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APPENDIX A
ASSESSMENT METHODOLOGY GUIDELINES FOR EVALUATING DESIGNATED USE STATUS OF MASSACHUSETTS SURFACE WATERS

The Clean Water Act (CWA) Section 305(b) water quality reporting process is an essential aspect of the Nation's water pollution control effort. It is the principal means by which EPA, Congress, and the public evaluate existing water quality, assess progress made in maintaining and restoring water quality, and determine the extent of remaining problems. By this process, states report on waterbodies within the context of meeting their designated uses. These uses include: *Aquatic Life, Fish Consumption, Drinking Water, Primary Contact Recreation, Secondary Contact Recreation, Shellfish Harvesting* and *Aesthetics*. Two subclasses of Aquatic Life are also designated in the Massachusetts Surface Water Quality Standards (SWQS): Cold Water Fishery – waters capable of sustaining a year-round population of cold water aquatic life, such as trout – and Warm Water Fishery – waters that are not capable of sustaining a year-round population of cold water aquatic life (MassDEP 1996).

The SWQS, summarized in Table A1, prescribe minimum water quality criteria to sustain the designated uses. Furthermore, these standards describe the hydrological conditions at which water quality criteria must be applied (MassDEP 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 Massachusetts Department of Environmental Protection (MassDEP) will determine by on a case-by-case basis the most severe hydrological condition for which the aquatic life criteria must be applied.

The availability of appropriate and reliable scientific data and technical information is fundamental to the 305(b) reporting process. It is EPA policy (EPA Order 5360.1 CHG 1) that any individual or group performing work for or on behalf of EPA establish a quality system to support the development, review, approval, implementation, and assessment of data collection operations. To this end MassDEP describes its Quality System in an EPA-approved Quality Management Plan to ensure that environmental data collected or compiled by the MassDEP are of known and documented quality and are suitable for their intended use. For external sources of information, MassDEP requires the following: 1) an appropriate Quality Assurance Project Plan (QAPP) including a laboratory Quality Assurance /Quality Control (QA/QC) plan; 2) use of a state certified lab (or as otherwise approved by DEP for a particular analysis); and 3) sample data, QA/QC and other pertinent sample handling information documented in a citable report. This information will be reviewed by MassDEP to determine its validity and usability to assess water use support. Data use could be modified or rejected due to poor or undocumented QAPP implementation, lack of project documentation, incomplete reporting of data or information, and/or project monitoring objectives unsuitable for MassDEP assessment purposes.

EPA provides guidelines to states for making their use support determinations (EPA 1997 and 2002, Grubbs and Wayland III 2000 and Wayland III 2001). The determination of whether or not a waterbody supports each of its designated uses is a function of the type(s), quality and quantity of available current information. Although data/information older than five years are usually considered “historical” and used for descriptive purposes they can be utilized in the use support determination provided they are known to reflect the current conditions. While the water quality standards (Table A1) prescribe minimum water quality criteria to sustain the designated uses, numerical criteria are not available for every indicator of pollution. Best available guidance from available literature may be applied in lieu of actual numerical criteria (e.g., freshwater sediment data may be compared to *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* 1993 by D. Persaud, R. Jaagumagi and A. Hayton). Excursions from criteria due solely to “naturally occurring” conditions (e.g., low pH in some areas) do not constitute violations of the SWQS.

Each designated use within a given segment is individually assessed as ***support*** or ***impaired***. When too little current data/information exist or no reliable data are available, the use is ***not assessed***. In this report, however, if there is some indication that water quality impairment may exist, and it is not “naturally occurring”, the use is identified with an “Alert Status”. It is important to note that not all waters are

assessed. Many small and/or unnamed ponds, rivers, and estuaries have *never been assessed*; the status of their designated uses has never been reported to EPA in the Commonwealth's 305(b) Report or the Integrated List of Waters nor is information on these waters maintained in the waterbody system database (WBS) or the new assessment database (ADB).

Table A1. Summary of Massachusetts Surface Water Quality Standards (MassDEP 1996, MA DPH 2002, and FDA 2003).

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 - 9.0 SU and Δ1.0 outside the naturally occurring range. Class SA and Class SB: 6.5 - 8.5 SU and Δ0.2 outside the normally occurring range. Class SC: 6.5 - 9.0 SU 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 A1 Continued. Summary of Massachusetts Surface Water Quality Standards (MassDEP 1996, MA DPH 2002, and FDA 2003).

Bacteria (MassDEP 1996 and MA DPH 2002) 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*.	<u>Class A:</u> Fecal coliform bacteria: An arithmetic mean of <20 cfu/100 ml in any representative set of samples and <10% of the samples >100 cfu/100 ml. <u>Class B:</u> At public bathing beaches, as defined by MA DPH, where *E. coli* is the chosen indicator: No single *E. coli* sample shall exceed 235 *E. coli* /100 ml and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 *E. coli* / 100 ml. At public bathing beaches, as defined by MA DPH, where Enterococci are the chosen indicator: No single Enterococci sample shall exceed 61 Enterococci /100 ml and the geometric mean of the most recent five Enterococci samples within same bathing season shall not exceed 33 Enterococci /100 ml. 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 ml in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 ml. (This criterion may be applied on a seasonal basis at the discretion of the MassDEP.) <u>Class C:</u> Fecal coliform bacteria: Shall not exceed a geometric mean of 1,000 cfu/100 ml, nor shall 10% of the samples exceed 2,000 cfu/100 ml. <u>Class SA:</u> Fecal coliform bacteria: Waters designated shellfishing shall not exceed a geometric mean (most probable number (MPN) method) of 14 MPN/100 ml, nor shall more than 10% of the samples exceed 28 MPN/100 ml, or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest version of the Guide for the Control of Molluscan Shellfish Areas (more stringent regulations may apply). At public bathing beaches, as defined by MA DPH, where Enterococci are the chosen indicator: No single Enterococci sample shall exceed 104 Enterococci /100 ml and the geometric mean of the five most recent Enterococci levels within the same bathing season shall not exceed 35 Enterococci /100 ml. 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 ml in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 ml. (This criterion may be applied on a seasonal basis at the discretion of the MassDEP.) <u>Class SB:</u> Fecal coliform bacteria: Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean (MPN method) of 88 MPN/100 ml, nor shall <10% of the samples exceed 260 MPN/100 ml or other values of equivalent protection base on sampling and analytical methods used by the Massachusetts Shellfish Sanitation Program in the latest revision of the guide for the Control of Moluscan Shellfish (more stringent regulations may apply). At public bathing beaches, as defined by MA DPH, where Enterococci are the chosen indicator: No single Enterococci sample shall exceed 104 Enterococci /100 ml and the geometric mean of the most recent five Enterococci levels within the same bathing season shall not exceed 35 Enterococci /100 ml. 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 ml in any representative set of samples, nor shall more than 10% of the samples exceed 400 cfu/100 ml. (This criterion may be applied on a seasonal basis at the discretion of the MassDEP.) <u>Class SC:</u> Fecal coliform bacteria: Shall not exceed a geometric mean of 1,000 cfu/100 ml, nor shall 10% of the samples exceed 2,000 cfu/100 ml.

DESIGNATED USES

The Massachusetts Surface Water Quality Standards designate the most sensitive uses for which the surface waters of the Commonwealth shall be enhanced, maintained and protected. Each of these uses is briefly described below (MassDEP 1996):

- *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; *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* and *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 MassDEP's data collection techniques dictate that a weight of evidence be used to make the assessment, with biosurvey results used as the final arbiter of borderline cases. The following chart provides an overview of the guidance used to assess the status (support or impaired) of the *Aquatic Life Use*.

Variable	***Support*** Data available clearly indicates support or minor modification of the biological community. Excursions from chemical criteria (Table A1) not frequent or prolonged and may be tolerated if the biosurvey results demonstrate support.	***Impaired*** There are frequent or severe violations of chemical criteria, presence of acute toxicity, or a moderate or severe modification of the biological community.
BIOLOGY		
Rapid Bioassessment Protocol (RBP) III*	Non/Slightly impacted	Moderately or Severely Impacted
Fish Community	Best Professional Judgment (BPJ)	BPJ
Habitat and Flow	BPJ	Dewatered streambed due to artificial regulation or channel alteration, BPJ
Eelgrass Bed Habitat (Howes *et al.* 2003)	Stable (No/minimal loss), BPJ	Loss/decline, BPJ
Non-native species	BPJ	Non-native species present, BPJ
Plankton/Periphyton	No/infrequent algal blooms	Frequent and/or prolonged algal blooms
TOXICITY TESTS**		
Water Column/Ambient	≥75% survival either 48 hr or 7-day exposure	<75% survival either 48 hr or 7-day exposure
Sediment	≥75% survival	<75% survival
CHEMISTRY-WATER**		
Dissolved oxygen (DO)/Percent saturation (MassDEP 1996, EPA 1997)	Infrequent excursion from criteria (Table A1), BPJ (minimum of three samples representing critical period)	Frequent and/or prolonged excursion from criteria [river and shallow lakes - exceedances >10% of representative measurements; deep lakes (with hypolimnion) - exceedances in the hypolimnetic area >10% of the surface area during maximum oxygen depletion].
pH (MassDEP 1996, EPA 19 November 1999)	Infrequent excursion from criteria (Table A1)	Criteria exceeded >10% of measurements.
Temperature **(**MassDEP 1996,EPA 1997)	Infrequent excursion from criteria (Table A1)[1]	Criteria exceeded >10% of measurements.
Toxic Pollutants (MassDEP 1996, EPA 1999a) Ammonia-N (MassDEP 1996, EPA 1999b) Chlorine (MassDEP 1996, EPA 19 November 1999a)	Infrequent excursion from criteria (Table A1) Ammonia is pH and temperature dependent[2] 0.011 mg/L (freshwater) or 0.0075 mg/L (saltwater) total residual chlorine (TRC)[3]	Frequent and/or prolonged excursion from criteria (exceeded >10% of measurements).
CHEMISTRY-SEDIMENT**		
Toxic Pollutants (Persaud *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 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 (MA DPH), Bureau of Environmental Health Assessment (MA DPH 2005 and Krueger 2006). The MA DPH list identifies waterbodies where elevated levels of a specified contaminant in edible portions of freshwater species pose a health risk for human consumption. Hence, the Fish Consumption Use is assessed as non-support in these waters.

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

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

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

1. Due to concerns about chemical contamination, primarily from polychlorinated biphenyl compounds (PCB) and other contaminants, no individual should consume lobster tomalley from any source. Lobster tomalley is the soft green substance found in the tail and body section of the lobster.
2. Pregnant and breastfeeding women and those who are considering becoming pregnant should not eat bluefish due to concerns about PCB contamination in this species.

The following is an overview of EPA's guidance used to assess the status (support or impaired) of the *Fish Consumption Use*. Because of the statewide advisory no waters can be assessed as support for the *Fish Consumption Use*. Therefore, if no site-specific advisory is in place, the *Fish Consumption Use* is not assessed.

Variable	***Support*** No restrictions or bans in effect	***Impaired*** There is a "no consumption" advisory or ban in effect for the general population or a sub-population for one or more fish species or there is a commercial fishing ban in effect.
MA DPH Fish Consumption Advisory List	Not applicable, precluded by statewide advisory (Hg)	Waterbody on MA DPH Fish Consumption Advisory List

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

DRINKING WATER USE

The term *Drinking Water Use* denotes those waters used as a source of public drinking water. These waters may be subject to more stringent regulation in accordance with the Massachusetts Drinking Water Regulations (310 CMR 22.00). They are designated for protection as Outstanding Resource Waters in 314 CMR 4.04(3). MassDEP's Drinking Water Program (DWP) has primacy for implementing the provisions of the federal Safe Drinking Water Act (SDWA). Except for suppliers with surface water sources for which a waiver from filtration has been granted (these systems also monitor surface water quality) all public drinking water supplies are monitored as finished water (tap water). Monitoring includes the major categories of contaminants established in the SDWA: bacteria, volatile and synthetic organic compounds, inorganic compounds and radionuclides. The DWP maintains current drinking supply monitoring data. The suppliers currently report to MassDEP and EPA the status of the supplies on an annual basis in the form of a consumer confidence report (http://yosemite.epa.gov/ogwdw/ccr.nsf/Massachusetts). Below is EPA's guidance to assess the status (support or impaired) of the drinking water use.

Variable	***Support*** 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 http://www.mass.gov/dep/water/drinking.htm and from local public water suppliers.

SHELLFISHING USE

This use is assessed using information from the Department of Fish and Game's Division of Marine Fisheries (DMF). A designated shellfish growing area is an area of potential shellfish habitat. Growing areas are managed with respect to shellfish harvest for direct human consumption, and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (described below) with respect to shellfish harvest. Shellfish areas under management closures are *not assessed.* Not enough testing has been done in these areas to determine whether or not they are fit for shellfish harvest, therefore, they are closed for the harvest of shellfish.

Variable	***Support*** 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.mass.gov/mgis/dsga.htm. This coverage currently reflects classification areas as of July 1, 2000.

[1] **Approved** - "...open for harvest of shellfish for direct human consumption subject to local rules and regulations..." An approved area is open all the time and closes only due to hurricanes or other major coastwide events.

[2] **Conditionally Approved** - "...subject to intermittent microbiological pollution..." During the time the area is open, it is "...for harvest of shellfish for direct human consumption subject to local rules and regulations…" A conditionally approved area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, shellfish harvested are treated as from an approved area.

[3] **Restricted** - area contains a "limited degree of pollution." It is open for "harvest of shellfish with depuration subject to local rules and state regulations" or for the relay of shellfish. A restricted area is used by DMF for the relay of shellfish to a less contaminated area.

[4] **Conditionally Restricted** - "...subject to intermittent microbiological pollution..." During the time area is restricted, it is only open for "the harvest of shellfish with depuration subject to local rules and state regulations." A conditionally restricted area is closed some of the time due to runoff from rainfall or seasonally poor water quality. When open, only soft-shell clams may be harvested by specially licensed diggers (Master/Subordinate Diggers) and transported to the DMF Shellfish Purification Plant for depuration (purification).

[5] **Prohibited -** Closed for harvest of shellfish.

PRIMARY CONTACT RECREATION USE

This use is suitable for any recreational or other water use in which there is prolonged and intimate contact with the water with a significant risk of ingestion of water during the primary contact recreation season (1 April to 15 October). These include, but are not limited to, wading, swimming, diving, surfing and water skiing. The chart below provides an overview of the guidance used to assess the status (support or impaired) of the *Primary Contact Recreation Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria and/or formal bathing area closures, or severe aesthetic conditions that preclude the use
Bacteria (105 CMR 445.000) Minimum Standards for Bathing Beaches State Sanitary Code) (MassDEP 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 A1). Shellfish Growing Area classified as "Approved" by DMF.	At "public bathing beach" areas: Formal beach closures/postings >10% of time during swimming season (the number of days posted or closed exceeds 10% during the locally operated swimming season). Other waters: Samples* collected during the primary contact season do not meet the criteria (Table A1).
Aesthetics (MassDEP 1996) - *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance* [growth or amount] *species of aquatic life*		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

* Data sets to be evaluated for assessment purposes must be representative of a sampling location (at least five samples per station recommended) over 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. Because of low sample frequency (i.e., less than ten samples per station) an impairment decision will not be based on a single sample exceedance (i.e., the geometric mean of five samples is <200 cfu/100 ml but one of the five sample exceeds 400 cfu/100 ml). The method detection limit (MDL) will be used in the calculation of the geometric mean when data are reported as less than the MDL (e.g. use 20 cfu/100 ml if the result is reported as <20 cfu/100 ml). Those data reported as too numerous to count (TNTC) will not be used in the geometric mean calculation; however frequency of TNTC sample results should be presented.

SECONDARY CONTACT RECREATION USE

This use is suitable for any recreation or other water use in which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact incident to shoreline activities. Following is an overview of the guidance used to assess the status (support or impaired) of the *Secondary Contact Use*. Excursions from criteria due to natural conditions are not considered impairment of use.

Variable	***Support*** Criteria are met, no aesthetic conditions that preclude the use	***Impaired*** Frequent or prolonged violations of criteria, or severe aesthetic conditions that preclude the use
Fecal Coliform Bacteria (MassDEP 1996)	Other waters: Samples* collected must meet the Class C or SC criteria (see Table A1).	Other waters: Samples* collected do not meet the Class C or SC criteria (see Table A1).
Aesthetics (MassDEP 1996) - *All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance* [growth or amount] *species of aquatic life*		
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

*Data sets to be evaluated for assessment purposes must be representative of a sampling location (at least five samples per station recommended) over time. Because of low sample frequency (i.e., less than ten samples per station) an impairment decision will not be based on a single sample exceedance. Samples collected on one date from multiple stations on a river are not considered adequate to assess this designated use.

AESTHETICS USE

All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life. The aesthetic use is closely tied to the public health aspects of the recreational uses (swimming and boating). Below is an overview of the guidance used to assess the status (support or impaired) of the *Aesthetics Use*.

Variable	***Support*** Narrative "free from" criteria met	***Impaired*** Objectionable conditions frequent and/or prolonged
Odor, oil and grease, color and turbidity, floating matter	Narrative "free from" criteria met or excursions neither frequent nor prolonged, BPJ.	Narrative "free from" criteria not met - objectionable conditions either frequent and/or prolonged, BPJ.
Transparency (MA DPH 1969)	Public bathing beach and lakes – Secchi disk depth ≥1.2 meters (≥ 4') (minimum of three samples representing critical period).	Public bathing beach and lakes - Secchi disk depth <1.2 meters (< 4') (minimum of three samples representing critical period).
Nuisance organisms	No overabundant growths (i.e., blooms) that render the water aesthetically objectionable or unusable, BPJ.	Overabundant growths (i.e., blooms and/or non-native macrophyte growth dominating the biovolume) rendering the water aesthetically objectionable and/or unusable, BPJ.

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APPENDIX B

TEN MILE RIVER WATERSHED 2002 DWM BIOLOGICAL ASSESSMENT

Technical Memorandum TM-52-6

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Worcester, MA

16 September 2005

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CONTENTS

Tables and Figures

INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Barbour et al. 1999, Barbour et al. 1995). Biological surveys and assessments are the primary approaches to biomonitoring.

As part of the Massachusetts Department of Environmental Protection/ Division of Watershed Management's (MA DEP/DWM) 2002 Ten Mile River watershed assessments, aquatic benthic macroinvertebrate biomonitoring was conducted to evaluate the biological health of various rivers and streams within the watershed. A total of eleven biomonitoring stations were sampled to investigate the effects of nonpoint and point source stressors—both historical and current—on the aquatic communities of the watershed. Some stations sampled during the 2002 biomonitoring survey were previously "not assessed" by DEP, while other historical stations—sampled most recently in 1997 (MA DEP 2000)—were reevaluated to determine if water quality and habitat conditions have improved or worsened over time. To minimize the effects of temporal (seasonal and year to year) variability, sampling was conducted at approximately the same time of the month as the 1997 biosurveys. Sampling locations, along with station identification numbers and sampling dates, are noted in Table B1. Sampling locations are also shown in Figure B1.

In some cases (e.g., point source investigations), a site-specific sampling approach was implemented, in which the aquatic community and habitat downstream from the perceived stressor (downstream study site) were compared to an upstream reference station (control site) representative of "least disturbed" biological conditions for that waterbody. While the alternative to this site-specific approach is to compare the study site to a regional or watershed reference station (i.e., "best attainable" condition), the site-specific approach is more appropriate for an assessment of a known or suspected stressor, provided that the stations being compared share basically similar instream and riparian habitat characteristics (Barbour et al. 1999). Since both the quality and quantity of available habitat affect the structure and composition of resident biological communities, effects of such features can be minimized by sampling similar habitats at stations being compared, providing a more direct comparison of water quality conditions (Barbour et al. 1999). Sampling highly similar habitats also reduces metric variability, attributable to factors such as current speed and substrate type. Upstream reference stations were established in the Bungay and Ten Mile rivers.

To provide additional information necessary for making basin-wide *Aquatic Life* use-support determinations required by Section 305(b) of the Clean Water Act, all Ten Mile River watershed macroinvertebrate biomonitoring stations were compared to a regional reference (i.e., watershed reference) station most representative of the "best attainable" conditions in the watershed. Use of a watershed reference station is particularly useful in assessing nonpoint source pollution originating from multiple and/or unknown sources in a watershed (Hughes 1989). Two regional reference stations were used for the 2002 Ten Mile River bioassessments—one on the mainstem Ten Mile River near its headwaters (TM01), and the other on the Sevenmile River (SM00), which is classified as both an *Outstanding Resource Water* and a *Class A* public water supply (MA DEP 1996). Both stations have been historically used as reference conditions by DEP for bioassessment purposes (MA DEP 2000). TM01 serves as the primary reference station for mainstem Ten Mile River biomonitoring stations, while SM00 is the primary reference for tributary stations. In addition, both stations were compared to each other. The reference stations were situated upstream from all known point sources of water pollution, and were also assumed (based on historical DEP water quality data, topographic map examinations, and field reconnaissance) to be minimally impacted (relative to other portions of the watershed) by nonpoint sources.

During "year 1" of its "5-year basin cycle", problem areas within the Ten Mile River watershed were better defined through such processes as coordination with appropriate groups (EOEA Ten Mile River Watershed Team, local watershed associations, MA DEP/DWM), assessing existing data, conducting site visits, and reviewing NPDES and water withdrawal permits. Following these activities, the 2002 biomonitoring plan was more closely focused and the study objectives better defined. Table 2 includes a

summary of the important current and historical conditions and perceived problems identified prior to the 2002 Ten Mile River watershed biomonitoring survey.

The main objectives of 2002 biomonitoring in the Ten Mile River watershed were: (a) to determine the biological health of streams within the watershed by conducting assessments based on aquatic macroinvertebrate communities; and (b) to identify problem stream segments so that efforts can be focused on developing or modifying NPDES permits, Water Management Act (WMA) permits, stormwater management, and control of other nonpoint source (NPS) pollution. Specific tasks were:

1. Conduct benthic macroinvertebrate sampling and habitat assessments at locations throughout the Ten Mile River watershed.

2. Based upon the macroinvertebrate and habitat data, identify river segments within the watershed with potential point/nonpoint source pollution problems; and

3. Using the benthic macroinvertebrate data and supporting water chemistry and field/habitat data:
   - Assess the types of water quality and/or water quantity problems that are present, and
   - if possible, make recommendations for remedial actions or additional monitoring and assessment.
   - Provide macroinvertebrate and habitat data to MA DEP/DWM's Environmental Monitoring and Assessment Program for assessments of *Aquatic Life* use-support status required by Section 305(b) of the Federal Clean Water Act (CWA).
   - Provide macroinvertebrate and habitat data for other informational needs of Massachusetts environmental agencies.

Table B1. List of biomonitoring stations sampled during the 2002 Ten Mile River watershed survey, including station identification number, mile point, site description, and sampling date. Stations are listed hydrologically (from upstream-most drainage in the watershed to downstream-most) with mainstem stations listed first.

Station ID	Upstream Drainage Area (mi^2)	River Mile	Ten Mile River Watershed Site description	Sampling Date
TM01*	1.7	19.8	Ten Mile River, 100 m dnst. from Fuller St., Plainville, MA	23 July '02
TM02*	3.3	18.8	Ten Mile River, 100 m dnst.from West Bacon St., Plainville, MA	23 July '02
TM06*	10.9	14.0	Ten Mile River, 200 m dnst. from Cedar St., (above WWTP), N. Attleborough, MA	23 July '02
TM06A*	11.0	13.8	Ten Mile River, 460 m dnst. from Cedar St., (below WWTP), Attleboro, MA	23 July '02
TM11*	25.2	9.0	Ten Mile River, 120 m dnst. from Tiffany St., Attleboro, MA	24 July '02
TM14*	42.0	5.0	Ten Mile River, 200 m dnst. from Central Ave., Pawtucket, RI	24 July '02
BR03	2.8	4.5	Bungay River, 300 m dnst. from Bungay Rd., (above hatchery), N. Attleborough, MA	7 Nov '02**
BR02	3.5	4.0	Bungay River, nr. end of Mary-Kennedy Rd., (below hatchery), N. Attleborough, MA	7 Nov '02**
SM00*	3.5	5.6	Sevenmile River, 50 m upst. from Draper Ave., N. Attleborough, MA	23 July '02
FM01*	1.0	1.6	Fourmile River, 100 m dnst. from West St., Attleboro, MA	24 July '02
CB01A	3.0	0.9	Coles Brook, 100 m dnst. from Talbots Way, Seekonk, MA	24 July '02

*biomonitoring conducted by DEP here in 1997 (MA DEP 2000); **multiplate sampler retrieval date following 8-week colonization

Table B2. Existing conditions and perceived problems identified prior to the 2002 Ten Mile River watershed survey.

Ten Mile River Watershed Stations	Conditions
TM01; TM06; TM06A; TM11; CB01	-sedimentation (includes sand/gravel operation inputs)[1]
TM02; TM04; TM06; TM06A; TM11; TM14; CB01; FM01	-urban runoff/miscellaneous NPS pollution[1]
TM06A; TM14	-point source discharges – municipal WWTPs[1,2]
BR02	-point source discharges – federal fish hatchery[1,2]
TM02; TM04; TM06; TM06A; TM11; TM14	-303d listed for nutrients and/or organic enrichment/low D.O.[1,3]
TM01; TM02; SM00; CB01	-groundwater withdrawals/flow reductions[1]
BR02; BR03; FM01; CB01	-"not assessed" by DEP[1]
TM01; SM00; BR03	- reference condition[1]

[1]MA DEP 2000; [2]MA DEP 2005; [3]MA DEP 2002a

TEN MILE RIVER WATERSHED
2002 BIOMONITORING STATIONS

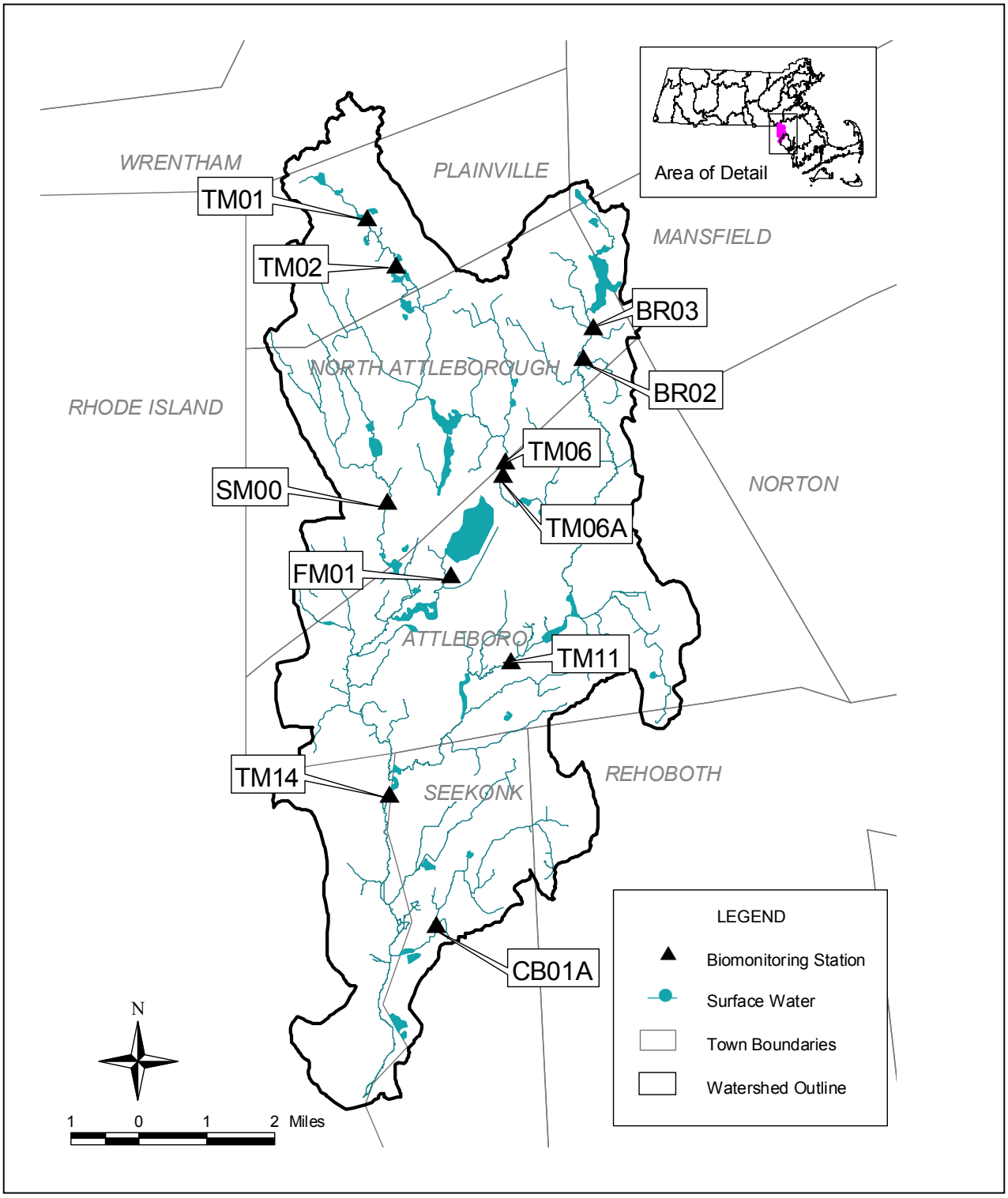


Figure B1. Location of MA DEP/DWM biomonitoring stations for the 2002 Ten Mile River watershed survey.

Ten Mile River Watershed

Basin Description

The Ten Mile River drains an area of 54 square miles in southeastern Massachusetts and eastern Rhode Island. Originating in Savage's Pond in Plainville, Massachusetts, the river flows generally south to southwest through the Massachusetts communities of Plainville, North Attleborough, Attleboro, and Seekonk to Pawtucket and East Providence, Rhode Island before emptying into the Seekonk River and ultimately into the Narragansett Bay estuary. The total length of the Ten Mile River is 22 miles, of which 15 miles are in Massachusetts. The elevation of the river drops from 230 feet above mean sea level at its source to ten feet at its confluence with the Seekonk River. River flow is characterized, and controlled, by 15 dams along its course.

The two major tributaries to the Ten Mile River are the Bungay and Sevenmile rivers. The former originates in a wetland in the town of North Attleborough and flows southerly through an extensive wetland system for approximately five miles, joining the Ten Mile River just upstream of Mechanics Pond in the city of Attleboro. The drainage area of the Bungay River system is less than eight square miles. The Sevenmile River begins in the town of North Attleborough and flows in a southerly direction through a series of impoundments which are controlled for the city of Attleboro's water supply system. The drainage area for the Sevenmile subbasin is 12.7 square miles. In addition to three minor tributaries (Fourmile Brook, Coles Brook, and Scott's Brook), there are a total of 45 lakes and ponds covering 1296 acres located in the Ten Mile River watershed.

The physical characteristics of the Ten Mile River watershed are dominated by low, gently rolling hills with elevations ranging from near sea level at the mouth to over 400 feet above sea level in the northern portion of the basin. Urban development in the watershed is centered in the communities of Plainville, North Attleborough, Attleboro, Pawtucket, and East Providence with the heaviest development often adjacent to the mainstem Ten Mile River. Recent development in the Ten Mile basin has reflected the growth patterns in eastern Massachusetts and has brought increased pressure upon the natural resources of the watershed.

The Ten Mile River watershed supplies both surface water (3 withdrawal sites) and groundwater (29 wells) to six municipal public water supply systems and five privately owned public water supply systems. These suppliers withdraw up to 10.54 MGD from these sources and are permitted to increase the withdrawals an additional 1.23 MGD by the year 2011. The watershed also receives wastewater discharges from two municipal treatment facilities and nine non-municipal sources.

METHODS

Macroinvertebrate Sampling

The macroinvertebrate sampling procedures employed during the 2002 Ten Mile River watershed biomonitoring survey are described in the *Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates* standard operating procedures (Nuzzo 2002), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Barbour et al. 1999). For most stations, the macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream (Figure 2). Sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Sampling was conducted at each station by MA DEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the MA DEP/DWM lab for further processing.

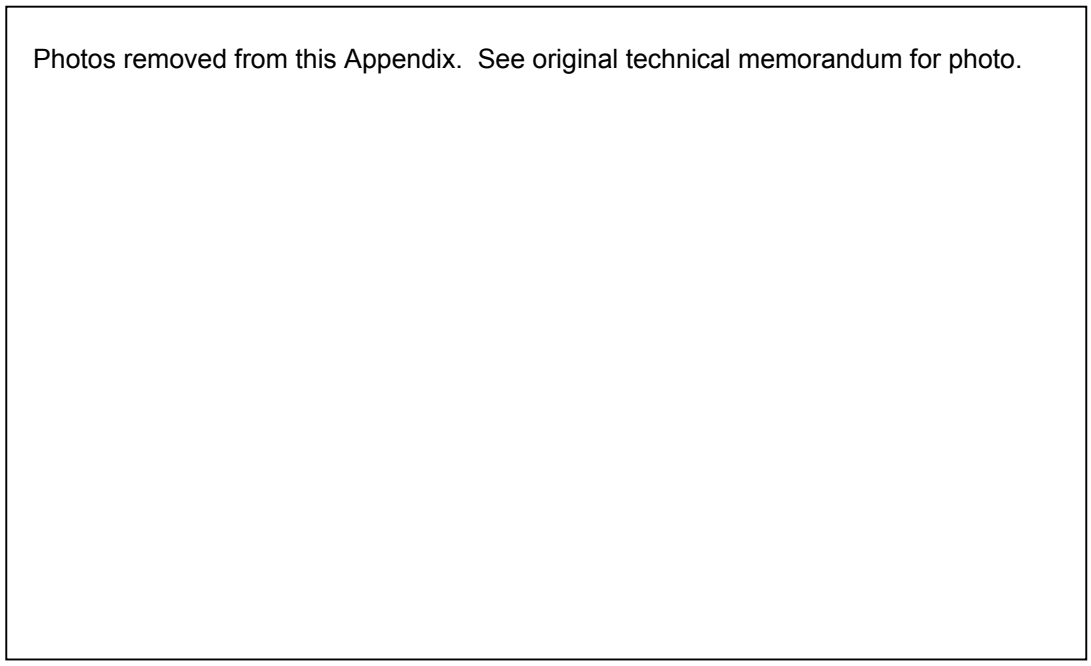


Figure B2. MA DEP/DWM biologist collecting macroinvertebrates using the “kick-sampling” technique.

Where conditions were inappropriate for the sampling of natural substrates, artificial substrate samplers were utilized. Artificial substrates, such as rock baskets or multiplate samplers, are especially useful in larger streams and rivers, or in streams lacking appropriate flow regimes and/or substrate types for kick sampling (Plafkin et al.1989). Artificial substrate samplers are also an ideal means of sampling because each sampler offers an identical area and substrate for colonization, and thus, a more standardized collection technique than kick sampling. Biological sampling in the Bungay River required artificial substrate sampler deployment. Hester-Dendy multiplate samplers were deployed as triplicates at each station. Samplers were fastened horizontally to a 38 cm x 18 cm x 9 cm concrete block and placed on the streambed (Figure 3). Multiplates were deployed for an 8 week period, allowing for sufficient macroinvertebrate colonization. Upon retrieving samplers, each multiplate was submerged in a water-filled 1000 ml polyethylene bottle, and transported to the DWM biomonitoring laboratory where they were disassembled and rinsed, and organisms were picked and prepared (i.e., removed and preserved in 70% ethanol) for sample processing.

Figure B3. Multiplate samplers for shallow-water deployment.

Macroinvertebrate Sample Processing and Analysis

The macroinvertebrate sample processing and analysis procedures employed for the 2002 Ten Mile River watershed biomonitoring samples are described in the standard operating procedures (Nuzzo 2002) and were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Macroinvertebrate sample processing entailed distributing whole samples in pans, selecting grids within the pans at random, and sorting specimens from the other materials in the sample until approximately 100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity. Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Plafkin et al. 1989). Based on the taxonomy, various community, population, and functional parameters, or "metrics", were calculated which allow measurement of important aspects of the biological integrity of the community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated. Deficiency of any one metric should not invalidate the entire approach (Barbour et al. 1999). Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for a selected "least-impacted" reference station yields an impairment score for each site. The analysis separates sites into four categories: non-impacted, slightly impacted, moderately impacted, and severely impacted. Each impact category corresponds to a specific *Aquatic Life* use-support determination used in the CWA Section 305(b) water quality reporting process—non-impacted and slightly impacted communities are assessed as "support" in the 305(b) report; moderately impacted and severely impacted communities are assessed as "impaired." A definition of the *Aquatic Life* use designation is provided in the *Massachusetts Surface Water Quality Standards* (SWQS) (MA DEP 1996). Impacts to the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Barbour et al. 1999). Those biological metrics calculated and used in the analysis of 2002 Ten Mile River watershed macroinvertebrate data are listed and defined below [For a more detailed description of metrics used to evaluate benthos data, and the predicted response of these metrics to increasing perturbation, see Barbour et al. (1999)]:

1. Taxa Richness—a measure based on the number of taxa present. Generally greater with better water quality, habitat diversity, and habitat suitability. The lowest possible taxonomic level is assumed to be genus or species.

2. EPT Index—a count of the number of genera/species from the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). As a group these are considered three of the more sensitive aquatic insect orders. Therefore, the greater the contribution to total richness from these three orders, the healthier the community.

3. Biotic Index—Based on the Hilsenhoff Biotic Index (HBI), this is an index designed to produce a numerical value to indicate the level of organic pollution (Hilsenhoff 1982). Organisms have been assigned a value ranging from zero to ten based on their tolerance to organic pollution. Tolerance values currently used by MA DEP/DWM biologists were originally developed by Hilsenhoff and have since been supplemented by Bode et al. (1991) and Lenat (1993). A value of zero indicates the taxon is highly intolerant of pollution and is likely to be found only in pollution-free waters. A value of ten indicates the taxon is tolerant of pollution and may be found in highly polluted waters. The number of organisms and the individually assigned values are used in a mathematical formula that describes the degree of organic pollution at the study site. The formula for calculating HBI is:

$$HBI = \sum \frac{x_i t_i}{n}$$

where:

x_i = number of individuals within a taxon
t_i = tolerance value of a taxon
n = total number of organisms in the sample

4. Ratio of EPT and Chironomidae Abundance—The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Skewed populations having a disproportionate number of the generally tolerant Chironomidae ("midges") relative to the more sensitive insect groups may indicate environmental stress.

5. Percent Contribution Dominant Taxon—is the percent contribution of the numerically dominant taxon (genus or species) to the total number of organisms. A community dominated by few species indicates environmental stress. Conversely, more balance among species indicates a healthier community.

6. Ratio of Scraper and Filtering Collector Functional Feeding Groups—This ratio reflects the community food base. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source (Barbour et al. 1999). Scrapers predominate when diatoms are the dominant food resource, and decrease in abundance when filamentous algae and mosses prevail. Filtering collectors thrive where filamentous algae and mosses are prevalent and where fine particulate organic matter (FPOM) levels are high.

7. Community Similarity—is a comparison of a study site community to a reference site community. Similarity is often based on indices that compare community composition. Most Community Similarity indices stress richness and/or richness and abundance. Generally speaking, communities with comparable habitat will become more dissimilar as stress increases. In the case of the Ten Mile River watershed bioassessment, an index of macroinvertebrate community composition was calculated based on similarity (i.e., affinity) to the reference community, expressed as percent composition of the following organism groups: Oligochaeta, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera, Chironomidae, and Other. This reference site affinity approach is based on a modification of the Percent Model Affinity (Novak and Bode 1992). The (RSA) metric is calculated as:

   $100 - (\Sigma\ \delta \times 0.5)$

   where δ is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBPIII scores as follows: <35% receives 0 points; 2 points in the range from 35 to 49%; 4 points for 50 to 64%; and 6 points for $\geq$65%.

Multiplate Sample Analysis

A determination of whether or not the perceived stressor (i.e., the fish hatchery discharge) has caused an impact to the downstream macroinvertebrate community is made by DWM based on the combined results of all calculated metrics. Mean metric values for replicates are compared between sites, with mean values scored and compared using the same multi-metric approach outlined above.

Additionally, statistical analysis of data (metrics values) can be performed for the test site and compared to the control site using tests of significance:

Mann-Whitney test:

The Mann-Whitney Test is one of the most powerful non-parametric tests, and can be a useful alternative to *t-tests* and their assumptions of normality (Zar 1984). The general description of this statistical test can be found in Sokal and Rohlf (1969). The statistic is calculated as follows:

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

where n_1 and n_2 are the number of observations in samples 1 and 2, respectively, and R_1 is the sum of the ranks of the observation in sample 1. If U is found to be as great or greater than the critical value at 0.05 significance, the null hypothesis (i.e., the two means are equal) is rejected.

Habitat Assessment

An evaluation of physical and biological habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2002 Ten Mile River watershed biosurveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and related streamside features. Most parameters evaluated are instream physical attributes often related to overall land-use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a reference station to provide a final habitat ranking.

QUALITY CONTROL

Field and laboratory Quality Control (QC) activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Quality Control procedures are further detailed in the standard operating procedures (Nuzzo 2002).

Field Sampling Quality Control

Field Sampling QC entails: 1) Pre- and post-sampling rinses, inspection of, and picking of nets, sieves, and pans to prevent organisms collected from one station to be transferred to samples taken elsewhere; 2) On-site preservation of benthos kick sample in 95% ethanol to ensure proper preservation; and 3) To assess the consistency of the sampling effort, collection of a duplicate sample is performed at 10% of the stations sampled in the watershed. Two samples are collected “side by side” —a second kick sample (i.e., the duplicate) is taken adjacent to (where different assessment results are not expected due to the apparent absence of additional stressors) the original kick at each of the ten kicks conducted in a given 100 m sample reach. Duplicate samples are composited in a similar manner as the original sample; yet, they are preserved in a separate sample bottle marked “duplicate” and with all other information regarding station location remaining the same. Duplicate samples are used for the calculation of Precision of the benthos data.

Field Analytical Quality Control

Field Analytical QC entails multiple observers (at least both DWM benthic biologists, and a third person)—all trained in the habitat evaluation procedures—performing the Habitat Assessment at each biomonitoring station. A standardized Habitat Assessment Field Scoring Sheet is completed at all biomonitoring stations. Disagreement in habitat parameter scoring is discussed and resolved before the Habitat Assessment can be considered complete.

Fixed Laboratory Quality Control

Fixed Laboratory QC entails the following: 1) Taxonomy bench sheets are examined by a reviewer (the DWM benthic biologist not responsible for the taxonomic identifications) for errors in transcription from bench notebook, count totals, and spelling. All bench sheets are examined, and detected errors are brought to the taxonomist’s attention, discussed, and corrected. 2) Taxonomic duplication, in which “spot checks” are performed by a reviewer (the DWM benthic biologist not responsible for the taxonomic identifications) on taxonomy, is performed at the reviewer’s discretion. In general, all taxa that are rarely encountered in routine benthos samples, or taxa that the primary taxonomist may be less than optimally proficient at identifying, are checked. Spot checks are performed for all stations. Specimens may be sent to authorities for particular taxonomic groups. 3) Data reduction and analysis, including biological metric

scoring (metric values are calculated through queries run in the DWM Benthic Macroinvertebrate Database), comparisons to reference station metrics, and impairment designations, are checked by a reviewer (the DWM benthic biologist not responsible for performing the taxonomy and data analysis) for all benthos data at all stations. Detected errors are brought to the original taxonomist's attention and resolved. 4) Precision, a measure of mutual agreement among individual measurements or enumerated values of the same property of a sample and usually expressed as a standard deviation in absolute or relative terms, is compared using raw benthos data and metric values. If metric values and resulting scoring are significantly different (i.e., beyond an acceptable Relative Percent Difference) between the original and duplicate samples, the investigators will attempt to determine the cause of the discrepancy. Guidance regarding the calculation of Precision, including Relative Percent Difference (RPD) calculations and recommendations, can be found in US EPA (1995) and Barbour et al. (1999).

RESULTS AND DISCUSSION

The biological and habitat data collected at each sampling station during the 2002 biomonitoring survey are attached as an Appendix (Tables A1 – A7). Table A1 is the macroinvertebrates taxa list for each station and includes organism counts, the functional feeding group designation (FG) for each macroinvertebrate taxon, and the tolerance value (TV) of each taxon.

Summary tables of the macroinvertebrate data analysis, including biological metric calculations, metric scores, Mann-Whitney test results, and impairment designations, are also included in the Appendix. Table A2 summarizes biomonitoring station comparisons to the Ten Mile River reference station (TM01). Table A3 is the summary table for station comparisons to the Sevenmile River reference site (SM00). Tables A4 and A5 show results of upstream-downstream (i.e., site-specific) comparisons for paired stations TM06-TM06A and BR02-BR03 respectively. Habitat assessment scores for each station are also included in the summary tables, while more detailed summaries of habitat parameters are shown in Tables A6 and A7.

The Ten Mile River watershed was affected by drought-induced low flows during the 2002 biomonitoring survey (MA DCR 2005). Drought conditions and below normal precipitation persisted for several months (February-September 2002) prior to the September macroinvertebrate sampling period, reducing stream discharges well below the expected mean for their period of record (MA DCR 2005; USGS 2003). The net effect was a reduction in available instream habitat, including exposure of stream bottom substrates during the 2002 biosurveys. These habitat constraints may result in the stranding or concentration of biota (both benthic macroinvertebrates and fish) into the remaining available habitats. In addition, these conditions tend to increase the stress upon sensitive species, and increase the metabolic rate of poikilothermic biota.

The 2002 biomonitoring data for this watershed generally indicate various degrees of nonpoint source-related problems in many of the streams examined. Urban runoff, habitat degradation, and other forms of NPS pollution compromise water quality and biological integrity throughout the watershed—most notably at TM11, TM14, and FM01. Serious water quality and biological impairment were also evident at TM06A, most likely the result of upstream wastewater treatment activities. That said, some tributaries examined (e.g., Sevenmile and Bungay rivers) in the Ten Mile River watershed remain relatively non-impacted and are indicative of the "best attainable" conditions in the watershed. It is imperative that anthropogenic perturbations be kept to a minimum in these unimpaired waterbodies.

SEVENMILE RIVER

SM00—Sevenmile River, mile point 5.6, 50 m upstream from Draper Avenue, North Attleborough, MA

Habitat

The 100 m sampling reach began approximately 50 m upstream from Draper Avenue and meandered through an extensive deciduous forest that provided 60% canopy cover to the stream. The sampling reach was approximately 2.5 m wide with a fairly uniform depth of 0.2 m. Flow regimes were dominated

by swift current velocity that, along with an abundance of cobble substrates, provided macroinvertebrates with excellent epifaunal habitat. Fish cover was also exceptional, due to the optimal channel flow status and a good mix of snags, submerged logs, boulder, and overhanging vegetation. Instream aquatic vegetation was minimal and consisted of a few small beds of water starwort (*Callitriche* sp.); Algae were not observed anywhere in the SM00 reach. Banks were stable and well vegetated with grasses and herbaceous growth (ferns; mosses; jewelweed, *Impatiens capensis*; goldenrod, *Salidago* sp.; reed grass, *Phragmites australis*; greenbrier, *Smilax rotundafolia*), and large boulders along the margins of the stream providing additional stability. Riparian vegetation extended undisturbed from both banks, with a profusion of shrubs (riverbank grape, *Vitis riparia*; rose, *Rosa* sp.; dogwood, *Cornus* sp.; buckthorn, *Rhamnus* sp; *Viburnum* sp.) giving way to deciduous trees (red maple, *Acer rubrum*; birch, *Betula* sp.; elm, *Ulmus rubra*).

SM00 received a total habitat assessment score of 175/200 (Table A6). Instream sediment deposition, which was confined to slow-water areas and was also observed here during the 1997 survey—continues to threaten epifaunal habitat potential in this portion of the Sevenmile River. Sources of sediment inputs are unknown; however, impervious surfaces associated with commercial development located upstream in the vicinity of Route 1 should be considered.

As was the case during the 1997 biosurveys, this was one of two (a second reference station, TM01, is discussed next) designated watershed reference stations for all Ten Mile River watershed biomonitoring stations by virtue of its instream and riparian habitat potential (highest habitat assessment score in 1997 and 2002), presumed good water quality [(Sevenmile River is classified as both an *Outstanding Resource Water* and a *Class A* public water supply (MA DEP 1996)], minimal nonpoint source pollution inputs, and minimal upstream/adjacent land-use impacts (e.g., absence of point source inputs, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well vegetated riparian zone).

Benthos

Although its status as a watershed reference condition assumes biota here to be unimpacted, the SM00 macroinvertebrate community was nevertheless compared to the mainstem Ten Mile River reference station (TM01, which will be discussed next). The SM00 benthos assemblage received a total metric score of 40, representing 95% comparability to TM01 and resulting in an assessment of “non-impacted” for biological condition (Table A2). The metric values (Tables A2) calculated as part of the RBP analysis reflect the healthy benthic community one would expect to find in a “least impacted” stream. Total Taxa Richness was particularly high here (27—the highest richness in the entire 2002 survey). A measure of community structure, this richness metric is known to display some of the lowest inherent variability among the RBP metrics used (Resh 1988). The Percent Dominant Taxon (16%) metric also performed extremely well relative to other stations in the survey, indicating good overall balance in the SM00 benthic community.

TEN MILE RIVER

TM01—Ten Mile River, mile point 19.8, 100 m downstream from Fuller Street, Plainville, MA

Habitat

The TM01 sampling reach began approximately 100 m downstream from Fuller Street and the outlet of Fuller Pond in Plainville. Near its headwaters, the river is small here in this relatively undeveloped and forested portion of the watershed. Stream width was only about half a meter, with depth in the riffle areas and pools no more than a few inches. The extremely shallow conditions (channel flow status rated “poor”) resulted in vitually no instream cover for fish, and less than optimal epifaunal habitat for benthos—though macroinvertebrates were afforded an abundance of rocky substrates in the form of cobble and pebble. Instream aquatic vegetation (mainly watercress, *Nasturium* sp. and water starwort, *Callitriche* sp.) covered less than five percent of the reach bottom, while algal coverage was considerably extensive—filamentous forms and thin green film covered approximately 80% of the reach, although much of it appeared moribund. The abundance of algae here was surprising, as the surrounding forest shaded (70% canopy cover) the

majority of the reach, and sources of nutrients were not suspected this far upstream in the watershed. Riparian vegetation was diverse and extensive, comprised of a hardwood (red maple, *Acer rubrum*; ash, *Fraxinus americana*; red oak, *Quercus rubra*) mix and understory shrubs (rose, *Rosa* sp.; *Viburnum* sp.). Banks were well vegetated along both sides with a mix of grasses, vines (poison ivy, *Rhus radicans*), and herbaceous growth (jewelweed, *Impatiens capensis*; skunk cabbage, *Symplocarpus foetidus*). Nonpoint source pollution inputs were not observed in the TM01 sampling reach. Despite the potential for sediment inputs originating from the upstream road crossing and sand/gravel operation, instream sedimentation and embeddedness were virtually absent.

TM01 received a total habitat assessment score of 137/200 (Table A6). Low-scoring habitat parameters were directly a result of extremely low baseflow. In addition, the effects of drought conditions observed during the biosurvey here may have been exacerbated by baseflow reductions related to water withdrawals. A pumping station is located immediately adjacent to the TM01 sampling reach, and a total of four groundwater wells are registered for withdrawal in this portion of the Ten Mile River (MA DEP 2000).

As was the case during the 1997 Ten Mile River watershed biosurveys, this was the designated reference station for all mainstem Ten Mile River biomonitoring stations (and a secondary reference for tributary stations) based on its instream and riparian habitat potential, presumed good water quality, absence of nonpoint source pollution inputs, and minimal upstream/adjacent land-use impacts (e.g., absence of point source inputs, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well vegetated riparian zone). The utility of TM01 as a reference station should, however, be considered with caution as no doubt the potential for adjacent wells to alter natural baseflows in this portion of the river compromises the "reference potential" of this station—even during non-drought years—particularly since headwater discharge contributions to TM01 are minimal.

Benthos

TM01 was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and "least-impacted" conditions (Table A2). Compared to the SM00 reference station, the TM01 macroinvertebrate community received a total metric score of 36, representing 86% comparability to that reference condition and corroborating its own use as a reference station for other mainstem Ten Mile River biomonitoring stations. The dominant taxon at TM01 comprised a mere 14% (the lowest of all the biomonitoring stations) of the benthos sample, suggesting good balance among the benthic community here.

The abundance of the chironomid *Thienemannimyia* gr. among the resident biota here may be a reflection of the low baseflow conditions observed in this portion of the Ten Mile River during the 2002 biomonitoring survey, as this taxon has been known to predominate in streams subjected to periods of reduced flow (Robert Bode, NY DEC, personal communication, 1998). Also observed in the benthos sample was the caddisfly *Lepidostoma* sp.—a pollution sensitive taxon known to survive droughts (Del Rosario and Resh 2000; Bode, NY DEC, personal communication, 1998). The TM01 benthic community received a total metric score of 42 out of a possible score of 42 (Table A2).

TM02—Ten Mile River, mile point 18.8, 100 m downstream from West Bacon Street, Plainville, MA

Habitat

Station TM02 began approximately 100 m downstream from West Bacon Street in an urbanized (industrial and residential development) portion of the watershed. The sampling reach was located about midway between Plainville and Wetherells ponds and meandered through the property of a large cemetery near Plainville center. The impervious surfaces and extensive lawns, associated with the adjacent industries and cemetery respectively, resulted in a completely open-canopied (0% shaded) reach. The river is small here, with a width of less than one meter, and depths in the limited riffle areas of approximately 0.10 m. Much of the sampling reach was "flat" water—kicks were concentrated in two small areas on both sides of a large, deep (0.50 m) pool near the West Bacon Street crossing. Hard substrates

were small (i.e., mostly pebble, gravel, and sticks) in the reach, resulting in marginal epifaunal habitat for macroinvertebrates and providing little cover for fish. Aquatic vegetation was observed in about 25% of the reach and was comprised of rooted forms of submergent macrophytes (watercress, *Nasturium* sp.; milfoil, *Myriophyllum* sp.; water starwort, *Callitriche* sp.). Algae were not observed during the biosurvey here; however, turbid instream conditions made it difficult to see the river bottom. Both stream banks were stable and well vegetated with grasses and herbaceous vegetation. In addition to the herbaceous growth (smartweed, *Polygonum* sp.; raspberry, *Rubus* sp.; jewelweed, *Impatiens capensis*; Joe-Pye weed, *Eupatorium* sp.; goldenrod, *Salidago* sp.; turtlehead, *Chelone glabra*) near the banks, riparian vegetation included a narrow (6 - 10 m) zone of trees (red maple, *Acer rubrum*; white ash, *Fraxinus americana*; birch, *Betula* sp.; Scotch pine, *Pinus sylvestris*; Norway spruce, *Picea abies*) and shrubs (dogwood, *Cornus* sp.; elderberry, *Sambucus canadensis*; rose, *Rosa* sp.; *Rhododendron* sp.; buttonbush, *Cephalanthus occidentalis*) which offered at least some buffer between the river and potential NPS inputs from the adjacent road and the cemetery's large mowed lawn.

TM02 received a total habitat assessment score of 142/200 (Table A6). Poorly developed riffle habitat for macroinvertebrates, coupled with a reduced riparian zone, affected the total score most negatively. Instream sedimentation, which compromised benthic habitat quality during the 1997 biomonitoring survey here, was negligible during the 2002 sampling effort.

Benthos

TM02 received a total metric score of 38, representing 90% comparability to the mainstem reference station (TM01), and resulting in a "non-impacted" assessment of biological condition (Table A2). A similar (i.e., total metric score=38; "non-impacted") bioassessment was received when compared to its secondary reference station (SM00).

Several of the metric values for the TM02 benthic community outperformed those of both reference stations, including EPT Index (6—highest in the survey), EPT/Chironomidae, and Scraper/Filterer (4.27—highest in the survey). Only the Percent Dominant Taxon metric suffered point reductions, a result of a high density of the elmid beetle *Stenelmis* sp. The abundance of this scraping taxon indicates the presence of a periphyton-based food resource at TM02, as well as suitable levels of dissolved oxygen for this taxon's demanding respiratory requirements.

The current evaluation of the biota at TM02 represents an improvement over DWM's 1997 bioassessment, when comparisons to TM01 and SM00 resulted in a macroinvertebrate community assessment of "slightly impacted" and "moderately impacted" respectively (MA DEP 2000). Interestingly, scrapers were completely absent from the 1997 benthos assemblage, suggesting a shift in trophic structure since then (i.e., less deposited and suspended forms of organic matter, more periphyton).

TM06—Ten Mile River, mile point 14.0, 200 m downstream from Cedar Street, North Attleborough, MA

Habitat

The TM06 sampling reach began approximately 200 m downstream from Cedar Street and a short distance upstream from the North Attleborough WWTP discharge outfall. The river is wide (11 m) and shallow (0.10 - 0.30 m) in this forested and mostly shaded (80% canopy cover over reach) portion of the watershed, with cobble/gravel substrates and swift current velocity providing optimal habitat for macroinvertebrates. The lack of large hard substrates or deep water, despite the optimal channel flow status, resulted in minimal cover and marginal habitat for fish, however. Aquatic vegetation covered about 10% of the sampling reach and was comprised mainly of water starwort (*Callitriche* sp.), while algal cover was virtually absent. The riparian zone was heavily wooded and undisturbed along the left bank, consisting of an herbaceous/shrub (ferns; jewelweed, *Impatiens capensis*; goldenrod, *Salidago* sp.; greenbrier, *Smilax rotundifolia*; Japanese knotweed, *Polygonum cuspidatum*; buckthorn, *Rhamnus* sp.; barberry, *Berberis* sp.) layer along the river's edge before giving way to stands of red maple (*Acer rubrum*), red oak (*Quercus rubra*), and white pine (*Pinus strobus*). Banks were slightly less stable along the right bank, consisting of grasses and ferns that also provided understory vegetative cover within the

narrow riparian zone. NPS pollution in the form of yard waste was observed near the right bank and was associated with an adjacent residence, while additional potential inputs originating from the upstream road crossing (Cedar Street) were also considered.

TM06 received a total habitat assessment score of 159/200—the lack of stable fish cover affecting the score most negatively (Table A6). Effects from sedimentation (i.e., substrate embeddedness and instream sediment deposition), which were considerable here in 1997 and resulted in the listing of this segment as an impaired, Category 5 Water (i.e., reported to Congress and EPA as a 303(d)-listed water) due to "siltation" (MA DEP 2002a), were minimal during the 2002 biosurvey.

Benthos

When compared to its mainstem reference station on the Ten Mile River, TM06 received a total metric score of 40, representing 95% comparability to TM01 and placing the macroinvertebrate community in the "non-impacted" category for biological condition (Table A2). TM06 received a similar bioassessment when compared against the SM00 reference station, again resulting in a bioassessment of "non-impacted" based on 90% comparability to the reference site (Table A3). The TM06 benthos assemblage contained a greater number of pollution sensitive EPT taxa than both reference stations in terms of both richness and density, as seen in the high scoring EPT Index and EPT/Chironomidae metric values (Table A2). These results all point toward a relatively healthy benthic macroinvertebrate community in this portion of the river, which was also the conclusion made following the 1997 biomonitoring survey conducted here (MA DEP 2000). That overall biological integrity remains good at TM06 supports its use as an upstream reference (i.e., site-specific control) station for comparisons to TM06A in attempting to investigate impacts from the North Attleborough WWTP discharge. These upstream-downstream comparisons will be discussed next.

TM06A—Ten Mile River, mile point 13.8, 460 m downstream from Cedar Street, Attleboro, MA

Habitat

The TM06A biomonitoring reach began 460 m downstream from Cedar Street and just a short distance (approx. 200 m) below the discharge outfall for the North Attleborough WWTP (NPDES permit no. MA0101036). The mostly shaded (70%) reach was approximately 10 m wide and slightly deeper (0.20 - 0.30 m in riffles and runs) than TM06. Rocky substrates were plentiful, albeit small (mostly gravel and pebble), providing numerous short riffles areas and suboptimal epifaunal habitat for macroinvertebrates. Dense (50% cover) instream moss and macrophyte (watercress, *Nasturtium* sp.; water starwort, *Callitriche* sp.) cover, however, provided additional benthic microhabitat. The homogeneous nature of the substratum, and lack of other types of stable habitat resulted in poor fish cover. And despite optimal channel flow status, a lack of deep water resulted in limited pool habitat for fish.

Left bank stability and vegetative cover were good, with vines (poison ivy, *Rhus radicans*) and various forms of herbaceous (jewelweed, *Impatiens capensis*; goldenrod, *Salidago* sp.; Japanese knotweed, *Polygonum cuspidatum*) and shrubby (buckthorn, *Rhamnus* sp.; barberry, *Berberis* sp.) growth giving way to a wide and forested (red maple, *Acer rubrum*; birch, *Betula* sp.; ash, *Fraxinus americana*) riparian zone. Along the right bank, the close proximity of minimally buffered lawns resulted in unstable and poorly vegetated banks and a riparian zone devoid of any vegetation other than mowed grass. As was also noted during the 1997 biosurvey here, piles of yard waste (grass clippings and leaves) were deposited in multiple locations along the right bank throughout the sampling reach. Instream sediment deposition (gravel bars), though perhaps not to the extent observed in 1997, was again noted as was slight turbidity in the water column.

TM06A received a total habitat assessment score of 133/200 which was slightly better than the 1997 habitat evaluation here (Table A6). Poor fish cover and riparian disruption along the right bank affected the total score most negatively.

Benthos

The TM06A benthic community received a total metric score of 22, representing 52% comparability to both the mainstem reference station (TM01) and the Sevenmile River (SM00) reference site and resulting in an assessment of "moderately impacted" for biological condition (Tables A2 and A3). This was the worse bioassessment of all the mainstem Ten Mile River biomonitoring stations and second worse in the entire 2002 Ten Mile River watershed survey.

When using TM06 as a reference condition (i.e., upstream-downstream comparison) TM06A received a total metric score of 18, representing only 45% comparability to the upstream control. These findings suggest the N. Attleborough WWTP is the primary source of perturbation to downstream biota in this segment of the Ten Mile River (Table A4). The sudden and dramatic shift from a well-balanced and non-impacted benthic community immediately above the WWTP to one structured in response to organic enrichment immediately below the facility corroborates the impact of the discharge on biological potential in this portion of the river and the resulting "moderately impacted" bioassessment of TM06A. That organic loadings, and probably associated low levels of dissolved oxygen, are a probable cause of aquatic degradation within the TM06A benthic community is supported by a number of low-scoring metric values (Tables A2-A4). In particular, reduced Taxa Richness, an extremely low EPT Index (1—the lowest of all biomonitoring stations), and an elevated Biotic Index (7.05—the highest of all biomonitoring stations) all point toward a benthic community in which pollution sensitive taxa have become displaced by those more tolerant of organic pollutants. Indeed, the numerically dominant (n=27) taxon in the TM06A benthos assemblage, the midge *Micropsectra polita*, has a Tolerance Value of 7 (10 being the most tolerant of conventional organic wastes) (Table A1). This taxon has been proven useful as an indicator species for certain types of organic inputs, having been observed in high densities in streams impacted by cattle wastes (Bode and Novak 1998). Interestingly, *Micropsectra* sp. was absent from the benthos sample collected at TM06A in 1997, although that assemblage (also found to be "moderately impacted") was also dominated (n=45) by a taxon highly tolerant of organic wastes—the isopod *Caecidotea communis* (MA DEP 2000). *Caecidotea communis* remains well represented in the 2002 sample, with 17 individuals documented.

TM11—Ten Mile River, mile point 9.0, 120 m downstream from Tiffany Street, Attleboro, MA

Habitat

The TM11 sampling reach began approximately 120 m downstream from Tiffany Street, near the Dodgeville section of Attleboro. The reach was essentially a single long, deep riffle of uniform depth (0.40 m) with mainly cobble and large pebble substrates subjected to swift current velocity—optimal epifaunal habitat for macroinvertebrates but less than ideal as fish habitat. The homogeneity of substrates and flow regime throughout the sampling reach led to the decision of DWM biologists to collect an additional (i.e., duplicate) benthos sample at this station, as outlined in the QAPP (Fiorentino 2002). Stream width was approximately 8 m and channel flow status was optimal—water easily reached the upper banks. Instream aquatic vegetation covered approximately 40% of the stream bottom and was comprised mainly of rooted emergent macrophytes (water starwort, *Callitriche* sp.; waterweed, *Elodea* sp.) and some moss. Algal coverage appeared minimal, but was difficult to estimate due to high turbidity in the water column—a very heavy particulate load appeared responsible for the opaqueness of the water here. A narrow band of hardwoods (red maple, *Acer rubrum*; oak, *Quercus* sp.; birch, *Betula* sp.) along both sides of the river resulted in almost complete shading (90%) of the entire reach. Immediately beyond this thin riparian zone were the manicured lawns of adjacent residences near the right bank and a cemetery along the left bank, offering potential NPS pollution inputs. Both stream banks were well vegetated with grasses, vines (poison ivy, *Rhus radicans*), and shrubs (alder, *Alnus rugosa*; elderberry, *Sambucus canadensis*). Bank vegetation provided good stability along the right bank; however, much of the left bank showed signs of instability in the form of bank erosion.

The TM11 sampling reach received a total habitat assessment score of 144/200 (Table A6). Riparian disruption (i.e., reduced vegetative zone) and erosion along the left bank led to the majority of the point reductions for habitat quality. Instream sedimentation and associated substrate embeddedness appeared

less serious here than during the 1997 biosurvey when the parameters both received scores of 11 (MA DEP 2000).

Benthos

Compared to its primary reference station in the Ten Mile River (TM01) TM11 received a total metric score of 36, representing 86% comparability to the mainstem reference and resulting in a bioassesment of "non-impacted" (Table A2). Comparisons to the reference station in the Sevenmile River resulted in an assessment of "slightly impacted" (76% comparable to SM00) for biological condition (Table A3). The duplicate benthos assemblage performed slightly worse when compared to TM01, receiving a total metric score (30) that was 71% comparable to the mainstem reference condition and resulting in an assessment of "slightly impacted" (Table A2). Compared to the SM00 reference station, the duplicate sample performed similarly to TM11, again receiving a total metric score (30; 71% comparable to SM00) indicating "slightly impacted" biological condition (Table A3). The slight discrepancies between TM11 and the duplicate sample when compared to to the mainstem reference station are the result of increased numbers of a single filter-feeding taxon, Pisidiidae, in the duplicate sample and are probably attributed to within-site natural variability (Table A1). In general, both TM11 and its duplicate sample were highly similar to one another in terms of community composition and structure, as indicated by the duplicate's high Reference Affinity (87%) when compared to TM11, as well as numerous other similarly performing metrics (Tables A2 and A3).

Regardless of which TM11 benthos sample (i.e., the original or duplicate) is utilized, low scoring metric values for Taxa Richness and Percent Dominant Taxon suggest a somewhat unbalanced community—the result of a high density (n=35 in TM11; n=45 in TM11 duplicate) of the "finger nail clam" Pisidiidae and indicative of substantial suspended FPOM loads in this portion of the river (Table A1). Pisidiid clams were also well represented in the 1997 benthos assemblage collected here, which was also considered "slightly impacted" (MA DEP 2000). The hyperdominace of this filter-feeder in both the TM11 and TM11 duplicate samples is probably most directly related to the productive nature of various upstream waterbodies in this portion of the watershed. The entire length of the Ten Mile River from the North Attleborough WWTP to TM11 (and beyond) is currently on the 303(d) list of impaired waters for nutrients, organic enrichment, and associated low dissolved oxygen (MA DEP 2004). In addition, Dodgeville and Mechanics ponds—located just upstream from TM11—are impaired by nutrients and noxious aquatic plants (MA DEP 2004), reflecting the eutrophic conditions that contribute organic loads as a major food resource for downstream aquatic communities such as TM11.

TM14—Ten Mile River, mile point 5.0, 200 m downstream from Central Avenue, Pawtucket, RI

Habitat

The TM14 sampling reach began approximately 200 m downstream from Central Avenue in Pawtucket near the Rhode Island-Massachusetts border and about 1 km downstream from the Attleboro Water Pollution Control Facility (NPDES permit no. MA0100595) discharge. Despite the urban nature of this portion of the watershed, the biomonitoring reach was afforded a completely closed canopy (100% shaded) from the trees (red maple, *Acer rubrum*; oaks, *Quercus* spp.; ash, *Fraxinus* sp.) on both sides of the main channel. A secondary channel existed along the west side of the river; however, deep water and massive boulders—which appeared to be associated with old mill activity and bank stabilization efforts—made sampling there difficult. Both channels displayed optimal channel flow status, with water easily reaching the base of both banks and minimal amounts of substrates exposed. Current velocity was swift throughout the 20 m-wide sampling reach, resulting in well-developed riffle and run habitat of varying (0.1 m – 0.50 m) depths. Coupled with an abundance of large (mostly boulder and cobble) rocky substrates, snags, and other woody debris, both fish and macroinvertebrates were provided with excellent habitat throughout the reach. Instream vegetation was absent, although some patches of waterweed (*Elodea* sp.) were observed just upstream from the top of the reach. Algal coverage was minimal (<5% coverage) at TM14, consisting of thin films of green algae. Both banks were well vegetated and stabilized with an abundance of grasses, vines (Virginia creeper, *Parthenocissus quinquefolia*; riverbank grape, *Vitis riparia*), and herbaceous vegetation (jewelweed, *Impatiens capensis*; ferns), and shrubs (witchhazel,

Hamamelis virginiana; rose, *Rosa* sp.; barberry, *Berberis* sp.; dogwood, *Cornus* sp.; honeysuckle, *Lonicera* sp.). And despite the close proximity of commercial development and parking lots along both sides of the river, trees and other vegetation appeared to provide some buffering from potential nonpoint sources of pollution. Nevertheless, instream deposits of sediment and trash (scrap metal) greatly compromised aesthetics here and appear to have persisted since the 1997 biosurvey when they were first documented (MA DEP 2000).

TM14 received a total habitat assessment score of 163/200. This was one of the highest habitat evaluations in the survey—second only to the reference station in the Sevenmile River—and the highest received by a mainstem Ten Mile River biomonitoring station (Table A6). That said, instream sedimentation poses a serious threat to biological potential throughout the TM14 sampling reach. Sand and other fine sediments drastically reduce macroinvertebrate microhabitat by filling the interstitial spaces of epifaunal substrates. In addition, the filling of pools with sediment reduces fish cover and may be detrimental to fish egg incubation and survival. Sediment sources probably originate from numerous areas in this highly urbanized portion of the watershed—upstream road crossings, parking lots and other impervious surfaces, and nearstream sand/gravel operations all may contribute to the instream deposition observed at TM14.

Benthos

When compared to its mainstem reference station, the TM14 macroinvertebrate community received a total metric score of 32, representing 76% comparability to TM01 and resulting in a "slightly impacted " bioassessment (Table A2). Discrepancies with reference station metric values were mainly confined to Scraper/Filterer and Percent Dominant Taxon values resulting from an influx of filter-feeding taxa at TM14 that appear to have displaced more pollution-sensitive scraping forms (Tables A1 and A2). Particularly abundant (n=30) in the TM14 benthos assemblage was the net-spinning philopotamid caddisfly, *Chimarra* sp., which relies on suspended forms of fine organic particulates as a food resource. Interestingly, filter-feeding caddisflies dominated (n=54) the 1997 benthos assemblage collected here also; however, that sample was comprised mainly of hydropsychids, which display a slightly higher tolerance of organic pollutants than Philopotamidae.

The TM14 benthic community performed better when compared to its secondary reference station, SM00. A total metric score of 36 represented 86% comparability to SM00 and resulted in a biological condition assessment of "non-impacted". The hyperdominance of *Chimarra* sp. again was responsible for metric score reductions, both in the Percent Dominant Taxon and Taxa Richness metrics (Table A3).

The high overall habitat evaluation relative to both reference stations infers that water quality is more limiting to biological potential than habitat effects at TM14. The Attleboro WPCF may be partially responsible for water quality degradation and the resulting effects on the benthic macroinvertebrate community at TM14. Discharge effects, or nonpoint sources of organic enrichment associated with urban runoff, are reflected in the preponderance (approximately half of the assemblage) of filter-feeding caddisflies in the macroinvertebrate assemblage. In addition, the impounded nature of the river between the Attleboro WPCF and TM14—which is 303(d)-listed due to impairment from nutrients, organic inputs, and other pollutants (MA DEP 2004)—probably contributes high levels of FPOM to this portion of the river. Considerable turbidity was observed at this station as well.

FOURMILE RIVER

FM01—Fourmile River, mile point 1.6, 100 m downstream from West Street, Attleboro, MA

Habitat

The FM01 sampling reach began approximately 100 m downstream from West Street in a housing development located between Manchester and Orrs ponds. The stream was small here, with a width of 2 m and a maximum depth of only 0.10 m despite the optimal channel flow status. Only about half the reach contained substrates suitable for kick sampling—small cobble and pebble subjected to shallow riffles provided suboptimal epifaunal habitat. The shallow nature of the stream, coupled with small-sized

substrates and a total lack of stable cover, led to very poor fish habitat. Heavy deposits of fine sediments throughout the reach compromised all types of aquatic habitat—this was by far the most severe sediment deposition observed in the 2002 biomonitoring survey (Table A6). Neither instream vegetation nor algae were observed, and the water column appeared slightly turbid. Riparian and bank vegetation along the left bank has been completely replaced with a manicured lawn, and much of this bank has areas of erosion. The right bank remains relatively stable and well vegetated with various shrubs (rose, *Rosa* sp.; barberry, *Berberis* sp.; bittersweet, *Celastrus* sp.; dogwood, *Cornus* sp.; honeysuckle, *Lonicera* sp.; and herbaceous vegetation (ferns; goldenrod, *Salidago* sp.; smartweed, *Polygonum* sp.). The riparian zone between this bank and an adjacent road is narrow but wooded (red maple, *Acer rubrum*; red oak, *Quercus rubra*; hemlock, *Tsuga canadensis*; white pine, *Pinus strobus*), providing a narrow vegetative buffer and shading about 60% of the TM14 sampling reach. An old stone wall runs parallel to the sampling reach near the right bank, and a small footbridge traverses the stream approximately midreach.

FM01 received a total habitat assessment score of 96/200 (Table A6). This was easily the worst habitat evaluation received by a biomonitoring station in the 2002 survey. Contributing most to habitat shortcomings were a lack of stable fish habitat, severe instream sedimentation, and riparian disruptions associated with the adjacent lawn. Similar types of habitat degradation were observed here during the 1997 biomonitoring survey when only a qualitative sampling effort was made (MA DEP 2000).

Benthos

The FM01 benthos assemblage received a total metric score of only 18, representing 43% comparability to both the mainstem Ten Mile River reference station (TM01) and the Sevenmile reference station (SM00) and resulting in a “moderately impacted” bioassessment (Tables A2 and A3). This was the worst assessment of biological condition in the entire 2002 Ten Mile River watershed survey and is particularly troubling given the Fourmile River’s status as an *Outstanding Resource Water* (MA DEP 1996). The dominance of the community by relatively few taxa, particularly the filter-feeding Hydropsychidae (n=74) indicates an unbalanced community responding to an overabundance of fine particulate organic matter (FPOM) in the water column. Significant deposits of FPOM were also observed on much of the instream substrate. The preponderance of filter-feeders among the FM01 benthos assemblage is probably the result of an ample supply of suspended FPOM originating from the large upstream impoundment (Manchester Pond). As is typical in lentic systems such as lakes and impoundments, autochthonous forms of organic matter become an important food resource for downstream lotic communities (Wetzel 1975). When these lentic systems are subjected to increasingly productive conditions, the result can be an almost complete displacement of other trophic groups by filter feeding taxa downstream from the impoundment, as appears to be the case at FM01.

In addition to questionable water quality, sediment inputs responsible for instream habitat degradation at FM01 probably compromise biological potential as well. Reduced substrate microhabitat due to embeddedness and sediment deposition may contribute to the suppressed EPT community (EPT Index was only 2) observed at FM01, as these forms may be susceptible to increases in sediment loading due to their inability to burrow (Johnson et al. 1993). More recently, a study by Zweig and Rabeni (2001) found EPT density and EPT richness to be significantly negatively correlated with deposited sediment.

COLES BROOK

CB01A—Coles Brook, mile point 0.9, 100 m downstream from Talbots Way, Seekonk, MA

Habitat

The CB01A biomonitoring reach began approximately 100 m downstream from Talbots Way in a small housing development just upstream from Newman Avenue. In addition to the surrounding residential development, a golf course (Ledgemont Country Club) and several (5) groundwater wells registered to the Seekonk Water District are located a short distance upstream from CB01A (MA DEP 2000). The reach was approximately 5 m wide and was well shaded (100% canopy cover) with trees. The stream channel was only about half full of water, resulting in extremely shallow (0.05 m) riffles that, despite the

abundance of cobble substrates, provided epifaunal habitat for macroinvertebrates that was marginal at best. In addition, the lack of stable cover due to substrate exposure and shallow (0.10 m) pools resulted in virtually no productive fish habitat. Instream deposition of fine sediments, both organic (FPOM) and inorganic (sand/silt), affected about a third of the stream bottom in the CB01A sampling reach. Sources of sedimentation are unknown, but the upstream road crossing and the eroding right bank offer potential sediment inputs. Aquatic vegetation was minimal and consisted of mosses, while algal cover was less than 1%. Banks were fairly well vegetated on both sides of the channel—a shrub and vine layer was comprised mainly of rose (*Rosa* sp.), dogwood (*Cornus* sp.), and poison ivy (*Rhus radicans*). Bank stability was excellent along the left bank, while numerous areas (half of the reach) of instability were observed along the right bank. Riparian vegetation was undisturbed along the forested (red maple, *Acer rubrum*; white pine, *Pinus strobus*) right bank; however, only a narrow (6 m) vegetative buffer existed between the left bank and an adjacent residence (lawn).

CB01A received a total habitat assessment score of 117/200, which was the second lowest habitat score of all the 2002 Ten Mile River watershed biomonitoring stations (Table A6). The poorest-performing habitat parameters—instream cover, velocity-depth combinations, and channel flow status—were most-affected by the lack of water here. While the extremely reduced baseflow at CB01A during the 2002 biosurvey may result from naturally occurring factors (i.e., drought), it is possible that these low-flow conditions are exacerbated by the water withdrawals located upstream.

Benthos

Despite considerable instream habitat limitations related to low baseflow, the CB01A benthic community was highly comparable (90%) to both reference stations, receiving a total metric score of 38. The resulting bioassessment, “non-impacted”, indicates good overall water quality in this portion of Coles Brook. Metric scoring reductions (score=4/6) were primarily due to slight reductions in total Taxa Richness and an elevated Percent Dominant Taxon—the result of numerous (n=27) *Chimarra* sp. in the CB01A benthos sample. Equally well-represented (n=25) was the elmid beetle *Stenelmis crenata*. It is possible that this taxon is able to thrive in the flow-stressed conditions observed here due to its ability to burrow into the substrates during prolonged periods of low flow (Bode, personal communication 1998). The co-dominance of both *Stenelmis* sp. and *Chimarra* sp.—algal grazers and filter-feeders, respectively—indicates the importance of multiple food resources (i.e., periphyton and FPOM) in this portion of the stream.

BUNGAY RIVER

BR03—Bungay River, mile point 4.5, 300 m downstream from Bungay Road, upstream from federal fish hatchery, North Attleborough, MA

Habitat

Macroinvertebrate biomonitoring in the Bungay River was conducted to investigate potential discharge impacts from the North Attleborough National Fish Hatchery (NPDES permit no. MA0005398). The facility was reissued a new permit in August 2002 to discharge both conventional and toxic pollutants, including formalin—a commonly used antifungal agent used for the therapeutic treatment of fish eggs. While the hatchery is permitted to discharge directly to the Bungay River, it instead diverts its effluent through a series of former fish holding/rearing ponds. This process allows a variety of aquatic and wetland vegetation to “naturally” treat (e.g., nutrient uptake, etc.) effluent before it is discharged back to the river.

As the control station, BR03 was located upstream from the federal hatchery discharge and holding ponds. The sampling reach was approximately 300 m downstream from Bungay Road and immediately below a small tributary that enters the Bungay River from the northwest. Hester-Dendy multiplate samplers were utilized to provide a more quantitative and standardized sampling effort than the kick sampling method. Use of mulitplates also allowed for sample replication, as triplicates at each station, which would produce data that could be used for statistical hypothesis testing to determine differences between upstream and downstream benthic communities. Furthermore, since water quality effects are the

suspected stressor in this investigation, the use of multiplates helps to minimize habitat as a confounding variable; that is, as a source of limitation to the aquatic community here. Triplicate samplers were deployed for a period of eight weeks, allowing ample time for colonization of multiplates by macroinvertebrates.

This portion of the river was small and sluggish flowing, with a width of 2 m and glide-dominated (i.e., velocity < 0.30 m/sec) flow regimes about half a meter deep. Substrates were comprised of an even mix of sand and silt. Deposits of muck (FPOM) were observed along the margins of the channel. Forest and wetland dominated the surrounding landscape and provided partial shading (50% canopy cover) to the reach where samplers were deployed. With the exception of instream aquatic vegetation, mainly beds of bur-reed (*Sparganium* sp.) and some watercress (*Nasturtium* sp.), fish cover was lacking. Limited pool variability and poor channel sinuosity contributed to the motononous fish habitat. Epifaunal habitat was also considered marginal—again macrophytes providing the most productive habitat for macroinvertebrates. Much of the stream bottom appeared affected by sediment deposition in the form of bars of fine inorganic materials—the small tributary appeared at least partially responsible for the delivery of sediment loads here, as a sandy delta was observed at its mouth. Banks were well vegetated and stabilized with a layer of shrubs (elderberry, *Sambucus canadensis*), vines (riverbank grape, *Vitis riparia*), and herbaceous vegetation (jewelweed, *Impatiens capensis*; Joe-Pye weed, *Eupatorium* sp.; goldenrod, *Salidago* sp.; cat tail, *Typha* sp.) before giving way to an undisturbed riparian zone of oaks (*Quercus* spp.) and white pine (*Pinus strobus*).

BR03 received a total habitat assessment score of 138/200 (Table A7). The most severe limitations to habitat were related to instream features and channel morphology. Bank and riparian parameters scored well.

Benthos

Means were calculated for metric values for each triplicate sample. Means for each metric were scored and totalled, to yield a total metric score (42 being the highest score possible) for the BR03 macroinvertebrate community. The BR03 benthos assemblage received a total metric score of 38. In general, benthic community structure appeared similar for each replicate, as indicated in the high within-sample Community Similarity metric values (Table A5). Point losses occurred only with the Percent Dominant Taxon metric, the result of a dominance of each replicate assemblage by relatively few taxa—most notably, tubificid worms, gammarid amphipods (*Gammarus* sp.), and the leptocerid caddisfly, *Mystacides* sp. (Table A1). All three taxa share similar feeding habits (i.e., they are all gathering-collectors), suggesting deposited forms of organic materials are a major food resource in this portion of the river. The high densities of these taxa in this portion of the Bungay River do not necessarily indicate good or poor water quality, as the predicted response of gathering-collectors to increasing perturbation has been shown to be highly variable (Barbour et al. 1996).

BR02—Bungay River, mile point 4.0, near end of Mary-Kennedy Road, downstream from federal fish hatchery, North Attleborough, MA

Habitat

The test station, BR02, was located approximately 300 m downstream from the federal fish hatchery discharge. The three replicate samplers were placed just downstream from a small footbridge and picnic area in a relatively undeveloped portion of the watershed. With the exception of nearby sand/gravel operations, land-use was dominated by forest and extensive wetlands in all directions. Flow regimes here were similar to those observed at BR03—"flat water" was dominated by runs/glides and pools with depths ranging from 0.30 m – 0.50 m. The stream was approximately 4 m wide and partially shaded (30% canopy cover). Fish and macroinvertebrate habitat was slightly better than at the upstream station, with a 40% mix of stable habitat (submerged logs, overhanging shrubs, undercut banks) and well-suited for full colonization. As with BR03, instream substrates were dominated by sand and silt, although some coarser materials (gravel, cobble, and pebble) were present as well. Beds of bur-reed (*Sparganium* sp.) covered 10% of the reach and, along with mosses, provided additional epifaunal microhabitat. Channel sinuosity,

channel flow status (water reaches base of both banks), and pool variability were slightly better here than at BR03. The sediment deposition observed at BR03 appears to persist in this portion of the river as well. While some sediment inputs may originate from upstream, erosion of sandy banks resulting from foot traffic were observed on the upstream side of the footbridge near the BR02 reach. Other NPS pollution included trash associated with the picnic area. Bank stability within the sampling reach was good, aided by dense grass and herbaceous (jewelweed, *Impatiens capensis*; Joe-Pye weed, *Eupatorium* sp.; goldenrod, *Salidago* sp.) vegetation along both sides of the channel. Riparian vegetative zone width was optimal, with a shrub (elderberry, *Sambucus canadensis*) and vine (riverbank grape, *Vitis riparia*) layer near the river margins giving way to undisturbed forest (oaks, *Quercus* spp.; white pine, *Pinus strobus*) and wetland.

BR02 received a total habitat assessment score of 156/200 (Table A7). Habitat parameters were slightly better than, yet remained highly comparable to, those observed at the upstream reference station, BR03.

Benthos

In general, the benthic community sampled at BR02 appeared highly dissimilar to the BR03 assemblage. Community Similarity (i.e., Reference Affinity) was 54%, which was considered significantly different than BR03 based on results of the Mann-Whitney Test (Table A5). Dissimilarity was mainly the result of an absence of tubificid worms, gammarid amphipods, and leptocerid caddisflies (*Mystacides* sp.)—all of which occurred in high densities at BR03 (Table A1). The virtual absence of the EPT *Mystacides* sp. on BR02 samplers also contributed to an EPT/Chironomidae metric value (0.75) that was significantly different than the mean value (4.84) at BR03 (Table A5). Two other metric mean values at BR02 were significantly different than those of BR03—Biotic Index and Percent Dominant Taxon (Table A5). Interestingly, these metrics actually outperformed those calculated for the BR03 samplers, suggesting the BR02 benthic community is better balanced and comprised of more taxa less tolerant of organic pollution than in the BR03 community. The absence of tolerant taxa such as Tubificidae and Gammaridae—numerically dominant among the BR03 benthos assemblage—suggests reduced levels of organic enrichment and a shift in trophic structure in this portion of the river. Indeed, the appearance of numerous filtering-collectors, predators, and shredders at BR02 indicates improved trophic balance compared to the BR03 macroinvertebrate community which was dominated by gathering-collectors (Table A1).

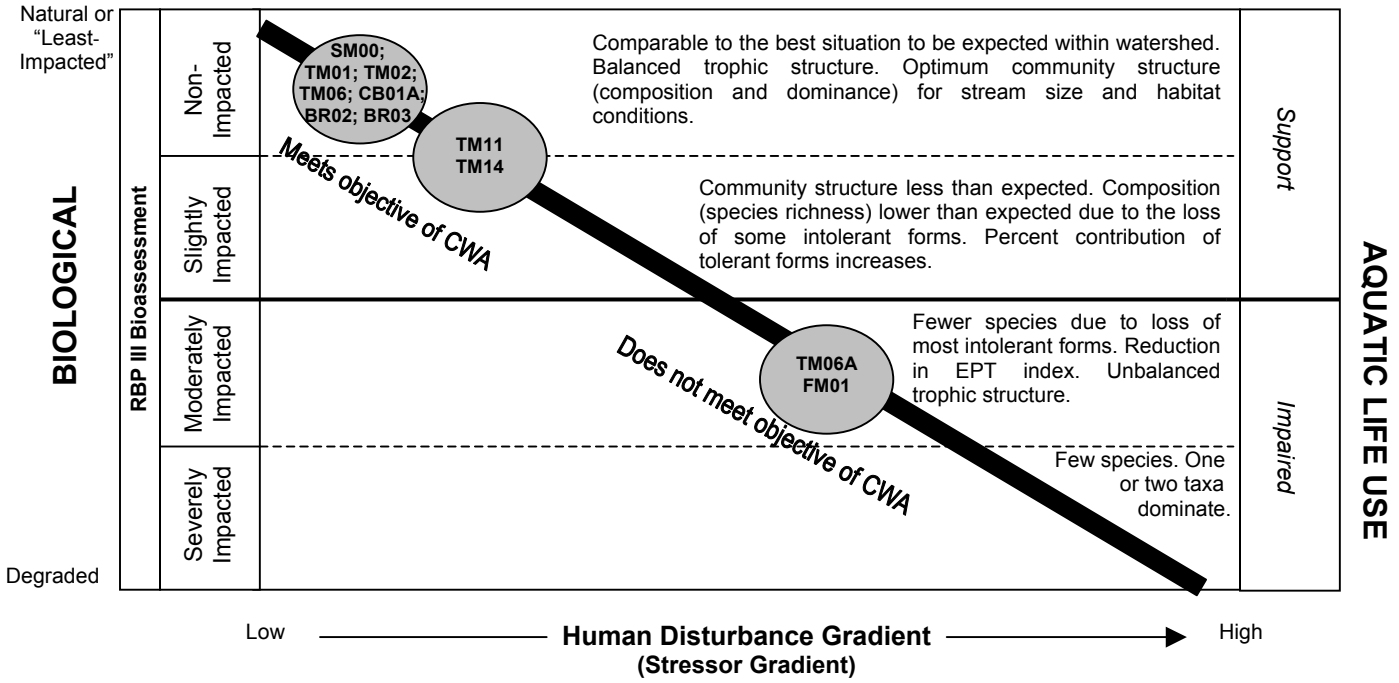
When means of metric values are scored, BR02 receives a total metric score of 32, representing 84% comparability to those of BR03 and resulting in an assessment of “non-impacted” for biological condition (Table A5). Taxa Richness, EPT Index, Biotic Index, Scraper/Filterer, and Percent Dominant Taxon metrics all outperformed values calculated from BR03 multiplate samplers.

Based on results of the Mann-Whitney tests of significance, coupled with the multimetric scoring (i.e., RBPIII) assessment, it is concluded that while the BR02 macroinvertebrate community does appear different than the upstream reference community, those differences are attributed to factors other than water quality degradation between the two sites. Reasons for discrepancies in metric performance between the two stations are not entirely clear; however, the extensive forest and wetland area upstream from BR02 (yet below BR03) may provide a greater variety of allochthonous food resources (e.g., CPOM for shredders such as Limnephilidae) and better trophic balance here than at BR03, where these types of inputs are contributed less due to a shift towards more anthropogenic land-uses.

SUMMARY AND RECOMMENDATIONS

With the exception of a few segments that exhibited minimally impacted conditions for the Ten Mile River watershed, most biomonitoring stations investigated during the 2002 survey indicated various degrees of impairment. Impacts to the resident biota at these sites were generally a result of habitat degradation and/or nonpoint source-related water quality impairment, with occasional point source effects observed as well.

The schematic below is based on a proposed conceptual model that predicts the response of aquatic communities to increasing human disturbance. It incorporates both the biological condition impact categories (non-, slightly, moderately, severely impacted—relative to reference station) outlined in the RBPIII biological assessment methodology currently used by MA DEP and the Tiered Aquatic Life Use (TALU) conceptual model developed by US EPA and refined by various state environmental agencies (US EPA 2003). The model summarizes the main attributes of an aquatic community that can be expected at each level of the biological condition category, and how these metric-based bioassessments can then be used to make *Aquatic Life* use determinations as part of the 305(b) reporting process. "Slightly impacted" or "non-impacted" aquatic communities—such as those encountered at SM00, TM01, TM02, TM06, CB01A, BR02, and BR03—support the Massachusetts SWQS designated *Aquatic Life* use in addition to meeting the objective of the Clean Water Act (CWA), which is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Environmental Law Reporter 1988). "Moderately impacted" communities observed at TM06A and FM01 do not support the *Aquatic Life* use and fail to meet the goals of the CWA.



SEVENMILE RIVER

SM00

Benthos: Reference station; Non-impacted compared to Ten Mile River reference station (TM01)
Habitat: Reference station; >100% comparable to Ten Mile River reference station

The SM00 macroinvertebrate community was thought to represent the "best attainable" (i.e., least-impacted) conditions in the watershed with respect to biological integrity and water quality. The assemblage was dominated by numerous pollution sensitive taxa and displayed balanced trophic

structure. Sediment deposition continues to threaten habitat potential and biological integrity in this portion of the river. Anthropogenic sources of sedimentation should be investigated, especially in the vicinity of Route 1 located just upstream. BMPs should be implemented to minimize runoff from various impervious areas associated with commercial development along the Route 1 corridor.

As a reference condition, and in light of potential nonpoint source pollution threats, biomonitoring is recommended here during the next DEP Ten Mile River watershed survey scheduled for 2007. Fish population sampling should accompany the macroinvertebrate sampling effort.

Ten Mile River

TM01

Benthos: Reference station; Non-impacted compared to Sevenmile River reference station (SM00)
Habitat: Reference station; 78% comparable to Sevenmile River reference station

Low-scoring habitat parameters were directly a result of extremely low baseflow. The effects of drought conditions observed during the biosurvey here may be exacerbated by baseflow reductions related to water withdrawals. Yet, despite flow-related habitat constraints, TM01 was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and “least-impacted” conditions.

To document biological conditions during a non-drought year, biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007. Fish population sampling should accompany the macroinvertebrate sampling effort. The potential for habitat here to support healthy benthic populations, including some taxa (e.g., leuctrid stoneflies, lepidostomatid caddisflies) highly sensitive to pollution, illustrates the need to maintain minimum baseflow in this portion of the Ten Mile River. The presence of nearstream groundwater wells may compromise this station’s potential as a reference station in the future.

The considerable algal coverage observed here was unexpected. Upstream sources of nutrients, while unknown, should be investigated.

TM02

Benthos: Non-impacted compared to Ten Mile River reference station; Non-impacted compared to Sevenmile River reference station
Habitat: 100% comparable to Ten Mile River reference station; 81% comparable to Sevenmile River reference station

The current evaluation of the biota at TM02 represents an improvement over DWM’s 1997 bioassessment, when comparisons to TM01 and SM00 resulted in a macroinvertebrate community assessment of “slightly impacted” and “moderately impacted” respectively (MA DEP 2000). It is unclear whether possible changes in biological health here are the result of water quality improvement or better habitat afforded the TM02 biota. As mentioned earlier, sediment deposition in the TM02 sampling reach was minimal, unlike during the 1997 biosurvey when instream deposits affected much of the reach.

Although the cemetery adjacent to the TM02 sampling reach is somewhat buffered from the river by a narrow band of riparian vegetation, the scaling back of lawn maintainence activities here would help to reduce the potential for NPS pollution inputs to this portion of the river.

Biomonitoring is recommended here during the next DEP Ten MIle River watershed survey in 2007. Fish population sampling should accompany the macroinvertebrate sampling effort.

TM06

Benthos: Non-impacted compared to Ten Mile River reference station; Non-impacted compared to Sevenmile River reference station
Habitat: 100% comparable to Ten Mile River reference station; 91% comparable to Sevenmile River reference station

That overall biological integrity remains good here supports the use of TM06 as an upstream reference (i.e., site-specific control) station for comparisons to TM06A in efforts to investigate impacts from the North Attleborough WWTP discharge.

Effects from sedimentation (i.e., substrate embeddedness and instream sediment deposition), which were considerable here in 1997 and resulted in this segment's listing as an impaired Category 5 Water for siltation (MA DEP 2002a), were minimal during the 2002 biosurvey. As a result, DWM should consider de-listing "siltation" as a pollutant in this portion of the river.

To continue to monitor biological health in this portion of the river, while maintaining its utility as an upstream reference station for TM06A, biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007. Fish population sampling should accompany the macroinvertebrate sampling effort.

TM06A

Benthos: Moderately impacted compared to Ten Mile River reference station; Moderately impacted compared to the upstream reference station (TM06); Moderately impacted compared to Sevenmile River reference station
Habitat: 97% comparable to Ten Mile River reference station; 84% comparable to the upstream reference station; 76% comparable to Sevenmile River reference station

As was the case with the 1997 bioassessment of TM06A, the benthic community here displayed low comparability to all reference conditions used. The particularly low (45%) comparability to the upstream control suggests the N. Attleborough WWTP is the primary source of perturbation to TM06A biota. (Table A4). The sudden and dramatic shift from a well-balanced and non-impacted benthic community immediately above the WWTP to one structured in response to organic enrichment immediately below the facility corroborates the discharge's impact on biological potential in this portion of the river.

A thorough NPDES permit review, and either consideration of more stringent limits or better compliance with existing limits, are warranted for the N. Attleborough WWTP, as the facility's treated wastewater quality is suspect and its current permit is scheduled for reissuance in 2005 (Paul Hogan, MA DEP, personal communication, 2005). Biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007, especially if the WWTP is subjected to new permit limit requirements or treatment upgrades before then. Fish population sampling should accompany the macroinvertebrate sampling effort. As water quality appears to limit biological integrity in this portion of the Ten Mile River, additional monitoring of various physico-chemical parameters in 2007 would be instrumental in determining the specific types of water quality degradation present here.

In addition, river-abutting homeowners should be educated about low-impact landscaping options, the importance of maintaining a riparian buffer, proper disposal of yard wastes (e.g., grass clippings) and use of environmentally sensitive lawn care products (e.g., slow releasing fertilizers)—all of which would help to minimize nonpoint source pollution inputs to this portion of the Ten Mile River.

TM11

Benthos: Slightly/Non-impacted compared to Ten Mile River reference station; Slightly impacted compared to Sevenmile River reference station
Habitat: 100% comparable to Ten Mile River reference station; 82% comparable to Sevenmile River reference station

Although the multimetric RBP analysis indicated only minimal impacts to the TM11 benthic community, several metrics suggest a somewhat unbalanced community indicative of substantial suspended FPOM loads in this portion of the Ten Mile River. The hyperdominace of filter-feeding taxa in both the TM11 and TM11 duplicate samples is probably most directly related to the productive nature of this portion of the river and eutrophic impoundments located upstream.

In addition to exacerbating bank instability (erosion), the removal of bank and riparian vegetation along both sides of the river here threatens biological health due to the potential for reduced buffering capacity from NPS pollution. Improvements to the riparian zone through the re-establishment of streamside vegetation would help to minimize the effects of NPS pollution originating from adjacent lawns, roads, and sand/gravel operations. While sources of the severe instream turbidity (a heavy particulate load appears responsible for the opaque water color here) observed at TM11 are unknown, a site visit is recommended to the large sand/gravel operation immediately upstream from TM11 (located on Tiffany Street along the west side of river) to determine the need for a stormwater management plan or other BMPs.

Biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007. Fish population sampling should accompany the macroinvertebrate sampling effort.

TM14

Benthos: Slightly impacted compared to Ten Mile River reference station; Non-impacted compared to Sevenmile River reference station
Habitat: 100% comparable to Ten Mile River reference station; 93% comparable to Sevenmile River reference station

Point source discharge effects, or nonpoint sources of organic enrichment associated with urbanization (i.e., urban runoff), are reflected in the preponderance (approximately half of the assemblage) of filter-feeding caddisflies in the TM14 macroinvertebrate assemblage. In addition to water quality effects, instream deposits of sand and FPOM threaten habitat quality and biological potential here as well. The urbanized nature of this portion of the Ten Mile River watershed may make it difficult to isolate specific sources (e.g., road runoff, stormwater, point sources, etc.) of inorganic and/or organic loadings; however, a stream-cleanup effort would greatly improve the aesthetics of the TM14 reach.

Biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007. Fish population sampling should accompany the macroinvertebrate sampling effort. As water quality appears most responsible for limitations to biological integrity in this portion of the Ten Mile River, additional monitoring of various physico-chemical parameters in 2007 would be instrumental in determining the specific types of water quality degradation present here.

Fourmile River

FM01

Benthos: Moderately impacted compared to Sevenmile River reference station; Moderately impacted compared to Ten Mile River reference station
Habitat: 55% comparable to Sevenmile River reference station; 70% comparable to Ten Mile River reference station

The biological condition here was assessed as the worst (for both benthos and habitat quality) in the entire 2002 Ten Mile River watershed survey and is particularly troubling given the Fourmile River's status as an *Outstanding Resource Water* (MA DEP 1996). The hyperdominance of the community by relatively few taxa, particularly the filter-feeding Hydropsychidae (n=74) indicates an unbalanced community responding to an overabundance of fine particulate organic matter (FPOM)—likely originating from Manchester Pond.

In addition to questionable water quality, sediment inputs responsible for instream habitat degradation at FM01 compromise biological potential here as well. Furthermore, the effects of sedimentation may be more pronounced due to epifaunal habitat already compromised by reductions (anthropogenic and/or naturally occurring) to instream baseflow. An investigation into the source of sediment loads (sand deposition) observed at FM01 is recommended, as is implementing BMPs at upstream road crossings or other impervious surfaces adjacent to the sampling reach. In addition, the restoration of an adequate riparian buffer along both stream banks in the FM01 sampling reach would help to minimize the potential for runoff and other NPS pollution inputs from the adjacent lawn and/or road. Outreach efforts should include educating the abutting homeowner about environmentally sensitive lawn maintenance options that are available.

Biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007. Fish population sampling should accompany the macroinvertebrate sampling effort. DEP should also consider additional water quality monitoring in Manchester Pond (baseline lake survey and estimate of trophic status), as part of future watershed surveys.

Coles Brook

CB01A

Benthos: Non-impacted compared to Sevenmile River reference station; Non-impacted compared to Ten Mile River reference station
Habitat: 67% comparable to Sevenmile River reference station; 85% comparable to Ten Mile River reference station

It is unclear whether the baseflow reductions observed during the 2002 biosurvey were naturally occurring or exacerbated by upstream water withdrawals. Low water levels resulted in virtually no fish cover and extremely reduced benthic habitat. Despite these habitat limitations, however, the CB01A benthic community was surprisingly comparable (90%) to both reference stations. Biomonitoring is recommended here during the next DEP Ten Mile River watershed survey in 2007 to continue to assess the potential effects of the numerous nearstream water withdrawals in this sub-basin. Fish population sampling should accompany the macroinvertebrate sampling effort. The potential for habitat here to support healthy benthic populations, including some taxa (e.g., leuctrid stoneflies, leptocerid caddisflies, leptophlebiid mayflies) highly sensitive to pollution, illustrates the need to maintain minimum baseflow in this portion of the watershed.

BMPs at all road crossings in the housing subdivision surrounding CB01A may help to alleviate the effects (e.g., instream sedimentation) of road runoff in this segment of Coles Brook. The buffering capacity of this stream from adjacent NPS pollution has been seriously compromised downstream from the CB01A sampling reach in the form of riparian vegetative removal and lawn maintainence. In addition,

illegal streamflow modifications (damming, channelization), which were observed during field reconnaissance activities by DWM biologists in the lower portion of Coles Brook (just upstream from Newman Avenue), should be investigated.

Bungay River (BR03 and BR02)

BR02

Benthos: Non-impacted compared to upstream reference station (BR03)
Habitat: 100% comparable to upstream reference station (BR03)

Although the BR02 macroinvertebrate community was dissimilar to the upstream assemblage, differences in community structure and function do not appear to be the result of water quality degradation from the federal fish hatchery discharge or other sources of anthropogenic perturbation. The BR02 benthos assemblage displayed greater diversity and included more pollution sensitive taxa than at BR03. These differences can be attributed to differing food resources in this portion of the river—possibly resulting from land-use changes between the two stations and evidenced in a more balanced trophic structure at BR02 (i.e., more specialized functional feeding groups present) than at BR03 (dominated by gathering-collectors).

Nonpoint source pollution related to the adjacent picnic area at BR02 can be addressed with signage and perhaps a trash receptacle. Sources of instream sediment deposition observed in both the BR02 and BR03 sampling reaches are unknown; however, the sandy delta observed near the mouth of the unknown tributary near BR03 suggests that it contributes at least some of these sediment inputs. This unnamed stream drains an area of residential development and various impervious surfaces, including Route 152 and Interstate 95. BMPs at upstream road crossings may be warranted.

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APPENDIX

Taxa list, RBPIII benthos analysis, Mann-Whitney results, and Habitat evaluations

Table 1. Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2002 Ten Mile River watershed biomonitoring survey. Refer to Table 1 for a listing and description of sampling stations.

Taxon	FG[1]	TV[2]	SM00[3]	TM02	TM01[3]	TM06	TM06A	TM11	TM11 (dup)[4]	TM14	CB01A	FM01	BR03[3] (rep 1)[5]	BR03[3] (rep 2)[5]	BR03[3] (rep 3)[5]	BR02 (rep 1)[5]	BR02 (rep 2)[5]	BR02 (rep 3)[5]
Physidae	GC	8	1	2			7	1			5	2		1			1	
Gyraulus sp.	SC	8		1														
Gyraulus deflectus	SC	8															3	
Gyraulus parvus	SC	8				2												
Pisidiidae	FC	6	4	3	1	3	18	35	45		10		2	1	3			
Lumbricina	GC	8										3						
Enchytraeidae	GC	10									1							
Dero vaga	GC	10						1										
Nais variabilis	GC	10	6				8					1						
Pristinella osborni	GC	10					1											
Pristinella sima	GC	10									3							
Aulodrilus pluriseta	GC	8		2												1		
Tubificidae (IWB)	GC	10	2	11			7					1	21	25	30			1
Tubificidae (IWH)	GC	10											3	4	1			
Lumbriculidae	GC	7	8	1	1	15	1				5	5						
Eclipidrilus sp.	GC	5				3												
Glossiphoniidae	PR	7													1	1		
Caecidotea communis	GC	8	2	13	15	2	17	1		1								
Caecidotea r. racovitzai	GC	8											10	10	20	5	6	7
Crangonyx sp.	GC	6		1														
Gammarus sp.	GC	6			1	1							21	28	51	2	3	
Hydrachnidia	PR	6	3		1						1					2		

Table 1 (cont.)

Taxon	FG[1]	TV[2]	SM00[3]	TM02	TM01[3]	TM06	TM06A	TM11	TM11 (dup)[4]	TM14	CB01A	FM01	BR03[3] (rep 1)[5]	BR03[3] (rep 2)[5]	BR03[3] (rep 3)[5]	BR02 (rep 1)[5]	BR02 (rep 2)[5]	BR02 (rep 3)[5]
Baetidae	GC	4			7													
Baetidae (short terminal filaments)	GC	6						3	4									
Baetidae (subequal terminal filaments)	GC	6				4												
Caenis sp.	GC	6								1								
Attenella sp.	GC	1		2														
Eurylophella sp.	GC	2	1															
Heptageniidae	SC	4						3										
Stenonema sp.	SC	3				10			5									
Leptophlebiidae	GC	2									3			1		4	4	
Calopterygidae	PR	5	1															
Calopteryx sp.	PR	6											1					
Leuctra sp.	SH	0			2													
Leuctridae/Capniidae	SH	2									1							
Nigronia serricornis	PR	0	2			1						2				1	1	3
Sialis sp.	PR	4																2
Brachycentrus sp.	FC	1							1									
Micrasema sp.	SH	2	2															
Cheumatopsyche sp.	FC	5	16		8	20	10	4	5	5	5	3		1		1	1	
Hydropsyche betteni	FC	6	13	2	9	3		3	4	9		71	1		2	1		
Lepidostoma sp.	SH	1			3													
Leptoceridae	PR	4				1		3	1		1							
*Mystacide*s sp.	GC	4											37	20	33	2		2
Triaenodes sp.	SH	6								1								
Limnephilidae	SH	4		1				1	1							7	14	13
Hydatophylax sp.	SH	2											2	1	3			
Pycnopsyche sp.	SH	4															1	

Table 1 (cont.)

Taxon	FG[1]	TV[2]	SM00[3]	TM02	TM01[3]	TM06	TM06A	TM11	TM11 (dup)[4]	TM14	CB01A	FM01	BR03[3] (rep 1)[5]	BR03[3] (rep 2)[5]	BR03[3] (rep 3)[5]	BR02 (rep 1)[5]	BR02 (rep 2)[5]	BR02 (rep 3)[5]
Molanna sp.	SC	6														1	1	
Chimarra sp.	FC	4	3	3		4		4	10	30	27							
Polycentropodidae	FC	6		3					1							1		1
Lype diversa	GC	2		1														
Parapoynx sp.	SH	5											1		1			
Ancyronyx variegata	GC	5						1							1		1	2
Macronychus glabratus	SH	5								1						1		
Microcylloepus pusillus	GC	3							2	17								
Optioservus sp.	SC	4	1		15		1			1	1							
Optioservus ovalis	SC	4		3														
Oulimnius latiusculus	SC	4		5	7					4								
Stenelmis sp.	SC	5	16	36	3	24	13	31	21	12					1	3		
Stenelmis crenata	SC	5	1	2		1		2	2		25	2						
Ectopria nervosa	SC	5	1															
Probezzia sp.	PR	6	3													1		
Micropsectra polita gr.	GC	7					27											
Microtendipes pedellus gr.	FC	6								1	1			2	1	13	8	9
Paralauterborniella sp.	GC	8											1					1
Paratendipes sp.	GC	6											1					
Polypedilum sp.	SH	6	3															
Polypedilum fallax	SH	6	1													1		
Polypedilum flavum	SH	6			5				1									
Polypedilum tritum	SH	6	1			1				1								
Stictochironomus sp.	GC	9											3	7	6			
Tribelos sp.	GC	7									1					3	1	
Micropsectra sp.	GC	7				1												

Table 1 (cont.)

Taxon	FG[1]	TV[2]	SM00[3]	TM02	TM01[3]	TM06	TM06A	TM11	TM11 (dup)[4]	TM14	CB01A	FM01	BR03[3] (rep 1)[5]	BR03[3] (rep 2)[5]	BR03[3] (rep 3)[5]	BR02 (rep 1)[5]	BR02 (rep 2)[5]	BR02 (rep 3)[5]
Paratanytarsus sp.	FC	6	1															
Rheotanytarsus exiguus gr.	FC	6							1	1								1
Rheotanytarsus pellucidus	FC	5	1					1		2		1					1	
Tanytarsus sp.	FC	6									2					9	5	14
Zavrelia sp.	FC	4														1	2	
Potthastia longimana gr.	GC	2	2															
Orthocladiinae	GC	5	2									1		1	1			
Brillia sp.	SH	5	1								1							
Corynoneura sp.	GC	4			2						5				1		1	
Diplocladius sp.	GC	8	2			1												
Limnophyes sp.	GC	8		1														
Orthocladius sp.	GC	6										1						
Parametriocnemus sp.	GC	5	1		3						4	3						1
Thienemanniella sp.	GC	6								1								
Tvetenia paucunca	GC	5								1		4						
Tanypodinae	PR	7			1													
Clinotanypus sp.	PR	8		1														
Conchapelopia sp.	PR	6				1											1	
Procladius sp.	PR	9														1		
Thienemannimyia gr.	PR	6		3	15						3					1	1	
Dixa sp.	FC	1			1													
Hemerodromia sp.	PR	6	1	3	5													
Simulium sp.	FC	5				4			1			1						
Simulium tuberosum cpl.	FC	4								4								
Simulium vittatum cpl.	FC	9								6								
Tipulidae	SH	5		1								3						

Table 1 (cont.)

Taxon	FG[1]	TV[2]	SM00[3]	TM02	TM01[3]	TM06	TM06A	TM11	TM11 (dup)[4]	TM14	CB01A	FM01	BR03[3] (rep 1)[5]	BR03[3] (rep 2)[5]	BR03[3] (rep 3)[5]	BR02 (rep 1)[5]	BR02 (rep 2)[5]	BR02 (rep 3)[5]
Hexatoma sp.	PR	2																1
Tipula sp.	SH	6				4												
TOTAL			102	101	105	106	110	94	105	99	105	104	104	102	156	63	56	58

[1]Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.
[2]Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for very tolerant organisms.
[3] Reference station
[4] Duplicate sample
[5] Replicate (triplicate) sample

Table 2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Ten Mile River watershed survey on 23 and 24 July 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the mainstem reference station (TM01), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a listing and description of sampling stations.

STATION	**TM01**		**TM02**		**TM06**		***TM06A***		**TM11***		**TM14**		**SM00**		**FM01**		**CB01A**	
STREAM	Ten Mile River		Ten Mile River		Ten Mile River		Ten Mile River		Ten Mile River		Ten Mile River		Sevenmile River		Fourmile River		Coles Brook	
HABITAT SCORE	137		142		159		133		144		163		175		96		117	
TAXA RICHNESS	19	*6*	22	*6*	20	*6*	11	*2*	14 15	*4* *4*	19	*6*	27	*6*	15	*4*	20	*6*
BIOTIC INDEX	5.28	*6*	6.08	*6*	5.32	*6*	7.05	*4*	5.44 5.25	*6* *6*	4.69	*6*	5.71	*6*	5.93	*6*	5.17	*6*
EPT INDEX	5	*6*	6	*6*	6	*6*	1	*0*	7 9	*6* *6*	5	*6*	5	*6*	2	*0*	5	*6*
EPT/CHIRONOMIDAE	1.12	*6*	2.40	*6*	10.5	*6*	0.37	*2*	21.0 16.0	*6* *6*	6.57	*6*	2.33	*6*	7.40	*6*	2.18	*6*
SCRAPERS/FILTERERS	1.32	*6*	4.27	*6*	1.09	*6*	0.50	*4*	0.77 0.41	*6* *2*	0.29	*2*	0.50	*4*	0.03	*0*	0.58	*4*
% DOMINANT TAXON	14%	*6*	36%	*2*	23%	*4*	25%	*4*	37% 43%	*2* *0*	30%	*2*	16%	*6*	68%	*0*	26%	*4*
REFERENCE AFFINITY	100%	*6*	65%	*6*	70%	*6*	70%	*6*	71% 74%	*6* *6*	62%	*4*	71%	*6*	39%	*2*	79%	*6*
TOTAL METRIC SCORE		*42*		*38*		*40*		*22*		*36* *30*		*32*		*40*		*18*		*38*
% COMPARABILITY TO REFERENCE STATION	100%		90%		95%		52%		86% 71%		76%		95%		43%		90%	
BIOLOGICAL CONDITION (DEGREE OF IMPACT)	**REFERENCE**		**NON-IMPACTED**		**NON-IMPACTED**		**MODERATE IMPACT**		**NON/ SLIGHT IMPACT**		**SLIGHT IMPACT**		**NON-IMPACTED**		**MODERATE IMPACT**		**NON-IMPACTED**	

* metric values and scores represent original sample and duplicate sample collected at this station

Table 3. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Ten Mile River watershed survey between on 23 and 24 July 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the regional reference station (SM00), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a listing and description of sampling stations.

STATION	**SM00**		**TM01**		**TM02**		***TM06***		**TM06A**		**TM11***		**TM14**		**FM01**		**CB01A**	
STREAM	Sevenmile River		Ten Mile River		Ten Mile River		Ten Mile River		Ten Mile River		Ten Mile River		Ten Mile River		Fourmile River		Coles Brook	
HABITAT SCORE	175		137		142		159		133		144		163		96		117	
TAXA RICHNESS	27	*6*	19	*4*	22	*6*	20	*4*	11	*2*	14 15	*4* *4*	19	*4*	15	*2*	20	*4*
BIOTIC INDEX	5.71	*6*	5.28	*6*	6.08	*6*	5.32	*6*	7.05	*4*	5.44 5.25	*6* *6*	4.69	*6*	5.93	*6*	5.17	*6*
EPT INDEX	5	*6*	5	*6*	6	*6*	6	*6*	1	*0*	7 9	*6* *6*	5	*6*	2	*0*	5	*6*
EPT/CHIRONOMIDAE	2.33	*6*	1.12	*2*	2.40	*6*	10.5	*6*	0.37	*0*	21.0 16.0	*6* *6*	6.57	*6*	7.40	*6*	2.18	*6*
SCRAPERS/FILTERERS	0.50	*6*	1.32	*6*	4.27	*6*	1.09	*6*	0.50	*6*	0.77 0.41	*6* *2*	0.29	*6*	0.03	*0*	0.58	*6*
% DOMINANT TAXON	16%	*6*	14%	*6*	36%	*2*	23%	*4*	25%	*4*	37% 43%	*2* *0*	30%	*2*	68%	*0*	26%	*4*
REFERENCE AFFINITY	100%	*6*	71%	*6*	65%	*6*	82%	*6*	69%	*6*	54% 60%	*4* *4*	71%	*6*	62%	*4*	90%	*6*
TOTAL METRIC SCORE		*42*		*36*		*38*		*38*		*22*		*32* *30*		*36*		*18*		*38*
% COMPARABILITY TO REFERENCE STATION	100%		86%		90%		90%		52%		76% 71%		86%		43%		90%	
BIOLOGICAL CONDITION (DEGREE OF IMPACT)	**REFERENCE**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**		**MODERATE IMPACT**		**SLIGHT IMPACT**		**NON-IMPACTED**		**MODERATE IMPACT**		**NON-IMPACTED**	

* metric values and scores represent original sample and duplicate sample collected at this station

Table 4. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Ten Mile River watershed survey on 23 July 2002. Shown are the calculated metric values, metric scores (in italics) based on comparability to the upstream reference (TM06), and the corresponding assessment designation for the test station (TM06A). Stations TM06 and TM06A bracket the N. Attleborough WWTP discharge in Attleboro, MA.

STATION	**TM06**		**TM06A**	
STREAM	Ten Mile River		Ten Mile River	
HABITAT SCORE	159		133	
TAXA RICHNESS	20	*6*	11	*2*
BIOTIC INDEX	5.32	*6*	7.05	*4*
EPT INDEX	6	*6*	1	*0*
EPT/CHIRONOMIDAE	10.5	*6*	0.37	*0*
SCRAPER/FILTERER	1.09	*6*	0.50	*4*
% DOMINANT TAXON	23%	*4*	25%	*4*
REFERENCE AFFINITY	100%	*6*	57%	*4*
TOTAL METRIC SCORE	*40*		*18*	
% COMPARABILITY TO REFERENCE	100%		45%	
BIOLOGICAL CONDITION (DEGREE OF IMPACT)	**REFERENCE**		**MODERATE IMPACT**	

Table 5. Summary of data analysis for macroinvertebrate communities sampled in the Bungay River between July and 21 August 1997. Seven biological metrics were calculated for taxa collected from each triplicate sample. Mean metric values for downstream samplers (BR02) were compared to those for the upstream reference station (BR03) using both the RBPIII multimetric approach and the Mann-Whitney Test. Both the metric scores and the Mann-Whitney Test's U-statistic values are included in the table and are used as the basis for evaluation of impairment. Bold-faced statistic values indicate significant (1-tailed; ≥ critical magnitude at 0.05 significance) differences between means.

STATION	***BR03-1*** (Rep1)	***BR03-2*** (Rep2)	**BR03-3** (Rep3)	**Mean**	**Score of Mean**	***BR02-1*** (rep1)	**BR02-2** (rep2)	***BR02-3*** (rep3)	**Mean**	**Score of Mean**	**U Statistic**
	Bungay River (upstream of discharge)					**Bungay River (downstream of discharge)**					
HABITAT SCORE	138					156					
TAXA RICHNESS	13	13	16	14	*6*	23	17	14	18	*6*	*6*
BIOTIC INDEX	6.42	7.07	6.63	6.71	*6*	5.56	5.29	5.33	5.39	*6*	***9***
EPT INDEX	3	4	3	3	*6*	7	4	3	5	*6*	*6.5*
EPT/CHIRONOMIDAE	8.0	2.30	4.22	4.84	*6*	0.59	1.05	0.62	0.75	*0*	***9***
SCRAPERS/FILTERERS*	null	null	0.17	0.17	*6*	0.15	0.24	null	0.20	*6*	*1*
% DOMINANT TAXON	36%	27%	33%	32%	*2*	21%	25%	24%	23%	*4*	***9***
COMMUNITY SIMILARITY	Rep1:Rep2=83%	Rep2:Rep3=86%	Rep3:Rep1=83%	84%	*6*	Rep1:rep1=46% Rep2:rep1=52% Rep3:rep1=48%	Rep1:rep2=60% Rep2:rep2=57% Rep3:rep2=56%	Rep1:rep3=57% Rep2:rep3=56% Rep3:rep3=56%	54%	*4*	***27***
TOTAL MEAN METRIC SCORE					*38*					*32*	
% COMPARABILITY TO REFERENCE STATION	100%					84%					
BIOLOGICAL CONDITION (DEGREE OF IMPACT)	**REFERENCE**					***NON-IMPACTED***					

* some values are undefined (null) for this metric due to an absence of filterers on some samplers

Table 6. Habitat assessment summary for biomonitoring stations in riffle/run prevalent (velocity> 0.30 m/sec) streams sampled during the 2002 Ten Mile River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

STATION	TM01*	TM02	TM06	TM06A	TM11	TM14	SM00*	FM01	CB01A
PRIMARY PARAMETERS (range is 0-20)	***SCORE***								
INSTREAM COVER	0	11	6	2	11	18	18	1	1
EPIFAUNAL SUBSTRATE	15	10	16	13	16	18	18	12	10
EMBEDDEDNESS	20	16	16	19	16	15	18	15	18
CHANNEL ALTERATION	19	18	19	18	16	15	20	12	18
SEDIMENT DEPOSITION	18	16	16	12	16	9	11	5	10
VELOCITY-DEPTH COMBINATIONS	4	8	12	9	13	11	12	6	6
CHANNEL FLOW STATUS	5	18	20	19	20	20	19	16	9
SECONDARY PARAMETERS (range is 0-10 for each bank)	***SCORE***								
BANK VEGETATIVE PROTECTION left	10	10	10	10	10	9	10	3	9
BANK VEGETATIVE PROTECTION right	10	10	9	3	10	10	10	8	8
BANK STABILITY left	10	9	10	10	4	9	9	5	10
BANK STABILITY right	10	10	7	7	10	10	10	10	5
RIPARIAN VEGETATIVE ZONE WIDTH left	6	2	10	10	1	9	10	0	3
RIPARIAN VEGETATIVE ZONE WIDTH right	10	4	8	1	1	10	10	3	10
TOTAL SCORE	**137**	**142**	**159**	**133**	**144**	**163**	**175**	**96**	**117**

*watershed reference station

Table A7. Habitat assessment summary for biomonitoring stations in glide/pool prevalent (velocity< 0.30 m/sec) streams sampled during the 2002 Ten Mile River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

STATION		BR03*	BR02
PRIMARY PARAMETERS (range is 0-20)		***SCORE***	
BOTTOM SUBSTRATE/ AVAILABLE COVER		10	13
POOL SUBSTRATE CHARACTERIZATION		15	16
POOL VARIABILITY		10	13
CHANNEL ALTERATION		15	20
SEDIMENT DEPOSITION		11	12
CHANNEL SINUOSITY		6	10
CHANNEL FLOW STATUS		15	17
SECONDARY PARAMETERS (range is 0-10 for each bank)		***SCORE***	
BANK VEGETATIVE PROTECTION	left right	10 8	9 9
BANK STABILITY	left right	10 10	9 9
RIPARIAN VEGETATIVE ZONE WIDTH	left right	10 8	10 9
TOTAL SCORE		**138**	**156**

*upstream reference station

APPENDIX C
SUMMARY OF NPDES INFORMATION

Ten Mile River Watershed Municipal and Sanitary Surface Wastewater Discharges

PERMITTEE	NPDES #	SEGMENT
City of Attleboro	**MA0100595**	**MA52-03**
The City of Attleboro is authorized (MA0100595 issued in September 1999) to discharge from the Attleboro Water Pollution Control Facility (WPCF) a flow of 8.6 MGD (average monthly) of treated effluent via outfall #001 to the Ten Mile River. The City of Attleboro, operating an advanced activated sludge facility, is proceeding with a 30 million dollar upgrade that has a projected completion date of 2007 (Kennedy 2005). Nitrification is performed for ammonia-nitrogen reduction (permit limit May 1 to May 30, 4.2 mg/L and June 1 to October 31, 1.5 mg/L). The ammonia-nitrogen concentrations in the effluent between April 1999 and March 2006 ranged from <0.05 to 1.2 mg/L (n=28)(TOXTD database). This WPCF is in the process of upgrading their disinfection and dechlorination systems. Sodium hypochlorite will replace gaseous chlorine for disinfection and sodium bisulfite will replace gaseous sulfur dioxide for dechlorination (Kennedy 2005). The TRC [0.0154 and 0.0266 mg/L (average monthly and maximum daily limits, respectively)] in the effluent between April 1999 and March 2006 were all <0.05 mg/L (n=30)(TOXTD database). Calcium oxide is used periodically for alkalinity restoration as a result of nitrification. The pH (6.5 to 8.3 SU limits) of the effluent between April 1999 and March 2006 ranged from 6.9 to 7.6 SU (n=30) and the effluent alkalinity for the same period ranged from 17 to 122 mg/L (n=26). Total phosphorus reduction (permit limit 1.0 mg/L average monthly between May 1 to October 31) is accomplished by the addition of ferric chloride at the headworks and by the addition of polyaluminum chloride at the head of the aeration system (Kennedy 2005). The facility's whole effluent toxicity limits are $LC_{50} \geq 100$ and C-NOEC $\geq$ 71% effluent using *Ceriodaphnia dubia* as a test specie on a quarterly basis. Other permitted parameters include CBOD, TSS, Fecal Coliform, D.O. and several recoverable metals (Copper, Zinc, Chromium, Silver, Nickel, Lead, Aluminum, Cadmium, and Cyanide).		
PERMITTEE	**NPDES #**	**SEGMENT**
Town of North Attleborough	**MA0101036**	**MA52-03**
The Town of North Attleborough is authorized (MA0101036 issued in September 1999) to discharge from the North Attleborough Wastewater Treatment Facility (WWTF) a flow of 4.61 MGD (average monthly) of treated effluent via outfall #001 to the Ten Mile River. The Town of North Attleborough is moving forward with a WWTF upgrade and expects to complete the project later in 2005 (Horton 2005). Provisions for the WWTF to perform biological nutrient removal has been included as part of the upgrade (Horton 2005). The WWTF currently performs nitrification year round to reduce effluent ammonia nitrogen concentrations (permit limits May 1 to May 31, 3 mg/l / June 1 to October 31, 1 mg/L / November 1 to November 30, 7 mg/L / December 1 to April 30, 10 mg/L). The ammonia-nitrogen concentrations in the effluent between December 1999 and February 2006 ranged from <0.1 mg/L to 10.7 mg/L (n= 26) (TOXTD database). Disinfection is accomplished by the addition of gaseous chlorine. Sodium bisulfite is used for dechlorination. The TRC [0.011 and 0.019 mg/L (average monthly and maximum daily permit limits, respectively)] in the effluent between December 1999 and February 2006 ranged from <0.02 to 0.52 mg/L (n= 26) (TOXTD database). It should be noted that five of the 24 TRC measurements exceeded 0.05 mg/L (a minimum quantification limit specified in the permit to be used for compliance evaluations). Caustic soda is used periodically for pH adjustments. The pH (6.5 to 8.3 SU limits) of the effluent between December 1999 and February 2006 ranged from 6.5 to 7.4 SU (n=26) (TOXTD database) and the effluent alkalinity for the same period ranged from 19 to 99 mg/L (n=26) (TOXTD database). Total phosphorus reduction (permit limit 1.0 mg/L average monthly between May 1 to October 31) is accomplished by the addition of aluminum sulfate at the head of primary treatment (Horton 2005). The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ and C-NOEC $\geq$94% effluent using *Ceriodaphnia dubia* as a test species on a quarterly basis. Some of the other permitted parameters include BOD, TSS, Fecal Coliform, D.O., Oil and Grease and some recoverable metals (Copper, Zinc, Chromium, Nickel, Lead, Iron, Aluminum, Cadmium, Cyanide,).		

Ten Mile River Watershed Commercial and Industrial Surface Wastewater Discharges

PERMITTEE	NPDES #	SEGMENT
Bristol Nursing Home	**MA0023426**	**MA52-05**
Bristol Nursing Home (MA0023426) has been closed since October 2001 according to sources at the EPA Boston Office. Therefore, the permit is terminated.		
PERMITTEE	**NPDES #**	**SEGMENT**
Craft, Inc.	**MA0002364**	**MA52-08**
Craft, Inc. has closed according to sources at the EPA Boston Office. Therefore, the permit is terminated.		
PERMITTEE	**NPDES #**	**SEGMENT**
Simon Property Group/ Mayflower Emerald Square	**MA0030244**	**MA52-07**
Simon Property Group/Mayflower Emerald Square located in North Attleborough (MA0030244 issued November 2004) is authorized to discharge from a facility located at 999 South Washington Street, treated stormwater runoff from on-site and off-site drainage areas in the upper watershed (outfall 001) and the lower watershed (outfall 002) to the Seven Mile River via an unnamed wetland in the Ten Mile Watershed. The same authorization and permit requirements exist for outfall# 001 and 002. Permitted (maximum daily) parameters include pH, TSS, Oil and grease, Lead, Copper, and Zinc. Flow is report only and there are no WET testing requirements.		

Ten Mile River Watershed Commercial and Industrial Surface Wastewater Discharges

PERMITTEE	NPDES #	SEGMENT
Texas Instruments, Inc.	**MA0001791**	**MA52-05**

Texas Instruments, Inc. (TI) is authorized (MA0001791 issued in March 2000) to discharge from the facility located at 34 Forest Street, Attleboro to receiving waters:

Speedway Brook (outfall 002 and 002A) to the Ten Mile River and
Cooper's Pond via unnamed brook (outfall 003 and 004)

Outfall# 002: Groundwater infiltration to Speedway Brook. All of the parameters excluding pH are report only for this outfall. It should be noted that the monthly discharge monitoring reports (DMRs) issued to TI have outfall# 002 listed as 002A (Elliot 2005).

Outfall# 002A: Treated contaminated groundwater is sampled before discharge via outfall# 002 to Speedway Brook. For outfall# 002A, permitted parameters are flow, (0.25 MGD, average monthly), pH (6.5 to 8.3 SU), and 3 listed VOCs (all having 0.1 mg/L maximum daily limits). The temperature limit for discharge is 83ºF. As of October 2005, TI is still treating contaminated groundwater. It should be noted that the monthly discharge monitoring reports (DMRs) issued to TI have outfall# 002A listed as 002B (Elliot, 2005).

Outfall# 003: Treated metal finishing wastewater has been physically tied in to the City of Attleboro's sewer system (Elliot 2005). WET requirements for outfall# 003 were $LC_{50} \geq 100\%$ and C-NOEC $\geq 40\%$ using *Ceriodaphnia dubia* and *Pimephales. Promelas* four times per year. In a letter dated June 9, 2005 from Michael Elliot of TI addressed to Denny Dart of EPA states that no discharge has occurred since January 2000 at outfall# 003.

Outfall# 004: Groundwater infiltration. All of the parameters excluding pH are report only for this outfall.

TI is in the process of selling and consolidating many of its buildings to a developer. The treatment of TI's wastewater is currently performed by a contracted operator (Elliot 2005).

PERMITTEE	NPDES #	SEGMENT
United States Fish and Wildlife Service	**MA0005398**	**MA52-06**

The United States Fish and Wildlife Service is authorized (MA0005398 issued in August 2002) to discharge from the North Attleborough National Fish Hatchery a flow of 1.7 MGD (average monthly) of treated culture water via outfall #001 to the Bungay River. The majority of the NPDES permitted effluent limits and monitoring requirements are centered on periodic cleaning operations, typically occurring each quarter. Some of the parameters that have effluent limits include BOD, TSS, pH, Total Ammonia, Total Phosphorus, and TRC. Formaldehyde, D.O., and whole effluent toxicity (WET) limits exist when formalin is in use. WET effluent limits are $LC_{50} \geq 100\%$ and C-NOEC $\geq 100\%$ and the required test species to use is *Ceriodaphnia dubia*. Sampling and analysis for WET testing must be performed quarterly during formalin discharge, when effluent concentrations are at a maximum. No WET testing is required if formalin is not used during the quarter.

Since the issuance of the August 2002 NPDES permit, the North Attleborough National Fish Hatchery has not continued the use of formalin. Hydrogen peroxide is used in place of formalin and therefore, no toxicity testing has been performed (Lofton 2005).

Ten Mile River Watershed General Surface Water Discharges

PERMITTEE Fortifiber Corporation	NPDES # MAG250033	SEGMENT MA52-06
Fortifiber Corporation of Attleboro (MAG250033 issued in January 2005) is authorized to discharge a flow (0.0001 MGD, average monthly and 0.0004 MGD, maximum daily) of non-contact cooling water to an unnamed pond that empties to the Bungay River via a culvert. Fortifiber has a paper converting, coating, and laminating process. A permitted TRC limit of 0.1 mg/L exists and the source of water is municipal. EPA has closed the NPDES file #MA0003701 as of January 2005.		
PERMITTEE **Mantrose-Haeuser Company, Inc.**	**NPDES #** **MAG250958**	**SEGMENT** **MA52-03**
Mantrose-Haeuser Company, Inc., located in Attleboro Massachusetts, is authorized (MAG250958 issued in January 2001) to discharge non-contact cooling water at a flow rate of 0.31 MGD (average monthly) via outfall# 001, 003, and 004 to the Ten Mile River. The Mantrose-Haeuser Company produces coatings for food and pharmaceutical products. Since the issuance of the General Permit, the NPDES Permit file MA0005703 is now closed. Private wells are used as the water source for non-contact cooling water. Whole effluent toxicity (WET) testing was performed in May 2001 using *Ceriodaphnia dubia*, as required in the NPDES permit that was in effect.		

References

Elloit, Michael. 2005. Personal Communication. *Texas Instrument's status of regulated outfalls.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 11 October 2005. Environmental Manager, Texas Instruments, Inc.

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Lofton, Lawrence. 2005. Personal Communication. *United States Fish and Wildlife Service, North Attleborough National Fish Hatchery operational and reporting status.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 26 April 2005. Hatchery Manager, United States Fish and Wildlife Service, North Attleborough National Fish Hatchery.

Young, Donald. 2005. Personal Communication. *Mantrose-Haeuser Company whole effluent toxicity sampling.* Communication with Richard Alden, Massachusetts Department of Environmental Protection, Division of Watershed Management, 26 April 2005. Plant Engineer, Mantrose-Haeuser Company, Inc.

APPENDIX D
TEN MILE RIVER WATERSHED
2002 DWM WATER QUALITY MONITORING DATA

Technical Memorandum

TM-52-06

December 2005

Stella D. Tamul
Massachusetts Department of Environmental Protection
Division of Watershed Management
DWM Control Number CN 137.0

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Stephen R. Pritchard, Secretary
Massachusetts Department of Environmental Protection
Robert W. Golledge Jr., Commissioner
Bureau of Resource Protection
Glenn Haas, Acting Assistant Commissioner

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List of Tables and Figures

INTRODUCTION

The Ten Mile River Watershed water quality survey was conducted in 2002, along with benthic macroinvertebrate sampling, fish population sampling, lake sampling, and fish contaminant monitoring as part of the Division of Watershed Management (DWM) Year Two monitoring. This technical memorandum details the water quality monitoring data collected during the survey season. Consistent with DWM's general approach to watershed monitoring to meet defined programmatic objectives, water quality surveys of streams/rivers in the Ten Mile River Watershed were conducted in May, June, July, August, and October at a total of 19 locations. Field measurements were taken for dissolved oxygen (including pre-dawn), temperature, conductivity, pH, and grab samples were taken for analytical parameters that are identified in the *Quality Assurance Project Plan for 2002 Watershed Monitoring in the Charles, Housatonic, North Coastal and Ten Mile Watersheds CN 81.0* (MassDEP 2002). The study area included the mainstem Ten Mile River and several of its tributaries. Table DD and Figure D1 detail locations of the 2002 sampling sites. Two additional studies were conducted in the Ten Mile River Watershed during the 2002 survey season: a Phosphorus Loading Study made use of nutrient and flow discharge data from seven of the 19 river stations - *Baseline Lake Survey 2002 Technical Memo CN 204.0* (MassDEP 2005a) and DWM conducted a method validation study of trace metals at three river stations in 2002 - *Aqueous Trace Metals Sampling and Analysis Using Modified "Clean" Techniques (September-October, 2002) CN 133.0* (MassDEP 2003).

The results of the 2002 Ten Mile River water quality monitoring factor into regulatory actions taken by MassDEP and the United States Environmental Protection Agency, are incorporated into DWM's Water Quality Assessment Reports, and are used to update Sections 305(b) and 303(d) reporting elements of the Clean Water Act (CWA). Additionally, these data are used in the development of Total Maximum Daily Loads (TMDLs) to address waters not attaining water quality standards and to aid in the development of National Pollutant Discharge Elimination System (NPDES) permits.

PROJECT OBJECTIVES

The goal of the Ten Mile River Watershed Year Two Survey was to obtain information that meets the following DWM programmatic objectives and watershed-specific sub-objectives:

Objective 1 - Evaluate specific water bodies for support of designated uses as defined in the surface water quality standards and evaluate the level of impairment of CWA Section 303(d)-listed waterbodies. Provide water quality data (bacteria, chemistry, etc.) for river segments. Evaluate aquatic life use support, as indicated by macroinvertebrate, periphyton, fish assemblages, and habitat.

Objective 2 - Provide quality-assured data for use by DWM in developing TMDLs for State 303(d) listed waterbodies. Study phosphorus transport from the North Attleborough and Attleboro wastewater treatment plants (WWTPs) to downstream reservoirs and develop NPDES phosphorus limits on these WWTPs.

Objective 3 - Screen fish to provide data to the Massachusetts Department of Public Health for public health risk assessment due to fish tissue contaminants (metals, polychlorinated biphenyls, and selected pesticides).

Objective 4 - Provide quality-assured Fecal Coliform, *E. coli*, and *Enterococcus* sp. bacteria data for the purpose of assessing primary and secondary contact recreational uses in rivers/streams.

Monitoring data collected from the Ten Mile River Watershed met the specific data quality objectives (DQOs) outlined in the 2002 QAPP. Quality assurance for watershed monitoring by DWM, as detailed in the 2002 QAPP, is provided to ensure implementation of an effective and efficient sampling design, and to provide data to meet specific data quality objectives.

Table D1. MassDEP DWM 2002 Ten Mile River Watershed Water Quality Sampling Station Descriptions and Sampling Schedule

Waterbody	Station (Unique ID)	Station Description	Survey Date										
			5/15	5/16	6/18	6/19	7/23	7/24	8/21	8/27	8/28	10/01	10/02
Ten Mile River	TM01 (W0168)	Fuller Street (downstream of Fuller Pond), Plainville	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2
	TM02 (W0905)	West Bacon Street, Plainville	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	--	1, 3, 5	2
	TM02A (W0904)	Fisher Street, North Attleborough	5	--	5	--	5	--	--	5	--	5	--
	TM04 (W0169)	Route 1, North Attleborough	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	--
	TM06 (W0170)	Cedar Road (approximately 850 feet upstream of North Attleborough WWTP (MA0101036) discharge), North Attleborough	1, 3, 5	2	1, 3, 4, 5, 6	2	1, 3, 5, 6	2	--	1, 3, 4, 5, 6	2	1, 3, 5	2
	TM06A (W0903)	East off Clifton Street (behind house #355) (approximately 500 feet downstream of North Attleborough WWTP (MA0101036) discharge, Attleboro	1, 3, 5	--	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2
Bungay River	BG02 (W0179)	Holden Street, Attleboro	--	--	--	--	1	2	--	1	2	1	2
	BG02A (W0901)	At outlet of impoundment locally known as Blackinton Pond approximately 400 feet downstream of North Main Street (Route 152), Attleboro	1, 3, 5	2	1, 3, 5, 6	2	1, 3, 5, 6	2	--	1, 3, 5, 6	2	1, 3, 5	2
Ten Mile River	TM08A (W0172)	Olive Street, Attleboro	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2
Speedway Brook	SW01 (W0180)	Route 152, Attleboro	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2
Ten Mile River	TM11 (W0173)	Tiffany Street, Attleboro	1, 3, 5	2	1, 3, 5, 6	2	1, 3, 5	2	6	1, 3, 5, 6	2	1, 3, 5	2
	TM13 (W0175)	Pond Street, Seekonk	1, 3, 5	2	1, 3, 5, 6	2	1, 3, 5	2	6	1, 3, 5, 6	2	1, 3, 5	2
Sevenmile River	SM00 (W0182)	Draper Avenue, North Attleborough	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2
Fourmile Brook	FM01 (W0181)	West Street, Attleboro	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2

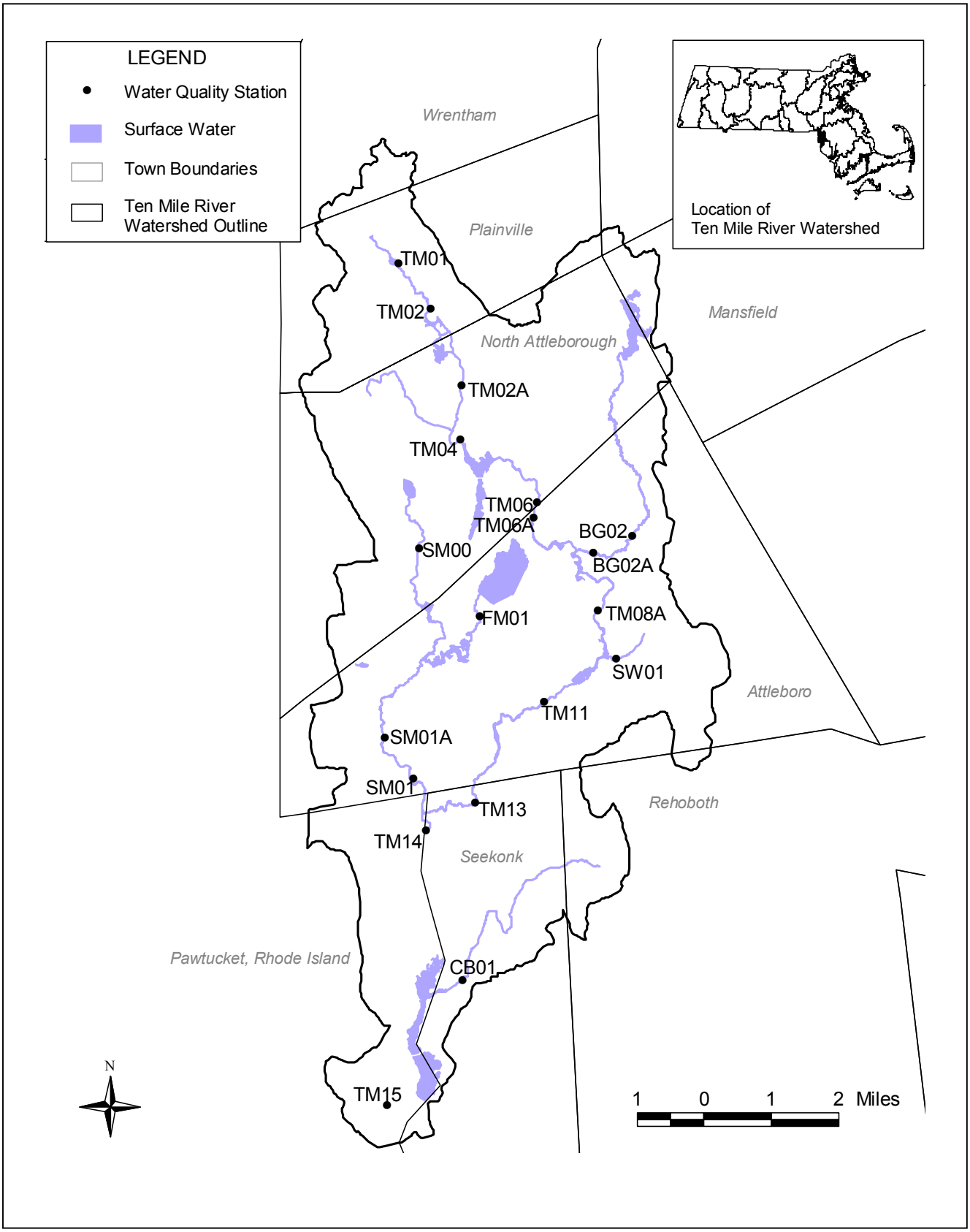
Note: -- = no samples collected, ** = samples not collected due to lack of water, 1 = multiprobe day run, 2 = multiprobe predawn run, 3 = nutrients/solids (Total Suspended Solids, Ammonia Nitrogen, Total Phosphorus, Total Suspended Solids, Chloride), 4 = nutrients (NO3-NO2-N, TKN, DRP, BOD5, CBOD3, CBOD7, CBOD14, CBOD21), 5 = bacteria (Fecal Coliform, *E.coli, Enterococcus* sp.), 6 = flow measurements

Table D1 (continued). MassDEP DWM 2002 Ten Mile River Watershed Water Quality Sampling Station Descriptions and Sampling Schedule

Waterbody	Station (Unique ID)	Station Description	Survey Date									
			5/15	5/16	6/18	6/19	7/23	7/24	8/21	8/27	8/28	10/01	10/02
Sevenmile River	SM01A (W0900)	Pitas Avenue, Attleboro	1, 3, 5	2	1, 3, 5	2	1, 3, 5	2	--	1, 3, 5	2	1, 3, 5	2
	SM01 (W0183)	Upstream of County Street, Attleboro	1, 3, 5	2	1, 3, 5, 6	2	1, 3, 5, 6	2	--	1, 3, 5, 6	2	1, 3, 5	2
Ten Mile River	TM14 (W0176)	Central Avenue (approximately 1/2 mile downstream of Attleboro WWTP (MA0100595) discharge), Seekonk, MA/Pawtucket, RI	1, 3, 5	2	1, 3, 4, 5, 6	2	1, 3, 5	2	6	1, 3, 4, 5, 6	2	1, 3, 5	2
Coles Brook	CB01 (W0184)	Route 152, Seekonk	1, 3, 5	2	1, 3, 5	2	**	**	--	**	**	1, 3, 5	2
Ten Mile River	TM15 (W0902)	Route 114/1A, East Providence, Rhode Island (near USGS flow gauging station #01109403)	--	--	5	--	--	--	--	5	--	--	--

Note: -- = no samples collected, ** = samples not collected due to lack of water, 1 = multiprobe day run, 2 = multiprobe predawn run, 3 = nutrients/solids (Total Suspended Solids, Ammonia Nitrogen, Total Phosphorus, Total Suspended Solids, Chloride), 4 = nutrients (NO3-NO2-N, TKN, DRP, BOD5, CBOD3, CBOD7, CBOD14, CBOD21), 5 = bacteria (Fecal Coliform, *E.coli, Enterococcus* sp.), 6 = flow measurements

Figure D1. MassDEP DWM 2002 Water Quality Monitoring Station Locations in the Ten Mile River Watershed.



STUDY AREA DESCRIPTION

The Ten Mile River Watershed is located in southeastern Massachusetts and a small portion of northeastern Rhode Island. It is the smallest of the 27 major watersheds in Massachusetts with a total drainage area of approximately 54 square miles (49 of which are within Massachusetts). The Ten Mile River originates from its headwaters in the Town of Plainville, meanders south along the Massachusetts and Rhode Island border before ultimately emptying into the Seekonk and Providence rivers.

Land Use
The Massachusetts Geographical Information System (MassGIS) Land Use data layer has 37 land use classifications interpreted from 1:25,000 aerial photography. Coverage is complete statewide for 1971, 1985, and 1999. Additionally, more than half the state was interpreted from aerial photography flown during 1990, 1991, 1992, 1995, or 1997 (MassGIS 2005). The land use datalayers for the Ten Mile River Watershed show forest (39%), residential (32%), and open land (11%) as being the top three land uses.

Tributaries
The Ten Mile River has two major tributaries, the Bungay River and the Sevenmile River. Unnamed tributaries to the Bungay River originate in the Town of Foxborough and flow south into Greenwood Lake located in Mansfield and North Attleborough. The Bungay River originates at the outlet of Greenwood Lake and flows south to join the Ten Mile River in Attleboro. The Sevenmile River begins in North Attleborough, flows south through Attleboro and joins the Ten Mile River in Seekonk. In addition to these major tributaries there are three minor tributaries (Fourmile Brook, Coles Brook, and Scott's Brook) that contribute flow to the Ten Mile River.

QUALITY ASSURANCE AND QUALITY CONTROL

Procedures used were consistent with the prevailing DWM sampling protocols that are described in the CN 1.21 - *Sample Collection Techniques for DWM Surface Water Quality Monitoring* (MassDEP 2005b). For all water quality surveys, quality control samples (field blanks and sample splits) were taken at a minimum of one each per analyte per crew per survey. All water quality and bacteria samples were delivered to the Wall Experiment Station (WES) laboratory for analysis.

DWM quality assurance and database management staff reviewed lab data reports and all multi-probe data. The data were validated and finalized per data validation procedures outlined in CN 56.2 - *DWM Data Validation Standard Operating Procedure* (MassDEP 2005c). All water sample data were validated by reviewing Quality Control (QC) sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). A complete summary of censoring and qualification decisions for all 2002 DWM data is provided in the CN 202.0 - *Data Validation Report for year 2002 Project Data* (MassDEP 2005d).

FIELD AND ANALYTICAL METHODS

Information pertaining to station location, rationale, and objectives is available in the 2002 QAPP (CN 81.0, MassDEP 2002). *In- situ* parameters measured using a multiprobe included dissolved oxygen, percent saturation, pH, conductivity, temperature, and total dissolved solids (TDS). Wade-in grab samples were also collected and sent to MassDEP's WES in Lawrence, MA where they were analyzed for *Enterococcus sp.*, *E. coli* and Fecal Coliform bacteria, ammonia as nitrogen (NH_3-N), low-level total phosphorus (TP), total suspended solids (TSS), and chloride. Additional analytes were collected at two sampling stations (TM06 and TM14) for the phosphorus loading study; Nitrate-Nitrite Nitrogen (NO3-NO2-N), Total Kjeldahl Nitrogen (TKN), Dissolved Reactive Phosphorus (DRP), Long-term Carbonaceous Biochemical Oxygen Demand (BOD), and Carbonaceous Biochemical Oxygen Demand (CBOD).

Flow was measured at six stations using a Swoffer 3000 flow meter. The standard operating procedures for flow surveys can be found in CN 68.0 - *Flow Measurement* (MassDEP 2005e).

Prior to the collection of samples, riparian vegetation, observed uses, potential pollution sources, the presence/absence of objectionable deposits (trash and debris and scum), the percentage of

periphyton/algae/aquatic plants covering the sampling reach, and sampling conditions were recorded on DWM field sheets.

WES supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MassDEP 2001).
The analytical methods, associated detection limits and project data quality objectives for water sample analyses at WES in 2002 were as follows (Table D2).

Table D2. WES Analytical Methods and Detection Limits

Water Quality Analyte	Method	MDL(mg/L) [1]	RDL(mg/L) [1]
Hydrolab® Multiprobe Series 3 and (4)	DWM SOP (CN 4.1)	--	--
Fecal Coliforms	SM-9222-D	5, 6, 7, 10, 20, **	**
E. coli modified M-TEC	EPA Modified 1103.1	6, 7, 10, 20, **	**
Enterococci sp.	EPA 1600	6, 7, 20, **	**
Ammonia-N	EPA 350.1	0.02, 0.04, 0.08, 0.10, 0.20	0.04, 0.06, 0.08, 0.10, 0.20, 0.30
Ammonia-N	SM-4500-NH3-B,C	0.01	**
Total Phosphorus	SM-4500-P-E	0.005, 0.01, 0.010, 0.02, 0.020	**, 0.015, 0.030, 0.03
Dissolved Reactive P	SM-4500-P-E	0.015	0.030
Nitrate-Nitrite-N	EPA 353.1	0.02, 0.20	0.06, 0.60
Kjeldahl-N	EPA 351.2	0.10	0.30
Total Suspended Solids	SM 2540-D	0.5, 1.0, 1	**, 1.0
Chloride	SM 4500-Cl-B	1.0	1.0, 2.0
Biological Oxygen Demand (BOD-5)	SM-5210-B	2.0	5.0
Carbonaceous BOD 3 day	SM-5210-B	2.0	5.0
CBOD – 7 day	SM-5210-B	2.0	5.0
CBOD – 14 day	SM-5210-B	2.0	5.0
CBOD – 21 day	SM-5210-B	2.0	5.0

[1] Multiple MDLs and/or RDLs reflect different detection levels established by WES for water analyses
** = WES did not provide MDLs and/or RDLs for the analyte in question
-- = No data

STATION OBSERVATIONS

Station observations were recorded on field sheets for each survey by a DWM investigator. Station observations are described below for each DWM sampling event (see Table D1 for survey frequency).

TM01, Ten Mile River at Fuller Street (downstream of Fuller Pond), Plainville, MA.
Station TM01 was accessed downstream of Fuller Street at the outlet of Fuller Pond. The immediate landuse for this sampling point is predominately forest and industrial (there is a large gravel mining operation that is located northwest of the sampling point). The river was approximately four feet wide and six inches deep with high flows during the May survey. Wetland vegetation was observed along the banks of the river and sparse amounts of green filamentous algae were observed on river substrates during all surveys. By the July survey, the water level had dropped and silt/sedimentation was observed on the river bottom. The flow had increased by the October survey; however, the silt/sedimentation was still present. During all surveys, the water column was described as having no odors and clear with the exception of the June survey where slight turbidity was noted in the water column.

TM02, Ten Mile River at West Bacon Street, Plainville, MA.
Station TM02 was accessed downstream of West Bacon Street within a cemetery property. The immediate landuse for this sampling point is predominately forest with some residential and industry. The river was approximately six feet wide and three feet deep with high flows observed during the May survey. Moderate amounts of green filamentous algae were observed on river substrates during the May survey but were unobservable during all other surveys. By the July survey, the water level had dropped

and stayed low for the remainder of the survey season (October). The water column was described as having no odors and clear, except for the July and August surveys, where turbidity in the water column was noted.

TM02A, Ten Mile River at Fisher Street, North Attleborough, MA.
Station TM02A was accessed initially upstream of the Fisher Street road crossing and a basket was used to collect samples from the bridge. By the July survey, the samples had to be collected (grab samples) downstream of the road crossing due to lack of sufficient water upstream. The immediate landuse for this sampling point is predominately forest and residential with some industry. The river is channelized at this location with concrete walls on either side. The river was approximately ten feet wide with normal flows observed during the May and June surveys. The flow had decreased by the July survey and stayed low for the remainder of the survey season. Moderate amounts of emergent grasses were observed in the river by the August survey. The water column was described as having no odors and clear, except for the June and July surveys, where turbidity in the water column was noted. Garbage (sunken trash and debris) was observed in the river during all survey events.

TM04, Ten Mile River at Route 1, North Attleborough, MA.
Station TM04 was accessed upstream of the Route 1 road crossing by walking in from the adjacent parking lot. The immediate landuse for this sampling point is predominately forest and residential with some industry. The river is channelized at this location with concrete walls on either side. The river was observed to be approximately fifteen feet wide and over two feet deep during the May and June surveys. The water level had decreased by the July survey and stayed low for the remainder of the survey season. Moderate amounts of emergent grasses were observed in the river by the June survey. The water column was described as having no odors and turbid during all surveys. Trash and debris was observed in the river during the July and August survey.

TM06, Ten Mile River at Cedar Street, North Attleborough, MA.
Station TM06 was accessed by walking in from the left bank upstream of the Cedar Street road crossing. The immediate landuse for this sampling point is forest and residential. The river was approximately fifteen feet wide and three feet deep with high flows observed during the May survey. By the June survey, the flow had dropped and stayed low for the remainder of the survey season (October). The water column was described as having no odors and clear. The river banks were buffered with hardwoods and low shrubs adjacent to residential properties.

TM06A, Ten Mile River East off of Clifton Street (approximately 500 feet downstream from North Attleborough WWTP), Attleboro, MA.
Station TM06A was accessed from a property on Clifton Street (house #355). The immediate landuse for this sampling point is forest and residential. The river was approximately fifteen feet wide and three feet deep with high flows observed during the May survey. By the July survey, the flow had dropped and stayed low for the remainder of the survey season (October). Due to the downstream proximity of this sample location to the North Attleborough WWTP discharge, a strong effluent smell was noted during every survey. Also, by the June survey, moderate amounts of aquatic macrophytes were observed in the river and moderate amounts of green filamentous algae were observed on river substrates. The water column was described as having no odors and turbid during all surveys. Yard waste was noted during all surveys along the right bank.

BG02, Bungay River at Holden Street, Attleboro, MA.
Station BG02 was accessed upstream of the Holden Street crossing adjacent to a canoe launch site. The immediate landuse for this sampling point is forest and residential. The river was approximately fifteen feet wide and too dark (i.e. colored) to observe the depth. This site was sampled in July, August, and October. During these surveys, the flow was observed to be low and the water column was described as clear and odorless, expect for the August survey where some turbidity was observed. Sparse amounts of duckweed were observed in the river during all surveys. Shoreline erosion was noted on the left bank of the river where a lawn abuts the river bank.

BG02A, Bungay River at outlet of Blackinton Pond, Attleboro, MA.
Station BG02A was accessed from a small park adjacent to Blackinton Pond at the outlet of the pond. The immediate landuse for this sampling point is forest and residential. Waterfowl were observed in the upstream pond during every survey. The river was approximately ten feet wide and two feet deep. The flow had decreased by the June survey and stayed low for the remainder of the survey season. The water was a slight yellow/tan color and was observed to be turbid during the May survey. A septic odor was noted when the water levels had dropped during the June and July surveys. Small amounts of trash and debris were observed along the river banks during all surveys. Due to the easy access (park access) of the sampling location, recreational activities (fishing) were observed during the survey season.

TM08A, Ten Mile River at Olive Street, Attleboro, MA.
Station TM08A was accessed from the upstream side of the Olive Street road crossing. The immediate landuse for this sampling point is forest and residential. The river was approximately ten feet wide, depth unknown, with normal flows observed during the May survey. The flow had decreased by the July survey and stayed low for the remainder of the survey season. Sparse amounts of submerged plants were observed in the river by the June survey. Moderate amounts of brown-colored algae were observed on rocks during the July survey, these algae became dense by the August survey, and were sparse again by the October survey. The water column was described as having no odors and clear, except for the July survey, where turbidity in the water column was noted.

SW01, Speedway Brook at Route 152, Attleboro, MA.
Station SW01 was accessed adjacent to the Route 152 road crossing. The immediate landuse for this sampling point is forest and residential. Initially, samples were collected upstream of the road crossing, but later in the season, the samples were collected downstream of the road crossing for better access. The brook was approximately five feet wide, depth unknown, with normal flows observed during the May survey. The flow had decreased by the June survey and stayed low for the remainder of the survey season. By the July survey, sparse amounts of brown-colored algae were observed on rocks. The water column was described as having no odors and clear with a yellow color, except for the July survey, where turbidity in the water column was noted.

TM11, Ten Mile River at Tiffany Street, Attleboro, MA.
Station TM11 was accessed through a cemetery property adjacent to the river downstream of Tiffany Street. The immediate landuse for this sampling point is forest and residential. The river was approximately twenty feet wide, depth unknown, with normal flows observed during the May survey. The flow had decreased by the June survey and stayed low for the remainder of the survey season. By the June survey, sparse amounts of algae were observed on rocks, the algae cover became brown with a moderate cover on the rocks by the July survey, and was sparse again by the October survey. The water column was described as having no odors and clear with a yellow color, except for the July survey, where turbidity in the water column was noted.

TM13, Ten Mile River at Pond Street, Seekonk, MA.
Station TM13 was accessed downstream from the Pond Street road crossing. The river was somewhat impounded at this location. The immediate landuse for this sampling point is forest and residential. Instream observations were unobservable (due to deep water) until the August survey where turbidity in the water column was noted. The flow was consistent during all surveys and there were no odors noted. The water was colored yellow and moderate amounts of water lilies and duckweed were noted.

SM00, Sevenmile River at Draper Avenue, North Attleborough, MA.
Station SM00 was accessed upstream of Draper Avenue by walking in from the road crossing. The immediate landuse for this sampling point is forest. This station was located downstream from a major shopping plaza that was recently developed. The river was approximately six feet wide and two feet deep with normal flows observed during the May survey. The flow had decreased by the June survey and stayed low for the remainder of the survey season. During all surveys, sparse to moderate amounts of algae were observed on rocks. The water column was described as having no odors and slightly turbid during the May survey and clear for the remainder of the survey season. Siltation and sedimentation were noted on the river substrates during all the surveys.

FM01, Fourmile Brook at West Street, Attleboro, MA.
Station FM01 was accessed downstream of West Street and adjacent to Greenfield Street in Attleboro, MA. The immediate landuse for this sampling point is predominately forest. Samples were collected downstream from a small impoundment of the brook (a small pond on a residential property) and adjacent to a residential property lawn. The brook was only three feet wide and less than a foot deep at the sampling location; a lawn bordered the left bank (mowed right to the edge of the bank) and a short strip of hardwoods bordered the right bank. With the exception of the May survey, the flows were low for the survey season. During all surveys, sparse to moderate amounts of algae were observed on rocks. The water column was described as having no odors and clear during all surveys.

SM01A, Sevenmile River at Pitas Avenue, Attleboro, MA.
Station SM01A was accessed upstream from a small wooden bridge (Pitas Avenue) in Attleboro, MA. The immediate landuse for this sampling point is predominately forest and some residential. The river was approximately 15 feet wide and 3 feet deep at the sampling location. A residential property bordered the left bank and hardwoods bordered the right bank. Shoreline erosion was observed on both banks during the survey season. The water levels decreased by the June survey and stayed low for the remainder of the survey season. During the October survey, sparse amounts of algae were observed on rocks and sparse amounts of aquatic plants were also visible in the river. The water column was described as having no odors and clear, except for the August survey where slight turbidity was noted.

SM01, Sevenmile River at County Street, Attleboro, MA.
Station SM01 was accessed upstream of County Street in Attleboro, MA. The immediate landuse for this sampling point is predominately forest and some residential. The river depth and width was unknown at this location (observed to be deep and dark) during the May survey. Flows decreased by the June survey and sparse amounts of submerged plants were observable. The river banks were channelized by a rock wall. The water column was described as having no odors and clear, except for the August survey where slight turbidity was noted.

TM14, Ten Mile River at Central Avenue, Seekonk, MA/Pawtucket, RI.
Station TM14 was accessed upstream of Central Avenue in Seekonk, MA, near the RI border. The river was approximately 15 feet wide and depth was undetermined at the sampling location. Hardwoods bordered both banks and the immediate landuse was predominately commercial (shopping plazas) and residential. The water levels decreased by the June survey and stayed low for the remainder of the survey season. During the June survey, sparse amounts of aquatic plants were visible in the river and dense amounts of green filamentous algae were observed on these aquatic plants. By the July survey, sparse amounts of aquatic plants were noted and a thin film of brown-colored algae was visible on the substrate. The water column was described as having no odors and clear, except for the August survey where slight turbidity and an effluent smell were noted.

CB01, Coles Brook at Route 152, Seekonk, MA.
Station CB01 was accessed downstream of Route 152 in Seekonk, MA. The immediate landuse for this sampling point is predominately forest and some residential. Directly upstream (upstream of Route 152) of the sampling location, the brook has been manipulated by a property owner. The brook has been partially dammed to create a pond on the property and flow was noticeably restricted during the survey season. The river was approximately 5 feet wide and depth was unknown at the sampling location. The water levels were observed to be normal during the May and June surveys; however, by the July survey there was no water in the brook downstream of Route 152. Samples were not collected during July and August due to lack of water, and by October; there was a normal level of water in the brook again. By the June survey, sparse amounts of aquatic plants were noted. The water column was described as having no odors and clear, except for the July and August surveys where there was no water.

TM15, Ten Mile River at Route 114/1A, East Providence, RI.
Station TM15 was accessed upstream of the road crossing adjacent to the USGS gage (01109403). The immediate landuse for this sampling point is forest, residential, and is adjacent to a golf course property. This station was only visited twice: June and August. The flows were normal during both surveys. During the June survey the water column was described as having no odors and clear; however, during the August survey, there was slight turbidity and a rotten/pond water smell was noted. There was also an algae scum/bloom observed during the August survey.

SURVEY CONDITIONS

Information on precipitation and stream discharge was analyzed to determine hydrologic conditions leading up to and during the water quality sampling events. Additionally, this review was used to determine whether the bacteria data were representative of "wet – an increase in flow" or "dry weather" sampling conditions. Climate data were collected from the National Weather Service's website (http://www.erh.noaa.gov/box/dailystns.shtml) (NOAA 2005). One weather station precipitation gage was used to determine precipitation and weather conditions for five days prior to and on the sampling dates: Taunton, MA (Table D3). Streamflow data were obtained from one continuous USGS stream gage in the watershed [Table D4, Ten Mile River at Pawtucket Avenue in East Providence, Rhode Island (01109403)]. The 2002 survey season was defined as a drought season by the USGS:

> A significant drought during the autumn, winter, and early spring 2002 water year resulted in streamflows and ground-water levels being consistently below normal for the period October 2001 through April 2002. Below-normal conditions recovered to near-normal for most of Massachusetts and Rhode Island when significant rainfall occurred during May through July. Although below-normal hydrologic conditions returned in August and September, the severity of the drought conditions was much less extreme than those experienced four months earlier.

Survey conditions are described below for each DWM sampling date.

15 May 2002 – Field notes indicated sunny skies and air temperatures between 50°F and 60°F. Two days prior to the sample date 2.21 inches of rain fell. This significant rain event increased the flow at the Ten Mile River gage in East Providence, RI (113 cfs to 310 cfs) on the sample date. Also, 0.42 inches of rain fell one day prior to the sample date. This water quality survey is considered to be conducted during wet weather.

16 May 2002 – Field notes indicated clear skies and air temperatures between 40°F and 50°F. This pre-dawn survey was conducted during wet weather, as was the 15 May survey above. There was 0.42 inches of rain two days prior to the sample date and there was 2.21 inches of rain three days prior to the sample date, which increased the flow at the Ten Mile River gage. The gage was still measuring a high discharge (200 cfs) on the sample date. This water quality survey is considered to be conducted during wet weather.

18 June 2002 – Field notes indicated clear skies and air temperatures in the 70°F range. Rain fell on day four, three, and two days prior to the sampling date, however, there was no rain fall on the day prior to sampling or on the sampling day. There was a flow increase recorded by the Ten Mile River gage in East Providence on three days prior to sampling and a decrease in flow the following days leading up to the sample date (83 cfs to 71 cfs). This water quality survey is considered to be conducted during dry weather.

19 June 2002 – Field notes indicated clear skies and air temperatures between 50°F and 60°F. This pre-dawn survey was conducted during dry weather, as was the 18 June survey above. There was no precipitation two days prior to the sample date. Precipitation did occur five, four and three days prior to the sample date, however, there was an increase in flow (72 cfs to 83 cfs) measured by the Ten Mile River gage on the days of precipitation and flow decreased by the sample date (63 cfs). This water quality survey is considered to be conducted during dry weather.

23 July 2002 – Field notes indicated clear skies and air temperatures in the 70°F range. The five days prior to the sample date were dry with the exception of minimal rainfall (0.07 inches and 0.01 inches) four and three days prior to sampling. Rain fell (0.21 inches) on the sample date, however, this event occurred after samples were collected. This water quality survey is considered to be conducted during dry weather.

24 July 2002 – Field notes indicated cloudy skies and air temperatures in the 60°F range. As with the 23 July survey, the days leading up to the survey were considered dry. Rain fell (0.21 inches) one day prior to the sample date and an hour into this pre-dawn survey. The Ten Mile River gage measure increased flow (19 cfs to 30 cfs) from the one day prior to the sample date to the day of sampling. This water quality survey is considered to be conducted during wet weather.

27 August 2002 – Field notes indicated clear skies and air temperatures in the 70°F range. The five days prior to the sample date experienced minimal rainfall and there was no precipitation one day prior to the sample date. This water quality survey is considered to be conducted during dry weather.

28 August 2002 – This pre-dawn survey was conducted during dry weather, as was the 27 August survey above. Field notes indicated clear skies and air temperatures in the 60°F range. There was no precipitation for two days prior to the sample date. (Note. The USGS gage reported flow at 15 cfs on 26 August and this sample date, which is at/below the 7Q10 for this gage).

1 October 2002 – Field notes indicated clear skies and air temperatures in the 60°F range. Rain fell on day five and four prior to the sampling date and there was minimal rain (0.01 inches) one day prior to sampling. There was no flow increase recorded by the Ten Mile River gage due to this minimal amount of precipitation in the days leading up the sampling date. This water quality survey is considered to be conducted during dry weather.

2 October 2002 – This pre-dawn survey was conducted during dry weather, as was the 1 October survey above. Field notes indicated clear skies and air temperatures in the 60°F range. There was no precipitation one day prior to the sample date and minimal rain (0.01 inches) two days prior to the sample date.

Table D3. 2002 Precipitation data summaries for MassDEP DWM surveys obtained from the NOAA website (http://www.erh.noaa.gov/box/dailystns.shtml) for Taunton, MA.

Ten Mile River Watershed Survey
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
5/15/2002	0.15	0.00	0.35	2.21	0.42	0.00
5/16/2002	0.00	0.35	2.21	0.42	0.00	0.00
6/18/2002	T	0.08	0.47	0.18	0.00	0.00
6/19/2002	0.08	0.47	0.18	0.00	0.00	T
7/23/2002	0.00	0.07	0.01	0.00	0.00	0.21
7/24/2002	0.07	0.01	0.00	0.00	0.21	0.07
8/27/2002	0.06	0.01	0.16	0.01	0.00	0.00
8/28/2002	0.01	0.16	0.01	0.00	0.00	0.01
10/01/2002	0.29	0.43	0.10	0.00	0.01	0.00
10/02/2002	0.43	0.10	0.00	0.01	0.00	0.01

T = Trace amount of precipitation measured

Table D4. USGS gage data summaries in the Ten Mile River Watershed for the 2002 MassDEP DWM surveys (USGS 2002 and 2003).

Ten Mile River Watershed Survey
USGS Flow Data Summary (reported in cubic feet per second)
7Q10 is 15.56 cfs at this gage

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date
Ten Mile River at Pawtucket Avenue in East Providence, Rhode Island (01109403)*						
5/15/2002	76	69	65	113	322	310
5/16/2002	69	65	113	322	310	200
6/18/2002	75	72	83	83	79	71
6/19/2002	72	83	83	79	71	63
7/23/2002	19	19	21	17	17	19
7/24/2002	19	21	17	17	19	30
8/27/2002	20	25	18	17	15	17
8/28/2002	25	18	17	15	17	15
10/01/2002	58	59	41	33	---	31
10/02/2002	59	41	33	---	31	30

* USGS notes that flow is affected by controls on reservoirs upstream (USGS 2002 and 2003)

2002 DATA SYMBOLS AND QUALIFIERS

The following data qualifiers or symbols are used in the MassDEP/DWM water quality database for qualified and censored water quality 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 data (i.e., data that has been discarded for some reason).
** = Missing data (i.e., data that should have been reported). See NOTE above.
-- = No data (i.e., data not taken/not required)
[ ] = A result reported inside brackets has been "censored", but is shown for informational purposes.

Multi-probe-specific Qualifiers

i = inaccurate readings from Multi-probe likely.

m = method not followed; one or more protocols contained in the DWM Multi-probe 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.

u = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc.

c = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard.

r = data not representative of actual field conditions.

Sample-Specific Qualifiers

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

d = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

e = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for *E. coli* bacteria > Fecal Coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

f = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

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

j = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl). Also used to note where values have been reported at levels less than the MDL.

m = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (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.

r = samples collected may not be representative of actual field conditions, including the possibility of "outlier" data and flow-limited conditions (e.g., pooled).

WATER QUALITY DATA

Raw data files, field sheets, lab reports and chain of custody (COC) records are stored in open files at the DWM in Worcester. All DEP DWM water quality data are managed and maintained in the *Water Quality Data Access Database*. Data exports for publishing are provided by DWM's database manager. Tables D5 – 8 below are data exports for the Ten Mile River Watershed.

Table D5. 2002 MassDEP Ten Mile River Watershed *in-situ* Multiprobe data.
OWMID (sample ID), Temp (Temperature), pH, Conductivity, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), and Percent Saturation

Ten Mile River, Station TM01, Unique ID W0168
Description: Fuller Street (downstream of Fuller Pond), Plainville, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0131	08:33	0.1 i	11.8	7.3 c	395	252	10.5	97
05/16/02	52-0167	02:19	0.3	13.0	6.9 u	394 u	252 u	11.0 u	104 u
06/18/02	52-0186	08:10	0.3	17.4	6.9 cu	354	227	9.7 u	100 u
06/19/02	52-0223	03:08	0.4	19.5	7.0 c	352	226	9.5	101
07/23/02	52-0240	08:00	0.1 i	19.9 u	6.5	283	181	5.9 u	64 u
07/24/02	52-0277	01:59	0.3	24.3 u	6.9 c	302	193	7.5	88
08/27/02	52-0295	07:33	## i	14.8	6.2	251 u	160 u	3.8	37
08/28/02	52-0333	02:12	0.1 i	14.5 u	6.2	251	161	4.5 u	44 u
10/01/02	52-0352	07:44	## i	13.7	6.7	263	168	3.9 u	37 u
10/02/02	52-0389	02:00	## i	20.4	8.0 c	373	239	10.4 u	112 u

Ten Mile River, Station TM02, Unique ID W0905
Description: West Bacon Street, Plainville, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0133	08:56	0.3	10.5	6.5 u	240	153	8.6	76
05/16/02	52-0168	02:34	0.6	12.2	6.6 u	253 u	162 u	8.8	82
06/18/02	52-0188	08:28	0.7	15.8	6.6	324	207	8.1	81
06/19/02	52-0224	03:24	0.5	17.4	6.6	327	209	7.7 u	79 u
07/23/02	52-0242	08:16	0.1 i	16.7	6.5	305	195	6.3	64
07/24/02	52-0278	02:14	0.2	18.2	6.3	260	166	4.8	51
08/27/02	52-0297	07:49	0.1 ir	17.7 r	6.4 r	304 ru	194 ru	0.9 ru	9 ru
08/28/02	No Flow	**	--	--	--	--	--	--	--
10/01/02	52-0354	08:03	## i	15.3	6.3	387	248	7.1 u	69 u
10/02/02	52-0390	02:11	## i	16.2	6.5 u	410	263	6.7	66

Ten Mile River, Station TM04, Unique ID W0169
Description: Route 1, North Attleborough, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0136	09:39	0.4	10.6	6.8 u	246	157	9.2	82
05/16/02	52-0169	02:53	0.7	11.6	6.6	265	169	8.8	80
06/18/02	52-0191	09:01	0.6	16.7	6.8 u	310	198	7.2	73
06/19/02	52-0225	03:39	0.4	17.9	6.7	323	207	6.4	66
07/23/02	52-0245	08:43	0.4	21.9	6.7	367	235	2.7 u	31 u
07/24/02	52-0279	02:28	0.4	22.9	6.4	183	117	3.3	38
08/27/02	52-0300	08:23	0.2 i	20.1 u	6.7	291	187	3.7 u	39 u
08/28/02	52-0335	02:31	0.3	20.4	6.7	303	194	5.0 u	54 u
10/01/02	52-0357	08:33	## i	15.5	6.4 u	458 u	293 u	5.1 u	50 u

Table D5 (continued). 2002 MassDEP Ten Mile River Watershed *in-situ* Multiprobe data.

Ten Mile River, Station TM06, Unique ID W0170

Description: Cedar Road (approximately 850 feet upstream of North Attleborough WWTP (MA0101036) discharge), North Attleborough, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0138	10:07	0.5	12.5	6.9 c	282	180	9.9	92
05/16/02	52-0170	03:09	0.3	12.6	6.7	286	183	9.6	89
06/18/02	52-0193	09:24	0.4	17.9	6.8	279	179	7.9	82
06/19/02	52-0226	03:55	0.2	18.8	6.8	281	180	7.8 u	82 u
07/23/02	52-0247	09:02	0.2	19.8	6.8	342	219	6.7	73
07/24/02	52-0280	02:41	0.2	21.4	6.7	277	177	5.4 u	60 u
08/27/02	52-0304	08:42	0.1 i	17.8	6.7	325	208	7.1	74
08/28/02	52-0336	02:47	0.1 i	18.1	6.7	328	210	7.2 u	75 u
10/01/02	52-0359	09:00	## i	16.8	6.6	289	185	7.8	79
10/02/02	52-0392	02:28	## i	18.3	6.6	288	184	7.4 u	77 u

Ten Mile River, Station TM06A, Unique ID W0903

Description: East off Clifton Street (approximately 500 feet downstream of North Attleborough WWTP (MA0101036) discharge) (behind house #355), Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0140	10:32	0.3	12.6	6.9 c	301 u	193 u	9.8	92
06/18/02	52-0195	09:45	0.7 m	17.3 m	6.8 m	426 m	273 m	8.1 m	83 m
06/19/02	52-0227	04:06	0.2	17.9	6.7	451	289	7.6	78
07/23/02	52-0249	09:15	0.2	20.6	6.8	658	421	5.3	58
07/24/02	52-0281	02:52	0.3	21.1	6.8	592	379	4.6 u	51 u
08/27/02	52-0306	09:14	0.1 i	20.3	6.7	657	420	6.2	68
08/28/02	52-0337	02:58	0.1 i	20.1	6.8	813 c	520 c	6.1 u	67 u
10/01/02	52-0361	09:12	## i	18.5	6.6	586	375	7.7 u	80 u
10/02/02	52-0393	02:37	## i	19.2 m	6.7 m	582 m	372 m	7.1 mu	75 mu

Bungay River, Station BG02, Unique ID W0179

Description: Holden Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
07/23/02	52-0252	10:00	0.2	24.4	6.6	333	213	5.2 u	61 u
07/24/02	52-0283	03:29	0.2	25.8	6.7	328	210	6.2	75
08/27/02	52-0309	10:04	## i	21.5	6.8	339	217	8.2	91
08/28/02	52-0339	03:33	0.1 i	22.1	7.0 c	340	217	9.4 u	106 u
10/01/02	52-0364	10:00	## i	16.2	6.4	308	197	6.5 u	65 u
10/02/02	52-0395	03:12	## i	18.1	6.6	313	200	8.3 u	86 u

Bungay River, Station BG02A, Unique ID W0901

Description: At outlet of impoundment locally known as Blackinton Pond approximately 400 feet downstream of North Main Street (Route 152), Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0146	11:48	0.5	11.0	6.0 u	139	89.2	7.1	64
05/16/02	52-0173	03:50	0.5	11.2	5.7 u	143	91.6	6.1	55
06/18/02	52-0201	11:03	0.4	18.9	6.4	267	171	6.7	70
06/19/02	52-0229	04:44	0.2	19.0	6.5	274	175	6.7 u	71 u
07/23/02	52-0254	10:15	0.2	25.3	6.6	335	214	5.6	67
07/24/02	52-0284	03:38	0.2	25.6	6.7	328	210	5.8 u	70 u
08/27/02	52-0311	10:20	0.1 i	22.3	6.7	332	213	7.0	79
08/28/02	52-0340	03:45	0.1 i	21.7	6.8	334	213	7.2	80
10/01/02	52-0368	10:21	## i	17.2	6.5	301	193	8.1 u	82 u
10/02/02	52-0396	03:22	## i	18.4	6.6	309	198	8.1	84

Table D5 (continued). 2002 MassDEP Ten Mile River Watershed *in-situ* Multiprobe data.

Ten Mile River, Station TM08A, Unique ID W0172

Description: Olive Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0148	08:05	1.1	11.7	6.5 u	285	182	9.2	85
05/16/02	52-0176	01:27	0.4	12.7	6.5	290	185	9.5	89
06/18/02	52-0205	07:50	0.1 i	17.6	6.6	359	230	7.6 u	78 u
06/19/02	52-0231	02:24	## i	20.3	6.6	378	242	7.5 u	81 u
07/23/02	52-0260	07:56	0.1 i	22.7	6.8	583 u	373 u	4.2	47
07/24/02	52-0286	02:13	0.2	23.9	6.7	503	322	3.2 u	38 u
08/27/02	52-0315	07:45	0.1 i	20.5	6.7	610	391	3.9 i	42 i
08/28/02	52-0342	02:15	0.2	20.7	6.7	603	386	4.2 i	46 i
10/01/02	52-0372	07:49	0.1 i	16.9	6.8	440	282	7.3 u	73 u
10/02/02	52-0398	02:27	## i	18.9	6.7	447	286	6.9	72

Speedway Brook, Station SW01, Unique ID W0180

Description: Route 152, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0152	08:52	0.3	10.0	5.8	119	76.3	8.0	71
05/16/02	52-0177	01:52	0.2	11.0	6.1	144	92.3	8.8	79
06/18/02	52-0207	08:14	## i	15.0	6.5	256	164	7.4	72
06/19/02	52-0232	02:42	## i	16.9	6.5	277	177	7.3 u	74 u
07/23/02	52-0262	08:23	0.1 i	20.5	6.8	482	308	4.2	46
07/24/02	52-0287	02:32	0.1 i	23.3	6.4	119	75.9	3.8	44
08/27/02	52-0317	08:05	0.1 i	18.3	6.7	467	299	4.6 i	48 i
08/28/02	52-0343	02:29	0.1 i	18.6	6.8	515	330	5.1 i	54 i
10/01/02	52-0374	08:07	## i	16.5	6.6	427	273	5.1 u	51 u
10/02/02	52-0399	02:42	## i	18.3	6.7	430	275	5.2 u	54 u

Ten Mile River, Station TM11, Unique ID W0173

Description: Tiffany Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0154	09:16	0.1 i	11.5	6.4 u	254	163	9.8	90
05/16/02	52-0178	02:13	0.3	12.7	6.7 u	264	169	10.2	95
06/18/02	52-0209	08:38	## i	18.6	6.7	338	217	8.4	88
06/19/02	52-0233	02:59	## i	21.0	6.8 u	348	223	8.3 u	91 u
07/23/02	52-0264	08:46	0.1 i	23.0	7.1 c	528	338	6.8	78
07/24/02	52-0288	02:48	0.4	24.4	7.2 c	530	339	6.7	79
08/27/02	52-0319	08:22	0.1 i	20.4	7.0 c	525	336	6.4 i	69 i
08/28/02	52-0344	02:46	0.2	20.9	7.0 c	544	348	6.6 i	72 i
10/01/02	52-0376	08:24	## i	17.0	6.8	399	255	7.9 u	79 u
10/02/02	52-0400	03:00	0.2 i	18.3	7.0 c	414	265	7.7	80

Ten Mile River, Station TM13, Unique ID W0175

Description: Pond Street, Seekonk, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0156	09:47	0.3	11.7	6.3 u	239 u	153 u	9.9	90
05/16/02	52-0179	02:35	0.3	12.4	6.6 u	244	156	9.9	91
06/18/02	52-0211	09:11	0.4	17.6	6.6	330	211	8.1	83
06/19/02	52-0234	03:17	0.1 i	21.0	6.7 u	328	210	8.0 u	87 u
07/23/02	52-0266	09:08	0.2	23.3	6.9 c	472	302	5.8	67
07/24/02	52-0289	03:07	0.5	24.3	6.9 c	465	298	4.9	58
08/27/02	52-0321	08:43	0.3	21.0	6.9	474	303	5.1 i	56 i
08/28/02	52-0345	03:07	0.4	21.4	6.9 c	479	306	5.2 i	58 i
10/01/02	52-0378	08:45	0.2	17.2	6.8	379	242	8.1	82
10/02/02	52-0401	03:21	0.3 i	18.6	6.9	392	251	7.4	78

Table D5 (continued). 2002 MassDEP Ten Mile River Watershed *in-situ* Multiprobe data.

Sevenmile River, Station SM00, Unique ID W0182
Description: Draper Avenue, North Attleborough, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0142	11:15	0.3	9.4	6.6 u	127	81.3	10.4	91
05/16/02	52-0172	03:28	0.3	10.1	6.5	153	98.0	9.8 u	86 u
06/18/02	52-0199	10:21	0.4	15.0	6.8	212	135	9.1 u	88 u
06/19/02	52-0228	04:23	0.1 i	15.6	6.8	233	149	8.7 u	86 u
07/23/02	52-0251	09:38	0.2	20.9	6.8	672	430	7.1	78
07/24/02	52-0282	03:10	0.2	21.6	6.8 u	452	289	6.8 u	76 u
08/27/02	52-0308	09:38	0.1 i	22.0	6.7	163	104	7.8	87
08/28/02	52-0338	03:14	0.2	21.8	6.7 u	162	104	7.8 u	87 u
10/01/02	52-0363	09:35	## i	15.6	6.7	459	294	8.7 u	85 u
10/02/02	52-0394	02:53	## i	17.0	6.8	467	299	8.2 u	83 u

Fourmile Brook, Station FM01, Unique ID W0181
Description: West Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0150	08:27	0.3	9.2	6.3	137	87.7	9.3	81
05/16/02	52-0175	04:08	0.1 i	9.6	6.3	166	106	9.0 u	78 u
06/18/02	52-0203	10:42	0.4	14.0	6.8	292	187	8.6	81
06/19/02	52-0230	05:02	0.2	12.5	6.7	293	188	8.7 u	80 u
07/23/02	52-0256	10:36	0.2	17.2 u	6.9	298	191	8.2	84
07/24/02	52-0285	03:52	0.2	15.7	6.7	295	189	7.7	76
08/27/02	52-0313	10:39	## i	16.5	6.8	305	195	8.1	82
08/28/02	52-0341	04:00	0.1 i	15.4	6.8	305	195	8.0 u	79 u
10/01/02	52-0370	10:52	## i	16.7	6.7	306	196	7.9	79
10/02/02	52-0397	03:35	## i	16.7	6.7	306 u	196 u	7.6 u	76 u

Sevenmile River, Station SM01A, Unique ID W0900
Description: Pitas Avenue, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0160	10:27	0.2	10.7	6.2	220	141	9.0	81
05/16/02	52-0181	03:12	0.6	10.6	6.5	242	155	8.9	79
06/18/02	52-0217	09:56	0.3	13.7	6.4 u	341	218	8.0	76
06/19/02	52-0236	03:51	## i	14.7	6.4	346	221	7.6	73
07/23/02	52-0272	09:59	0.2	19.5	6.4	369	236	6.3	67
07/24/02	52-0291	03:48	0.3	21.1	6.6	320	205	5.7	63
08/27/02	52-0327	09:30	0.2	17.1	6.4	377	241	6.6 i	67 i
08/28/02	52-0347	03:46	0.2	17.0	6.4	384	246	6.7 i	68 i
10/01/02	52-0384	09:33	## i	14.6	6.5	361	231	7.6 u	73 u
10/02/02	52-0403	03:59	0.2 i	16.3	6.5	363	232	7.0 u	70 u

Sevenmile River, Station SM01, Unique ID W0183
Description: Upstream of County Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0158	10:09	0.4	10.3	6.2 u	228	146	8.8	78
05/16/02	52-0180	02:53	0.5	11.2	6.4	258	165	8.6	77
06/18/02	52-0213	09:33	0.5	14.6	6.4	378	242	7.8	75
06/19/02	52-0235	03:34	## i	16.0	6.4	391	250	7.3 u	72 u
07/23/02	52-0268	09:36	0.3	19.9	6.5	411	263	6.7	72
07/24/02	52-0290	03:31	0.2	20.5	6.5	378	242	5.7	63
08/27/02	52-0323	09:05	0.1 i	17.7	6.5	403	258	7.1 i	73 i
08/28/02	52-0346	03:27	0.3	17.2	6.5	413	264	7.2 i	73 i
10/01/02	52-0380	09:01	0.1 i	14.8	6.5	403	258	7.8	75
10/02/02	52-0402	03:41	0.1 i	16.5	6.5	404	258	7.2	72

Table D5 (continued). 2002 MassDEP Ten Mile River Watershed *in-situ* Multiprobe data.

Ten Mile River, Station TM14, Unique ID W0176

Description: Central Avenue (approximately 1/2 mile downstream of Attleboro WWTP (MA0100595) discharge), Seekonk, MA /Pawtucket, RI.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0162	10:54	0.1 i	11.8	6.5	292	187	9.8	90
05/16/02	52-0182	03:34	0.7	12.2	6.8	310	199	9.7	90
06/18/02	52-0219	10:29	0.1 i	18.0	6.7	412	264	9.0	93
06/19/02	52-0237	04:11	## i	19.4	6.7	469	300	7.7	82
07/23/02	52-0274	10:27	0.3	22.5	7.1 c	641	410	6.9	79
07/24/02	52-0292	04:10	0.4	23.3	7.1 c	744 c	476 c	5.1	59
08/27/02	52-0329	09:55	0.2	20.3	6.9 c	655	419	6.7 i	73 i
08/28/02	52-0348	04:06	0.4	20.7	7.0 c	931 c	596 c	6.2 i	68 i
10/01/02	52-0386	09:56	0.7	16.8	6.9	472	302	8.0	80
10/02/02	52-0404	04:18	0.1 i	18.4	6.9 c	611	391	7.2 u	75 u

Coles Brook, Station CB01, Unique ID W0184

Description: Route 152, Seekonk, MA.

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/L)	DO (mg/L)	DO Saturation (%)
05/15/02	52-0166	11:29	0.8	10.5	5.5	60.0	38.4	10.0 u	89 u
05/16/02	52-0183	03:54	0.9	11.1	5.8	63.5	40.7	10.1	90
06/18/02	52-0221	11:01	0.6	16.2	6.2	90.9	58.2	7.2 u	71 u
06/19/02	52-0238	04:30	0.3 i	17.1	6.1	94.0	60.2	6.0 u	60 u
07/23/02	No Flow	10:55j	--	--	--	--	--	--	--
07/24/02	No Flow	**	--	--	--	--	--	--	--
08/27/02	No Flow	10:15j	--	--	--	--	--	--	--
08/28/02	No Flow	**	--	--	--	--	--	--	--
10/01/02	52-0388	10:16	0.5	14.5	6.6	155	99.0	5.8	56
10/02/02	52-0405	04:36	0.5 i	15.6	6.8	154	99.0	7.9	78

Table D6. 2002 MassDEP Ten Mile River Watershed Instream Physicochemical and Bacteria Data. OWMID (sample ID), *E. coli* and Fecal Coliform bacteria, and *Enterococcus sp.*, ammonia as nitrogen (NH_3-N), low-level total phosphorus (TP), total suspended solids (TSS), chloride, Nitrate-Nitrite Nitrogen (NO3-NO2-N), Total Kjeldahl Nitrogen (TKN), Dissolved Reactive Phosphorus (DRP), Biochemical Oxygen Demand (BOD), and Carbonaceous Biochemical Oxygen Demand (CBOD).

Ten Mile River, Station TM01, Unique ID W0168

Description: Fuller Street (downstream of Fuller Pond), Plainville, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0130	08:35	20	<20	<20	<0.06	0.012 j	2.5
06/18/02	52-0185	08:16	13	13	--	<0.02	--	8.8
07/23/02	52-0239	07:58	1400	19	90	<0.06	0.014 j	1.5
08/27/02	52-0294	07:32	160	130	130	<0.06	--	29
10/01/02	52-0351	07:42	13 h	6 h	26 h	## b	0.034	<1.0

Ten Mile River, Station TM02, Unique ID W0905

Description: West Bacon Street, Plainville, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0132	08:53	180	120	270	<0.06	0.022	1.7
06/18/02	52-0187	08:25	90	39	--	<0.06	0.046	30
07/23/02	52-0241	08:15	150 e	190 e	310	<0.06	0.055	2.5
08/27/02	52-0296	07:46	880 e	1600 e	140	0.33	0.074	21
08/28/02	No Flow	**	--	--	--	--	--	--
10/01/02	52-0353	08:02	13 eh	26 eh	52 h	## b	0.031	24

Ten Mile River, Station TM02A, Unique ID W0904

Description: Fisher Street, North Attleborough, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)
05/15/02	52-0134	09:20	480	480	370
06/18/02	52-0189	08:50	97 e	150 e	--
07/23/02	52-0243	08:28	1700 e	2200 e	500
08/27/02	52-0298	08:05	580	470	490
10/01/02	52-0355	08:15	220 eh	290 eh	430 h

Ten Mile River, Station TM04, Unique ID W0169

Description: Route 1, North Attleborough, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0135	09:35	740	560	500	<0.06	0.040	3.4
06/18/02	52-0190	09:00	540	430	--	0.09	0.040	3.1
07/23/02	52-0244	08:39	450	290	350	<0.02	0.16	9.8
08/27/02	52-0299	08:15	150	100	280	<0.06	0.093	8.3
10/01/02	52-0356	08:30	330 h	270 h	370 h	## b	0.078	2.4

Table D6 (continued). 2002 MassDEP Ten Mile River Watershed Physicochemical and Bacteria Data.

Ten Mile River, Station TM06, Unique ID W0170

Description: Cedar Road (approximately 850 feet upstream of North Attleborough WWTP (MA0101036) discharge), North Attleborough, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0137	10:05	220	120	120	--	<0.06	0.037	3.8
06/18/02	52-0192	09:25	84	84	--	52	<0.06	0.047	2.7
06/18/02	52-0197	09:25	52	45	--	52	<0.06	0.047	2.6
07/23/02	52-0246	08:55	330	230	370	--	<0.02	0.15	2.3
08/27/02	52-0301	08:45	250	160	600	65	<0.02	0.13	<1.0
08/27/02	52-0302	08:45	160 e	240 e	680	65	<0.02	0.11	<1.0
10/01/02	52-0358	08:58	200 h	150 h	180 h	--	## b	0.11	<1.0

(parameter list for Station TM06 continued)

Date	OWMID	Time (24hr)	NO3-NO2-N (mg/L)	TKN (mg/L)	DRP (mg/L)	BOD(5) (mg/L)	CBOD(3) (mg/L)	CBOD(7) (mg/L)	CBOD(14) (mg/L)	CBOD(21) (mg/L)
05/15/02	52-0137	10:05	--	--	--	--	--	--	--	--
06/18/02	52-0192	09:25	0.40	0.40	0.021 j	<2.0	--	--	--	--
06/18/02	52-0197	09:25	0.40	0.42	0.021 j	<2.0	--	--	--	--
07/23/02	52-0246	08:55	--	--	--	--	--	--	--	--
08/27/02	52-0301	08:45	1.0	0.28 j	0.10	--	<2.0	<2.0	<2.0	2.5 dj
08/27/02	52-0302	08:45	1.1	0.29 j	0.10	--	<2.0	<2.0	<2.0	3.8 dj
10/01/02	52-0358	08:58	--	--	--	--	--	--	--	--

Ten Mile River, Station TM06A, Unique ID W0903

Description: East off Clifton Street (approximately 500 feet downstream of North Attleborough WWTP (MA0101036) discharge) (behind house #355), Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0139	10:32	98	78	160	--	0.06	0.072	8.5
06/18/02	52-0194	09:45	39	39	--	76	<0.06	0.27	1.8
07/23/02	52-0248	09:15	58	6	32	--	0.66	0.78	1.7
08/27/02	52-0305	09:10	380	380	210	110	0.06	0.81	2.2
10/01/02	52-0360	09:10	58 eh	71 eh	39 h	--	## b	0.45	3.6

Bungay River, Station BG02A, Unique ID W0901

Description: At outlet of impoundment locally known as Blackinton Pond approximately 400 feet downstream of North Main Street (Route 152), Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0143	11:43	980	310	840 d	--	<0.06	0.037	1.9
05/15/02	52-0144	11:43	1400	290	410 d	--	<0.06	0.036	1.6
06/18/02	52-0200	11:00	370	280	--	59	<0.06	0.041	1.8
07/23/02	52-0253	10:15	1200	640	3000	--	<0.06	0.075 d	4.3
07/23/02	52-0257	10:15	1200	600	3200	--	<0.06	0.047 d	4.0
08/27/02	52-0310	10:15	5200	4200	620	78	<0.06	0.055	12
10/01/02	52-0365	10:15	530 eh	560 eh	1400 h	--	## b	0.039	2.0
10/01/02	52-0366	10:15	610 h	580 h	2200 h	--	## b	0.037	1.8

Ten Mile River, Station TM08A, Unique ID W0172

Description: Olive Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0147	07:50	580 h	200 h	440 h	0.12 b	0.12	4.4
06/18/02	52-0204	07:40	110 h	100 h	--	0.09	0.13	2.3
07/23/02	52-0259	07:51	90	19	160	0.07	0.19	1.4
08/27/02	52-0314	07:45	170	110	110	0.06	0.20	<1.0
10/01/02	52-0371	07:45	93 ehj	93 eh	120 h	0.11	0.19	1.7

Table D6 (continued). 2002 MassDEP Ten Mile River Watershed Physicochemical and Bacteria Data.

Speedway Brook, Station SW01, Unique ID W0180
Description: Route 152, Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0151	08:50	330 e	350 e	540	0.10 b	0.044	2.2
06/18/02	52-0206	08:10	290	210	--	0.29	0.048	2.6
07/23/02	52-0261	08:21	340	97	340	0.28	0.049	1.1
08/27/02	52-0316	08:00	770	160	490	0.26	0.058	3.9
10/01/02	52-0373	08:05	3000 hj	2200 h	4800 h	0.91	0.069	2.7

Ten Mile River, Station TM11, Unique ID W0173
Description: Tiffany Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0153	09:20	510	330	370	--	0.14 b	0.11	7.0
06/18/02	52-0208	08:40	42 e	58 e	--	67 f	0.06	0.11	3.3
07/23/02	52-0263	08:39	130	65	65	--	<0.02	0.094	1.2
08/27/02	52-0318	08:16	65	32	100	100 f	<0.02	0.11	1.2
10/01/02	52-0375	08:20	340 ehj	370 eh	110 h	--	<0.06	0.11	1.9

Ten Mile River, Station TM13, Unique ID W0175
Description: Pond Street, Seekonk, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0155	09:40	410	370	310	--	0.12 b	0.12	6.7
06/18/02	52-0210	09:09	220	140	--	64 f	0.07	0.14	4.4
07/23/02	52-0265	09:08	1700	590	250	--	<0.06	0.17	3.0
08/27/02	52-0320	08:40	370	370	170	91 f	0.06	0.12	2.0
10/01/02	52-0377	08:40	410 hj	250 h	100 h	--	<0.06	0.11	4.0

Sevenmile River, Station SM00, Unique ID W0182
Description: Draper Avenue, North Attleborough, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0141	11:12	220	220	220	<0.06	0.053	4.3
06/18/02	52-0196	10:15	390	350	--	<0.02	0.028	<1.0
07/23/02	52-0250	09:30	150	52	520	<0.02	0.032	13
08/27/02	52-0307	09:30	140	120	160	<0.02	0.028	1.6
10/01/02	52-0362	09:30	130 h	130 h	150 h	## b	0.023 j	<1.0

Fourmile Brook, Station FM01, Unique ID W0181
Description: West Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0149	08:20	78	59	20	0.10 b	0.028	1.8
06/18/02	52-0202	10:40	32 e	39 e	--	0.15	0.016	1.2
07/23/02	52-0255	10:32	65	39	110	0.10	0.030	<1.0
08/27/02	52-0312	10:35	97	19	97	0.15	0.017	<1.0
10/01/02	52-0369	10:40	32 h	26 h	32 h	## b	0.025 j	<1.0

Table D6 (continued). 2002 MassDEP Ten Mile River Watershed Physicochemical and Bacteria Data.

Sevenmile River, Station SM01A, Unique ID W0900
Description: Pitas Avenue, Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0159	10:22	410 e	440 e	390	<0.06 b	0.043	7.3
06/18/02	52-0214	09:54	540	500	--	<0.06	0.024	2.5
06/18/02	52-0215	09:54	530 e	650 e	--	<0.06	0.029	2.3
07/23/02	52-0269	09:58	530	130	1800 d	<0.02	0.040	1.3
07/23/02	52-0270	09:58	650	120	770 d	<0.02	0.037	1.3
08/27/02	52-0324	09:21	510	400	400	<0.02	0.025	1.6
08/27/02	52-0325	09:21	410	380	420	<0.02	0.025	1.6
10/01/02	52-0381	09:30	190 hj	130 h	210 h	<0.02	0.023 j	2.9
10/01/02	52-0382	09:30	160 hj	110 h	120 h	<0.02	0.025 j	3.5

Sevenmile River, Station SM01, Unique ID W0183
Description: Upstream of County Street, Attleboro, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0157	10:05	460	330	580	--	<0.06 b	0.053	6.0
06/18/02	52-0212	09:31	330 e	420 e	--	83 f	<0.06	0.036	3.1
07/23/02	52-0267	09:26	380	90	440	--	<0.06	0.030	1.3
08/27/02	52-0322	08:58	430	280	360	91 f	<0.06	0.022	1.0
10/01/02	52-0379	09:00	130 hj	90 h	180 h	--	<0.06	0.033	3.3

Ten Mile River, Station TM14, Unique ID W0176
Description: Central Avenue (approximately 1/2 mile downstream of Attleboro WWTP (MA0100595) discharge), Seekonk MA/Pawtucket, RI

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0161	10:50	800	370	560	--	0.11 b	0.13	6.4
06/18/02	52-0218	10:28	270	160	--	78 f	0.24	0.20	4.2
07/23/02	52-0273	10:24	230	58	190	--	<0.02	0.17	2.0
08/27/02	52-0328	09:50	310	290	210	120 f	0.21	0.15	5.4
10/01/02	52-0385	09:55	120 hj	97 h	270 h	--	0.15	0.11	3.1

(parameter list for Station TM14 continued)

Date	OWMID	Time (24hr)	NO3-NO2-N (mg/L)	TKN (mg/L)	DRP (mg/L)	BOD(5) (mg/L)	CBOD(3) (mg/L)	CBOD(7) (mg/L)	CBOD(14) (mg/L)	CBOD(21) (mg/L)
05/15/02	52-0161	10:50	--	--	--	--	--	--	--	--
06/18/02	52-0218	10:28	3.0	0.69	0.16	<2.0	--	--	--	--
07/23/02	52-0273	10:24	--	--	--	--	--	--	--	--
08/27/02	52-0328	09:50	4.9	1.1	0.11	--	<2.0	<2.0	2.1 j	5.1
10/01/02	52-0385	09:55	--	--	--	--	--	--	--	--

Coles Brook, Station CB01, Unique ID W0184
Description: Route 152, Seekonk, MA.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0163	11:30	240 e	250 e	650	0.08 b	0.049	5.2
05/15/02	52-0164	11:30	350	220	760	0.08 b	0.050	4.7
06/18/02	52-0220	10:55	300	190	--	0.06	0.062	1.6
07/23/02	No Flow	10:55j	--	--	--	--	--	--
07/24/02	No Flow	**	--	--	--	--	--	--
08/27/02	No Flow	10:15j	--	--	--	--	--	--
08/28/02	No Flow	**	--	--	--	--	--	--
10/01/02	52-0387	10:10	100 hj	71 h	190 h	<0.02	0.032	<1.0

Table D6 (continued). 2002 MassDEP Ten Mile River Watershed Physicochemical and Bacteria Data.

Ten Mile River, Station TM15, Unique ID W0902

Description: Route 114/1A (near USGS flow gauging station #01109403), East Providence, Rhode Island

Date	OWMID	Time (24hr)	Chloride (mg/L)
06/18/02	52-0222	11:30	62 f
08/27/02	52-0332	10:23	130 f

Table D7. 2002 MassDEP Ten Mile River Watershed stream discharge measurements.

Ten Mile River, Station TM06, Unique ID W0170

Description: Cedar Road (approximately 850 feet upstream of North Attleborough WWTP (MA0101036) discharge), North Attleborough, MA.

Date	Time (24hr)	Discharge (cfs)
6/18/2002	11:32	9.2
7/23/2002	11:25	0.7
8/27/2002	13:00	0.6

Bungay River, Station BG02A, Unique ID W0901

Description: At outlet of impoundment locally known as Blackinton Pond approximately 400 feet downstream of North Main Street (Route 152), Attleboro, MA.

Date	Time (24hr)	Discharge (cfs)
6/18/2002	12:46	10.7
7/23/2002	10:15	2.5
8/27/2002	11:00	1.9

Ten Mile River, Station TM11, Unique ID W0173

Description: Tiffany Street, Attleboro, MA.

Date	Time (24hr)	Discharge (cfs)
6/18/2002	14:25	33.7
8/21/2002	13:00	14.3
8/27/2002	12:00	9.7

Ten Mile River, Station TM13, Unique ID W0175

Description: Pond Street, Seekonk, MA.

Date	Time (24hr)	Discharge (cfs)
6/18/2002	12:38	35.3
8/21/2002	10:30	13.7
8/27/2002	10:15	6.7

Sevenmile River, Station SM01, Unique ID W0183

Description: Upstream of County Street, Attleboro, MA.

Date	Time (24hr)	Discharge (cfs)
6/18/2002	10:10	4.5
7/23/2002	09:00	1.6
8/27/2002	09:50	1.8

Ten Mile River, Station TM14, Unique ID W0176

Description: Central Avenue (approximately 1/2 mile downstream of Attleboro WWTP (MA0100595) discharge), Seekonk, MA /Pawtucket, RI.

Date	Time (24hr)	Discharge (cfs)
6/18/2002	09:51	55.7
8/21/2002	08:30	26.8
8/27/2002	08:30	15.9

Quality Control Data

Ten Mile River Watershed quality control data for ambient field blanks and field duplicate samples can be found in Tables D8 and D9.

Table D8. 2002 MassDEP Ten Mile River Watershed Quality Control Data Blanks.

Date	OWMID	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0145	11:43j	<20	<20	<20	--	<0.06	<0.005	<1.0
05/15/02	52-0165	11:30j	<20	<20	<20	--	0.08 b	<0.005	<1.0
06/18/02	52-0198	09:25j	<6	<6	--	<1.0	<0.02	<0.005	<1.0
06/18/02	52-0216	10:00j	<6	<6	--	--	<0.02	<0.005	<1.0
07/23/02	52-0258	10:15j	<6	<6	<6	--	<0.02	<0.005	<1.0
07/23/02	52-0271	10:01j	<6	<6	<6	--	<0.02	<0.005	<1.0
08/27/02	52-0303	08:40j	<6	<6	<6	<1.0	<0.02	<0.005	<1.0
08/27/02	52-0326	09:19	<6	<6	<6	--	<0.06	<0.005	<1.0
10/01/02	52-0367	10:15j	<6 h	<6 h	<6 h	--	[0.21] b	<0.005	<1.0
10/01/02	52-0383	09:30j	<7 hj	<7 h	<7 h	--	<0.02	<0.005	<1.0

(parameter list continued)

Date	OWMID	Time (24hr)	NO3-NO2-N (mg/L)	TKN (mg/L)	DRP (mg/L)	BOD(5) (mg/L)	CBOD(3) (mg/L)	CBOD(7) (mg/L)	CBOD(14) (mg/L)	CBOD(21) (mg/L)
05/15/02	52-0145	11:43j	--	--	--	--	--	--	--	--
05/15/02	52-0165	11:30j	--	--	--	--	--	--	--	--
06/18/02	52-0198	09:25j	<0.02	<0.10	<0.015	<2.0	--	--	--	--
06/18/02	52-0216	10:00j	--	--	--	--	--	--	--	--
07/23/02	52-0258	10:15j	--	--	--	--	--	--	--	--
07/23/02	52-0271	10:01j	--	--	--	--	--	--	--	--
08/27/02	52-0303	08:40j	<0.02	<0.10	<0.015	--	<2.0	<2.0	<2.0	<2.0
08/27/02	52-0326	09:19	--	--	--	--	--	--	--	--
10/01/02	52-0367	10:15j	--	--	--	--	--	--	--	--
10/01/02	52-0383	09:30j	--	--	--	--	--	--	--	--

Table D9. 2002 MassDEP Ten Mile River Watershed Quality Control Data Duplicates.

Ten Mile River, Station TM06, Unique ID W0170

Description: Cedar Road (approximately 850 feet upstream of North Attleborough WWTP (MA0101036) discharge), North Attleborough, MA.

Date	OWMID	*QAQC*	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	Chloride (mg/L)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
06/18/02	52-0192	52-0197	09:25	1.924	1.924	--	52	<0.06	0.047	2.7
06/18/02	52-0197	52-0192	09:25	1.716	1.653	--	52	<0.06	0.047	2.6
Relative	*Percent*	*Difference*		*11.4%*	*15.2%*	--	*0.0%*	*0.0%*	*0.0%*	*3.8%*
08/27/02	52-0301	52-0302	08:45	2.398	2.204	2.778	65	<0.02	0.13	<1.0
08/27/02	52-0302	52-0301	08:45	2.204 e	2.380 e	2.833	65	<0.02	0.11	<1.0
Relative	*Percent*	*Difference*		*8.4%*	*7.7%*	*1.9%*	*0.0%*	*0.0%*	*16.7%*	*0.0%*

(parameter list continued)

Date	OWMID	*QAQC*	Time (24hr)	NO3-NO2-N (mg/L)	TKN (mg/L)	DRP (mg/L)	BOD(5) (mg/L)	CBOD(3) (mg/L)	CBOD(7) (mg/L)	CBOD(14) (mg/L)	CBOD(21) (mg/L)
06/18/02	52-0192	52-0197	09:25	0.40	0.40	0.021 j	<2.0	--	--	--	--
06/18/02	52-0197	52-0192	09:25	0.40	0.42	0.021 j	<2.0	--	--	--	--
Relative	*Percent*	*Difference*		*0.0%*	*4.9%*	*0.0%*	*0.0%*	--	--	--	--
08/27/02	52-0301	52-0302	08:45	1.0	0.28 j	0.10	--	<2.0	<2.0	<2.0	2.5 dj
08/27/02	52-0302	52-0301	08:45	1.1	0.29 j	0.10	--	<2.0	<2.0	<2.0	3.8 dj
Relative	*Percent*	*Difference*		*9.5%*	*3.5%*	*0.0%*	--	*0.0%*	*0.0%*	*0.0%*	*41.3%*

COLES BROOK, STATION CB01, UNIQUE ID W0184

Description: Route 152, Seekonk, MA.

Date	OWMID	*QAQC*	Time (24hr)	Fecal Coliform (CFU/100mL)	*E.coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0163	52-0164	11:30	2.380 e	2.398 e	2.813	0.08 b	0.049	5.2
05/15/02	52-0164	52-0163	11:30	2.544	2.342	2.881	0.08 b	0.050	4.7
Relative	*Percent*	*Difference*		*6.7%*	*2.3%*	*2.4%*	*0.0%*	*2.0%*	*10.1%*

Table D9 (continued). 2002 MassDEP Ten Mile River Watershed Quality Control Data Duplicates.

Sevenmile River, Station SM01A, Unique ID W0900
Description: Pitas Avenue, Attleboro, MA.

Date	OWMID	QAQC	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
06/18/02	52-0214	52-0215	09:54	2.732	2.699	--	<0.06	0.024	2.5
06/18/02	52-0215	52-0214	09:54	2.724 e	2.813 e	--	<0.06	0.029	2.3
Relative	*Percent*	*Difference*		*0.3%*	*4.1%*	--	*0.0%*	*18.9%*	*8.3%*
07/23/02	52-0269	52-0270	09:58	2.724	2.114	3.255 d	<0.02	0.040	1.3
07/23/02	52-0270	52-0269	09:58	2.813	2.079	2.886 d	<0.02	0.037	1.3
Relative	*Percent*	*Difference*		*3.2%*	*1.7%*	*12.0%*	*0.0%*	*7.8%*	*0.0%*
08/27/02	52-0324	52-0325	09:21	2.708	2.602	2.602	<0.02	0.025	1.6
08/27/02	52-0325	52-0324	09:21	2.613	2.580	2.623	<0.02	0.025	1.6
Relative	*Percent*	*Difference*		*3.6%*	*0.9%*	*0.8%*	*0.0%*	*0.0%*	*0.0%*
10/01/02	52-0381	52-0382	09:30	2.279 hj	2.114 h	2.322 h	<0.02	0.023 j	2.9
10/01/02	52-0382	52-0381	09:30	2.204 hj	2.041 h	2.079 h	<0.02	0.025 j	3.5
Relative	*Percent*	*Difference*		*3.3%*	*3.5%*	*11.0%*	*0.0%*	*8.3%*	*18.8%*

Bungay River, Station BG02A, Unique ID W0901
Description: At outlet of impoundment locally known as Blackinton Pond approximately 400 feet downstream of North Main Street (Route 152), Attleboro, MA.

Date	OWMID	*QAQC*	Time (24hr)	Fecal Coliform (CFU/100mL)	*E. coli* (CFU/100mL)	*Enterococcus* sp. (CFU/100mL)	NH3-N (mg/L)	TP (mg/L)	TSS (mg/L)
05/15/02	52-0143	52-0144	11:43	2.991	2.491	2.924 d	<0.06	0.037	1.9
05/15/02	52-0144	52-0143	11:43	3.146	2.462	2.613 d	<0.06	0.036	1.6
Relative	*Percent*	*Difference*		*5.0%*	*1.2%*	*11.3%*	*0.0%*	*2.7%*	*17.1%*
07/23/02	52-0253	52-0257	10:15	3.079	2.806	3.477	<0.06	0.075 d	4.3
07/23/02	52-0257	52-0253	10:15	3.079	2.778	3.505	<0.06	0.047 d	4.0
Relative	*Percent*	*Difference*		*0.0%*	*1.0%*	*0.8%*	*0.0%*	*45.9%*	*7.2%*
10/01/02	52-0365	52-0366	10:15	2.724 eh	2.748 eh	3.146 h	## b	0.039	2.0
10/01/02	52-0366	52-0365	10:15	2.785 h	2.763 h	3.342 h	## b	0.037	1.8
Relative	*Percent*	*Difference*		*2.2%*	*0.6%*	*6.1%*	--	*5.3%*	*10.5%*

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APPENDIX E
DWM 2002 LAKE SURVEY DATA IN THE TEN MILE RIVER WATERSHED

In the Ten Mile River Watershed, baseline lake surveys were conducted in July, August, and September 2002 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Falls Pond, Farmers Pond, Mechanics Pond, Dodgeville Pond, Central Pond, and James V. Turner Reservoir were sampled three times each (generally at monthly intervals). A technical memorandum by Dr. Mark Mattson (in preparation) entitled *Baseline Lake 2002 Technical Memo* provides details of sample collection methods, results, data, and weed maps for the lakes surveyed in the Hudson, Housatonic, Charles, and Ten Mile watersheds in 2002 (Mattson in preparation). A subset of lakes from the Ten Mile River Watershed was targeted for some additional sampling to support the point source phosphorus study (MassDEP 2005a). That study, further described in the Ten Mile section of the DWM QAPP focused on a mass balance transport model of phosphorus from the point sources to each of the five reservoirs downstream of the North Attleboro treatment plant. The additional lake sampling included chloride analysis in June and September and an effort to collect 24 hour dissolved oxygen data from the largest and most downstream reservoirs, Central Pond and Turner Reservoirs on the Rhode Island-Massachusetts border (MassDEP 2005a).

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 samples were also collected and analyzed for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling Standard Operating Procedure* and the *Hydrolab® Series 3 Multiprobe Standard Operating Procedure* (MassDEP 1999a and MassDEP 1999b). The Wall Experiment Station (WES), 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* (MassDEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES Standard Operating Procedure (SOP). 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 available in the 2002 Data Validation Report (MassDEP 2005b). Apparent color and chlorophyll *a* were measured according to standard procedures at the MassDEP DWM office in Worcester (MassDEP 2002a and MassDEP 2002b). 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 *TMDL Baseline Lakes Survey 2002* (Mattson in preparation). Data were excerpted from the *Baseline Lake Survey 2002 Technical Memo* and presented in tables E1 and E2.

Table E1. 2002 MassDEP DWM Ten Mile River Watershed Baseline Lakes *physico-chemical* data.

TEN MILE RIVER/Falls Pond, Unique ID: W0958 Station: A
Description: North Basin deep hole, North Attleborough

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/18/02	2.4	10:30	7.6	LB-1940	--	10:15	0.5	48	--	0.024	32*
				LB-1943	--	10:25	7.1	--	--	0.34	--
				LB-1941	--	10:35	0 - 7.1	--	11.3*	--	--
07/25/02	2.9	15:35	8.2	LB-2081	LB-2082	16:05	0.5	--	--	0.016	16*
				LB-2082	LB-2081	16:07	0.5	--	--	0.021	18*
				LB-2083	--	16:15	7.5	--	--	0.55	--
				LB-2085	LB-2086	17:00	0 - 7.5	--	13.5*	--	--
				LB-2086	LB-2085	17:05	0 - 7.5	--	16.1*	--	--
08/27/02	2.3	14:20	6.7	LB-2222	--	14:15	0.5	--	--	0.022	33* h
				LB-2223	--	14:20	6.2	--	--	0.33	--
				LB-2224	--	14:25	0 - 6.2	--	21.5* d	--	--

Table E1 (cont). 2002 MassDEP DWM Ten Mile River Watershed Baseline Lakes *physico-chemical* data.

Pipe/Discharge to TEN MILE RIVER, Unique ID: W0982 Station: MA0101036
Description: end of final discharge pipe from the Attleboro WWTP (NPDES=MA0101036), Attleboro

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/18/02	--	--	--	LB-1933	--	09:30	--	120	--	0.60	--
08/27/02	--	--	--	LB-2229	--	08:45	--	120	--	1.0	--

TEN MILE RIVER/Farmers Pond, Unique ID: W0959 Station: A
Description: deep hole southeastern end, Attleboro

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/18/02	>1.2	12:00	1.2	LB-1945	LB-1946	11:30	0.5	70	--	0.21	35*
				LB-1946	LB-1945	11:35	0.5	70	--	0.21	33*
				LB-1948	LB-1947	11:45	0 - 0.5	--	3.2*	--	--
				LB-1947	LB-1948	11:50	0 - 0.5	--	3.4*	--	--
07/25/02	>0.8	**	0.8	LB-2089	--	12:20	0.5	--	--	0.56 b	<15*
				LB-2090	--	12:25	0 - 0.5	--	2.7*	--	--
08/27/02	**	09:45	1.0	LB-2226	--	09:35	0.5	110	--	0.63 b	23* h
				LB-2227	--	09:45	0.5	--	52* d	--	--

TEN MILE RIVER/Mechanics Pond, Unique ID: W0960 Station: A
Description: deep hole, southern end, Attleboro

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/18/02	>1.6	13:50	1.6	LB-1927	--	13:45	0.5	68	--	0.15	55*
				LB-1928	--	13:50	0 - 1.0	--	5.8*	--	--
07/23/02	>1.1	15:05	1.3	LB-2068	LB-2069	14:55	0.5	--	--	0.24 b	60*
				LB-2069	LB-2068	14:58	0.5	--	--	0.26 b	50*
				LB-2071	LB-2072	14:55	** - **	--	58*	--	--
				LB-2072	LB-2071	14:58	** - **	--	57*	--	--
08/27/02	>1.2	10:50	1.2	LB-2209	LB-2210	10:44	0.5	110	--	0.24	38* h
				LB-2210	LB-2209	10:45	0.5	--	--	0.26	37* h
				LB-2212	LB-2213	10:50	0 - 1.0	--	20.4* d	--	--
				LB-2213	LB-2212	10:55	0 - 1.0	--	31.7* d	--	--

TEN MILE RIVER/Dodgeville Pond, Unique ID: W0961 Station: A
Description: deep hole, southern end of pond, Attleboro

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/18/02	2.0	15:30	2.5	LB-1930	--	15:30	0.5	66	--	0.12 b	60*
				LB-1931	--	15:30	2.0	--	--	0.16 br	--
				LB-1932	--	15:35	0 - 2.0	--	1.9*	--	--
07/23/02	>2.0	13:10	2.0	LB-2075	--	13:05	0.5	--	--	0.078 b	31*
				LB-2076	--	13:10	1.5	--	--	0.16 b	--
				LB-2077	--	13:10	0 - 1.8	--	7.9*	--	--
08/27/02	>2.2	12:20	2.2	LB-2215	--	12:15	0.5	22	--	0.13 b	34* h
				LB-2216	--	12:20	1.7	--	--	0.13 b	--
				LB-2217	--	12:25	0 - 1.7	--	8.3* d	--	--

Pipe/Discharge to TEN MILE RIVER, Unique ID: W0981 Station: MA0100595
Description: end of final discharge pipe from the North Attleborough WWTP (NPDES=MA0100595), Seekonk

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/18/02	--	--	--	LB-1934	--	14:30	--	230	--	1.0	--
08/27/02	--	--	--	LB-2228	--	11:35	--	280	--	0.40	--

Table E1 (cont). 2002 MassDEP DWM Ten Mile River Watershed Baseline Lakes *physico-chemical* data.

TEN MILE RIVER (Saris: 5233625), Unique ID: W0964 Station: B
Description: inlet to Central Pond, south of railroad track east of Narragansett Park Drive, Pawtucket, Rhode Island

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
07/24/02	--	--	--	LB-2100	--	12:54	--	--	--	0.15 b	--

TEN MILE RIVER, Unique ID: W0984 Station: C
Description: approximately 160 feet upstream of inlet to Central Pond, Pawtucket, Rhode Island

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/19/02	--	--	--	LB-1962	--	12:50	--	85	--	0.22	--
08/28/02	--	--	--	LB-2240	--	10:20	--	130	--	0.13	--

TEN MILE RIVER/Central Pond, Unique ID: W0963 Station: A
Description: center of pond, East Providence, Rhode Island

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/19/02	1.8	13:35	2.1	LB-1953	LB-1954	13:25	0.5	74	--	## b	60*
				LB-1954	LB-1953	13:25	0.5	74	--	## b	65*
				LB-1958	--	13:30	1.6	--	--	## b	--
				LB-1956	LB-1957	13:40	0 - 1.6	--	4.7* d	--	--
				LB-1957	LB-1956	13:40	0 - 1.6	--	6.3* d	--	--
07/24/02	2.2	11:38	2.5	LB-2094	LB-2095	11:31	0.5	--	--	## b	33*
				LB-2095	LB-2094	11:31	0.5	--	--	## b	27*
				LB-2097	LB-2098	11:57	0 - 2.0	--	3.5*	--	--
				LB-2098	LB-2097	11:57	0 - 2.0	--	3.5*	--	--
08/28/02	1.5	11:00	2.0	LB-2235	LB-2236	10:50	0.5	140	--	0.32 b	39*
				LB-2236	LB-2235	10:55	0.5	--	--	0.32 b	41*
				LB-2238	LB-2239	11:05	0 - 1.5	--	45.6*	--	--
				LB-2239	LB-2238	11:10	0 - 1.5	--	43.4*	--	--

TEN MILE RIVER/James V. Turner Reservoir, Unique ID: W0962 Station: A
Description: deep hole, southern end of reservoir, East Providence, Rhode Island

Date	Secchi (m)	Secchi Time (24hr)	Depth (m)	OWMID	QAQC	Time (24hr)	Sample Depth (m)	Chloride (mg/L)	Chl-a (mg/m3)	TP (mg/L)	Apparent Color (PCU)
06/19/02	2.2	11:30	4.2	LB-1959	--	11:25	0.5	65	--	0.14	65*
				LB-1961	--	11:25	3.0	--	--	0.17	--
				LB-1960	--	11:40	0 - 3.5	--	** *	--	--
07/24/02	2.6	14:35	3.0	LB-2102	--	14:40	0.5	--	--	0.12 b	34*
				LB-2103	--	14:42	2.5	--	--	0.11 b	--
				LB-2104	--	14:45	0 - 2.5	--	4.5*	--	--
08/28/02	1.1	11:45	4.0	LB-2242	--	11:25	0.5	130	--	0.29 b	39*
				LB-2243	--	11:30	3.5	--	--	0.30 b	--
				LB-2244	--	11:40	0 - 3.5	--	45.2*	--	--

Table E2. 2002 MassDEP DWM Ten Mile River Watershed Baseline Lakes *in-situ* data.

TEN MILE RIVER/Falls Pond, Unique ID: W0958 Station: A
Description: North Basin deep hole, North Attleborough

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
07/25/02	LB-2087	15:54	0.5	25.7	7.4	293	188	7.8	93
	LB-2087	16:01	1.4	25.5	7.4	293	187	7.8	92
	LB-2087	16:08	2.4	25.0	7.4	293	188	7.6	89
	LB-2087	16:18	3.5	21.8 u	6.6	282	180	1.5	16
	LB-2087	16:49	4.0	16.1 u	6.7	268	172	1.0	10
	LB-2087	16:26	4.5	14.5	6.7	271	174	4.3 iu	41 iu
	LB-2087	16:56	5.0	13.2 u	6.7	286	183	<0.2	<2
	LB-2087	16:33	5.5	11.9	6.8	299	191	<0.2	<2
	LB-2087	16:40	6.5	10.7	6.8	320	205	<0.2	<2
	LB-2087	16:45	7.5	10.4	6.8	327	209	<0.2	<2

TEN MILE RIVER/Farmers Pond, Unique ID: W0959 Station: A
Description: deep hole southeastern end, Attleboro

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
07/25/02	LB-2091	12:11	0.5	19.3 u	6.7	672	430	3.1	33

TEN MILE RIVER/Mechanics Pond, Unique ID: W0960 Station: A
Description: deep hole, southern end, Attleboro

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
07/23/02	LB-2073	14:44	0.5	25.0 u	9.6 c	533 u	341 u	17.6 u	217 u

TEN MILE RIVER/Dodgeville Pond, Unique ID: W0961 Station: A
Description: deep hole, southern end of pond, Attleboro

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
07/23/02	LB-2078	12:45	0.5	25.7 u	8.1 c	536	343	9.7 u	117 u
	LB-2078	12:55	1.5	23.8 u	6.9 c	547	350	4.3	50

TEN MILE RIVER/Central Pond, Unique ID: W0963 Station: A
Description: center of pond, East Providence, Rhode Island

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
07/24/02	LB-2099	11:13	0.5	25.9	9.6 c	547	350	10.8	130
	LB-2099	11:20	1.5	25.9	9.6 c	550	352	11.0	132
	LB-2099	11:26	2.0	25.8	9.6 c	550	352	11.2	134

TEN MILE RIVER/James V. Turner Reservoir, Unique ID: W0983 Station: B
Description: Newman Avenue, East Providence, Rhode Island

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
08/28/02	52-0350	04:27	1.0	24.0	8.7 c	733 c	469 c	10.4 u	121 u

TEN MILE RIVER/James V. Turner Reservoir, Unique ID: W0962 Station: A
Description: deep hole, southern end of reservoir, East Providence, Rhode Island

Date	OWMID	Time (24hr)	Sample Depth (m)	Temp (°C)	pH (SU)	Conductivity at 25°C (µS/cm)	TDS (mg/l)	DO (mg/l)	DO Saturation (%)
07/24/02	LB-2105	14:13	0.6	26.3	9.3 c	495	317	8.3 u	100 u
	LB-2105	14:19	1.5	26.3	9.3 c	495	317	8.3 u	100 u
	LB-2105	14:25	2.5	26.3	9.4 c	496	317	8.3	101

Data Qualifiers

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

General Symbols (applicable to all types):

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

"**" denoted either censored or missing data.

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

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

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

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

Multi-probe-specific Qualifiers:

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

"i" = General Depth Criteria: Apply to each OWMID#
- Clearly erroneous readings due to faulty depth sensor: Censor (i)
- Negative and zero depth readings: Censor (i); (likely in error)
- 0.1 m depth readings: Qualify (i); (potentially in error)
- 0.2 and greater depth readings: Accept without qualification; (likely accurate)

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

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

" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, ie. operator error (eg. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

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

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

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

and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

" r " = data not representative of actual field conditions.

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

Sample-Specific Qualifiers:

" a " = accuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

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

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

" e " = not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" f " = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

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

" j " = 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< x <rdl). Also used to note where values have been reported at levels less than the mdl.

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

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

" r " = samples collected may not be representative of actual field conditions, including the possibility of "outlier" data and flow-limited conditions (e.g., pooled).

Sample codes for sampling:

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

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

Time: Local time.

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

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

References

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MassDEP. 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.

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

MassDEP. 1999b. *Hydrolab® Series 3 Multiprobe Standard Operating Procedure* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2005a. *Quality Assurance Project Plan for TMDL Baseline Lake Survey 2002.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2005b. *Data Validation Report for Year 2002 Project Data*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2002a. *Standard Operating Procedures for Apparent Color CN2.1* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP. 2002b *Standard Operating Procedures for Chlorophyll a CN3.2* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

APPENDIX F
USEPA NPDES COMPLIANCE SAMPLING INSPECTION

NPDES Permit # MA0101036

North Attleborough Wastewater Treatment Plant
Cedar Road
North Attleborough, MA 02760
(508) 695-7872

On August 19-20, 2002, Daniel Granz and Lisa Thuot, Investigations & Analysis Unit conducted an NPDES Compliance Sampling Inspection at the North Attleborough Wastewater Treatment Plant (WWTP) located in North Attleborough, MA. Merril Hastings, Operator, was the facility representative.

The North Attleborough WWTP is a 4.6 million gallon per day (MGD) advanced municipal wastewater treatment facility which discharges to the Ten Mile River. The facility operates as an activated sludge treatment system with nitrification and phosphorus removal. The effluent is filtered through rapid sand filters, disinfected with chlorination, and de chlorinated before discharge to the Ten Mile River. The final effluent was clear with no suspended or floating solids, oil sheens, or foam during the inspection.

An ISCO automatic sampler was installed to collect a 24-hour composite sample (1008 A.M. on 8/19 to 1008 A.M. on 8/20) of the final effluent. The sampler collected a 200-ml aliquot every 30 minutes with two aliquots per sampler bottle. After collection, the composite was made by combining the 24 individual aliquots proportional to flow based on the facility flow monitoring data.

Grab samples were collected for oil & grease, fecal coliform, total cyanide, and total residual chlorine (TRC) analyses.

The facility flow data reported is the 24-hour flow during the composite sample collection.

The data are summarized in the attached table.

North Attleborough WWTP 8/19-20/02 EPA Sampling Data

Parameter / Sample Type	**Results**	**Sept. 1999 Permit limits**
Flow /continuous	2.218 MGD (facility meter)	4.61 MGD monthly ave.
BOD_5 /composite	4.2 mg/l 77.7 lbs./day	15 mg/l daily max.
$BOD_{ultimate}$ /composite	10 mg/l 185 lbs./day	no limit
TSS /composite	ND <5 mg/l <92.5 lbs./day	15 mg/l daily max.
Ammonia nitrogen / composite	2.06 mg/l 38.1 lbs./day	2 mg/l daily max. 6/1 to 10/31
TKN /composite	3.0 mg/l 55.5 lbs./day	report
NO_2 /composite	ND <0.03 mg/l <0.55 lbs./day	report
NO_3 /composite	4.57 mg/l 84.5 lbs./day	report
Total phosphorus /composite	0.412 mg/l 7.6 lbs./day	2 mg/l daily max.
Total cyanide /grab 1100 hrs. 8/20	ND <0.0040 mg/l	0.022 mg/l daily max.
Fecal coliform /grab 1020 hrs. 8/19	88 colonies/100ml	400 colonies/100ml daily max.
Oil & grease /grab 1100 hrs.8/20	ND <4.8 mg/l	report
Total residual chlorine / grab 1020 hrs. 8/19	ND <0.02 mg/l	0.019 mg/l daily max.
Aluminum / composite	0.054 mg/l	0.140 mg/l daily max.
Antimony /composite	0.00069 mg/l	no limit
Arsenic / composite	ND <0.0010 mg/l	no limit
Barium / composite	0.0063 mg/l	no limit
Beryllium / composite	ND < 0.00020 mg/l	no limit

North Attleborough WWTP
8/19-20 EPA Sampling Data continued

Parameter / Sample Type	Results	Sept. 1999 Permit Limits
Cadmium / composite	0.00026 mg/l	report
Calcium / composite	25 mg/l	no limit
Chromium / composite	0.0020 mg/l	report
Cobalt / composite	0.00050 mg/l	no limit
Copper / composite	0.011 mg/l	0.020 mg/l daily max.
Iron / composite	0.077 mg/l	report
Lead / composite	0.00090 mg/l	report
Magnesium / composite	4.3 mg/l	no limit
Manganese / composite	0.022 mg/l	no limit
Molybdenum / composite	0.0029 mg/l	no limit
Nickel / composite	0.0052 mg/l	report
Selenium / composite	ND <0.0025 mg/l	no limit
Silver / composite	ND <0.00020 mg/l	no limit
Thallium / composite	ND <0.00050 mg/l	no limit
Vanadium / composite	0.00020 mg/l	no limit
Zinc / composite	0.062 mg/l	report

ND - not detected above reporting limits

NPDES Permit # MA0100595

Attleboro Wastewater Pollution Control Facility
Pond Street
Attleboro, MA 02703
(508) 761-5167

On August 19-20, 2002, Daniel Granz and Lisa Thuot, Investigations & Analysis Unit conducted an NPDES Compliance Sampling Inspection at Attleboro Wastewater Pollution Control Facility (WPCF) located in Attleboro, MA. Paul Kennedy, Operator, was the facility representative.

The Attleboro WPCF is a 8.6 million gallon per day (MGD) advanced municipal wastewater treatment facility which discharges to the Ten Mile River. The facility operates as an activated sludge treatment system with nitrification and phosphorus removal. The effluent is filtered through rapid sand filters, disinfected with chlorination, de chlorinated, and aerated before discharge to the Ten Mile River. The final effluent was clear with no suspended or floating solids, oil sheens, or foam during the inspection.

An ISCO automatic sampler was installed to collect a 24-hour composite sample (1125 A.M. on 8/19 to 1125 A.M. on 8/20) of the final effluent. The sampler collected a 250-ml aliquot every 30 minutes with two aliquots per sampler bottle. After collection, the composite was made by combining the 24 individual aliquots proportional to flow based on the facility flow monitoring data.

Grab samples were collected for oil & grease, fecal coliform, total cyanide, and total residual chlorine (TRC) analyses.

The TRC was measured on site using the DPD method with a spectrophotometer for determining the color development. The 1140 A.M. TRC sample (0.10 mg/l) with the DPD reagent in it developed a pink color which was shown to Mr. Kennedy. Another TRC sample (0.03 mg/l) was collected at 1157 A.M. which was also analyzed at the facility laboratory by amperometric titration. The facility titration detected no TRC. However, the sample aliquot with the DPD reagent developed a slight pink color. The effluent was clear with no color interferences affecting the DPD method for TRC.

The facility flow data reported is the 24-hour flow during the composite sample collection.

The data are summarized in the attached table.

Attleboro WPCF

8/19-20/02 EPA Sampling Data

Parameter / Sample Type	**Results**	**Sept. 1999 Permit limits**
Flow /continuous	4.296 MGD (facility meter)	8.6 MGD monthly ave.
BOD_5 /composite	ND <2.0 mg/l <71.6 lbs./day	15 mg/l daily max. 1077 lbs./day daily max.
$BOD_{ultimate}$ /composite	10 mg/l 358 lbs./day	no limit
TSS /composite	ND <5 mg/l <179 lbs./day	15 mg/l daily max. 1077 lbs./day
Ammonia nitrogen / composite	0.465 mg/l 16.7 lbs./day	2.5 mg/l daily max. 6/1-10/31 108 lbs./day weekly ave.
TKN /composite	1.6 mg/l 57.3 lbs./day	monitor & report
NO_2 /composite	ND <0.03 mg/l <1.1 lbs./day	monitor & report
NO_3 /composite	16.7 mg/l 598 lbs./day	monitor & report
Total phosphorus /composite	0.441 mg/l 15.8 lbs./day	1.5 mg/l daily max. 72 lbs./day weekly ave.
Total cyanide /grab 1235 hrs. 8/20	ND <0.0040 mg/l	0.033 mg/l daily max.
Fecal coliform /grab 1140 hrs. 8/19	ND <4 colonies/100ml	400 colonies/100ml daily max.
Oil & grease /grab 1235 hrs.8/20	ND <4.4 mg/l	no limit
Total residual chlorine / grab 1140 hrs. 8/19 1157 hrs. 8/19	 0.10 mg/l 0.03 mg/l	0.0266 mg/l daily max.
Aluminum / composite	0.063 mg/l	0.950 mg/l daily max.
Antimony /composite	0.0012 mg/l	no limit
Arsenic / composite	ND <0.0010 mg/l	no limit
Barium / composite	0.0070 mg/l	no limit
Beryllium / composite	ND < 0.00020 mg/l	no limit

Attleboro WPCF

8/19-20 EPA Sampling Data continued

Parameter / Sample Type	Results	Sept. 1999 Permit Limits
Cadmium / composite	0.0014 mg/l	0.020 mg/l daily max.
Calcium / composite	80 mg/l	no limit
Chromium / composite	0.0020 mg/l	1.305 mg/l daily max.
Cobalt / composite	0.00060 mg/l	no limit
Copper / composite	0.055 mg/l	0.070 mg/l daily max.
Iron / composite	ND < 0.050 mg/l	no limit
Lead / composite	0.00050 mg/l	0.060 mg/l daily max.
Magnesium / composite	4.1 mg/l	no limit
Manganese / composite	0.015 mg/l	no limit
Molybdenum / composite	0.0100 mg/l	no limit
Nickel / composite	0.026 mg/l	1.650 mg/l daily max.
Selenium / composite	ND <0.0025 mg/l	no limit
Silver / composite	ND <0.00020 mg/l	0.023 mg/l daily max.
Thallium / composite	ND <0.00050 mg/l	no limit
Vanadium / composite	0.0010 mg/l	no limit
Zinc / composite	0.020 mg/l	0.270 mg/l daily max.

ND - not detected above reporting limits

APPENDIX G
MASSDEP 2002 FISH TOXICS MONITORING IN THE TEN MILE RIVER WATERSHED

INTRODUCTION

Fish toxics monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection (MassDEP) Offices/Divisions- Watershed Management (DWM), Research and Standards (ORS), and Environmental Analysis, the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement, 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.

In June 2002, fish were collected by the MassDEP DWM at two sites in the Ten Mile River Watershed: Whiting Pond in North Attleborough, MA and Mechanics Pond in Attleboro, MA.

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 2002, MassDEP DWM Fish Toxics Monitoring was conducted under an EPA-approved Fish Toxics Quality Assurance Project Plan (MassDEP 2003). Data Quality Objectives are presented in the above-mentioned QAPP. There were no deviations from the QAPP.

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. All fish were collected using boat-mounted electroshocking gear and/or gill nets. Fish selected for analysis were placed in an ice filled cooler and brought back to the 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.

RESULTS

The results of MassDEP 2002 Ten Mile River Watershed fish toxics monitoring surveys described below are excerpted from *2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Ryder 2004). Data for DWM surveys is presented in Table G1. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in databases at the MassDEP DWM office in Worcester. Quality assurance data are available in *Data Validation Report for Year 2002 Project Data* (MassDEP 2005).

Whitings Pond
During the summer of 2002, Whitings Pond, North Attleborough, was sampled in the Ten Mile River Watershed. Mercury concentrations exceeded the MDPH trigger level of 0.5 mg/kg in the two of the five samples analyzed. The largemouth bass and bluegill samples were found to contain 0.83 and 0.54 mg/kg of mercury respectively. The presence of elevated concentrations of mercury in largemouth bass and bluegill resulted in the issuance of a MDPH advisory recommending (MDPH 2006):

> "Children under 12, pregnant women, nursing mothers, and women of childbearing age who may become pregnant should refrain from consuming bluegill and largemouth bass from Whitings Pond to prevent exposure of developing fetuses, nursing infants and young children to mercury" and
>
> "The general public should limit consumption of bluegill and largemouth bass caught from Whitings Pond to two meals per month".

Mechanics Pond
During the summer of 2002, Mechanics Pond, Attleboro, was sampled in the Ten Mile River Watershed. Trace concentrations of PCB Congeners (BZ#s 118, 114, 105, 170 and 180), Arochlors (1260 and 1254), and DDT (or it's metabolites DDD and DDE), were detected in fish from Mechanics Pond. Thirteen of the seventeen results were qualified as "Estimated value-concentration <RDL or certain criteria not met" The presence of chlordane (although an "estimated concentration….") in white perch resulted in the issuance of a MDPH advisory recommending (MDPH 2006):

> "Children under 12, pregnant women, nursing mothers, and women of childbearing age who may become pregnant should refrain from consuming white perch from Mechanics Pond to prevent exposure of developing fetuses, nursing infants and young children to chlordane" and
>
> "The general public should limit the consumption of white perch caught from Mechanics Pond to two meals per month".

Table G1. Analytical Results for 2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (μg/g)	Pesticides (μg/g)
Whiting Pond, North Attleborough, Ten Mile River Watershed													
WTF02-01	6/25/02	LMB	33.2	406	2002037 (L2002246-1) (L2002251-1)	<0.040	<0.20	0.83	<0.060	0.20	0.06	ND	ND
WTF02-02	6/25/02	LMB	33.7	519									
WTF02-03	6/25/02	LMB	30.9	368									
WTF02-04	6/25/02	B	18.4	134	2002038 (L2002246-2) (L2002251-2)	<0.040	<0.2	0.54	<0.060	0.17	0.13	ND	ND
WTF02-05	6/25/02	B	18.0	124									
WTF02-06	6/25/02	B	18.1	123									
WTF02-07	6/25/02	P	16.8	104	2002039 (L2002246-3) (L2002251-3)	<0.040	<0.20	0.38	<0.060	0.27	0.12	ND	ND
WTF02-08	6/25/02	P	17.9	123									
WTF02-09	6/25/02	P	17.9	124									
WTF02-10	6/25/02	BC	19.4	110	2002040 (L2002246-4) (L2002251-4	<0.040	<0.20	0.39	<RDL (0.080)	0.16	0.16	ND	ND
WTF02-11	6/25/02	BC	20.1	128									
WTF02-12	6/25/02	BC	20.6	116									
WTF02-13	6/25/02	BB	38.2	869	2002041 (L2002246-5) L2002251-5)	<0.040	<0.20	0.13	<0.060	0.09	0.31	BZ#118-0.0013J BZ#180-0.0015J	DDE- 0.012J
WTF02-14	6/25/02	BB	36.9	793									
WTF02-15	6/25/02	BB	37.3	697									
Mechanics Pond, Attleboro, Ten Mile River Watershed													
MXF02-01	6/26/02	LMB	33.7	505	2002042 (L2002247-1) (L2002253-1)	<0.040	<0.20	0.27	<0.060	0.97	0.07	BZ#118-0.0015J	ND
MXF02-02	6/26/02	LMB	30.0	399									
MXF02-03	6/26/02	LMB	33.6	689									
MXF02-04	6/26/02	B	18.6	142	2002043 (L2002247-2) (L2002253-2)	<0.040	<0.20	0.15	<0.060	1.1	0.17	BZ#180-0.0019J	DDE-0.0098J
MXF02-05	6/26/02	B	18.9	158									
MXF02-06	6/26/02	B	19.9	176									
MXF02-07	6/26/02	P	18.2	139	2002044 (L2002247-3) (L2002253-3)	<0.040	<0.20	0.19	<0.060	1.1	0.17	BZ#118-0.0023J BZ#180-0.0019J	DDE-0.0097J
MXF02-08	6/26/02	P	19.4	172									
MXF02-09	6/26/02	P	17.6	133									
MXF02-10	6/26/02	BC	21.7	120	2002045 (L2002247-4) (L2002253-4)	<0.040	<0.20	0.34	<RDL (0.080)	0.99	0.14	BZ#118-0.0015J BZ#180-0.0015J	ND
MXF02-11	6/26/02	BC	23.0	157									
MXF02-12	6/26/02	BC	20.5	117									
MXF02-13	6/26/02	WP	25.7	247	2002046 (L2002247-5) (L2002253-5)	<0.040	<0.20	0.20	<0.060	2.2	0.67	A1260-0.13 A1254-0.078 BZ#118-0.0079 BZ#114-0.0023J BZ#105-0.0017J BZ#180-0.0077 BZ#170-0.0033J	Chlor[2]-0.092J DDD-0.013J DDE-0.033
MXF02-14	6/26/02	WP	24.9	210									
MXF02-15	6/26/02	WP	27.7	330									

REFERENCES

MassDEP. 2003. *Quality Assurance Project Plan for 2002 Fish Toxics Monitoring.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

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Maietta, R. J. and J. Ryder. 2004. *2002 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

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