 2001.

MRWC. 2002. *Draft Report, Draft TMDL for aquatic life impairment in the Shawsheen Headwaters October 2002.* Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, October 2002.

MRWC. 2003a. *Draft Report, Shawsheen Bacteria TMDL Implementation Plan – Part II, Project 01-01/MWI January 2003.* Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, January 2003.

MRWC. 2003b. *Draft Report, Shawsheen Bacteria TMDL Implementation Plan – Part I, Project 01-01/MWI January 2003.* Prepared by the Merrimack River Watershed Council and Northern Middlesex Council of Governments, January 2003.

NHESP 2002. Unpublished data. Massachusetts Division of Fisheries and Wildlife. Natural Heritage & Endangered Species program. Westborough, MA.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the protection and management of aquatic sediment quality in Ontario.* Water Resources Branch, Ontario Ministry of the Environment. Queen's Printer for Ontario. Canada.

Richards, Todd. 2003. *Shawsheen River Fish Population Data.* MA Division of Fisheries and Wildlife. Westboro, MA. Communication with Division of Watershed Management. MA. E-mail to Stella Kiras, MADEP dated 20 February 2003.

Rizzo Associates, Inc. 1996. *Hanscom Air Force Base Stormwater Quality Testing Program, Bedford, MA, January 1996.* Prepared by Rizzo Associates, Inc. 7 January 1996.

Scarlet, Ginny. 2003. Personal Communication. *Stormwater permitting information.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Screpetis. A. 1975. *Shawsheen River Basin 1975 Water Quality Analysis and Basin Plan*. Massachusetts Water Resources Commission, Division of water Pollution Control, Westborough, MA.

Socolow, R.S., L.Y. Comeau, J.L. Zanca, and L.R. Ramsbey. 1999. *Water Resources Data for Massachusetts* and *Rhode Island, Water Year 1999.* U.S. Geological Survey Report MA-RI-98-1. Water Resources Division, Northboro, MA.

Socolow, R.S., J.L. Zanca, D. Murino Jr., and L.R. Ramsbey. 2000. *Water Resources Data for Massachusetts* and *Rhode Island, Water Year 1999.* U.S. Geological Survey Report MA-RI-99-1. Water Resources Division, Northboro, MA.

Socolow, R.S., J.S. WJitley, D. Murino Jr., and L.R. Ramsbey. 2001. *Water Resources Data for Massachusetts* and *Rhode Island, Water Year 1999.* U.S. Geological Survey Report MA-RI-00-1. Water Resources Division, Northboro, MA.

Socolow, R.S., C.R. Leighton, J.F. Whitely, and D.J. Venetuolo. 2002. *Water Resources Data for Massachusetts* and *Rhode Island, Water Year 2001.* U.S. Geological Survey Report MA-RI-01-1. Water Resources Division, Northboro, MA.

Tatsutani, M. Editor. NESCAUM, NEWMOA, NEIWPCC, EMAN. 1998. *Northeast States/Eastern Canadian Provinces Mercury Study A Framework for Action.* Northeast States for Coordinated Air Use Management (NESCAUM), Northeast Waste Management Official's Association (NEWMOA), New England Interstate Water Pollution Control Commission (NEIWPCC), and Canadian Ecological Monitoring and Assessment Network (EMAN).

UMass Amherst. 1999. *Land Use Datalayer - statewide 1:25000.* Published by MassGIS (MA Office of Geographic and Environmental Information), Executive Office of Environmental Affairs for the Resource Mapping Project at the University of Massachusetts Amherst, MA.

USGS. 13 June 2001. *Surface-Water Monitoring Activities – Updated August 2000*. [Online]. United States Geological Survey. http://nh.water.usgs.gov/CurrentProjects/nawqa/pdf/sw_web.pdf , 8/18/00.

Wayland III, R.H. 2001. Memorandum to EPA Regional Water Management Directors, EPA Regional Science and Technology Directors, and State, Territory and Authorized Tribe Water Quality Program Directors dated 19 November 2001. Re: *2002 Integrated Water Quality Monitoring and Assessment Report Guidance*. United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. Washington, DC.

LIST OF APPENDICES, TABLES, AND FIGURES

Technical Memorandum TM-83-2

SHAWSHEEN WATERSHED

DWM YEAR 2000 WATER QUALITY MONITORING DATA

April 22, 2003

DWM Control Number (CN): 100.0

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Ellen Roy Herzfelder, Secretary
Massachusetts Department of Environmental Protection
Edward P. Kunce, Acting Commissioner
Bureau of Resource protection
Cynthia Giles, Assistant Commissioner
Division of Watershed Management
Glenn Haas, Director

Introduction and Project Objectives

DWM environmental monitoring activities in the Shawsheen watershed in 2000 consisted of two bacterial water quality sampling events at riverine sites, two baseline lake surveys to support the development of TMDLs, fish toxics monitoring, and fish population assessment. This technical memorandum presents the riverine water quality sampling component of the survey. Results of the other monitoring efforts, including lakes, are described in separate memoranda or reports.

At the request of the EOEA watershed team, DWM personnel collected water samples for fecal coliform analysis from sites along the Shawsheen River and selected tributaries. The main stem Shawsheen River is listed on the proposed 2002 Massachusetts 303(d) List of Impaired Waters due, in part, to elevated bacteria levels. The team requested that new coliform bacteria data be obtained to provide an updated status assessment, and to determine whether improvements from on-going clean-up efforts could be detected. Due to resource limitations, however, a Quality Assurance Project Plan (QAPP) was not completed for this sampling, and the level of effort is inadequate for a completely new recreational use assessment. However, this screening-level monitoring can serve to corroborate historical information and may help to identify more detailed monitoring needs for the future.

QUALITY CONTROL AND METHODS

While a QAPP was not prepared for the Shawsheen water quality sampling effort, procedures used were consistent with the prevailing DWM sampling protocols that are described in the Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure (MA DEP 1999a). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied sterile bacteria bottles in accordance with the WES Laboratory Quality Assurance Plan and Standard Operating Procedures (MA DEP 1995).

Lab data reports were reviewed by DWM quality assurance and database management staff. The data were validated and finalized per data validation procedures outlined in DWM SOP CN 56.0. A summary of censoring and qualification decisions for 2000 DWM data is provided in the DWM 2000 Data Validation Report (CN 83.0). A list of DWM data qualifiers that can be applied to final data is provided in Appendix A.

DWM personnel collected water samples for fecal coliform bacteria analysis from 20 stations (Table A1 and Figure A1) on August 29 and September 18, 2000. Water samples were collected from each site and transported on ice to WES where they were analyzed by Method SM 9222D according to the WES Standard Operating Procedure (SOP). Each survey crew took a minimum of one ambient field blank and one field split sample for quality control purposes. At drop locations, plastic buckets were used to collect water. See CN 83.0 for discussion of the implications of bucket use to bacteria data.

Table A1**.** 2000 DEP-DWM Shawsheen River Watershed survey. Location of sites sampled for bacterial analysis on August 29, 2000 and September 18, 2000.

STREAM	STATION	SEGMENT NO.	DESCRIPTOR
Content Brook	CB01	MA 83-09	Upstream of Beech Street, Tewksbury
Elm Brook	EB02	MA 83-05	Upstream of Great Road, Routes 4 & 225, Bedford.
Rogers Brook	RB01A	MA 83-04	Approximately 550 feet upstream of confluence with Shawsheen River, Andover,
Rogers Brook	RB02A	MA 83-04	Downstream of Morton Street , Andover
Shawsheen River	SH01	MA 83-01	Downstream of Summer Street, Bedford.
Shawsheen River	SH01A-US	MA 83-08	Left culvert (of three) located south of the east/west runway on Hanscom Air Force Base, Bedford.
Shawsheen River	SH02	MA 83-01	Upstream of Page Road, Bedford
Shawsheen River	SH06	MA 83-02	Downstream of Route 3A, Billerica.
Shawsheen River	SH06A	MA 83-02	Instream just in front of Burlington water intake located behind Shawsheen High School accessed off Cook Street, Billerica
Shawsheen River	SH07	MA 83-02	Downstream of Salem Road/Shawsheen Avenue (Rte 129), Billerica/Wilmington at USGS Gage.
Shawsheen River	SH07A	MA 83-02	Downstream of Route 38, Tewksbury.

Table A1 cont. 2000 DEP-DWM Shawsheen River Watershed survey. Location of sites sampled for bacterial analysis on August 29, 2000 and September 18, 2000.

STREAM	STATION	SEGMENT NO.	DESCRIPTOR
Shawsheen River	SH07B	MA 83-02	Approximately 350 meters upstream (southwest) of Route 93, Andover/Tewksbury Accessed from Roullard Circle.
Shawsheen River	SH08A	MA 83-02	Upstream side of Ballardvale Dam, (300 feet downstream of Andover Street), Andover
Shawsheen River	SH09	MA 83-03	Upstream of Central Street, Andover.
Shawsheen River	SH09A	MA 83-03	Upstream of Brook St. (near Shawsheen Rd.), Andover.
Shawsheen River	SH10	MA 83-03	Downstream of Route 28, Andover.
Shawsheen River	SH11	MA 83-03	Downstream of Route 114, Salem Turnpike, North Andover/Lawrence
Shawsheen River	SH12	MA 83-03	Adjacent (south) to Merrimack Street, just upstream of route 495 crossing where Shawsheen River goes underground.
Strong Water Brook	SW01	MA 83-07	Upstream from Shawsheen Street, Tewksbury approximately 100 feet from confluence with Shawsheen River
Vine Brook	VB01	MA 83-06	Upstream of Burlington Road (Route 62), Bedford.

Conditions prior to each survey were characterized by analyzing precipitation and streamflow data.

Two weather station precipitation gages, USGS – Hanscom Field and NWS-Lawrence, MA were used to determine precipitation and weather conditions for the five days prior to and including the sampling dates.

Discharge (hereinafter referred to as streamflow) data were obtained from two continuous USGS stream gages on the Shawsheen River - No. 01100568 at Hanscom Field near Bedford, and No. 01100600 near Wilmington (Figure A1). Streamflow statistics for these gages are available from USGS (Wandle Jr., S.W. *et al.* 1984, USGS 1998 and Socolow *et al.* 2000). The periods of record (POR) for the gages are: Shawsheen River at Hanscom Field; October 1995 to the present; and Shawsheen River near Wilmington; November 1963 to the present.

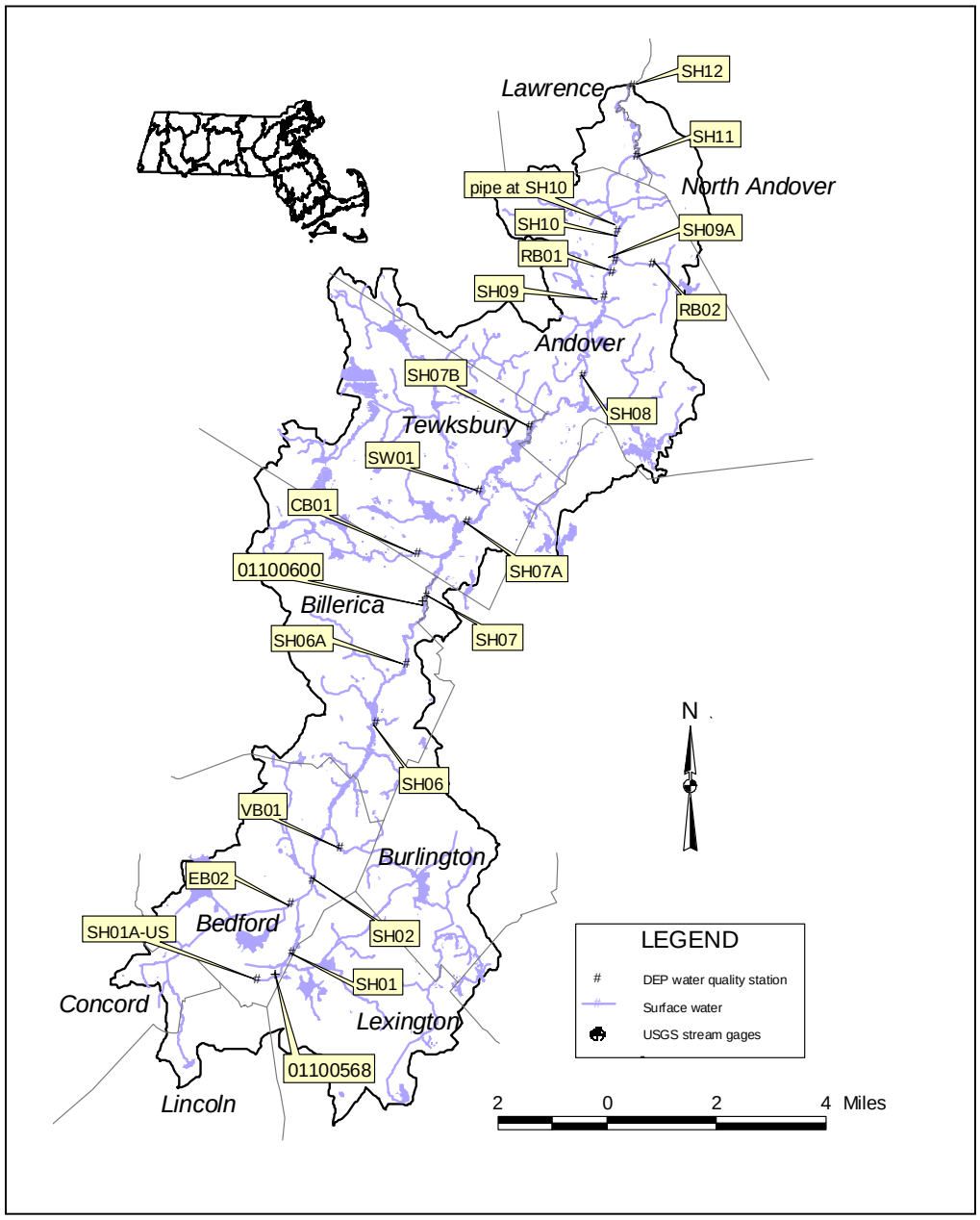


Figure A1. Location of 2000 DEP water quality sampling stations and USGS gaging stations in the Shawsheen River Watershed.

PRECIPITATION AND DISCHARGE DATA

To fulfill the assessment guidance, information on precipitation (Table A2) and stream discharge (Table A3) were analyzed to estimate hydrological conditions during the water quality sampling events. This review was conducted to estimate the streamflow condition in relation to the 7-day, 10-year (7Q10) low flow. Additionally, this review was used to determine whether the fecal coliform bacteria data were representative of "wet" or "dry weather" sampling conditions. Survey conditions are described below for each DWM sampling event reviewed for the assessment.

August 29, 2000: This survey was conducted during and following relatively dry weather (Table A2). Streamflow at both USGS gages (Table A3) was below the monthly averages for their respective periods

of record. Daily streamflow values for the Shawsheen River at Wilmington were six times higher than the 7-day, 10-year (7Q10) low flow estimate five days prior to the survey and decreased steadily to a value three times higher than 7Q10 on the actual sampling date. Data collected during this survey are interpreted as being representative of dry weather conditions.

September 18, 2000: While little or no rain fell on the sampling date or up to two days previously, over one inch of rain was recorded at both precipitation gages three days prior to the sampling date (Table A2, Figure A2). As depicted in Table A3 the streamflow at the two USGS gages responded to this precipitation. Due to its headwater location and the expansive impervious cover associated with Hanscom Field, mean streamflow at the Hanscom Field gage on the day of the rain event was seven times higher than that of the previous day, yet returned to pre-storm flow conditions by the following day. Subsequent daily mean flow values remained below the September 2000 monthly average up to and including the sampling date.
Therefore, data obtained from small tributaries and headwater stations in the main stem Shawsheen River (i.e., SH01 and SH02) can be considered representative of dry-weather conditions.

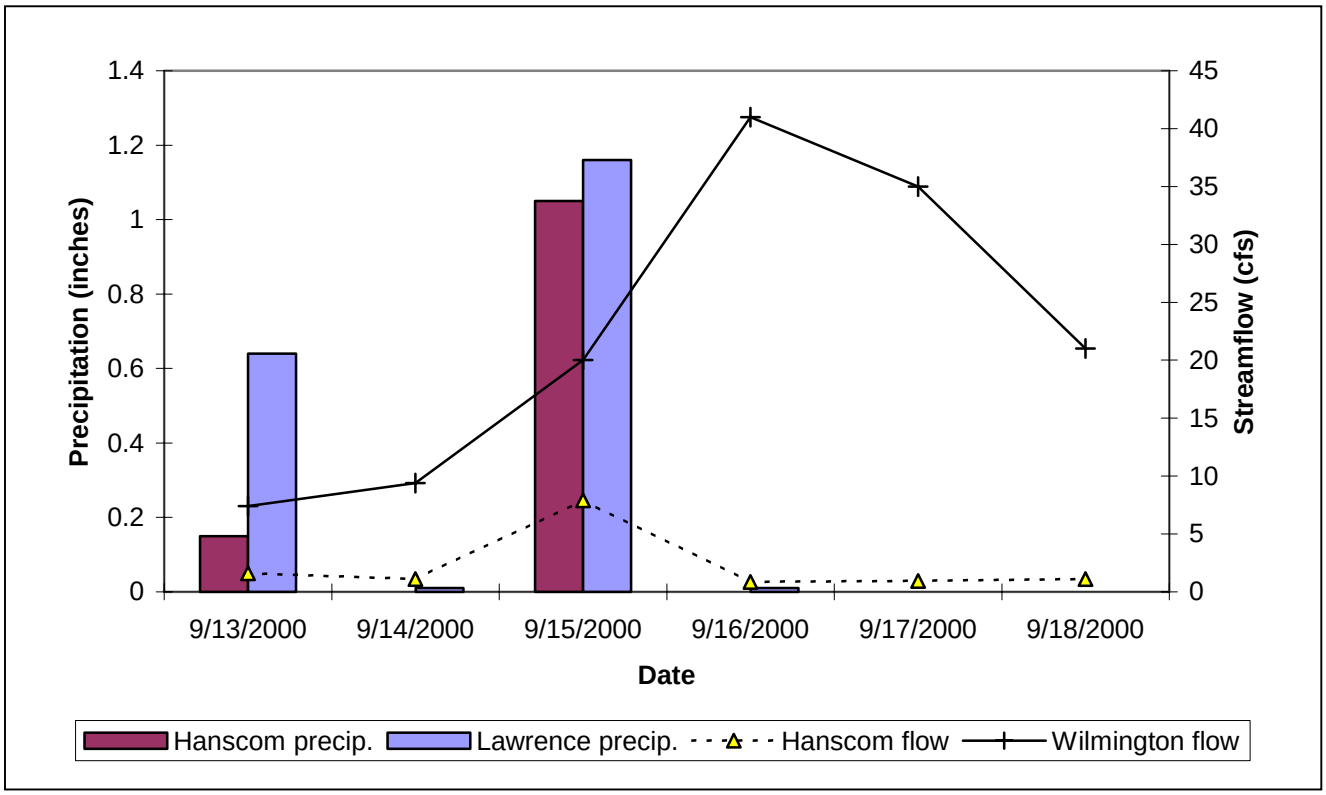
The hydrograph representing the same time period at the Wilmington gage was characterized by a flood peak three times higher than pre-storm streamflow values on the day following the rainfall event. While decreasing daily, the streamflow remained more than twice the pre-storm value on the sampling date. Streamflow was approximately three times the 7-day, 10-year (7Q10) low flow estimate prior to the storm and increased to a value 18 times the 7Q10 on the day after the rain event. Data from the main stem Shawsheen River at and downstream from station SH06 (interpreted with caution) are considered as being representative of wet weather conditions.

Table A2. 2000 Shawsheen River Watershed Survey Precipitation Data Summary.

Precipitation Data Summary (reported in inches of rain)						
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date
USGS gage at Hanscom Field near Bedford, MA. (Socolow *et al*. 2001)						
8/29/00	.01	.00	.00	.00	.00	.00
9/18/00	.15	.00	1.05	.00	.00	.00
National Weather Service at Lawrence, MA. (unofficial NWS data at http.//tgsv5.nws.noaa.gov/er/box/clstns.htm)						
8/29/00	0.01	0.00	0.01	T*	0.00	0.00
9/18/00	0.64	0.01	1.16	0.01	0.00	0.00

Table A3. 2000 Shawsheen River Watershed Survey Flow Data Summary (Socolow *et al*. 2001).

USGS Flow Data Summary (reported in cfs)								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	Period of Record Monthly Mean
Shawsheen River at Hanscom Field near Bedford, MA. Gage #01100568								
8/29/00	1.1	.45	.86	1.3	1.7	1.8	1.26	1.90
9/18/00	1.6	1.1	7.9	.85	.94	1.1	1.45	3.66
Shawsheen River near Wilmington, MA. (Provisional 7Q10 = 2.306 cfs (USGS 1998)) Gage #01100600								
8/29/00	13	12	9.7	8.7	8.0	7.8	17.8	21.8
9/18/00	7.4	9.4	20	41	35	21	14	21.8



WATER QUALITY DATA

Raw data files, field sheets, lab reports and chain of custody (COC) records are stored in open files at the Division of Watershed Management (DWM) in Worcester. All DEP DWM water quality data is managed and maintained in the *Water Quality Data Access Database*.

Validated fecal coliform data for the Shawsheen watershed are presented in the following tables. Based on thorough data review and validation, there was no need to censor or qualify any of the bacteria data. As expected, ambient field blanks were all less than detection limits. Relative percent difference (RPD) precision estimates for log10 values of field split (duplicate) results were all within acceptance limits.

Table A4. 2000 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
FIELD BLANK			
Station: BLANK			
Description: QAQC: Field Blank Sample			
83-0222	8/29/2000	09:26	<10
83-0233	8/29/2000	11:20	<10
83-0246	9/18/2000	10:07	<5
83-0257	9/18/2000	11:30	<5
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH01A-US, Mile Point: 26			
Description: Drainage culvert from Hanscom Air Force Base, Bedford 3 pipes sampled from left pipe but all connected to same D box			
83-0217	8/29/2000	08:57	360
83-0241	9/18/2000	09:45	500
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH01, Mile Point: 25			
Description: at Summer Street, Bedford on north side of road downstream instream			
83-0218	8/29/2000	09:07	89
83-0242	9/18/2000	09:51	180
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH02, Mile Point: 23.5			
Description: at Page Road, Bedford upstream from center cement bridge structure			
83-0220	8/29/2000	09:33	600
83-0221	8/29/2000	09:33	470
83-0244	9/18/2000	10:06	330
83-0245	9/18/2000	10:07	540
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH06, Mile Point: 19.6			
Description: at Route 3A, Billerica off bridge downstream side			
83-0224	8/29/2000	10:05	380
83-0248	9/18/2000	10:25	200
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH06A, Mile Point: 18			
Description: at Burlington water intake – behind school at Alexander Road, Billerica brick building pump station cement pontoon on river at intake			
83-0225	8/29/2000	10:20	50
83-0249	9/18/2000	10:35	86

Table A4 (cont). 2000 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH07, Mile Point: 16.2			
Description: at USGS Gage, (Salem Road/Route 129 (Shawsheen Avenue)), Billerica/Wilmington off bridge downstream side.			
83-0226	8/29/2000	10:30	490
83-0250	9/18/2000	10:40	4,000
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH07A, Mile Point: 13.9			
Description: at Route 38, Tewksbury on bridge downstream side			
83-0228	8/29/2000	10:45	120
83-0252	9/18/2000	11:00	110
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH07B, Mile Point: 10.2			
Description: approximately 350 meters upstream/southwest of Route 93, Andover/Tewksbury (south of Roullard Circle, Tewksbury)			
83-0230	8/29/2000	11:10	150
83-0254	9/18/2000	11:20	110
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH08A, Mile Point: 8.1			
Description: Off the upstream side of Ballardvale Dam (approximately 300 feet downstream of Andover Street), Andover			
83-0231	8/29/2000	11:22	99
83-0232	8/29/2000	11:22	200
83-0255	9/18/2000	11:30	140
83-0256	9/18/2000	11:30	140
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH09, Mile Point: 6.2			
Description: at Central Street, Andover upstream from bridge			
83-0234	8/29/2000	11:30	89
83-0258	9/18/2000	11:40	110
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH09A, Mile Point: 5.3			
Description: Brook St. (near Shawsheen Rd.), Andover upstream off bridge			
83-0235	8/29/2000	11:35	180
83-0259	9/18/2000	11:45	110

Table A4 (cont). 2000 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH10, Mile Point: 4.8			
Description: at Route 28, Andover on bridge downstream side			
83-0238	8/29/2000	11:56	300
83-0262	9/18/2000	12:03	670
Pipe/Discharge to SHAWSHEEN RIVER (Saris: 8349000)			
Station: pipe@SH10, Mile Point: 4.79			
Description: pipe discharging to Shawsheen River, approximately 80 feet downstream/northeast of Main Street (Route 28), Andover. (from right bank looking downstream from bridge)			
83-0265	9/18/2000	12:03	9,800
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH11, Mile Point: 2.7			
Description: at Route 114, Salem Turnpike, on downstream side of bridge, North Andover/Lawrence			
83-0239	8/29/2000	12:08	970
83-0263	9/18/2000	12:10	15,000
SHAWSHEEN RIVER (Saris: 8349000)			
Station: SH12, Mile Point: 0.3			
Description: at Merrimack Street, Lawrence from north bank long rope to sample side of river approximately 30-40 feet above right where river goes underground			
83-0240	8/29/2000	12:15	680
83-0264	9/18/2000	12:30	190
ROGERS BROOK (Saris: 8349050)			
Station: RB02A, Mile Point: 1.3			
Description: Just downstream of Morton Street, Andover			
83-0237	8/29/2000	11:46	<10
83-0261	9/18/2000	11:55	9,600
ROGERS BROOK (Saris: 8349050)			
Station: RB01A, Mile Point: 0.11			
Description: Approximately 550 feet upstream from confluence with Shawsheen River, Andover.			
83-0236	8/29/2000	11:40	7,500
83-0260	9/18/2000	11:49	10,000
STRONG WATER BROOK (Saris: 8349075)			
Station: SW01, Mile Point: 0.01			
Description: at Shawsheen Street, Tewksbury from bridge upstream side approximately 100 feet from confluence			
83-0229	8/29/2000	10:55	50
83-0253	9/18/2000	11:10	90

Table A4 (cont). 2000 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
CONTENT BROOK (Saris: 8349150)			
Station: CB01, Mile Point: 0.5			
Description: upstream/west at Beech Street, Tewksbury			
83-0227	8/29/2000	10:37	190
83-0251	9/18/2000	10:50	110
VINE BROOK (Saris: 8349275)			
Station: VB01, Mile Point: 0.6			
Description: at route 62, Bedford upstream side of bridge (standing on cement? Steel? pipe culvert			
83-0223	8/29/2000	09:45	20
83-0247	9/18/2000	10:14	130
ELM BROOK (Saris: 8349375)			
Station: EB02, Mile Point: 0.02			
Description: at Great Road, Routes 4 & 225, Bedford on bridge upstream wooden foot path next to bridge			
83-0219	8/29/2000	09:18	470
83-0243	9/18/2000	10:01	380

While DWM is generally confident in these bacteria data, the level of effort (two surveys) is inadequate for a proper 305(b) assessment. These data can be used, however, for comparative evaluation to historical data and may help to identify problem areas requiring additional, more definitive monitoring.

REFERENCES

MA DEM. 1998. Open File. *Monthly Precipitation Report.* Commonwealth of Massachusetts, Executive Office of Environmental Affairs, Department of Environmental Management. Boston, MA.

MA DEP. 1995, January Draft. *Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Senator William X. Wall Experiment Station. Lawrence, MA.

MA DEP. 1998a. *Commonwealth of Massachusetts Summary of Water Quality 1998.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999a. CN 1.0 *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure*. 25 October 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2000. Open File. *PALIS updates.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Watershed Planning and Permitting Program, Worcester, MA.

Socolow, R.S., J.S. Whitley, Domenic Murino, Jr., and L.R. Ramsbey. 2001. *Water Resources Data for Massachusetts and Rhode Island, Water Year 2000*. U.S. Geological Survey Report MA-RI-00-1. Water Resources Division. Northborough, MA.

USGS. 1998. Unpublished Data. *Provisional low-flow frequency statistics for gaging stations (3.5" floppy disc).* United States Geological Survey, Water Resources Division. Marlborough, MA.

Wandle Jr., S.W. and R.A. Fontaine. 1984. *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts—Merrimack River Basin*. U.S. Geological Survey Water-Resources Investigations Report 84-4284. Boston, MA

MA DEP. 2001. CN 56.0 *DWM Data Validation Standard Operating Procedure .* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2003. CN 83.0 2000 *Data Validation Report .* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

APPENDIX A: 2000 Data Symbols and Qualifiers *(excerpted from CN 83.0)*

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and Hydrolab® 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, including the magnitude or extent of the problem(s).

General Symbols (applicable to all types):

" ** " = Censored or missing data (i.e., data that should have been reported)

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

" **<mdl** " = Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (e.g. <0.2).

Hydrolab®-specific Qualifiers:

" i " = **i**naccurate readings from Hydrolab® multiprobe 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.

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 "** = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" **s "** = field **s**heet recorded data were used to accept data, not data electronically recorded in the Hydrolab® surveyor unit, due to operator error or equipment failure.

" **u "** = **u**nstable 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 **c**alibration 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.

" **?** " = Light interference on Turbidity sensor (Hydrolab® error message). Data is typically censored.

Sample-specific Qualifiers:

" a " = **a**ccuracy 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** " = **b**lank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).

" **d** " = precision of field **d**uplicates (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** " = **f**requency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

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

" **p** " = samples not **p**reserved per SOP or analytical method requirements.

" **r** " = samples collected may not be **r**epresentative of actual field conditions, based on documented or suspected field sampling error, or inexplicable or improbable ("outliers") values.

APPENDIX B- 2000 MA DEP DWM BASELINE LAKE SURVEYS IN THE SHAWSHEEN RIVER WATERSHED

In the Shawsheen River Watershed, baseline lake surveys were conducted as part of the TMDL development between July and September 2000 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Long Pond, Tewksbury and Fosters Pond, Andover were sampled three times each (monthly intervals).

- The deep hole in the western lobe of Fosters Pond, Andover, was sampled 11 July , 8 August, and 12 September 2000.
- A second site at the northern end (central lobe) of Fosters Pond was sampled 12 September 2000.
- The deep hole at the center of Long Pond, Tewksbury was sampled 11 July , 8 August, and 12 September 2000.

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 creating profiles. In-lake (as well as unnamed tributary) 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* (MA DEP 1999a and MA DEP 1999b). The Wall Experiment Station (WES), the Department'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* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES Standard Operating Procedure (SOP). Both quality control samples (field blanks, trip blanks, and split samples) and raw water quality samples were transported on ice to WES on each sampling date; they were subsequently analyzed according to the WES SOP. Information about data quality objectives (accuracy, precision, detection limits, holding times, representativeness and comparability) is also presented in Appendix A. Apparent color and chlorophyll *a* were measured according to standard procedures at the MA DEP DWM office in Worcester (MA DEP 1999c and MA DEP 1999d). An aquatic macrophyte survey was conducted at each lake. The aquatic plant cover (native and non-native) and species distribution was mapped and recorded. Details on procedures used can be found in the *Baseline Lake Survey Quality Assurance Project Plan* (MA DEP DWM 1999e).

Data was excerpted from the *Baseline Lake Survey 2000 Technical Memo* and presented in tables B1 and B2.

> Several ponds, particularly seepage ponds with boarding wetlands exhibited high apparent color and in some cases, exhibited extremely high total phosphorus concentrations. Long Pond in Tewksbury had a surface TP concentration of 0.4 mg/l (extremely high). Potential nutrient sources around this lake were further investigated and a trailer park with a failing septic system was identified as a potential source of nutrients.

Table B1. 2000 DWM Shawsheen River Watershed *in-situ* Hydrolab® lake data.

Date	OWMID	Time (24hr)	Depth (m)	Temp (C)	pH (SU)	Cond@ 25C (uS/cm)	TDS (mg/l)	DO (mg/l)	SAT (%)
Fosters Pond (Palis: 83005)									
Station A : deep hole in western lobe of pond, Andover									
7/11/2000	LB-0610	11:15	0.5	24.0	6.8	272	174	8.0	93
8/8/2000	LB-0704	13:50	0.5	26.2	7.3c	267	171	9.4	115
		13:58	1.0	26.0	7.2c	267	171	9.3	113
		14:04	1.5	24.3u	6.4	270	173	4.8	57
		14:10	2.0	22.1u	6.2	268	171	1.3	15
		14:17	2.4	21.6	6.1	269	172	0.5	6
		14:27	3.0	20.7u	6.2	279	179	<0.2	<2
Fosters Pond (Palis: 83005)									
Station: B: northern end of central lobe of pond, Andover									
9/12/2000	LB-0794	13:15	0.5	22.2u	6.5	302	193	6.4	72
		13:21	1.5	20.5	6.1	301	193	2.7	29
		13:30	2.5	18.7u	6.1	306	196	0.8u	8u
		13:34	3.5	15.7u	6.2	332	213	<0.2	<2
		13:37	4.5	11.1	7.0	503	322	<0.2	<2
		13:41	4.8	10.7	7.1c	519	332	<0.2	<2
Long Pond (Palis: 83010)									
Station: A: deep hole center of pond, Tewksbury									
7/11/2000	LB-0606	14:24s	0.5s	23.7s	6.7s	276s	177s	6.0s	69s
		14:31s	1.5s	22.1s	6.3s	282s	180s	0.7s	7s
		14:38s	1.8s	21.0s	6.4s	311s	199s	<0.2s	<2s
	LB-0880	14:43s	1.8s	21.0s	6.4s	313s	197s	<0.2s	<2s
		14:48s	1.5s	22.2s	6.3s	280s	180s	0.6s	7s
		14:54s	0.5s	24.2s	6.8s	275s	176s	**su	**su
8/8/2000	LB-0700	11:30	0.5	24.2u	6.4u	262	167	**u	**u
		11:39	1.0	22.8u	6.2	263	169	<0.2	<2
		11:46	1.5	20.9	6.2	280	179	<0.2	<2
9/12/2000	LB-0787	10:29	0.5	22.0	7.2c	301	193	9.4	105
		10:37	1.0	21.9	7.0	302	193	8.8	98
		10:47	1.6	19.4u	6.3	309u	198u	<0.2	<2

" ** " = Censored or missing data

" 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.)

" s " = field sheet recorded data were used to accept data, not data electronically recorded in the Hydrolab® surveyor unit, due to operator error or equipment failure.

" 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).

Table B2. 2000 DWM Shawsheen River Watershed inlake Secchi depth, alkalinity, color, total phosphorus and chlorophyll *a* data.

Date	Time (24hr)	Secchi Depth (m)	Station Depth (m)	OWMID	OWMID QA/QC	Sample Depth (m)	Alkalinity (mg/l)	Total Phosphorus mg/l	Color (PCU)	Chlorophyll *a* (mg/m^3)
Fosters Pond (Palis: 83005)										
Station: A: deep hole in western lobe of pond, Andover										
7/11/2000	10:45	1.5	3.4	LB-0607	**	0.5	17	0.041	65	--
				LB-0608	**	2.9	23	0.053	** m	--
				LB-0609	**	0 - 2.9	--	--	--	8.8
8/8/2000	13:00	2.1	3.4	LB-0701	**	0.5	18	0.029	47	--
				LB-0702	**	**m	25m	0.063m	100m	--
				LB-0703	**	0 - 2.8	--	--	--	7.6
9/12/2000	14:15	2.2	**	LB-0798	**	0.5	--	0.025	--	--
Fosters Pond (Palis: 83005)										
Station: B: northern end of central lobe of pond, Andover										
9/12/2000	13:50	2.8	5.3	LB-0795	**	0.5	23	0.013	46	--
				LB-0796	**	4.8	54	0.083	400	--
				LB-0797	**	**m	--	--	--	35.7 m
Long Pond (Palis: 83010)										
Station: A: deep hole center of pond, Tewksbury										
7/11/2000	14:05	0.7	2.3	LB-0601	LB-0602	0.5	25	0.41	200	--
				LB-0602	LB-0601	0.5	25	0.41	200	--
				LB-0603	BLANK	--	<2	<0.005	<15	--
				LB-0604	**	0 - 1.8	--	--	--	37.5
				LB-0605	**	1.8	29	0.57	250	--
8/8/2000	11:55	0.6	2.0	LB-0694	LB-0695	0.5	24	0.38	240	--
				LB-0695	LB-0694	0.5	24	0.39	260	--
				LB-0696	DUP**	0.5	24	0.40	230	--
				LB-0697	**	**m	25m	0.35 m	180m	--
				LB-0698	BLANK	--	<2	<0.005	<15	--
				LB-0699	**	0 - 1.5	--	--	--	29.9 h
9/12/2000	11:41	0.6	2.1	LB-0788	BLANK	--	<2	<0.005	<15	--
				LB-0789	LB-0790	0.5	26	0.39	80d	--
				LB-0790	LB-0789	0.5	26	0.42	** d	--
				LB-0791	DUP	0.5	27	0.38	70	--
				LB-0792		1.6	27	0.39	80	--
				LB-0793		**m	--	--	--	13.5 m

" ** " = Censored or missing data
" -- " = No data
" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected
" 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 (e.g. sediment in sample, floc formation), lab error (e.g., cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.

Table B3. 2000 DWM Shawsheen River Watershed inlake physico-chemical QA/QC field replicate data.

Date	OWMID	QA/QC	Sample Depth (m)	Alkalinity (mg/l)		Total Phosphorus (mg/l)	Color (PCU)	Chlorophyll *a* (mg/m^3)
Long Pond (Palis: 83010)								
Station: A: deep hole center of pond, Tewksbury								
7/11/00	LB-0601	LB-0602	0.5	25		0.41	200	--
7/11/00	LB-0602	LB-0601	0.5	25		0.41	200	--
Relative	***Percent Difference***			***0.0%***	***0.0%***	***0.0%***		
8/8/00	LB-0694	LB-0695	0.5	24		0.38	240	--
8/8/00	LB-0695	LB-0694	0.5	24		0.39	260	--
Relative	***Percent Difference***			***0.0%***	***2.6%***	***8.0%***		
9/12/00	LB-0789	LB-0790	0.5	26		0.39	80d	--
9/12/00	LB-0790	LB-0789	0.5	26		0.42	** d	--
Relative	***Percent Difference***			***0.0%***	***7.4%***			

" ** " = Censored or missing data

" -- " = No data

" **d** " = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected

REFERENCES

MA DEP. 1995 January Draft. *Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis. Wall Experiment Station, Lawrence, MA.

MA DEP. 1999a. CN 1.0 *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure*. October 25, 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999b. CN 4.0 *Hydrolab® Series 3 Multiprobe, Standard Operating Procedure*. September 23, 1999. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999c. CN 2.0 *Apparent Color Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999d. CN 3.0 *Chlorophyll a Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 1999e. *Baseline Lake Survey Quality Assurance Project Plan.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2000. CN 161.0. *Baseline Lake Survey 2000 Technical Memo.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

APPENDIX C- MA DEP OWM/DWM FISH TOXICS MONITORING IN THE SHAWSHEEN RIVER WATERSHED 1995, 1999, AND 2000

INTRODUCTION

Fish toxics monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection Offices/Divisions- Watershed Management (MA DEP DWM), Research and Standards (ORS), and Environmental Analysis, the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE), and the Massachusetts Department of Public Health (MDPH). Fish toxics monitoring is typically conducted to assess the concentrations of toxic contaminants in freshwater fish, identify waterbodies where those concentrations may pose a risk to human health, and identify waters where toxic contaminants may impact fish and other wildlife.

Fish toxics monitoring in the Shawsheen River Basin was conducted by MA DEP DWM personnel in 1995 in the Shawsheen River at Ballardvale Impoundment (also known as Lowell Junction Pond) in Andover.

A directed fish toxics study was performed by the DEP ORS and DWM during 1999 at Ames Pond, Tewksbury and Pomps Pond, Andover.

In 2000, fish toxics monitoring was conducted by MA DEP DWM on Round Pond, Tewksbury and Fosters Pond, Andover.

PROJECT OBJECTIVES

Fish tissue 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, Polychlorinated biphenyls (PCBs) and chlorinated pesticides. In 2000, MA DEP DWM Fish Toxics Monitoring was conducted under an EPA-approved Fish Toxics Quality Assurance Project Plan CN 0037.0. Data Quality Objectives are presented in the above-mentioned QAPP. There were no deviations from the QAPP

A directed study of fish in lakes in northeastern Massachusetts was performed by the DEP ORS during 1999 in order to examine possible spatial patterns in the occurrence of higher fish mercury concentrations and to compare the fish contamination situation in this localized geographic region to statewide and regional data (MA DEP 2000). Northeastern Massachusetts has an important history of industrialization dating back into the nineteenth century with the extensive burgeoning of mills along the Merrimack River. Most of this industry is now gone and the infrastructure for the mills is now slowly being converted to non-manufacturing uses. Many of the older, larger towns are relatively densely populated areas, yet surrounding lands are relatively undeveloped. This region was recently identified through the use of an air deposition model as having the highest predicted annual levels of recent wet and dry atmospheric deposition of mercury in the state. The area has the state's largest concentration of point sources of atmospheric mercury emissions: three municipal solid waste incinerators and a medical waste incinerator. Zones downwind from major point sources may be subject to increased deposition of a variety of contaminants. While historic records of atmospheric mercury deposition in this area do not exist, past widespread burning of coal for domestic heat and industrial boilers in the late nineteenth and first half of the twentieth centuries probably contributed to a relatively high background mercury signature in the environment of this part of the state.

The objectives of the study were to:

6) sample fish from many lakes in northeastern MA where fishing takes place in order to determine if fish consumption advisories are needed for those lakes;

7) determine whether the frequency of advisories is greater in this area than across the state as a whole;

8) determine if there are any spatial patterns in fish mercury concentrations within the study area related to the locations of the major point sources of mercury emissions;

9) determine how well measured mercury concentrations match those predicted by a fish tissue mercury prediction model developed by MA DEP;

10) compare mercury concentrations in fish from the region with those from other parts of Massachusetts.

The lakes sampled in this study were chosen on the basis of the following: size of lake (4 hectares minimum size), availability of fish species, fishing pressure, access, and proximity to other lakes. Two lakes in the Shawsheen River Basin selected for inclusion in this study were sampled by DWM in cooperation with ORS: Ames Pond, Tewksbury and Pomps Pond, Andover.

METHODS

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing, and shipping fish collected for the fish toxics monitoring. In 1995 fish were collected on 21 and 28 September 1995 in the Shawsheen River at Ballardvale Impoundment (also known as Lowell Junction Pond) in Andover. On 6 September 2000, fish were collected from Round Pond, Tewksbury using gillnets and trotlines set overnight. Fosters Pond in Andover was sampled using boat-mounted electroshocking gear on 4 August 2000. Additionally, Ames Pond, Tewksbury and Pomps Pond, Andover were sampled in 1999 for toxics in fish tissue as part of an ORS research project.

Fish selected for analysis were placed in an ice filled cooler and brought back to the OWM/DWM laboratory for processing. Processing included measuring lengths and weights and visually inspecting fish for tumors, lesions, or other indications of stress or disease. Scales, spines, or pectoral fin ray samples were obtained from each sample to determine the approximate age of the fish. Fish were filleted (skin off) with stainless steel knives on glass cutting boards.

1995 FISH TOXICS

Field methods

In 1995 and 2000 uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish. The characteristics of each site determine the method(s) of sample collection. All ponds on Nantucket were sampled using gill nets and all ponds on Martha's Vineyard were sampled by electrofishing and gill netting. Electrofishing is performed by maneuvering a shock boat through the littoral zone and shallow water habitat of the waterbody and collecting stunned fish. Alternatively, gill nets are set in various locations and checked every two hours.

Fish collected were stored in a live well filled with site water until the completion of sampling. After removal from the live well, all fish to be analyzed were stored on ice prior to sample preparation. Live fish, which were not included as part of the sample, were released. Where possible, fish selected for analysis represented species and sizes desired by the angling public for consumption, as well as from different feeding guilds (i.e., top level predator, invertivore, omnivore). Lengths and weights were measured and fish were visually inspected for tumors, lesions, or other indications of stress or disease. Fish included in the sample were processed in the field. Scale samples or pectoral fin spines were obtained from each fish to determine the approximately age of the fish. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed with water to remove slime, scales, and other fluids

such as blood, and then re-rinsed in demonized water before (and/or after) each sample. Composite fillet samples targeted for metals analysis were placed in VWR 32-ounce high-density polyethylene (HDPE) cups with covers. The opposite fillets were wrapped in aluminum foil for % lipid, PCB and organochlorine pesticide analyses. Samples were tagged and frozen for subsequent delivery to the MA DEP's Wall Experiment Station (WES). Additional details related to the collection, handling, and processing of samples in 2000 are presented in the report entitled *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys*.

Laboratory methods

In 1995 methods used at WES for analyzing metals include the cold vapor method using a VGA hydride generator for mercury. Varian 1475 flame atomic absorption was used for all remaining metals (arsenic, cadmium, lead, and selenium). PCB/organochlorine pesticides analyses were performed on a gas chromatograph equipped with an electron capture detector. (Maietta 1995). Additional information on analytical techniques used at WES is available from the laboratory.

In 2000 methods used at WES for analyzing metals include the cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy for mercury. Cadmium and lead were analyzed using a Perkin Elmer, Optima 3000 XL ICP – Optical Emission Spectrophotometer (MA DEP 1995a). Arsenic and selenium were analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace. Atomic Absorption Spectrophotometer PCB/organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector (Maietta and Colonna-Romano 2000). Additional information on analytical techniques used at WES is available from the laboratory.

1999 ORS STUDY

Fish were collected between 14 April and 26 May using box nets, gill nets, trot lines, electroshocking, and rod and reel. Fish were removed from the water, rinsed with ambient water, wrapped individually in aluminum foil, placed in polyethylene bags and placed on ice for delivery to the laboratory within 24 hours of collection (MA DEP 2002). Fish tissue was analyzed for mercury according to EPA procedures.

RESULTS

The results of MA DEP Shawsheen River Basin fish toxics monitoring surveys are described below for each sampling event (MA DEP 1995b, MA DEP 2000, and Maietta and Colonna-Romano 2000). Data for all surveys are presented in Table B1 and B2 and sampling locations are depicted in Figure B1. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in databases at the MA DEP Division of Watershed Management office in Worcester. Quality Assurance Data is available in *Data Validation Report for Year 2000 Project Data (CN 083.0) DRAFT December 19, 2002*.

1995 FISH TOXICS

Ballardvale Impoundment

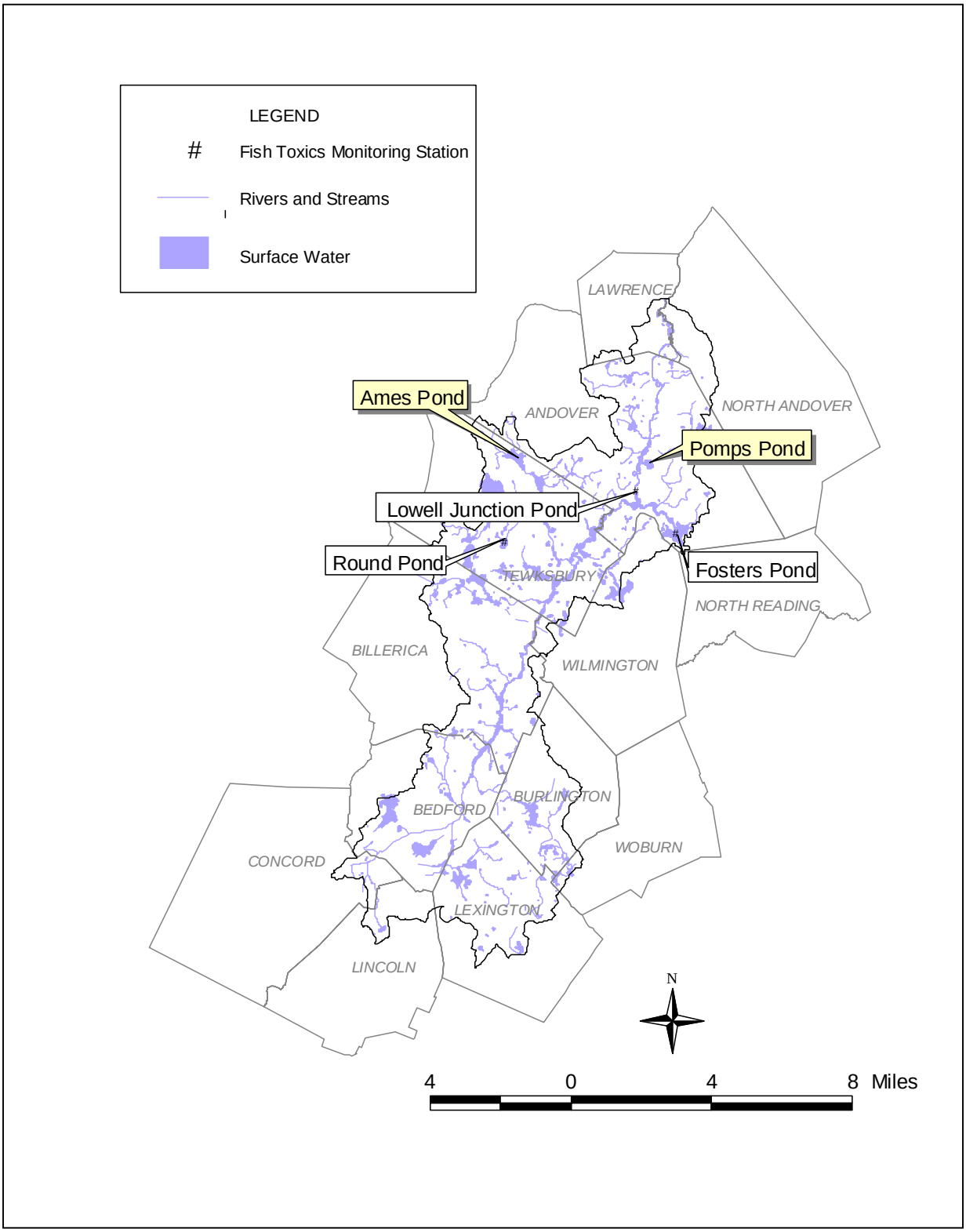
Samples of American eel (*Anguilla rostrata*), black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), white sucker (*Castomus commersoni*), yellow bullhead (*Ameiurus natalis*), and yellow perch (*Perca flavescens*) were collected from Ballardvale Impoundment on 21 and 28 September 1995 and retained for analysis at the Wall Experiment Station. Three-fillet composites of white sucker, large mouth bass, yellow perch, and American eel were analyzed for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB arochlors and congeners, and pesticides. Additionally a two-fillet composite of yellow bullhead and an individual large mouth bass sample were also analyzed for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB arochlors and congeners, and pesticides.

Mercury in the fish tissue ranged from BDL (below detection limit) to 0.670 mg/kg wet weight. The mercury data triggered a site-specific advisory against the consumption of fish from Ballardvale Impoundment:

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat largemouth bass and black crappie from this water body."
2. "The general public should limit consumption of largemouth bass and black crappie from this water body to two meals per month."

Selenium levels ranged from 0.101 to 0.297 mg/kg wet weight. Arsenic concentrations ranged from BDL to 0.075 mg/kg we weight. PCB arochlors and congeners, pesticides, cadmium, and lead were not detected in the edible fillets of all samples analyzed from Ballardvale Impoundment.

Figure C1. Shawsheen River Watershed Fish Toxics Sampling Locations.



1999 FISH TOXICS

Ames Pond

The mercury data triggered a site-specific advisory against the consumption of fish from Ames Pond:

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat largemouth bass from this water body."
2. "The general public should limit consumption of largemouth bass to two meals per month."

Pomps Pond

The mercury data triggered a site-specific advisory against the consumption of fish from Pomps Pond:

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body."
2. "The general public should not consume any largemouth bass from this waterbody."
3. "The general public should limit consumption of non-affected fish from this water body to two meals per month."

2000 FISH TOXICS

The results of MA DEP 2000 Shawsheen River Basin fish toxics monitoring surveys described below are excerpted from *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000).

Fosters Pond

This 135-acre pond Shawsheen River Watershed is located in the towns of Andover and Wilmington. Approximately half of the shoreline is developed with both seasonal and year round residences. The overall watershed is heavily developed except for an area located to the southeast of the pond that is forested. The northern arm and coves are almost completely covered with aquatic macrophytes. The main basin is open water but very turbid.

Electrofishing at Fosters Pond in Andover resulted in the collection of three largemouth bass, three chain pickerel, three yellow perch, three white perch, three black crappie, and two brown bullhead. Additional species observed included bluegill, pumpkinseed, common carp, golden shiner, and American eel.

The mercury data triggered a site-specific advisory against the consumption of fish from Fosters Pond The MDPH trigger level for mercury (0.5 mg/kg) was met or exceeded in four of the five samples analyzed. In light of elevated mercury concentrations, the MDPH issued the following fish consumption advisory in February of 2001:

1. "Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from this water body."
2. "The general public should limit consumption of all fish from this water body to two meals per month"

Cadmium, lead, and arsenic were below method detection limits (MDLs) in all samples analyzed and selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth.

PCBs and organochlorine pesticides were below MDLs in six samples analyzed from Fosters Pond.

Round Pond

This 10-acre dystrophic pond is located in the Shawsheen River Watershed in the town of Tewksbury. The watershed is approximately 50% developed. Much of the littoral (approximately 50% of total lake surface area) zone is completely covered by aquatic macrophytes. The water is stained.

Gillnets and trotlines set overnight at Round Pond in Tewksbury resulted in the collection of three brown bullhead, three yellow bullhead, and one largemouth bass. All fish were collected from the trotlines.

While mercury was low in bullhead, it was at the MDPH trigger level (0.5 mg/kg) in an individual largemouth bass. Unfortunately, DWM was unable to collect additional bass samples from this waterbody, and therefore an advisory was not issued.

Cadmium, lead, and arsenic were below MDLs in all samples analyzed and selenium concentrations are consistent with those found in other waterbodies across the Commonwealth

PCBs and organochlorine pesticides were below MDLs in all samples analyzed from Round Pond.

SUMMARY

Fish toxics monitoring in the Shawsheen River Watershed in 1995, 1999, and 2000 resulted in site-specific fish consumption advisories for four of the waterbodies sampled.

While one sample of fish tissue collected from Round Pond, Tewksbury indicated elevated levels of mercury, MDPH does not issue site-specific advisories based on elevated concentrations in individual samples. Additional sampling should be conducted in Round Pond to determine if a site-specific fish consumption advisory is warranted.

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Table C1. 2000 DEP DWM Shawsheen River Watershed fish toxics monitoring data excerpted from *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano. 2000). Results, reported in wet weight, are from individual 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 Arochlors and Congeners (μg/g)	Pesticides (μg/g)
Fosters Pond, Andover													
FPF00-1	8/4/00	LMB	37.7	680	2000021 (L2000255-1)	<0.02	<0.20	0.81	<0.04	0.128	0.59	ND	ND
FPF00-2	8/4/00	LMB	35.0	630									
FPF00-3	8/4/00	LMB	33.1	530									
FPF00-4	8/4/00	CP	38.9	350	2000022 (L2000255-2)	<0.02	<0.20	0.52	<0.04	0.078	0.59	ND	ND
FPF00-5	8/4/00	CP	41.1	390									
FPF00-6	8/4/00	CP	38.2	350									
FPF00-7	8/4/00	YP	25.5	200	2000023 (L2000255-3)	<0.02	<0.20	0.46	<0.04	0.133	0.22	ND	ND
FPF00-8	8/4/00	YP	25.5	200									
FPF00-9	8/4/00	YP	25.9	200									
FPF00-10	8/4/00	WP	21.8	130	2000024 (L2000255-4)	<0.02	<0.20	0.50	<0.04	0.187	0.25	ND	ND
FPF00-11	8/4/00	WP	21.5	140									
FPF00-12	8/4/00	WP	22.3	140									
FPF00-13	8/4/00	BC	24.8	210	2000025 (L2000255-5)	<0.02	<0.20	0.82	<0.04	0.126	0.14	ND	ND
FPF00-14	8/4/00	BC	23.0	160									
FPF00-15	8/4/00	BC	24.0	180									
FPF00-16	8/4/00	BB	29.5	280	2000026 (L2000255-6)	<0.02	<0.20	0.12	<0.04	0.077	0.44	ND	ND
FPF00-17	8/4/00	BB	26.0	200									
Round Pond, Tewksbury													
RPF00-01	9/6/00	BB	36.0	760	2000060 (L2000377-1 metals) (L2000374-1 organics)	<0.02	<0.20	0.080	<0.04	0.09	0.50	ND	ND
RPF00-02	9/6/00	BB	37.5	760									
RPF00-03	9/6/00	BB	32.0	430									
RPF00-04	9/6/00	YB	29.5	440	2000061 (L2000377-2 metals) (L2000374-2 organics)	<0.02	<0.20	0.13	<0.04	0.13	0.94	ND	ND
RPF00-05	9/6/00	YB	32.1	500									
RPF00-06	9/6/00	YB	29.1	360									
RPF00-07	9/6/00	LMB	32.8	430	2000062 (L2000377-3 metals) (L2000374-3 organics)	<0.02	<0.20	0.50	<0.04	0.13	0.12	ND	ND

[1]**Species** (YP) yellow perch *Perca flavescens* (LMB) largemouth bass *Micropterus salmoides* (YB) yellow bullhead *Ameiurus natalis*
(WP) white perch *Morone americana* (CP) chain pickerel *Esox niger*

ND - not detected or the analytical result is at or below the established MDL. See Maietta and Colonna-Romano 2000.

Table C2. Analytical results for 1995 Shawsheen River Basin Fish Toxics Monitoring Year 2 Watershed Surveys. Results, reported in wet weight, are from individual or composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Sample Type[2]	Length (cm)	Weight (g)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids %	PCB Arochlor and Congeners (µg/g)	Pesticides (µg/g)
Ballardvale Impoundment													
BIF95-1	09/21/95	WS	C	40.3	640								
BIF95-2	09/21/95	WS	C	35.5	470	<0.20	<1.00	<0.020	0.075	0.233	0.72	ND[3]	ND
BIF95-3	09/21/95	WS	C	32.1	360								
BIF95-4	09/21/95	LMB	I	40.7	930	<0.20	<1.00	0.630	0.057	0.157	0.06	ND	ND
BIF95-5	09/21/95	YB	C	22.0	130	<0.20	<1.00	0.319	<0.040	0.297	0.16	ND	ND
BIF95-6	09/21/95	YB	C	22.6	150								
BIF95-7	09/28/95	LMB	C	37.2	730								
BIF95-8	09/28/95	LMB	C	34.7	620	<0.20	<1.00	0.670	<0.040	0.101	0.14	ND	ND
BIF95-9	09/28/95	LMB	C	33.7	570								
BIF95-10	09/28/95	BC	C	23.2	170								
BIF95-11	09/28/95	BC	C	24.1	190	<0.20	<1.00	0.567	<0.040	0.142	0.20	ND	ND
BIF95-12	09/28/95	BC	C	24.0	200								
BIF95-13	09/28/95	YP	C	24.9	190								
BIF95-14	09/28/95	YP	C	24.6	160	<0.20	<1.00	0.498	<0.040	0.147	0.17	ND	ND
BIF95-15	09/28/95	YP	C	26.1	210								
BIF95-16	09/28/95	AE	C	50.0	210								
BIF95-17	09/28/95	AE	C	52.0	250	<0.20	<1.00	0.287	<0.040	0.184	3.20	ND	ND
BIF95-18	09/28/95	AE	C	50.3	220								

Notes:

[1] Species
- American eel (AE) *Anguilla rostrata*
- black crappie (BC) *Pomoxis nigromaculatus*
- largemouth bass (LMB) *Micropterus salmoides*
- white sucker (WS) *Castomus commersoni*
- yellow bullhead (YB) *Ameiurus natalis*
- yellow perch (YP) *Perca flavescens*

[2] Sample Type:
- All samples were fillets with skin off
- Composite (C)
- Individual (I)

[3] ND= Not Detected

REFERENCES

MA DEP. 1995a. *Draft Laboratory Quality Assurance Plan and Standard Operating Procedures.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis. Wall Experiment Station. Lawrence, MA.

MA DEP. 1995b. Open File. *1995 Fish Toxics Monitoring Data in the Shawsheen River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2000. *Draft Fish Mercury Concentrations in Northeastern Massachusetts Lakes*. Massachusetts Department of Environmental Protection, Office of Research and Standards, Boston, MA.

MA DEP. 2002. CN 83.0. *Fish Contaminant Monitoring Program, Quality Assurance Project Plan, 2000.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Maietta, R. J. 1995. *1995 Public Request Fish Toxics Monitoring Surveys.* Massachusetts Department of Environmental Protection, Office of Watershed Management. Worcester, MA

Maietta, R. J. and J. Colonna-Romano. 2000. *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

APPENDIX D- 1995 MA DEP DWM WATER QUALITY MONITORING IN THE SHAWSHEEN RIVER WATERSHED

1995 MA DEP Survey Summary - Rivers

Synoptic water quality surveys were conducted in the Shawsheen River Watershed on 21 June, 12 July, 10 August, and 25 October 1995. Samples were taken from the mainstem Shawsheen River, at the discharge points where water flows from the vicinity of Hanscom Field, on Elm Brook, on Roger's Brook, on Vine Brook, and on Strong Water Brook (Table A5).

Conditions prior to each synoptic survey were characterized by analyzing precipitation and streamflow data. The seven-day, ten-year low flow, or 7Q10 (approximately equal to the 99% flow duration) of the Shawsheen River at the USGS gage is 2.46 cfs. In June 1995, there was no rainfall during the five days prior to the 21 June survey . Streamflow at the USGS gage on the 21st was 14 cfs, approximately six times higher than 7Q10 conditions. During July 1995, a total of 0.31 inches of rain fell within the five days prior to the survey. Streamflow was 13 cfs on 12 July approximately five times higher than low flow conditions. Within the five days prior to the August sampling event, 0.76 inches of rain were recorded at the Burlington station. Streamflow at the UGSG gage was recorded at 8.0 cfs, only 3.2 times higher than 7Q10 conditions. Extremely low flow conditions were documented in the Shawsheen River during the rest of August until mid-September 1995. The lowest annual seven day minimum for the period of record at the gage began on 2 September 1995. In October 1995, a large rainstorm (1.96 inches recorded at the Burlington station) occurred four days prior to the survey. Streamflow at the USGS gage on 25 October 1995 was 87 cfs, down from a high of 125 cfs measured on the 23rd.

Table D1. 1995 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
SHAWSHEEN RIVER			
Station: SH01B, Mile Point: 26.6			
Description: at Hanscom School - Hanscom Air Force Base, Lincoln (from footbridge at school upstream - miles calculated from straight line SH01AUS to school)			
83-0001	06/21/95	8:15	330
83-0025	07/12/95	8:04	540
83-0050	08/10/95	8:17	**
83-0091	10/25/95	8:00	220
83-0193	09/26/96	9:00	180
SHAWSHEEN RIVER			
Station: SH01A-US, Mile Point: 26			
Description: Drainage culvert from Hanscom Air Force Base, Bedford 3pipes sampled from left pipe but all connected to same D box			
83-0003	06/21/95	8:25	300
83-0027	07/12/95	8:35	**
83-0052	08/10/95	8:50	**
83-0072	10/25/95	8:35	100
83-0194	09/26/96	9:10	220

* = interference ** = missing/censored data -- = no data

Table D1 (cont). 1995 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
PIPE/DISCHARGE TO SHAWSHEEN RIVER			
Station: SH01A-MA, Mile Point: 25.99			
Description: Drainage culvert from below runway (Massport side), Bedford - discharges into Shawsheen River from sixth pipe from left side of pipe array			
83-0002	06/21/95	8:30	110
83-0026	07/12/95	8:25	**
83-0051	08/10/95	8:25	**
83-0071	10/25/95	8:20	20
83-0195	09/26/96	9:10	<20
SHAWSHEEN RIVER			
Station: SH01, Mile Point: 25			
Description: at Summer Street, Bedford on north side of road downstream instream			
83-0004	06/21/95	8:55	260
83-0028	07/12/95	9:10	470
83-0053	08/10/95	9:30	**
83-0073	10/25/95	8:55	20
83-0197	09/26/96	9:45	40
SHAWSHEEN RIVER			
Station: SH02, Mile Point: 23.5			
Description: at Page Road, Bedford upstream from center cement bridge structure			
83-0006	06/21/95	9:20	520
83-0030	07/12/95	9:56	800
83-0055	08/10/95	10:20	**
83-0075	10/25/95	9:30	300
83-0200	09/26/96	10:25	120
SHAWSHEEN RIVER			
Station: SH06, Mile Point: 19.6			
Description: at Route 3A, Billerica off bridge downstream side			
83-0008	06/21/95	9:50	310
83-0009	06/21/95	9:50	--
83-0032	07/12/95	10:35	160
83-0033	07/12/95	10:35	--
83-0057	08/10/95	11:00	**
83-0077	10/25/95	10:15	320
83-0078	10/25/95	10:15	--
83-0205	09/26/96	11:20	100
SHAWSHEEN RIVER			
Station: SH06A, Mile Point: 18			
Description: at Burlington water intake - behind school at Alexander Road, Billerica brick building pump station cement pontoon on river at intake			
83-0010	06/21/95	10:05	150
83-0034	07/12/95	10:50	110
83-0048	08/10/95	11:15	**
83-0093	10/25/95	10:35	230

* = interference ** = missing/censored data -- = no data

Table D1 (cont). 1995 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
SHAWSHEEN RIVER			
Station: SH07, Mile Point: 16.2			
Description: at USGS Gage, Salem Road/Route 129 (Shawsheen Avenue), Billerica/Wilmington (off bridge downstream side)			
83-0011	06/21/95	10:15	180
83-0035	07/12/95	11:05	140
83-0060	08/10/95	**	**
83-0059	08/10/95	11:35	**
83-0079	10/25/95	10:50	240
83-0206	09/26/96	11:45	40
SHAWSHEEN RIVER			
Station: SH07A, Mile Point: 13.9			
Description: at Route 38, Tewksbury on bridge downstream side			
83-0014	06/21/95	10:30	720
83-0037	07/12/95	11:22	200
83-0049	08/10/95	11:50	**
83-0080	10/25/95	11:00	200
83-0207	09/26/96	12:00	120
SHAWSHEEN RIVER			
Station: SH08, Mile Point: 8.2			
Description: above Ballardvale Dam, off bridge, on downstream side, Andover			
83-0015	06/21/95	11:05	160
83-0039	07/12/95	11:50	150
83-0062	08/10/95	12:35	**
83-0082	10/25/95	11:30	100
83-0209	09/26/96	12:20	40
SHAWSHEEN RIVER			
Station: SH09, Mile Point: 6.2			
Description: at Central Street, Andover upstream from bridge			
83-0016	06/21/95	11:10	100
83-0040	07/12/95	12:00	120
83-0063	08/10/95	12:45	**
83-0083	10/25/95	11:45	120
83-0210	09/26/96	13:30	100
SHAWSHEEN RIVER			
Station: SH09A, Mile Point: 5.3			
Description: Brook St. (near Shawsheen Rd.), Andover upstream off bridge			
83-0017	06/21/95	11:25	450
83-0041	07/12/95	12:10	50
83-0064	08/10/95	12:55	**
83-0084	10/25/95	12:00	90
83-0211	09/26/96	13:45	100

* = interference ** = missing/censored data -- = no data

Table D1 (cont). 1995 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
SHAWSHEEN RIVER			
Station: SH10, Mile Point: 4.8			
Description: at Route 28, Andover on bridge downstream side			
83-0020	06/21/95	12:00	260
83-0044	07/12/95	12:50	270
83-0065	08/10/95	13:55	**
83-0087	10/25/95	12:40	210
83-0214	09/26/96	14:10	80
SHAWSHEEN RIVER			
Station: SH11, Mile Point: 2.7			
Description: at Route 114, Salem Turnpike, on downstream side of bridge, North Andover/Lawrence			
83-0021	06/21/95	12:10	430
83-0045	07/12/95	12:55	470
83-0066	08/10/95	14:10	**
83-0088	10/25/95	12:50	500
83-0215	09/26/96	14:30	280
SHAWSHEEN RIVER			
Station: SH11A, Mile Point: 0.8			
Description: Loring Street, Lawrence			
83-0022	06/21/95	12:20	430
83-0046	07/12/95	13:10	900
83-0067	08/10/95	14:22	**
83-0089	10/25/95	13:00	200
SHAWSHEEN RIVER			
Station: SH12, Mile Point: 0.3			
Description: at Merrimack Street, Lawrence from north bank long rope to sample side of river approximately 30-40 feet above right where river goes underground			
83-0023	06/21/95	12:35	530
83-0047	07/12/95	13:20	960
83-0068	08/10/95	14:40	**
83-0090	10/25/95	13:20	2,500
83-0216	09/26/96	14:40	300

* = interference ** = missing/censored data -- = no data

Table D1 (cont). 1995 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
ROGERS BROOK			
Station: RB02, Mile Point: 1.1			
Description: off Chestnut Street near headwaters, Andover climb off bridge 5 feet downstream sample midstream			
83-0019	06/21/95	11:45	540
83-0043	07/12/95	12:35	520
83-0070	08/10/95	13:35	**
83-0086	10/25/95	12:20	70
83-0213	09/26/96	14:00	220
ROGERS BROOK			
Station: RB01, Mile Point: 0.1			
Description: approximately 200 feet from confluence with Shawsheen River, Andover down north bank rocky stream sample center river			
83-0018	06/21/95	11:35	3,360
83-0042	07/12/95	12:25	3,500
83-0069	08/10/95	13:15	**
83-0085	10/25/95	12:10	1,000
83-0212	09/26/96	13:50	1,300
STRONG WATER BROOK			
Station: SW01, Mile Point: 0.01			
Description: at Shawsheen Street, Tewksbury from bridge upstream side approximately 100 feet from confluence			
83-0013	06/21/95	10:45	280
83-0038	07/12/95	11:35	220
83-0061	08/10/95	12:10	**
83-0081	10/25/95	11:15	80
83-0208	09/26/96	12:10	<20
VINE BROOK			
Station: VBO, Mile Point: 6.1			
Description: at emergence of underground culvert at Grant Street, Lexington.			
83-0192	09/26/96	8:40	6,300
VINE BROOK			
Station: VB02, Mile Point: 6			
Description: at East Street, near Grant Street, Lexington.			
83-0203	09/26/96	10:50	40
VINE BROOK			
Station: VB02A, Mile Point: 2			
Description: at Terrace Hall Avenue near pump station, Burlington.			
83-0204	09/26/96	11:00	160
VINE BROOK			
Station: VB01, Mile Point: 0.6			
Description: at Route 62, Bedford upstream side of bridge (standing on cement? steel? pipe culvert) center stream			
83-0007	06/21/95	9:30	260
83-0031	07/12/95	10:15	290
83-0056	08/10/95	10:40	**
83-0076	10/25/95	9:20	2,800
83-0201	09/26/96	10:45	40

* = interference ** = missing/censored data -- = no data

Table D1 (cont). 1995 MA DEP DWM Shawsheen River Watershed bacteria data.

OWMID	Date	Time (24hr)	FECAL (colonies/100mL)
SPRING BROOK			
Station: SH03, Mile Point: 0.2			
Description: off downstream side of bridge on Rt. 62, Bedford.			
83-0092	10/25/95	**	40
83-0202	09/26/96	10:35	<20
ELM BROOK			
Station: EB03, Mile Point: 0.9			
Description: at South Road, Bedford.			
83-0199	09/26/96	10:10	60
ELM BROOK			
Station: EB02, Mile Point: 0.02			
Description: at Great Road, Routes 4 & 225, Bedford		on bridge upstream	wooden foot path next to bridge
83-0005	06/21/95	9:15	310
83-0029	07/12/95	9:35	500
83-0054	08/10/95	9:55	**
83-0074	10/25/95	9:45	200
83-0198	09/26/96	9:55	120
KILN BROOK			
Station: KB01, Mile Point: 0.4			
Description: at Hartwell Avenue, Lexington.			
83-0196	09/26/96	9:30	80

* = interference ** = missing/censored data -- = no data

Table D2. 1995 MA DEP DWM Shawsheen River Watershed instream physico/chemical data. All units in mg/L unless otherwise noted.

OWMID	Date	Time	Alkalinity	Hardness	Specific Conductivity (umhos)	Chloride	Suspended Solids	Total Solids	Turbidity (NTU)	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Total Phosphorus
SHAWSHEEN RIVER													
Station: SH01B, Mile Point: 26.6													
Description: at Hanscom School - Hanscom Air Force Base, Lincoln (from footbridge at school upstream - miles calculated from straight line SH01AUS to school)													
83-0001	6/21/1995	8:15	48	120	--	--	3.0	346	6.3	0.82	0.30	1.1	<0.05
83-0025	7/12/1995	8:04	44	69	--	104	4.0	--	7.6	0.53	0.22	0.96	<0.05
83-0050	8/10/1995	8:17	54	81	505	--	<2.5	308	3.3	0.95	0.17	0.50	<0.05
83-0091	10/25/1995	8:00	52	121	--	110	5.0	358	8.4	0.79	0.27	1.2	<0.05
83-0193	9/26/1996	9:00	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER													
Station: SH01A-US, Mile Point: 26													
Description: Drainage culvert from Hanscom Air Force Base, Bedford 3pipes sampled from left pipe but all connected to same D box													
83-0003	6/21/1995	8:25	**	**	--	--	**	-8	**	**	**	**	**
83-0027	7/12/1995	8:35	25	37	--	61	<2.5	--	2.4	0.34	0.10	0.60	<0.05
83-0052	8/10/1995	8:50	44	111	540	--	3.0	318	6.8	0.37	0.13	1.0	<0.05
83-0072	10/25/1995	8:35	51	120	--	114	<2.5	338	4.6	0.50	0.20	1.2	<0.05
83-0194	9/26/1996	9:10	--	--	--	--	--	--	--	--	--	--	--
PIPE/DISCHARGE TO SHAWSHEEN RIVER													
Station: SH01A-MA, Mile Point: 25.99													
Description: Drainage culvert from below runway (Massport side), Bedford - discharges into Shawsheen River from sixth pipe from left side of pipe array													
83-0002	6/21/1995	8:30	**	**	--	--	**	-8	**	**	**	**	**
83-0026	7/12/1995	8:25	31	36	--	55	<2.5	--	2.7	0.20	0.03	0.49	<0.05
83-0051	8/10/1995	8:25	33	63	300	--	6.0	189	9.3	0.28	0.02	0.41	0.05
83-0071	10/25/1995	8:20	33	47	--	37	<2.5	146	5.3	0.25	0.12	0.85	<0.05
83-0195	9/26/1996	9:10	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER													
Station: SH01, Mile Point: 25													
Description: at Summer Street, Bedford on north side of road downstream instream													
83-0004	6/21/1995	8:55	47	105	--	--	4.0	346	6.5	1.0	0.36	0.71	<0.05
83-0028	7/12/1995	9:10	30	44	--	86	<2.5	--	5.0	0.55	0.16	0.49	<0.05
83-0053	8/10/1995	9:30	42	95	510	--	3.0	290	6.9	0.43	0.10	0.59	<0.05
83-0073	10/25/1995	8:55	31	80	--	88	3.0	266	3.6	0.67	0.14	0.58	<0.05
83-0197	9/26/1996	9:45	--	--	--	--	--	--	--	--	--	--	--

* = interference ** = missing/censored data -- = no data

Table D2 (cont). 1995 MA DEP DWM Shawsheen River Watershed instream physico/chemical data. All units in mg/L unless otherwise noted.

OWMID		Date	Time	Alkalinity	Hardness	Specific Conductivity (umhos)	Chloride	Suspended Solids	Total Solids	Turbidity (NTU)	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Total Phosphorus
SHAWSHEEN RIVER														
Station: SH02, Mile Point: 23.5														
Description: at Page Road, Bedford upstream from center cement bridge structure														
83-0006		6/21/1995	9:20	37	82	--	--	<2.5	326	10	0.92	0.27	0.56	0.05
83-0030		7/12/1995	9:56	30	36	--	83	<2.5	--	9.8	0.53	0.04	0.04	0.05
83-0055		8/10/1995	10:20	37	95	415	--	<2.5	238	7.4	0.43	0.10	0.59	<0.05
83-0075		10/25/1995	9:30	21	69	--	64	<2.5	226	3.6	0.75	0.07	0.47	<0.05
83-0200		9/26/1996	10:25	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER														
Station: SH06, Mile Point: 19.6														
Description: at Route 3A, Billerica off bridge downstream side														
83-0008	83-0009	6/21/1995	9:50	37	67	--	--	<2.5	206	5.7	0.62	0.06	0.69	<0.05
83-0009	83-0008	6/21/1995	9:50	36	81	--	--	<2.5	270	6.3	0.61	0.06	0.71	0.06
83-0032	83-0033	7/12/1995	10:35	33	42	--	87	<2.5	--	4.8	0.40	<0.02	0.45	0.05
83-0033	83-0032	7/12/1995	10:35	32	42	--	87	<2.5	--	4.8	0.42	<0.02	0.42	0.05
83-0057		8/10/1995	11:00	33	70	360	--	<2.5	216	2.6	0.42	<0.02	0.35	<0.05
83-0077	83-0078	10/25/1995	10:15	19	55	--	54	<2.5	196	1.7	0.72	0.04	0.21	0.05
83-0078	83-0077	10/25/1995	10:15	18	56	--	55	3.0	192	1.7	0.86	0.06	0.21	0.06
83-0205		9/26/1996	11:20	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER														
Station: SH07, Mile Point: 16.2														
Description: at USGS Gage, Salem Road/Route 129 (Shawsheen Avenue), Billerica/Wilmington (off bridge downstream side)														
83-0011		6/21/1995	10:15	35	72	--	--	<2.5	246	3.5	0.53	<0.02	0.73	0.05
83-0035		7/12/1995	11:05	36	38	--	78	<2.5	--	2.7	0.40	<0.02	0.35	<0.05
83-0060	83-0059	8/10/1995	**	31	61	315	--	<2.5	198	1.6	0.31	<0.02	0.26	<0.05
83-0059	83-0060	8/10/1995	11:35	31	65	327	--	<2.5	202	1.7	0.43	<0.02	0.27	<0.05
83-0079		10/25/1995	10:50	1.0	<1.30	--	<1.0	<2.5	-10	0.20	<0.10	<0.02	<0.02	<0.05
83-0206		9/26/1996	11:45	--	--	--	--	--	--	--	--	--	--	--

* = interference ** = missing/censored data -- = no data

Table D2 (cont). 1995 MA DEP DWM Shawsheen River Watershed instream physico/chemical data. All units in mg/L unless otherwise noted.

OWMID	Date	Time	Alkalinity	Hardness	Specific Conductivity (umhos)	Chloride	Suspended Solids	Total Solids	Turbidity (NTU)	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Total Phosphorus
SHAWSHEEN RIVER													
Station: SH08, Mile Point: 8.2													
Description: above Ballardvale Dam, off bridge, on downstream side, Andover													
83-0015	6/21/1995	11:05	36	69	--	--	2.5	230	3.9	0.74	0.13	0.81	<0.05
83-0039	7/12/1995	11:50	31	35	--	69	3.0	--	3.8	0.62	0.08	0.53	<0.05
83-0062	8/10/1995	12:35	29	52	270	--	3.0	168	2.3	0.69	<0.02	0.36	0.05
83-0082	10/25/1995	11:30	17	41	--	44	3.0	138	1.6	0.64	<0.02	0.10	<0.05
83-0209	9/26/1996	12:20	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER													
Station: SH10, Mile Point: 4.8													
Description: at Route 28, Andover on bridge downstream side													
83-0020	6/21/1995	12:00	33	68	--	--	<2.5	268	2.8	0.53	0.03	0.92	<0.05
83-0044	7/12/1995	12:50	35	43	--	88	<2.5	--	2.4	0.39	<0.02	0.56	<0.05
83-0065	8/10/1995	13:55	28	56	285	--	<2.5	158	2.4	0.43	<0.02	0.43	<0.05
83-0087	10/25/1995	12:40	--	--	--	--	--	--	--	--	--	--	--
83-0214	9/26/1996	14:10	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER													
Station: SH11, Mile Point: 2.7													
Description: at Route 114, Salem Turnpike, on downstream side of bridge, North Andover/Lawrence													
83-0021	6/21/1995	12:10	34	71	--	--	3.0	238	3.5	0.71	0.06	0.89	<0.05
83-0045	7/12/1995	12:55	37	43	--	88	2.5	--	2.9	0.47	0.02	0.60	<0.05
83-0066	8/10/1995	14:10	--	--	--	--	--	--	--	--	--	--	--
83-0088	10/25/1995	12:50	15	40	--	43	5.0	150	1.7	0.69	<0.02	0.10	0.05
83-0215	9/26/1996	14:30	--	--	--	--	--	--	--	--	--	--	--
SHAWSHEEN RIVER													
Station: SH12, Mile Point: 0.3													
Description: at Merrimack Street, Lawrence from north bank long rope to sample side of river approximately 30-40 feet above right where river goes underground													
83-0023	6/21/1995	12:35	--	--	--	--	--	--	--	--	--	--	--
83-0047	7/12/1995	13:20	--	--	--	--	--	--	--	--	--	--	--
83-0068	8/10/1995	14:40	--	--	--	--	--	--	--	--	--	--	--
83-0090	10/25/1995	13:20	--	--	--	--	--	--	--	--	--	--	--
83-0216	9/26/1996	14:40	--	--	--	--	--	--	--	--	--	--	--

* = interference ** = missing/censored data -- = no data

Table D2 (cont). 1995 MA DEP DWM Shawsheen River Watershed instream physico/chemical data. All units in mg/L unless otherwise noted.

OWMID	Date	Time	Alkalinity	Hardness	Specific Conductivity (umhos)	Chloride	Suspended Solids	Total Solids	Turbidity (NTU)	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Total Phosphorus
ROGERS BROOK													
Station: RB02, Mile Point: 1.1													
Description: off Chestnut Street near headwaters, Andover climb off bridge 5 feet downstream sample midstream													
83-0019	6/21/1995	11:45	24	56	--	--	<2.5	212	2.2	0.67	<0.02	0.54	<0.05
83-0043	7/12/1995	12:35	34	39	--	82	5.0	--	4.2	0.40	<0.02	0.39	<0.05
83-0070	8/10/1995	13:35	25	57	320	--	<2.5	180	1.0	0.33	<0.02	0.37	<0.05
83-0086	10/25/1995	12:20	15	52	--	62	4.0	174	2.1	0.57	<0.02	0.64	<0.05
83-0213	9/26/1996	14:00	--	--	--	--	--	--	--	--	--	--	--
ROGERS BROOK													
Station: RB01, Mile Point: 0.1													
Description: approximately 200 feet from confluence with Shawsheen River, Andover down north bank rocky stream sample center river													
83-0018	6/21/1995	11:35	37	92	--	--	4.0	360	2.3	0.58	0.05	0.99	<0.05
83-0042	7/12/1995	12:25	49	66	--	156	<2.5	--	1.6	0.58	0.08	0.97	0.05
83-0069	8/10/1995	13:15	38	87	560	--	12	332	23	1.4	<0.02	0.71	0.11
83-0085	10/25/1995	12:10	33	69	--	92	<2.5	238	1.0	0.42	0.05	1.0	<0.05
83-0212	9/26/1996	13:50	--	--	--	--	--	--	--	--	--	--	--
STRONG WATER BROOK													
Station: SW01, Mile Point: 0.01													
Description: at Shawsheen Street, Tewksbury from bridge upstream side approximately 100 feet from confluence													
83-0013	6/21/1995	10:45	--	72	--	--	--	--	--	0.63	0.07	1.1	0.10
83-0038	7/12/1995	11:35	57	44	--	57	<2.5	--	5.3	0.47	0.02	0.66	0.07
83-0061	8/10/1995	12:10	44	66	260	--	<2.5	168	2.7	0.63	<0.02	0.55	0.07
83-0081	10/25/1995	11:15	--	--	--	--	--	--	--	--	--	--	--
83-0208	9/26/1996	12:10	--	--	--	--	--	--	--	--	--	--	--
VINE BROOK													
Station: VB01, Mile Point: 0.6													
Description: at Route 62, Bedford upstream side of bridge (standing on cement? steel? pipe culvert) center stream													
83-0007	6/21/1995	9:30	48	86	--	--	<2.5	242	3.1	0.64	0.07	0.12	0.05
83-0031	7/12/1995	10:15	44	41	--	82	<2.5	--	3.0	0.72	0.13	0.46	0.06
83-0056	8/10/1995	10:40	37	69	345	--	5.0	200	2.4	0.47	<0.02	0.05	0.05
83-0076	10/25/1995	9:20	23	48	--	46	3.0	170	1.3	0.69	0.08	0.04	0.06
83-0201	9/26/1996	10:45	--	--	--	--	--	--	--	--	--	--	--

* = interference ** = missing/censored data -- = no data

Table D2 (cont). 1995 MA DEP DWM Shawsheen River Watershed instream physico/chemical data. All units in mg/L unless otherwise noted.

OWMID	Date	Time	Alkalinity	Hardness	Specific Conductivity (umhos)	Chloride	Suspended Solids	Total Solids	Turbidity (NTU)	Total Kjeldahl Nitrogen	Ammonia	Nitrate	Total Phosphorus
ELM BROOK													
Station: EB02, Mile Point: 0.02													
Description: at Great Road, Routes 4 & 225, Bedford			on bridge	upstream	wooden foot path next to bridge								
83-0005	6/21/1995	9:15	41	89	--	--	<2.5	310	8.8	0.98	0.33	0.60	0.06
83-0029	7/12/1995	9:35	22	35	--	70	<2.5	--	14	0.56	0.12	0.26	0.05
83-0054	8/10/1995	9:55	26	60	540	--	4.0	172	15	0.37	0.01	0.51	<0.05
83-0074	10/25/1995	9:45	10	66	--	47	5.0	223	2.2	0.77	0.03	0.39	<0.05
83-0198	9/26/1996	9:55	--	--	--	--	--	--	--	--	--	--	--

* = interference ** = missing/censored data -- = no data

Table D3. 1995 MA DEP DWM Shawsheen River watershed *in-situ* Hydrolab data.

OWMID	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
SHAWSHEEN RIVER										
Station: SH01B, Mile Point: 26.6										
Description: at Hanscom School - Hanscom Air Force Base, Lincoln (from footbridge at school upstream - miles calculated from straight line SH01AUS to school)										
83-0101	06/21/95	08:27	0.5	14.9	6.9	567	0.4	8.2	81	--
83-0125	07/12/95	09:52	<0.3	16.5	6.8	561	0.4	6.9	70	--
83-0150	08/10/95	09:36	0.3	16.8	7.1	574	0.4	8.3	85	--
83-0191	10/25/95	09:51	<0.3	12.9	6.6	643	0.4	7.7	72	10
SHAWSHEEN RIVER										
Station: SH01A-US, Mile Point: 26										
Description: Drainage culvert from Hanscom Air Force Base, Bedford 3pipes sampled from left pipe but all connected to same D box										
83-0103	06/21/95	08:53	0.4	15.3	7.1	571	0.4	9.0	89	--
83-0127	07/12/95	10:35	0.3	16.7	7.1	356	0.2	9.2	94	--
83-0152	08/10/95	10:28	0.3	17.5	7.3	592	0.4	8.3	86	--
83-0172	10/25/95	10:16	<0.3	13.4	6.9	628	0.4	8.8	84	11
Pipe/Discharge to SHAWSHEEN RIVER										
Station: SH01A-MA, Mile Point: 25.99										
Description: Drainage culvert from below runway (Massport side), Bedford - discharges into Shawsheen River from sixth pipe from left side of pipe array										
83-0102	06/21/95	09:05	0.3	14.7	6.6	336	0.2	8.2	80	--
83-0126	07/12/95	10:24	0.3	16.4	6.4	326	0.2	7.2	73	--
83-0151	08/10/95	10:10	0.4	17.8	6.4	320	0.2	6.5	68	--
83-0171	10/25/95	10:26	<0.3	16.1	6.6	261	0.2	7.4	75	10
SHAWSHEEN RIVER										
Station: SH01, Mile Point: 25										
Description: at Summer Street, Bedford on north side of road downstream instream										
83-0104	06/21/95	09:31	0.4	16.3	6.6	571	0.4	5.5	55	--
83-0128	07/12/95	11:02	0.3	17.7	6.6	406	0.3	7.0	73	--
83-0153	08/10/95	10:56	0.4	18.0	6.7	513	0.3	5.9	62	--
83-0173	10/25/95	10:47	<0.3	12.7	6.4	441	0.3	6.5	61	8
SHAWSHEEN RIVER										
Station: SH02, Mile Point: 23.5										
Description: at Page Road, Bedford upstream from center cement bridge structure										
83-0106	06/21/95	10:09	0.3	18.2	6.8	**	0.3	6.5	68	--
83-0130	07/12/95	11:50	0.3	18.6	6.7	389	0.2	7.0	74	--
83-0155	08/10/95	11:49	0.5	20.3	6.8	438	0.3	7.1	78	--
83-0175	10/25/95	11:31	<0.3	12.8	6.3	360	0.2	7.2	68	8
SHAWSHEEN RIVER										
Station: SH06, Mile Point: 19.6										
Description: at Route 3A, Billerica off bridge downstream side										
83-0108	06/21/95	10:48	0.5	21.5	6.9	433	0.3	7.4	83	--
83-0132	07/12/95	12:41	0.3	20.7	6.9	412	0.3	9.0	100	--
83-0157	08/10/95	12:40	0.4	22.3	6.9	388	0.2	8.7	99	--
83-0177	10/25/95	12:19	<0.3	13.1	6.1	306	0.2	4.9	46	5

* = interference ** = missing/censored data -- = no data

Table D3 (cont). 1995 MA DEP DWM Shawsheen River watershed *in-situ* Hydrolab data.

OWMID	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
SHAWSHEEN RIVER										
Station: SH07, Mile Point: 16.2										
Description: at USGS Gage, (Salem Road/Route 129 (Shawsheen Avenue)), Billerica/Wilmington off bridge downstream side										
83-0111	06/21/95	11:11	0.5	22.6	7.1	394	0.3	7.4	85	--
83-0135	07/12/95	13:11	0.4	21.5	7.5	373	0.2	10.4	117	--
83-0159	08/10/95	13:10	0.5	23.6	7.3	341	0.2	8.5	99	--
83-0179	10/25/95	12:49	0.5	13.1	6.1	288	0.2	4.4	41	8
SHAWSHEEN RIVER										
Station: SH08, Mile Point: 8.2										
Description: above Ballardvale Dam, Andover off bridge on downstream side										
83-0115	06/21/95	11:44	0.4	24.9	6.8	377	0.2	4.8	57	--
83-0139	07/12/95	14:15	0.6	23.6	6.8	324	0.2	5.7	66	--
83-0162	08/10/95	14:04	0.7	22.7	6.8	294	0.2	5.3	61	--
83-0182	10/25/95	13:40	0.4	13.5	6.2	250	0.2	5.5	52	4
SHAWSHEEN RIVER										
Station: SH10, Mile Point: 4.8										
Description: at Route 28, Andover on bridge downstream side										
83-0120	06/21/95	13:11	0.4	24.5	7.4	374	0.2	8.1	97	--
83-0144	07/12/95	15:36	0.6	23.2	7.6	409	0.3	8.9	104	--
83-0165	08/10/95	15:23	0.6	25.0	7.7	307	0.2	8.3	100	--
83-0187	10/25/95	14:47	0.5	13.4	6.8	247	0.2	9.8	94	7
SHAWSHEEN RIVER										
Station: SH11, Mile Point: 2.7										
Description: at Route 114, Salem Turnpike, on downstream side of bridge, North Andover/Lawrence										
83-0121	06/21/95	13:31	0.6	23.6	7.2	384	0.2	7.7	90	--
83-0145	07/12/95	15:59	0.4	22.7	7.3	423	0.3	8.7	100	--
83-0166	08/10/95	15:47	0.5	23.8	7.3	343	0.2	8.1	95	--
83-0188	10/25/95	15:09	<0.3	13.3	6.7	246	0.2	9.8	93	7
SHAWSHEEN RIVER										
Station: SH12, Mile Point: 0.3										
Description: at Merrimack Street, Lawrence from north bank long rope to sample side of river approximately 30-40 feet above right where river goes underground										
83-0168	08/10/95	16:24	0.4	23.4	7.1	354	0.2	6.8	79	--
ROGERS BROOK										
Station: RB02, Mile Point: 1.1										
Description: off Chestnut Street near headwaters, Andover climb off bridge 5 feet downstream sample midstream										
83-0119	06/21/95	12:49	0.3	19.4	7.0	335	0.2	8.1	87	--
83-0143	07/12/95	15:06	<0.3	19.6	6.8	367	0.2	7.7	83	--
83-0170	08/10/95	14:55	0.3	22.0	6.9	332	0.2	7.3	83	--
83-0186	10/25/95	14:26	<0.3	13.6	6.8	313	0.2	8.2	79	5

* = interference ** = missing/censored data -- = no data

Table D3 (cont). 1995 MA DEP DWM Shawsheen River watershed *in-situ* Hydrolab data.

OWMID	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
ROGERS BROOK										
Station: RB01, Mile Point: 0.1										
Description: approximately 200 feet from confluence with Shawsheen River, Andover down north bank rocky stream sample center river										
83-0118	06/21/95	12:10	0.3	16.4	7.0	612	0.4	8.9	90	--
83-0142	07/12/95	14:43	<0.3	16.7	6.9	703	0.5	8.1	82	--
83-0169	08/10/95	14:30	0.3	18.8	7.0	573	0.4	8.0	86	--
83-0185	10/25/95	14:05	<0.3	13.6	6.9	446	0.3	9.2	88	6
STRONG WATER BROOK										
Station: SW01, Mile Point: 0.01										
Description: at Shawsheen Street, Tewksbury from bridge upstream side approximately 100 feet from confluence										
83-0138	07/12/95	13:44	0.3	21.5	7.1	322	0.2	8.5	96	--
83-0161	08/10/95	13:39	0.3	22.5	6.9	284	0.2	6.8	78	--
83-0181	10/25/95	13:16	<0.3	12.9	6.3	265	0.2	5.8	55	10
VINE BROOK										
Station: VB01, Mile Point: 0.6										
Description: at Route 62, Bedford upstream side of bridge (standing on cement? steel? pipe culvert) center stream										
83-0107	06/21/95	10:26	0.5	21.7	7.0	403	0.3	6.3	71	--
83-0131	07/12/95	12:11	0.3	20.3	7.0	396	0.3	7.3	80	--
83-0156	08/10/95	12:12	0.4	20.9	6.9	359	0.2	6.4	72	--
83-0176	10/25/95	11:53	<0.3	12.8	6.5	257	0.2	8.2	77	16
ELM BROOK										
Station: EB02, Mile Point: 0.02										
Description: at Great Road, Routes 4 & 225, Bedford on bridge upstream wooden foot path next to bridge										
83-0105	06/21/95	09:52	0.4	17.4	6.8	511	0.3	5.9	61	--
83-0129	07/12/95	11:27	0.3	17.5	6.6	377	0.2	7.3	76	--
83-0154	08/10/95	11:22	0.4	18.6	6.7	345	0.2	7.3	78	--
83-0174	10/25/95	11:10	<0.3	12.3	5.9	316	0.2	7.6	71	10

* = interference ** = missing/censored data -- = no data

1995 MA DEP Survey Summary - Lakes

Three types of assessments were conducted on lakes in the Shawsheen River Watershed. First, they were assessed against the criteria for use support from the "Summary of Water Quality Report". Next, the trophic status (level of nutrient enrichment) of each lake was evaluated. And last, the presence of non-native aquatic and/or wetland plant species was noted.

Information for making each type of assessment was primarily obtained during a series of "synoptic" surveys conducted during the summer of 1995. Fish advisory information was obtained from the Department of Public Health.

Synoptic surveys consisted of taking observations from at least one access point on each lake (multiple access points on larger lakes). At each lake, an attempt was made to observe the entire surface area to determine the extent of aerial macrophyte cover.

At each observation site the general water quality was noted and all aquatic and wetland macrophyte species were recorded along with their general abundance and an estimate of the total percent aerial coverage of all species. Qualitative macrophyte observations were aided by conducting several hauls with a plant "rake," which was constructed by bolting two garden rakes back-to-back, the handles cut to about half length, and then attached to about a 50' length of rope. Each time the rake was thrown to its maximum extension and then retrieved along the lake bottom. The rake was thrown several times in different directions from the observation site to provide more thorough coverage.

Where possible, transparency was measured using a standard 20 centimeter diameter Secchi disc attached to a rope with metric calibrations. When Secchi disc measurements were not feasible, transparency was estimated as being above or below 1.2 meters (based on the 4 foot Secchi disc bathing beach standard).

All observations were recorded on standardized field sheets. Assessments of trophic status and use impairment were made on site. Later, the assessments and supporting information were entered into the US EPA Water Body System database. Data on the presence of non-native plants were entered into a separate database intended for linking to the Massachusetts Geographic Information System (MassGIS).

TABLE D4. 1995 Shawsheen River Watershed summer lake status.

Lake Name (local name), Location	Waterbody Identification Code (WBID)	Size (Acres)	Trophic Status Estimate	Survey Observations (Objectionable Conditions)
Ames Pond, Tewksbury	MA83001	82	E	Clear, shallow water, dense vegetation along northern and southwest margins (1/3 dense cover), non-native species (Ls)
Bakers Meadow Pond, Andover	MA83002	18	E	Water clear and shallow, 100% plant coverage, mostly floating leaf plants, non-native species (Ls)
Butterfield Pond, Burlington/Lexington	MA83003	7	E	Turbid, gray-brown water, likely <4' secchi depth, water surface >35% covered with floating leaf plants, likely >50% coverage of submerged plants, sand and gravel operation likely contributes to turbidity, non-native species (Ls)
Fawn Lake, Bedford	MA83004	11	E	Clear and shallow water, bottom covered in organic ooze, filamentous algae abundant, shoreline mostly forested, 100% coverage of floating leaf plants, non-native species (Ls)

TABLE D4 (cont). 1995 Shawsheen River Watershed summer lake status.

Lake Name (local name), Location	Waterbody Identification Code (WBID)	Size (Acres)	Trophic Status Estimate	Survey Observations (Objectionable Conditions)
Fosters Pond, Andover/Wilmington	MA83005	135	E	Mostly clear water in coves, moderate turbidity in main basin, abundant submergent and floating leaf plants particularly in north end and western coves and among islands, non-native species (Ls, Cc)
Gravel Pit Pond (Hussey Brook Pond East), Andover	MA83007	5	E	Very dense emergent and floating vegetation at west end of pond, non- native species (Ls, Pc)
Hussey Brook Pond (West), Andover	MA83008	5	U	100% coverage with emergent and floating leaf plants
Hussey Pond, Andover	MA83009	2	E	Clear water below very dense algal mats and duckweed, may receive nutrients from Andover Country Club, bottom sediments emit hydrogen sulfide odor, non-native species (Ls)
Long Pond, Tewksbury	MA83010	39	E	Water unobservable due to dense to very dense watermeal coverage, non-native species (Ls)
Lowell Junction Pond (Ballardvale Impoundment), Andover	MA83011	40	E	Water slightly turbid, most of the pond has dense to very dense duckweed, floating leaf and emergent plant cover, non-native species (Ls, Cc)
Pomps Pond, Andover	MA83014	14	E	Slightly tea stained, most of the pond has dense to very dense plant cover, non-native species (Ls, Cc)
Pond Street Pond, Billerica	MA83021	9	E	No open water visible, 95% covered with very dense emergent plants, non-native species (Ls)
Rabbit Pond, Andover	MA83015	5	E	Pea-soup green, Secchi disk likely <4', most likely an algal bloom, essentially no aquatic plants
Richardson Pond (North), Billerica/Tewksbury	MA83020	59	E	Water not visible due to very dense emergent plants, non-native species (Ls, Pa)
Round Pond, Tewksbury	MA83018	25	H	Pond level very low, water unobservable due to very dense plant coverage, non-native species (Ls, Pa)

All waterbodies are Class B.
WBID – Waterbody Identification code.
Trophic State: **E**= Eutrophic, **H**= Hypereutrophic, **M**= Mesotrophic, **U**= Undetermined.
Non-native Plants: Ls = *Lythrum salicaria,* **Pc =** *Potamogeton crispus,* **Cc** = *Cabomba caroliniana,* **Pa** = *Phragmites australis*

APPENDIX E – SUMMARY OF NPDES AND WMA PERMITTING INFORMATION, SHAWSHEEN RIVER WATERSHED

Table E1. Shawsheen River Watershed Sanitary/Institutional surface wastewater discharges.

Permitee	NPDES #	Issuance	Flow (MGD)	Special Conditions/ notes	Receiving Water (segment)
Battle Road Farm Condominiums, Bedford	MA0031658	1988	0.033	seeking to increase flow to 0.45 MG	Isolated wetland (see information in MA83-08)

Table E2. Shawsheen River Watershed Industrial/Minor NPDES wastewater discharge facilities.

Permitee	NPDES #	Issuance	Flow (MGD)	Types of Discharge	Receiving Water (segment)
Jet Aviation, Bedford	MA0032271	1989	Note: Groundwater recovery operations (for remediation) ceased in 1998		Shawsheen River (MA83-08)
HAFB Treatment Plant, Bedford	MA0090697	1990	Note: Groundwater recovery operations (for remediation) ceased in 2002		Elm Brook (MA83-05)
Raytheon Corporation, Bedford	MA0033529		Note: Groundwater recovery operations (for remediation).		Elm Brook (MA83-05)
Millipore Corporation, Bedford	MA0025828	1983	Note: NCCW (0.03 MGD) discharge was eliminated via connection to MWRA in 1999.		Elm Brook (MA83-05)
Amoco Oil Company, Bedford	MA0035441		Note: Groundwater recovery operations (for remediation) ceased in January 2003		Elm Brook (MA83-05)
Burlington Groundwater Treatment Plant, Burlington	MA0102911	1986	Note: This groundwater discharge was operated for two years (1985-1987) and the permit was terminated on 15 May 2002 as the system went closed loop.		Vine Brook (MA83-06)
E.H. Perkins Construction, Inc. , Burlington	MA0004081		0.02-0.03 MGD	Treated rock washing/grinding process water	Vine Brook (MA83-06)
MITRE Corporation, Bedford	MA0027197		Note: This facility has routed (April 1996) their NCCW to the MWRA sewer system and the permit was terminated on 18 February 1997.		Vine Brook (MA83-06)
Bellofram site, Burlington	MA0036641	Application for NPDES permit; is an emergency exclusion for petroleum cleanup			
BTL Specialty Resins Corporation, Andover	MA0004952		Note: This facility's discharges have been connected to the Greater Lawrence Sanitary District wastewater treatment facility. This permit was terminated on 22 October 1998.		Shawsheen River (MA83-18)
Praxair, Inc., Tewksbury	MA0002135		Note: Currently, there is no flow discharging via an outfall to the settling basin (discharge of treated non-contact cooling water). EPA is in the process of terminating the NPDES permit		Unnamed trib (see MA83-18)
Penn Culvert Co., North Billerica	MA0030147		Note: Stormwater discharge permit was terminated on 13 February 2003.		Wetland (See MA83-09)
Eastern Terminals Inc., North Billerica	MA0030805				Middlesex Canal (see MA83-09)

Table E2 (cont.)**.** Shawsheen River Watershed Industrial/Minor NPDES wastewater discharge facilities.

Permitee	NPDES #	Issuance	Flow (MGD)	Types of Discharge	Receiving Water (segment)
Getty Petroleum Corp., Tewksbury	MA0036846	Application for NPDES permit; is an emergency exclusion for petroleum cleanup; terminated in 2001			
Tewksbury Hospital, Tewksbury	MA0030040		Note: Discharge for non-contact cooling water and boiler blowdown was terminated on 11 June 2001.		Strong water Brook (MA83-07)
Tyer Industries, Inc., Andover	MA0026972		Note: Discharge for non-contact cooling water was terminated on 9 October 2001.		Shawsheen River (MA83-19)
Powerhouse Property, Andover	NPDES Permit Exclusion for Construction Dewatering issued 7 November 1995				
Citgo Service Station, North Andover	MA0034631	Application for NPDES permit; is an emergency exclusion for petroleum cleanup; terminated in 1999			

NCCW = non-contact cooling water

Table E3. List of WMA registered and permitted average annual water withdrawals in the Shawsheen River Watershed (LeVangie, D. 2002. Water Management Act Database. Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Database Manager. Boston, MA.).

Permit	Registration	PWSID	System Name	Registered Volume (MGD)	20 Year Permitted Volume (MGD)	Source	G or S	Well/Source Name	Withdrawal Location (segment)
Shawsheen River Watershed									
	31502301	3023000	Bedford Department of Public Works	0.66	0	023-02G	G	Well #2 Shawsheen Road	Bedford (MA83-01)
	31502301	3023000	Bedford Department of Public Works	0.66	0	023-08G	G	Well #4 Shawsheen Road	Bedford (MA83-01)
	31502301	3023000	Bedford Department of Public Works	0.66	0	023-09G	G	Well #5 Shawsheen Road	Bedford (MA83-01)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	048-01S	S	Shawsheen River intake	Billerica (MA83-18)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-11G	G	Well #10	Burlington (MA83-06)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-12G	G	Well #11	Burlington (MA83-06)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-05G	G	Well #3 Middlesex Turnpike	Burlington (MA83-06)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-08G	G	Well #4 Middlesex Turnpike	Burlington (MA83-06)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-01G	G	Pumping Station #1	Burlington (MA83-06)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-02G	G	Pumping Station #2	Burlington (MA83-06)
9P31504801	31504801	3048000	Burlington Water Department	3.9	0	3048000-07G	G	Well #5 Middlesex Turnpike	Burlington (MA83-06)
	31500902		Indian Ridge Country Club	0.08	0		S	Irrigation pond	Andover (MA83-19)
	31500902		Indian Ridge Country Club	0.08	0		G	Irrigation well	Andover (MA83-19)
	31515501		Lexington Golf Club	0.07	0		G	Irrigation pond	Lexington (MA83-06)
	31515501		Lexington Golf Club	0.07	0		G	Irrigation well	Lexington (MA83-06)
	31515501		Lexington Golf Club	0.07	0		G	Irrigation well	Lexington (MA83-06)
	31529501	3295001	Tewksbury Hospital	0.3	0	3295001-01G	G	Old tubular wells	Tewksbury (MA83-07)
	31529501	3295001	Tewksbury Hospital	0.3	0	3295001-03G	G	East and Maple Street well	Tewksbury (MA83-07)
	31500901		Andover Country Club	0.09	0		S	Irrigation pond	Andover (MA83-03)

G – ground water, S – surface water

APPENDIX F- DEP GRANT AND LOAN PROGRAMS

Excerpted from the MA DEP World Wide Web sites, http://www.state.ma.us/dep/brp/mf/files/glprgm.pdf and http://www.state.ma.us/dep/brp/mf/othergrt.htm.

MASSACHSUETTS WATERSHED INITIATIVE PROJECT

Each year EOEA Watershed Team Leaders, in conjunction with State and Federal agencies, municipal governments and regional planning agencies, universities, local watershed associations, businesses and other groups, develop work plans that identify the most important goals for each watershed and the specific projects and programs which are needed to meet those goals.

- 99-06/MWI *GIS Data Layer of Storm Drain Systems and Solutions to Hot Spot Problems.* The purpose of this project is to continue mapping and documenting drain system conditions and solve identified nonpoint source pollution problems in the Shawsheen River Watershed.
- 01-01/MWI *Shawsheen River TMDL Implementation.* This project will implement recommendations set forth in the Shawsheen River Bacteria Total Maximum Daily Load (TMDL) Analysis developed by Limno-Tech, Inc., in conjunction with the Shawsheen River Watershed Team.
- 01-08/MWI *Shawsheen River Storm Drain Monitoring.* This project will conduct water quality and bacteriological sampling and habitat assessment at selected locations in the Shawsheen River Watershed.
- 02-12/MWI *Shawsheen River Storm Drain Catchment Monitoring.* This project will conduct sampling of selected storm drains in the Shawsheen River Watershed to identify existing and potential sources of pollution.
- 02-13/MWI *Vine Brook Comprehensive Bacteria TMDL Study.* This project will collect data and other information necessary to develop a bacteria TMDL for Vine Brook, a tributary stream to the Shawsheen River.

WELLHEAD PROTECTION GRANT PROGRAM

The Wellhead Protection Grant Program provides funds to assist public water suppliers in addressing wellhead protection through local projects and education.

- 99-19/WHP *Burlington Wellhead Protection Project*. This project will use 21 existing wells to implement a local water quality sampling and analysis program to ensure that the drinking water is safe by the early detection monitoring program of groundwater contamination in the Zone IIs.

104(b)(3) WETLANDS AND WATER QUALITY GRANT PROGRAM

This Grant Program is authorized under Wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. The Water Quality proposals received by DEP under this National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency is a results oriented approach that will focus attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are to: 1) achieve clean air, 2) achieve clean water, 3) protect wetlands, 4) reduce waste generation, and 5) clean up waste sites.

- 00-06/104 *Chronic Toxicity Testing*. The entire mainstem of the Shawsheen River is on the 1999 303d list as having been impaired due to “unknown toxicity”. This project will attempt to determine whether current management practices are effective in mitigating the impairment of the Shawsheen due to toxicity. A secondary objective is to qualitatively study the interrelation between toxicity, waterfront industrial-use and watershed management practices.

319 NONPOINT SOURCE GRANT PROGRAM

This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; address activities that are identified in the Massachusetts NPS Management Program Plan. Currently there are no 319 projects in the Shawsheen Watershed.

604(b) WATER QUALITY PLANNING GRANT PROGRAM

This Grant Program is authorized under Section 604(b) of the Federal Clean Water Act. The program is designed to assist eligible recipients in providing water quality assessment and planning assistance to local communities. Priority is given to projects that provide diagnostic information to support the DEP's watershed management activities and to projects located in one of the priority watersheds targeted for assessment work by the DEP. Currently there are no 604(b) projects in the Shawsheen Watershed.

RESEARCH AND DEMONSTRATION GRANT PROGRAM

The Research and Demonstration Program (R&D) is authorized by section 38 of Chapter 21 of the Massachusetts General Laws and is funded by proceeds from the sale of Massachusetts bonds. Specifically, the R&D Program was established to enable the Department to conduct a program of study and research and demonstration relating to water pollution control and other scientific and engineering studies "...so as to insure cleaner waters in the coastal waters, rivers, streams, lakes and ponds of the Commonwealth." Currently there are no R&D projects in the Shawsheen Watershed.

SOURCE WATER PROTECTION TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM

The Source Water Protection Technical Assistance/Land Management Grant Program provides funds to public water suppliers and third party technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface drinking water supplies. Currently there are no Source Water Protection projects in the Shawsheen Watershed.

CLEAN WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts State Revolving Loan Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state water quality requirements. The SRF Program is jointly administered by the Division of Municipal Services of the MA DEP and the Massachusetts Water Pollution Abatement Trust. Each year the MA DEP solicits projects from the Massachusetts municipalities and wastewater districts to be considered for subsidized loans, which are currently offered at 50% grant equivalency (approximates a two percent interest loan). The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed. Currently there are no SRF projects in the Shawsheen Watershed.

COMMUNITY SEPTIC MANAGEMENT PROGRAM

The enactment of the Open Space Bond Bill in March of 1996 provided new opportunities and stimulated new initiatives to assist homeowners with failing septic systems. The law appropriated $30 million to the MA DEP to assist homeowners. The Department will use the appropriation to fund loans through the Massachusetts Water Pollution Abatement Trust. The fund will provide a permanent state/local administered revolving fund to assist income-eligible homeowners in financing necessary Title 5 repairs. Working together, the MA DEP and the Trust have created the Community Septic Management Program to help Massachusetts' communities protect threatened ground and surface waters while making it easier to comply with Title 5. This loan program offers three options from which a local governmental unit can choose. Currently there are no Community Septic Management projects in the Shawsheen Watershed.

MASSACHUSETTS DRINKING WATER STATE REVOLVING FUND PROGRAM

The Massachusetts Drinking Water State Revolving Fund (DWSRF) provides low-cost financing to help community public water suppliers comply with federal and state drinking water requirements. The DWSRF Program's goals are to protect public health and strengthen compliance with drinking water requirements, while addressing the Commonwealth's drinking water needs. The Program incorporates affordability and watershed management priorities. The DWSRF Program is jointly administered by the Division of Municipal Services of the Department of Environmental Protection and the Massachusetts Water Pollution Abatement Trust (Trust). The current subsidy level is equivalent to a 50% grant, which approximates a two percent interest loan. The Program will initially operate with approximately $50 million in financing capacity. For calendar years 1999 through 2003, up to $400 million may be available through the loan program. Currently there are no DWSRF projects in the Shawsheen Watershed.