APPENDIX D
DWM 2002 AND 2003 LAKE SURVEY DATA IN THE HOUSATONIC RIVER WATERSHED

In the Housatonic River Watershed, the MassDEP Division of Watershed Management (DWM) staff conducted lake surveys at one lake in 2002 and four lakes in 2003. In 2005, three lakes were surveyed once each in August 2005 (MassDEP 2005a) including Goose Pond in Lee, Onota Lake in Pittsfield, and Stockbridge Bowl in Stockbridge. Final data for the 2005 surveys, however, are not yet available.

The lake surveys were conducted to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. *In situ* depth profile measurements using the multiprobe instruments (including dissolved oxygen, water temperature, pH, conductivity, and depth and calculated total dissolved solids and % oxygen saturation) were recorded once in each waterbody at deep-hole stations. In-lake samples were also collected and analyzed for total phosphorus, apparent color, and chlorophyll *a* (depth-integrated). Lake monitoring also included the mapping of aquatic vegetation, and Secchi disc readings.

For all survey years, 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 Procedures (SOP). Quality control samples (field blanks and duplicates) were also taken and transported on ice to WES on each sampling date.

2002

MassDEP DWM staff conducted baseline lake surveys at Lake Buel in June, July, and August 2002 (MassDEP 2002). Procedures used in 2002 for water sampling and sample handling are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring Standard Operating Procedure* and the *Hydrolab® Series3/Series 4 Multiprobe Standard Operating Procedure* (MassDEP 2001a and MassDEP 2001b). Apparent color and chlorophyll *a* were measured according to standard procedures at the MassDEP DWM office in Worcester (MassDEP 2001c and MassDEP 2001d). The aquatic plant cover (native and non-native) and species distribution were mapped and recorded (MassDEP 2002c). Details on procedures used can be found in the *Quality Assurance Project Plan for TMDL Baseline Lakes Survey 2002* (MassDEP 2002a).

Information about data quality objectives (accuracy, precision, completeness, representativeness and comparability) and qualified and censored data is available in the 2002 Data Validation Report (MassDEP 2005b). Water quality data were excerpted from the *Baseline Lake Survey 2002 Technical Memo* (MassDEP 2002b) and are presented in Table D1. Symbols and qualifiers used for DWM data are provided in Attachment 1 (excerpted from data validation report).

2003

In 2003, four lakes in the Housatonic River Watershed were surveyed as part of the nutrient criteria development efforts. Lake Garfield in Monterey, Laurel Lake in Lee, Mansfield Pond in Great Barrington, and Prospect Lake in Egremont were surveyed once each in August 2003.

Procedures used in 2003 for water sampling and sample handling are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring Standard Operating Procedure* and the *Water Quality Multi-probe Instrument Use Standard Operating Procedure* (MassDEP 2003b and MassDEP 2003c). Apparent color and chlorophyll *a* were measured according to standard procedures at the MassDEP DWM office in Worcester (MassDEP 2001c and MassDEP 2003d). The aquatic plant cover (native and non-native) and species distribution were mapped and recorded (MassDEP 2002c). Details on procedures used can be found in the *Quality Assurance Project Plan for Nutrient Criteria Lakes Survey 2003* (MassDEP 2003a).

Information about data quality objectives and qualified and censored data is available in the 2003 Data Validation Report (MassDEP 2005c). Water quality data were excerpted from the *Draft Baseline Lake Survey 2003 Technical Memo* (Mattson in preparation) and are presented in tables D2, D3, D4, and D5. Symbols and qualifiers used for DWM data are provided in Attachment 1 (excerpted from data validation report).

Table D1. 2002 water quality data deep hole in Lake Buel, Monterey.
Lake Buel (Palis: 21014)
Unique_ID: W0957 Station: A
Description: deep hole, northwestern end, Monterey

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
08/22/02									
	LB-2202	14:35	0.5	25.7	8.8 c	320	205	9.5	113
	LB-2202	14:41	1.5	25.7	8.8 c	320	205	9.5	113
	LB-2202	14:48	2.5	25.7	8.8 c	320	205	9.5	113
	LB-2202	14:59	3.5	25.3 u	8.8 c	323	207	10.0 u	118 u
	LB-2202	15:16	4.0	22.9 u	8.8 c	335	214	13.1	149
	LB-2202	15:06	4.5	20.7	8.7 c	345	221	14.1	152
	LB-2202	15:34	5.5	14.8 u	8.1 c	354	226	10.0 u	96 u
	LB-2202	15:23	6.9	11.5	7.3 c	356	228	2.1	19
	LB-2202	15:40	12.8	7.1	7.0 c	366	235	<0.2	<2

Lake Buel (Palis: 21014)
Unique_ID: W0957 Station: A
Description: deep hole, northwestern end, Monterey

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chloride	Chl-a	TP	AppColor
	m	24hr	m			24hr		--	m	mg/L	mg/m3	mg/L	PCU
06/13/02	4.8	13:50	13.4										
				LB-1913	LB-1914	13:35	VDOR	s	0.5	--	--	0.014 j	21*
				LB-1914	LB-1913	13:40	VDOR	s	0.5	--	--	0.013 j	20*
				LB-1919	--	13:45	VDOR	nb	12.9	--	--	0.059	--
				LB-1915	LB-1918	13:55	DINT	--	0 - 8.0	--	6.0* d	--	--
				LB-1918	LB-1915	13:55	DINT	--	0 - 8.0	--	4.6* d	--	--
07/31/02	3.4	10:30	12.5										
				LB-2055	LB-2056	10:45	VDOR	s	0.5	--	--	0.015 bd	<15*
				LB-2056	LB-2055	10:50	VDOR	s	0.5	--	--	0.044 bd	<15*
				LB-2057	--	10:53	VDOR	nb	11.5	--	--	## bdj	--
				LB-2059	LB-2060	10:58	DINT	--	0 - 7.0	--	##* b	--	--
				LB-2060	LB-2059	10:59	DINT	--	0 - 7.0	--	##* b	--	--
08/22/02	4.2	14:20	13.3										
				LB-2196	LB-2197	14:35	VDOR	s	0.5	--	--	0.009 j	<15*
				LB-2197	LB-2196	14:40	VDOR	s	0.5	--	--	0.009 j	<15*
				LB-2198	--	14:45	VDOR	nb	12.8	--	--	0.24	--
				LB-2200	LB-2201	14:50	DINT	--	0 - 12.8	--	10.5*	--	--
				LB-2201	LB-2200	15:00	DINT	--	0 - 12.8	--	12.6*	--	--

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

Table D2. 2003 water quality data deep hole in Lake Garfield, Monterey.

Lake Garfield (PALIS: 21040)
Unique_ID: W1075 Station: A
Description: [deep hole, Monterey]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/25/03									
	LC-0006	15:34	0.5	24.7	8.7	161	103	8.7	106
	LC-0006	15:40	2.5	23.9 u	8.8	160	102	8.7	105
	LC-0006	15:46	5.0	23.5	8.6	161	103	8.2	97
	LC-0006	15:52	6.0	15.9	6.9 u	158	101	1.0	10
	LC-0006	15:57	7.5	11.8	6.6 c	158	101	0.3	3
	LC-0006	16:02	9.0	9.6	6.7 uc	227	145	0.3	2

Lake Garfield (PALIS: 21040)
Unique_ID: W1075 Station: A
Description: [deep hole, Monterey]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	Apparent Color
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/25/03	4.4	15:30	9.5												
				LC-0003	--	15:35	VDOR	nb	9.0	--	<0.02	--	3.0 bh	0.66	--
				LC-0002	--	15:30	MNGR	--	--	--	<0.02	--	0.38 bh	0.011	15* h
				LC-0004	LC-0005	15:50	DINT	--	0 - 8.0	14.4*	--	--	--	--	--
				LC-0005	LC-0004	15:55	DINT	--	0 - 8.0	13.2*	--	--	--	--	--

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

Table D3. 2003 water quality data deep hole in Laurel Lake, Lee.

Laurel Lake (PALIS: 21057)
Unique_ID: W1076 Station: A
Description: [deep hole, Lee]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/26/03									
	LC-0014	12:41	0.5	24.8	8.5	589	377	8.9	109
	LC-0014	12:45	2.5	24.1	8.6	587	376	8.9	108
	LC-0014	12:52	5.0	23.5	8.4	594	380	9.1	109
	LC-0014	12:57	6.0	16.1 u	8.5	631 u	404 u	16.8 u	173 u
	LC-0014	13:04	7.0	12.8 u	8.3	639	409	14.1 u	135 u
	LC-0014	13:12	8.0	9.0	7.5	671	429	5.0 u	44 u
	LC-0014	13:16	9.0	7.6	7.3	686	439	1.4	12
	LC-0014	13:23	15.3	4.7	7.0	769 c	492 c	0.3	3

Laurel Lake (PALIS: 21057)
Unique_ID: W1076 Station: A
Description: [deep hole, Lee]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/26/03	5.8	13:00	15.8												
				LC-0011	--	13:00	VDOR	nb	15.3	--	<0.02	--	2.7 bh	0.41	--
				LC-0013	--	13:05	DINT	--	0 - 15.3	6.7*	--	--	--	--	--
				LC-0009	LC-0010	13:10	MNGR	--	--	--	<0.06	0.31	--	0.006	<15*
				LC-0010	LC-0009	13:10	MNGR	--	--	--	<0.02	--	0.37 bh	<0.005	<15*

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

Table D4. 2003 water quality data deep hole in Mansfield Pond, Great Barrington.

Mansfield Pond (PALIS: 21065)
Unique_ID: W1077 Station: A
Description: [deep hole, Great Barrington]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/26/03									
	LC-0021	11:09	0.5	25.4 u	9.0	356	228	7.9	98
	LC-0021	11:13	1.5	24.9	9.0	356	228	7.9	97
	LC-0021	11:18	2.5	24.8	9.0	356	228	7.8	96
	LC-0021	11:23	3.5	24.5	8.8	363	232	6.8 u	83 u
	LC-0021	11:28	4.3	23.6	7.1 u	429 u	274 u	0.8 u	10 u

Mansfield Pond (PALIS: 21065)
Unique_ID: W1077 Station: A
Description: [deep hole, Great Barrington]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/26/03	3.8	11:05	4.8												
				LC-0018	--	11:15	VDOR	nb	4.3	--	<0.02	--	1.3 bh	0.080	--
				LC-0016	LC-0017	11:05	MNGR	--	--	--	<0.02	--	0.51 bh	0.013	<15*
				LC-0017	LC-0016	11:05	MNGR	--	--	--	<0.02	--	0.52 bh	0.013	18*
				LC-0020	--	11:10	DINT	--	0 - 4.3	4.0*	--	--	--	--	--

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

Table D5. 2003 water quality data deep hole in Prospect Lake, Egregmont.

Prospect Lake (PALIS: 21084)
Unique_ID: W1078 Station: A
Description: [deep hole,southeastern end, Egremont]

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(°C)	(SU)	(uS/cm)	(mg/L)	(mg/L)	(%)
08/26/03									
	LC-0027	09:48	0.5	24.0	9.0	175	112	9.0	108
	LC-0027	09:53	1.5	23.9	9.0	176	112	8.8	106
	LC-0027	09:58	2.5	23.5	9.1	173	110	9.4	113
	LC-0027	10:04	3.6	21.5	8.2	198	127	7.3	84

Prospect Lake (PALIS: 21084)
Unique_ID: W1078 Station: A
Description: [deep hole,southeastern end, Egremont]

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	SmpTyp	RelDepth*	Depth	Chl-a	NO3-NO2-N	TKN	TN	TP	AppColor
	m	24hr	m			24hr			m	mg/m3	mg/L	mg/L	mg/L	mg/L	PCU
08/26/03	3.1	10:00	4.1												
				LC-0024	--	10:05	VDOR	nb	3.6	--	0.07	--	0.40 bh	0.015	--
				LC-0023	--	09:45	MNGR	--	--	--	<0.02	--	0.33 bh	0.012	15*
				LC-0025	LC-0026	10:00	DINT	--	0 - 3.6	9.0* d	--	--	--	--	--
				LC-0026	LC-0025	10:02	DINT	--	0 - 3.6	6.8* d	--	--	--	--	--

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

ATTACHMENT 1

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).

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

" -- " = 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. Specifically, for depth readings the following criteria were applied:

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 used:

OWMID: Office of Watershed Management Identification Code for the sample 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

Mattson, M. in preparation. *Baseline Lake Survey 2003 Technical Memo CN205.0*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

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. 2001a. *Sample Collection Techniques for DWM Surface Water Quality Monitoring CN001.1.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2001b. *Hydrolab® Series 3/Series 4 Multiprobe Standard Operating Procedure CN004.1.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2001c. *Standard Operating Procedures for Apparent Color CN2.1* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP. 2001d. *Standard Operating Procedures for Chlorophyll a CN3.2* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP 2002a. *Quality Assurance Project Plan for TMDL Baseline Lake Survey 2002 CN72.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2002b. *Baseline Lake Survey 2002 Technical Memo CN204.0*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2002c. *Aquatic Plant Mapping CN067.1*. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2003a. *Quality Assurance Project Plan for Nutrient Criteria Lakes Survey 2003 CN165.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2003b. *Sample Collection Techniques for DWM Surface Water Quality Monitoring CN001.2.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2003c. *Water Quality Multi-probe Instrument Use Standard Operating Procedure CN004.2.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP. 2003d. *Extracted Chlorophyll a (SM-10200 H) (USEPA Fluorometric Method 445 and 445 with the Welschmeyer modification) Standard Operating Procedures CN0003.3.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA

MassDEP 2005a. *Sampling Plan for Year 2005 Lake Nutrient Monitoring in Massachusetts CN224.1.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2005b. *Data Validation Report for Year 2002 Project Data CN202.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MassDEP 2005c. *Data Validation Report for Year 2003 Project Data CN211.0.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

APPENDIX E
MassDEP DWM 2002 Fish Toxics Monitoring in the Housatonic River Watershed

INTRODUCTION

Fish contaminant monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection (MassDEP) Divisions/Offices (Watershed Management (DWM), Environmental Analysis, and Research and Standards), the Massachusetts Department of Fish and Game, and the Massachusetts Department of Public Health (MA DPH). Fish contaminant monitoring is designed to screen the edible fillets of several species of fish desired by the angling public for consumption, as well as species representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals (Pb, Cd, Se, Hg, As), Polychlorinated biphenyls (PCBs), and organochlorine pesticides. These data are used by the MA DPH in assessing human health risks associated with the consumption of freshwater fishes.

In the Housatonic River Watershed fish contaminant monitoring surveys were conducted by MassDEP DWM staff in two waterbodies in 2002 including Pontoosuc Lake (Lanesborough/Pittsfield) and Lake Buel (Monterey (Maietta undated)). Fish contaminant monitoring data provided here include surveys conducted in 2002. The objective of these surveys was to screen the edible fillets of fishes for potential contaminants (e.g., selected metals, PCBs and organochlorine pesticides). All results were submitted to the MA DPH for review.

Project Objectives

Fish contaminant monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority and, therefore, fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom-dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, PCBs and chlorinated pesticides.

Fish toxics monitoring conducted in 2002 followed guidance in the Quality Assurance Project Plan (QAPP) for Fish Toxics Monitoring (MassDEP 2003). Data quality objectives are presented in the above-mentioned QAPP.

METHODS

Field Methods

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish (MassDEP 2003 and MassDEP 2005). The characteristics of each site determine the method(s) of sample collection. Waterbodies in the Housatonic Watershed were sampled by DWM using boat electrofishing. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody and collecting most fish shocked. Fish collected by electrofishing were stored in a live well filled with site water until the completion of sampling. Fish to be included in the sample were stored on ice and transported to the DWM laboratory in Worcester.

DWM Laboratory Methods (Sample processing)

Fish brought to the MassDEP DWM laboratory in Worcester were processed using protocols designed to assure accuracy and prevent cross-contamination of samples (MassDEP 2003 and MassDEP 2005). Specimen lengths and weights were recorded along with notes on tumors, lesions, or other anomalies noticed during an external visual inspection. Scales, spines, or pectoral fin ray samples were obtained for use in age determination. Species, length, and weight data can be found in Tables E1. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR high density polyethylene (HDPE) cups with covers. Composite samples were composed of three fillets from like-sized individuals of the same species (occasionally the same genus). Samples were tagged and frozen for subsequent delivery to the MassDEP's Wall Experiment Station (WES).

WES Laboratory Methods (Analytical)

All analyses for cadmium, lead and selenium were conducted using EPA method 200.7. All analyses for PCBs and organics were conducted using AOAC method 983.21. All mercury analyses prior to 2005 were conducted using EPA method 245.1. Additional information on analytical techniques used at WES is available from the laboratory (Maietta *et al*. 2004).

In 2002 mercury was analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead were analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emmission Spectrophotometer. Arsenic and selenium were analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer. PCB Arochlor, PCB congener, and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector “according to the modified AOAC 983.21 procedure for the analysis of PCB Arochlors, Congeners, and Organochlorine Pesticides” (Maietta *et al*. 2004).

RESULTS

All fish tissue data met DWM data quality objectives and passed quality control acceptance limits of the WES laboratory without qualification unless otherwise noted below. Fish toxics monitoring survey data can be found in Table E1 (excerpted from Maietta *et al*. 2004).

> Fish tissue data passed the QC acceptance limits of the WES laboratory. WES reported a number of lab-validated data with “qualification”. All but one of these “qualified” data points were for very low concentrations of either PCBs (Congeners and Arochlors) and/or organochlorine pesticides. One data point for arsenic at the detection limit was also qualified. The lab fortified matrix spike recovery for toxaphene was 50% resulting in “J” (estimated) qualification by WES. These QC data suggest potential poor recovery of toxaphene in samples. Lab accuracy estimates for metals (all analytes) using lab-fortified matrix samples were acceptable ranging from 80-112 % recovery except for two selenium samples at 126 and 128 % recovery and one lead sample at 130% recovery. QC sample recoveries were acceptable ranging from 83-117%. Lab accuracy estimates for metals (all analytes) using lab fortified blanks were acceptable ranging from 82 to 111 % recovery except for one lead sample at 128% recovery.

All quality assurance and quality control data are available from the laboratory upon request.

Table E1. 2002 Fish Toxics Monitoring data for Housatonic River Watershed Waterbodies (Pontoosuc Lake, Lanesborough/Pittsfield and Lake Buel, Monterey) (Maietta *et al*. 2004). 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)
Lake Buel, Monterey/New Marlborough, Housatonic River Watershed													
BF02-01	7/9/02	LMB	36.5	780	2002047 (L2002300-1) (L2002301-1)	<0.040	<0.20	0.40	<0.060	0.24	0.06	BZ#118-0.0012J	DDE-0.0068J
BF02-02	7/9/02	LMB	32.9	330									
BF02-03	7/9/02	LMB	33.5	462									
BF02-04	7/9/02	YP	27.2	230	2002048 (L2002300-2) (L2002301-2)	<0.040	<0.20	0.25	<0.060	0.21	0.20	ND	ND
BF02-05	7/9/02	YP	30.3	296									
BF02-06	7/9/02	YP	26.7	215									
BF02-07	7/9/02	BC	22.0	142	2002049 (L2002300-3) (L2002301-3)	<0.040	<0.20	0.22	0.080	0.21	0.05	ND	ND
BF02-08	7/9/02	BC	27.2	240									
BF02-09	7/9/02	BC	25.5	230									
BF02-10	7/9/02	P	18.0	120	2002050 (L2002300-4) (L2002301-4)	<0.040	<0.20	0.10	0.090	0.25	0.19	ND	ND
BF02-11	7/9/02	P	17.7	117									
BF02-12	7/9/02	P	18.1	128									
BF02-13	7/9/02	BB	29.6	333	2002051 (L2002300-5) (L2002301-5)	<0.040	<0.20	0.060	<0.060	0.12	0.21	ND	DDE-0.0083J
BF02-14	7/9/02	BB	27.3	219									
BF02-15	7/9/02	BB	27.2	233									
Pontoosuc Lake, Pittsfield, Housatonic River Watershed													
PNF02-01	6/20/02	LMB	44.0	1165	2002032 (L2002248-1) (L2002256-1)	<0.040	<0.20	0.25	<0.060	0.33	0.06	A1254-0.035J A1260-0.031J BZ#118-0.0027J BZ#180-0.0037J BZ#170-0.0018J	DDE-0.0085J
PNF02-02	6/20/02	LMB	38.6	883									
PNF02-03	6/20/02	LMB	38.8	846									
PNF02-04	6/20/02	YP	24.1	168	2002033 (L2002248-2) (L2002256-2)	<0.040	<0.20	0.12	<0.060	0.32	0.12	A1254-0.016J BZ#118-0.0014J	ND
PNF02-05	6/20/02	YP	23.2	163									
PNF02-06	6/20/02	YP	18.9	73									
PNF02-07	6/20/02	B	17.5	104	2002034 (L2002248-3) (L2002256-3)	<0.040	<0.20	0.050	<0.060	0.32	0.17	A1254-0.049 A1260-0.047J BZ#118-0.0046 BZ#180-0.0041J BZ#170-0.0025J	DDE-0.012J
PNF02-08	6/20/02	B	16.6	91									
PNF02-09	6/20/02	B	15.8	71									
PNF02-10	6/20/02	RB	22.1	220	2002035 (L2002248-4) (L2002256-4)	<0.040	<0.20	0.15	<0.060	0.23	0.07	A1254-0.014J BZ#118-0.0015J BZ#180-0.0019J	ND
PNF02-11	6/20/02	RB	19.7	154									
PNF02-12	6/20/02	RB	19.0	127									
PNF02-13	6/20/02	BB	26.4	259	2002036 (L2002248-5) (L2002256-5)	<0.040	<0.20	<RDL (0.030)	<0.060	<RDL (0.080)	0.37	A1254-0.047 A1260-0.069 BZ#180-0.0057 BZ#170-0.0027J	DDE-0.011J
PNF02-14	6/20/02	BB	29.4	319									

[1] Species Code , Common Name, *Scientific name*

(B)	bluegill	*Lepomis macrochirus*
(BB)	brown bullhead	*Ameiurus nebulosus*
(BC)	black crappie	*Pomoxis nigromaculatus*
(LMB)	largemouth bass	*Micropterus salmoides*
(P)	pumpkinseed	*Lepomis gibbosus*
(RB)	rock bass	*Ambloplites rupestris*
(YP)	yellow perch	*Perca flavescens*

ND - not detected or the analytical result is at or below the established method detection limit (MDL).

J-estimated value, concentration <RDL or certain QC criteria not met

RDL = reporting detection limit

< = result not detected above method detection limit, unless otherwise noted

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APPENDIX F

MassDEP / DWM TECHNICAL MEMORANDUM CN 197.3

2002 HOUSATONIC RIVER WATERSHED FISH POPULATION ASSESSMENT

Prepared by: Peter Mitchell, MassDEP/ Division of Watershed Management, Worcester, MA

Date: December, 2005

The Massachusetts Division of Watershed Management (MA DWM) conducted fish population surveys on the Housatonic River and its selected tributaries during August of 2002 (Figure 1). Sampling was conducted as part of a comprehensive water quality monitoring project carried out by MA DWM. Surveys of the resident fish populations were conducted at a total of seven stations (Table 1). Surveys were conducted using techniques similar to Rapid Bioassement Protocol V (fish) as described by Barbour et al (1999).

<u>Fish Population Sample Collection, Processing, and Analysis</u>

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

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

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain and Knight (1996) modified regionally following discussions with MA DEP and MA Division of Fisheries and Wildlife (DFW) biologists.

3. Trophic Classes- Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al. (1999).

For a more complete explanation of MA DWM fish collection procedures, see CN 75.1 “Fish Collection Procedures for Evaluation of Resident Fish Populations” (MassDEP 2003a). Tabulated results of the fish population surveys can be found in Table 3.

<u>Habitat Assessment</u>

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

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

Results

The Housatonic watershed was affected by drought during the time of sampling. This condition resulted in extremely low water levels (Figure 2), increased water temperatures, and a reduction of available, adequate habitat as expressed by the low "channel flow status" habitat scores in Table 2.

Station Specific Conditions and Findings:

Waterbody Name:	Williams River
Waterbody Location:	Upstream of Route 41 Bridge, Great Barrington
	Latitude: 42.13.35
	Longitude: 73.21.51
Sampling Date:	August 19, 2002

This river is classified as a class-B, cold-water fishery (Kennedy and Weinstein 2000). This station was also sampled in 2002 to assess the benthic community structure and health. For a more in-depth examination of habitat conditions, and benthic communities, please see Housatonic River Watershed 2002 Biological Assessment (CN 197.0)(Mitchell 2005).

As was the case during the aforementioned benthic survey, the Williams River stream reach was affected by low water conditions at the time of examination (Figure 2). This condition resulted in a "marginal" rating of the Channel Flow Status (9/20). The Bank Stability of both the right and left banks was also marginal (6/20, Total score), with steep banks subject to erosion and failure under high flow conditions. The fisheries habitat assessment noted optimal conditions regarding Channel Alteration, Embeddedness, and Bank Vegetative Protection. However, the survey also noted marginal conditions regarding Bank Stability (on both banks) and Channel Flow status. The total habitat score arrived at during the fish population survey of 2002 was 160/200.

Moderately tolerant, fluvial specialist / dependant species dominated the one hundred seven fish collected at this station (Halliwell et al 1998, Bain and Meixler 2000). Aside from the one brown trout, there were no cold-water fishes collected.

Waterbody Name:	Konkapot River
Waterbody Location:	Great Barrington Road, New Marlborough
	Latitude: 42.07.14
	Longitude: 73.16.10
Sampling Date:	August 19, 2002

Much of the proximal portion of the Konkapot watershed upstream of the 2002 fish population sampling reach is low-gradient, and meanders through an extensive wetland area, and then through a narrow flood plain approximately 0.1 miles wide. The stream gradient increases at the sampled reach (upstream of bridge crossing on Great Barrington Road) to 32 feet/mile. This station on the Konkapot River was also affected by low flow conditions during the 2002 fish population surveys. The reduced quantity of water resulted in a “marginal” classification of the Channel Flow Status habitat parameter (9/20). The Riparian Vegetative Zone Width score was reduced to a “marginal” level (5/10) along the left bank. Here, human activities have impacted the riparian zone a great deal, including abutting agricultural and residential development.

The ninety-seven collected fish specimens were dominated by tolerant (53%), fluvial specialist / dependant (99%) species. The collected brown trout appear to be reproducing, as the variety of their lengths indicates multiple age classes.

This segment has been recommended for “cold-water fishery” designation (Kennedy and Weinstein 2000) Two of the seven species collected were classified as cold-water species. The multiple age-classes of brown trout, combined with the presence of eastern brook trout, lend credence to the cold-water fishery designation.

Waterbody Name:	East Branch Housatonic River
Waterbody Location:	Hubbard Avenue, Pittsfield
	Latitude: 42.28.10
	Longitude: 73.11.48
Sampling Date:	August 20, 2002

This segment is located downstream from proximal upstream impoundments and industrial discharges. Historically, fish tissue examinations conducted below Center Pond (and, hence, within this segment) revealed elevated concentrations of PCBs (Kennedy and Weinstein 2000). According to the Western Wildlife District of the MA DFW, there is no management plan for the East Branch Housatonic River due to contamination issues (Bell 1999).

The total habitat conditions encountered at the East Branch of the Housatonic station were suboptimal (131/200) – the lowest habitat score of all seven stations examined in 2002.The Riparian Zone Width parameter scored poorly for both the right and left banks (2/20). The right bank was noted as being “marginal” in terms of Bank Vegetative Protection (4/10), and Bank Stability (4/10). This reach, like many of the examined reaches in 2002, was affected by low-flow conditions; resulting in a “marginal” Channel Flow Status determination (8/20).

Sixty-four fish were collected at the East Branch of the Housatonic station. The collected fish were dominated by moderately tolerant and fluvial specialist / dependant species.

This stream reach was also sampled in 2002 for the purposes of benthic community and habitat assessment. For a more in-depth examination of benthic parameters, see (Mitchell, 2005).

Waterbody Name:	Cleveland Brook
Waterbody Location:	Old Windsor Road, Hinsdale
	Latitude: 42.28.35
	Longitude: 73.07.45
Sampling Date:	August 20, 2002

Cleveland Brook is described as a cold-water, stable fishery (Kennedy and Weinstein 2000). The sampled stream reach was located downstream from the Cleveland Brook Reservoir. Instream discharges from this drinking-water impoundment account for the vast majority of flow to this reach, as there is only one, first-order, tributary entering Cleveland Brook between the station and the reservoir. The examined reach is 1 mile from the impoundment, with a very high gradient of 155 feet / mile. The demand for drinking water from the Town of Dalton, and the City of Pittsfield, combined with the low-flow conditions encountered in 2002, greatly reduced flows to this reach. These conditions resulted in a “marginal” score with regard to the Channel Flow Status (7/20). Also, the proximity of Old Windsor Road to this station reduced the right bank Riparian Zone Width to a “poor” condition (1/10). However, no other habitat measures scored below the “suboptimal” level, and the sampled reach attained an over-all habitat score of 147/200.

Eighty-seven fish were collected at the Cleveland Brook station. The collected fish were dominated by intolerant, fluvial specialist / dependant species. The eastern brook trout were numerically dominant (86%), and drove the numerical distribution to represent 90% cold-water species, and 90% top carnivores. The eastern brook trout appear to be reproducing, as the variety of their lengths indicates multiple age classes. The above conditions appear to support the current cold-water fishery designation for this stream.

Waterbody Name: Hop Brook
Waterbody Location: near Main Road, Tyringham
Latitude: 42.14.59
Longitude: 73.12.30
Sampling Date: August 20, 2002

Hop Brook flows through the narrow Tyringham valley. The valley, for the most part, is low-gradient, and the stream meanders through the pastures and fields in a natural manner. However, there is a constriction in the valley (between Cobble Hill, and Baldy Mountain) that marks a higher gradient stream section through the Town of Tyringham. Here, the stream drops 46 feet / mile. The Hop Brook sampling reach was located within this constricted area, behind the fire station, in the Town of Tyringham. The riparian zone abutting the Hop Brook station was highly modified; with pastures, lawns and a parking area replacing what was – at one time – a forested area. This resulted in a “poor” rating for both the left and right riparian zones (2/10 – left bank, 1/10 – right bank). The Channel Flow Status (9/20) was “marginal”, as was the case at other stations during the summer of 2002. The total habitat score for Hop Brook was 157/200.

Seven hundred and two fish were collected at Hop Brook. The collected fish were dominated by tolerant (64%), fluvial specialist / dependant (98%) species. The five brown trout appeared to be reproducing, as the varieties of their lengths indicate multiple age classes.

MA DFW sampled this station in 1998. Their results were quite similar to those observed by MA DWM in 2002. However, MA DFW collected one slimy sculpin in 1998, and no rock bass (Richards 2002).

Waterbody Name: Cady Brook
Waterbody Location: New Windsor Road, Hinsdale
Latitude: 42.28.27
Longitude: 73.05.23
Sampling Date: August 20, 2002

Cady Brook is described as a cold-water, stable fishery (Kennedy and Weinstein 2000). Cady Brook is a first-order stream that flows through a watershed devoid of permanent human habitation. That is not to say that human impact has not affected this stream. There exists a power line right-of-way (with associated sub-station), a dirt jeep trail, and an aqueduct within the small (7.5 mi^2) watershed. Cady Brook’s natural course to Windsor Reservoir is diverted to Cleveland Brook Reservoir through the use of this aqueduct. Both impoundments are drinking water sources for the Town of Dalton and the City of Pittsfield. The current effects of the above-mentioned human intrusions seemed to have no impact upon the sampled reach (the reach was 0.2 miles upstream of the aqueduct).

The within-reach habitat assessment of Cady Brook resulted in the highest habitat score of all Housatonic stations examined in 2002 (169/200). The stream was of relatively high gradient, with a drop of 53 feet / mile. Like all other stations in 2002, Cady Brook was affected by low-flow conditions. This is acknowledged in the “marginal” Channel Flow Status score (7/20). Also, both banks were “marginally” stable (5/10 – left bank, 3/10 – right bank). It is likely that this stream is subject to freshettes, and exhibits a “flashy” disposition. This would account for the marginally stable banks.

One hundred eighty-four fish were collected from Cady Brook. Two species (blacknose dace and eastern brook trout) were collected. Both species are fluvial specialist / dependant species. The blacknose dace are classified as tolerant, and the eastern brook trout are classified as intolerant. The eastern brook trout appear to be reproducing, as the variety of their lengths indicates multiple age classes. This condition supports this stream's classification as a cold-water fishery.

This reach was last sampled by DWM (for the purposes of fish population assessment) in 1992. Habitat observations from 1992 were similar to those observed in 2002. During the 1992 fish population survey, 58 fish were collected, comprising (in order of abundance): eastern brook trout (*Salvelinus fontanalis*) and blacknose dace (*Rhinicthys atratulus*), and a solitary brown trout (*Salmo trutta*).

Waterbody Name: Windsor Brook
Waterbody Location: Old Windsor Road, Hinsdale
Latitude: 42.29.02
Longitude: 73.05.48
Sampling Date: August 20, 2002

This stream is described as a cold-water, stable fishery (Kennedy and Weinstein 2000). The stream reach examined for fish population assessment was also examined for benthic community assessment.

Windsor Brook is a high gradient stream (115 ft / mile), supplying drinking water to both Windsor Reservoir (by natural channel) and to Cleveland Brook Reservoir (by aqueduct). Residents of both the Town of Dalton and the City of Pittsfield consume this water. Windsor Brook is currently listed in the 2004 Massachusetts Integrated List of Waters as a Category 4c water body ("impairment not due to a pollutant") as a result of the operation of the aqueduct that diverts water to Cleveland Brook Reservoir (Mass DEP 2005).

Habitat assessment performed during the 2002 fish population survey concluded in an over-all habitat score of 166/200. The only parameter to score at the "marginal" level was the Channel Flow Status (7/20). Windsor Brook, like all other 2002 Housatonic stations, was affected by low flow conditions. This is almost exactly what was observed by the benthic assessment team (164/200).

One hundred two fish were collected at Windsor Brook. The two species represented in this collection were blacknose dace (*Rhinicthys atratulus*, n=73), and eastern brook trout (*Salvelinus fontinalis*, n=29). Brook trout appear to be reproducing, as the varieties of their lengths indicate multiple age classes. The presence of multiple age-class eastern brook trout lends credence to the designation of this stream as a cold-water fishery.

MA DFW previously sampled this station in July of 1999 (Richards 2001). They also observed multiple age-classes of eastern brook trout. Windsor Brook was last sampled by MA DWM during the 1992 *Housatonic River Tributary Biomonitoring Survey* (Kennedy, Maietta and Nuzzo 1993). Although the 1992 station was located ~300 meters downstream from the 2002 station, the same two species were collected.

Summary of Conditions

The fishes collected during the 2002 Housatonic watershed survey indicate the relatively healthy conditions of local fisheries. The collected specimens seemed healthy, and many appeared to be reproducing, although at the time of sampling the watershed was affected by low-flow conditions that can hinder reproduction.

One of the most surprising findings was the richness of the population sampled at the East Branch of the Housatonic River (Hubbard Avenue Bridge, Pittsfield). The proximity of industrial impoundments and commercial development would lead one to expect a depauperate community. This was not the case. Nine species were collected at this station (tying it with Hop Brook for the most species collected).

However, fishes may be concentrating within this reach due to the proximity of the upstream dam, and the within reach “deep pool” (approximately 6-feet deep) that may be the largest refugia for fishes in the area.

Two of the smaller streams sampled (Windsor Brook and Cady Brook) contained only two species (eastern brook trout and blacknose dace). This condition should not be inferred to mean that these streams are impacted in some regard. The small watershed area, high-gradient nature, and small size of the stream, provides conditions that are amenable to these two species. Both of these species (in both streams) showed signs of local reproduction (multiple age classes). Both streams appear to contain a healthy fish population. However, an examination of Cady Brook below the aqueduct may result in Cady Brook joining Windsor Brook on the Integrated List due to flow alteration.

Cleveland Brook displayed conditions somewhat similar to Windsor Brook and Cady Brook in that the population was dominated by reproducing eastern brook trout. Although the release schedule from Cleveland Brook Reservoir is unknown, it is recommended that its operation provides adequate water for the continued propagation of cold-water species.

The community collected at Hop Brook was quite encouraging. This station had the greatest richness (9 species - tied with East Branch of the Housatonic) encountered. Six of the nine species collected showed signs that they are reproducing locally. Although this stream does not appear to be a cold-water fishery, the diverse resident fish community is illustrative of a healthy stream.

The fishes collected from the Konkapot River station (at Mill River Road, New Marlborough) displayed a community containing both high-gradient, cold-water species (eastern brook trout and longnose dace) and low-gradient, warmer-water species (rock bass and common shiner). However, the mere presence of cold-water species (although not obviously reproducing) under the stressful conditions encountered during the survey (low-flow, high temperatures) supports the 1997 request that this stream be classified as a cold-water fishery.

The Williams River is classified as a cold-water fishery, and is heavily utilized as such. However, the community encountered during the 2002 survey does not support this designation. The presence of reproducing smallmouth bass and common shiner indicate warmer conditions than are acceptable to most trout. While it is true that a solitary brown trout was collected, the thermal tolerance of this fish is much greater than that of native species. It may also be the case that the Williams River was greatly affected by low flow conditions. The proximal upstream riparian zone (600-meters upstream) provides little shading to the river, and the river is low gradient with many meanders within this area. These physical attributes, combined with low-flow conditions, tend to favor the development of warm water species.

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Figure 1: 2002 Housatonic Watershed MA DWM Fish Population Monitoring Stations

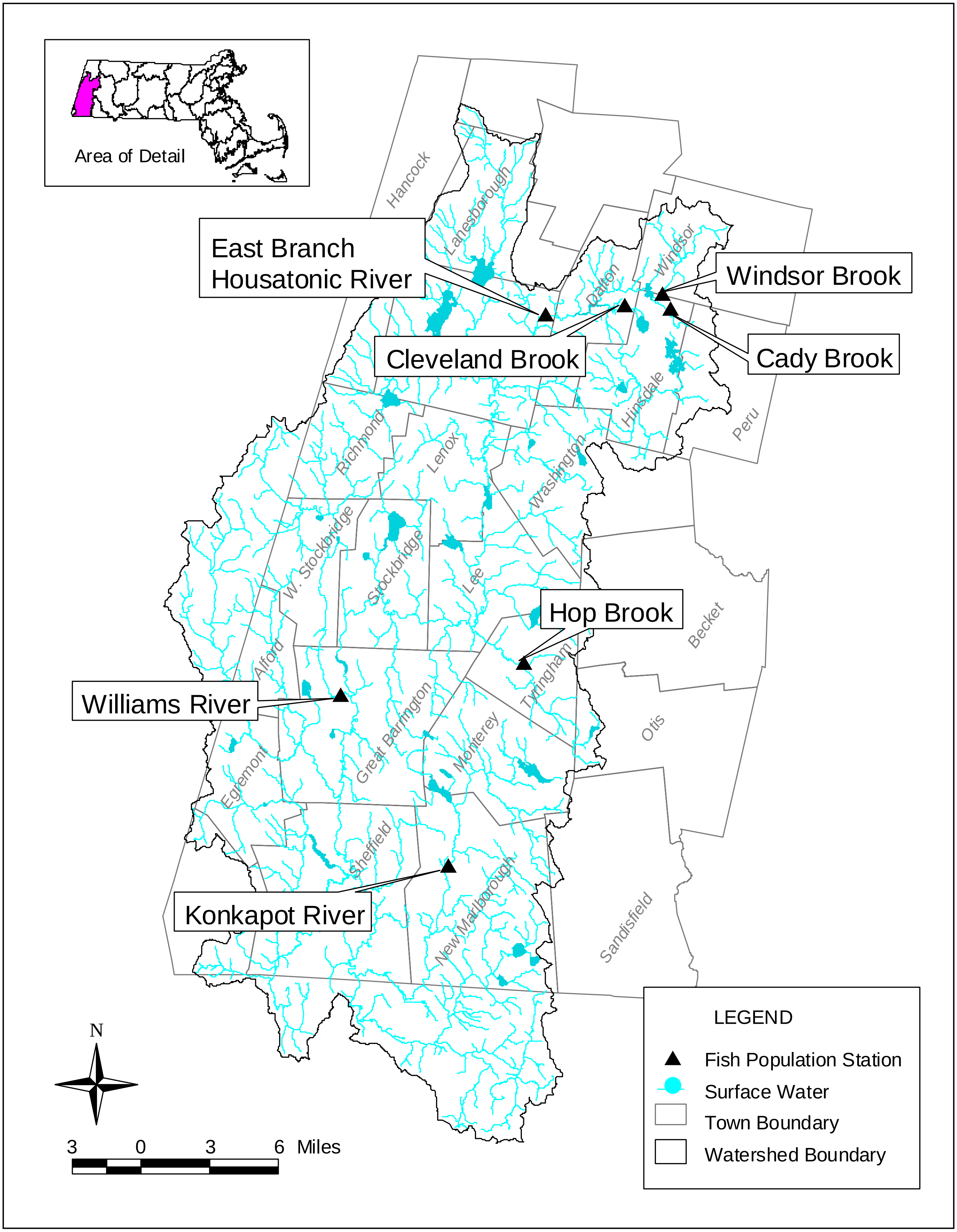
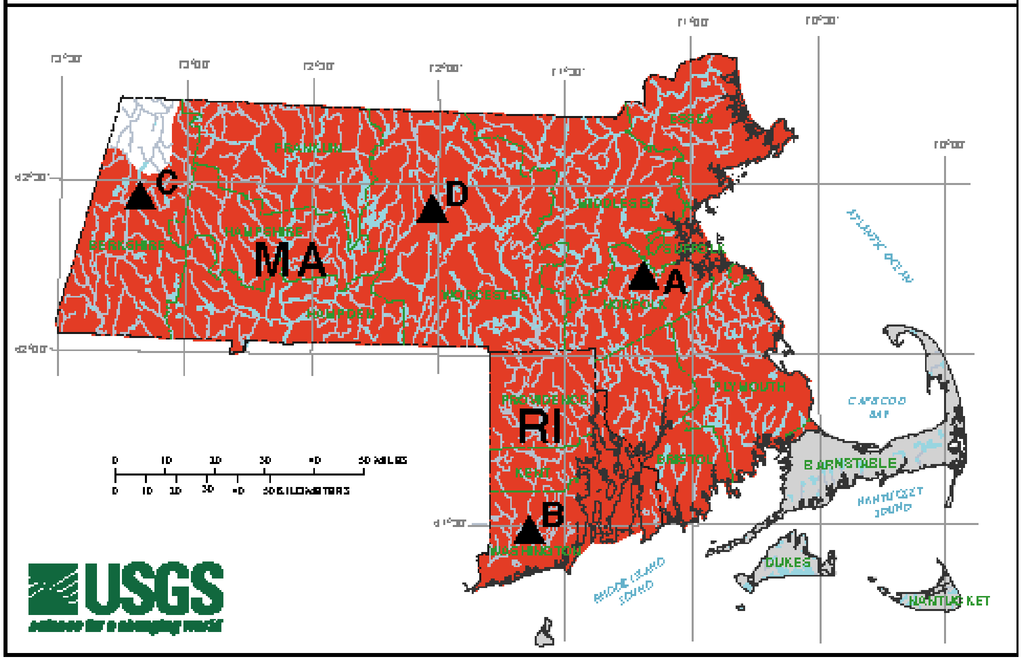


Figure 2. Massachusetts Surface-Water Runoff Conditions, August 2002. (USGS 2003).

Surface-Water Runoff
August 2002



COMPARISON WITH MONTHLY NORMAL RANGE

- ABOVE NORMAL - within the highest 25 percent of record for this month
- NORMAL RANGE
- BELOW NORMAL - within the lowest 25 percent of record for this month
- NO STREAM DATA
- ▲ INDEX STREAM GAGE AND IDENTIFIER LETTER

NOTE: Additional sites from those shown are used to determine ranges

Table 1: 2002 Housatonic Watershed Fish Population Station Locations

Waterbody	Location	Lat. / Lon.	Date
Williams River	Upstream of Route 41 Bridge, Great Barrington	42.13.35/ 73.21.51	19 August 2002
Konkapot River	Upstream of Mill River Road Bridge, New Marlborough	42.07.14/ 73.16.10	19 August 2002
East Branch Housatonic River	Upstream of Hubbard Avenue Bridge, Pittsfield	42.28.10/ 73.11.48	20 August 2002
Cleveland Brook	Upstream of Old Windsor Road Bridge, Hinsdale	42.28.35/ 73.07.45	20 August 2002
Hop Brook	Upstream of foot bridge, behind Fire Station, near Main Road, Tyringham	42.14.59/ 73.12.30	20 August 2002
Cady Brook	Upstream of New Windsor Road Bridge, Hinsdale	42.28.27/ 73.05.23	20 August 2002
Windsor Brook	Upstream of Old Windsor Road Bridge, Hinsdale	42.29.02/ 73.05.48	20 August 2002

Table 2: Habitat assessment summary for fish population stations sampled during the 2002 Housatonic river watershed survey of 19 and 20 August 2002.

Habitat Parameter	Williams River		Konkapot River		East Branch Housatonic River		Cleveland Brook		Hop Brook		Cady Brook		Windsor Brook	
Instream Cover	17		14		14		14		19		20		16	
Epifaunal Substrate	19		18		12		19		19		20		16	
Embeddedness	19		18		19		14		19		20		19	
Channel Alteration	20		15		13		19		15		20		20	
Sediment Deposition	15		18		19		13		18		19		18	
Velocity-Depth Combination	18		18		15		19		19		15		17	
Channel Flow Status	9		9		8		7		9		7		7	
Bank Vegetative Protection	10	10	9	9	9	9	9	9	9	9	10	10	10	10
Bank Stability	3	3	8	8	7	4	7	8	9	9	5	3	8	8
Riparian Vegetative Zone - Width	10	7	5	9	1	1	8	1	2	1	10	10	10	7
TOTAL SCORE	160		158		131		147		157		169		166	

Table 3. Fish population data collected by DWM at seven biomonitoring stations in the Housatonic River watershed on 19 and 20 August 2002. Sampling stations were located at: Williams River, Konkapot River, East Branch of the Housatonic River, Cleveland Brook, Hop Brook, Cady Brook, and Windsor Brook. Refer to Table 1 for a listing and description of sampling stations.

TAXON (SORTED BY FAMILY)	**Habitat Class**[1]	**Trophic Class**[2]	**Tolerance Class**[3]	**Williams R.**	**Konkapot R.**	**East Branch Housatonic**	**Cleveland Brook**	**Hop Brook**	**Cady Brook**	**Windsor Brook**
common shiner *Luxilus cornutus*	FD	GF	M	21	1	2	-	89	-	-
blacknose dace *Rhinicthys atratulus*	FS	GF	T	6	50	2	8	433	110	73
longnose dace *Rhinicthys cataractae*	FS	BI	M	60	29	21	-	135	-	-
creek chub *Semotilus atromaculatus*	MG	GF	T	-	-	5	-	11	-	-
fallfish *Semotilus corporalis*	MG	GF	M	-	-	6	-	-	-	-
white sucker C*atostomus commersoni*	FD	GF	T	4	1	3	1	6	-	-
tessellated darter *Etheostoma olmstedi*	FS	BI	M	2	-	-	-	18	-	-
brown trout *Salmo trutta*	FD	TC	I	1	12	3	3	5	-	-
brook trout *Salvelinus fontinalis*	FD	TC	I	-	3	-	75	1	74	29
smallmouth bass *Micropterus dolomieu*	MG	TC	M	13	-	-	-	-	-	-
pumpkinseed *Lepomis gibbosus*	MG	GF	M	-	-	2	-	-	-	-
rock bass *Ambloplites rupestris*	MG	GF	M	-	1	20	-	4	-	-
Total Number of Fish Collected	-	-	-	107	97	64	87	702	184	102

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

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

[3] Tolerance Classification - I (intolerant), M (moderately tolerant), T (tolerant). From Halliwell et al. (1999) Classification described as tolerance to "environmental perturbation".

APPENDIX G

HOUSATONIC RIVER WATERSHED

2002 Chlorophyll a and Periphyton Technical Memorandum

Prepared by
Joan Beskenis

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

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CN: 213.0

Introduction

Biological assessment was performed at several stations in the Housatonic River Basin located in Western Massachusetts during the summer of 2002. The sampling was conducted by personnel from Massachusetts Department of Environmental Protection (MassDEP). Mainstem stations were sampled for chlorophyll a from phytoplankton in conjunction with water quality sampling. Chlorophyll a is a pigment that is found in all plants and algae and provides an estimate of biomass as well as an indication of the biological production of the water body.

In the tributaries, samples were collected for the identification of periphyton (attached microscopic algae) and benthic algae (attached macroscopic algae); both types will be referred to as periphyton for this report. Estimates were made of the percent algal cover within the riffle of the sampling reach and algal type and abundance were also recorded. Periphyton sampling was limited to sites chosen for macroinvertebrate/habitat investigations.

Objectives of the periphyton sampling were to offer a means of comparing biological communities along with the macroinvertebrate and habitat information, and to examine community changes such as the amount and type of algae over time. The periphyton assessment provides a way to determine if the designated uses, as described in the Surface Water Quality Standards (MassDEP 1996), are being supported, threatened or lost in particular segments. Periphyton data can be used to evaluate two uses of the Housatonic River: Aquatic Life and Aesthetics.

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

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

by filamentous green algae (macroalgae) then nuisance amounts of algae are described as being present, but it still must be determined if designated uses of the particular reach have been altered. It must still be determined if the use of the benthos by aquatic life is threatened or if the aesthetics are impacted (Biggs 1996) (Barbour et al. 1999).

Because the Housatonic River is a large, often deep, often slow river, it can maintain its own population of phytoplankton. In order to learn more about the phytoplankton biomass in this river, chlorophyll a samples were collected to gather information on the main stem water quality and to determine if it was impacted by sources of nutrients (phosphorus and nitrogen) located along the river, in particular, agricultural runoff and wastewater treatment plants.

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

Materials and Methods

Chlorophyll a

Samples for chlorophyll a analysis and phytoplankton identifications were collected on July 31 and September 25, 2002 by wading in-stream and reaching into the main flow using a pole with a sample container attached. These grab samples were collected just below the surface in plastic containers that were placed into iced coolers until they could be returned to MassDEP's laboratory in Worcester for analysis. Samples were processed within the 24-hour holding period. Table 1 presents a list of stations included in the chlorophyll a sampling. A Turner Designs, Inc. TD-700 fluorometer was used in the chlorophyll a analysis (MassDEP 2000). Fifty milliliters of sample water are filtered through a glass fiber filter. The filter is ground using a motor driven grinder and a glass pestle. The ground material is transferred to plastic centrifuge tubes that are kept in the dark and refrigerated for 24 hours while the chlorophyll a extraction continues in 90% acetone. The plastic centrifuge tubes are kept in the dark, brought to room temperature, and then decanted into borosilicate disposable cuvettes that are placed in the TD-700 fluorometer for analysis. Results are reported in mg chlorophyll a per m^3 water.

Table 1: HOUSATONIC RIVER CHLOROPHYLL a SAMPLING Location of Sampling Stations		
Station	Location	Date Sampled
04B	Housatonic River-Holmes St. Bridge, Pittsfield	July 31, Sept. 25
04C	Housatonic River-New Lenox Rd. Bridge, New Lenox	July 31, Sept. 25
19AU	Housatonic River- At the foot-bridge, above dam at outlet to Woods Pond, east of Housatonic Street, Lenox	Sept. 25
19C	Housatonic River, Tyringham Rd., Lee	July 31, Sept. 25
HB	Hop Brook-Meadow St., Lee	July 31
20A	Housatonic River-Division Street Bridge (USGS gage), Great Barrington	July 31, Sept. 25
20D	Housatonic River-Kellogg Rd. Bridge, Sheffield	July 31, Sept. 25
19E	Housatonic River-Route 183, Stockbridge	July 31, Sept. 25

Periphyton Identifications and Relative Abundance

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

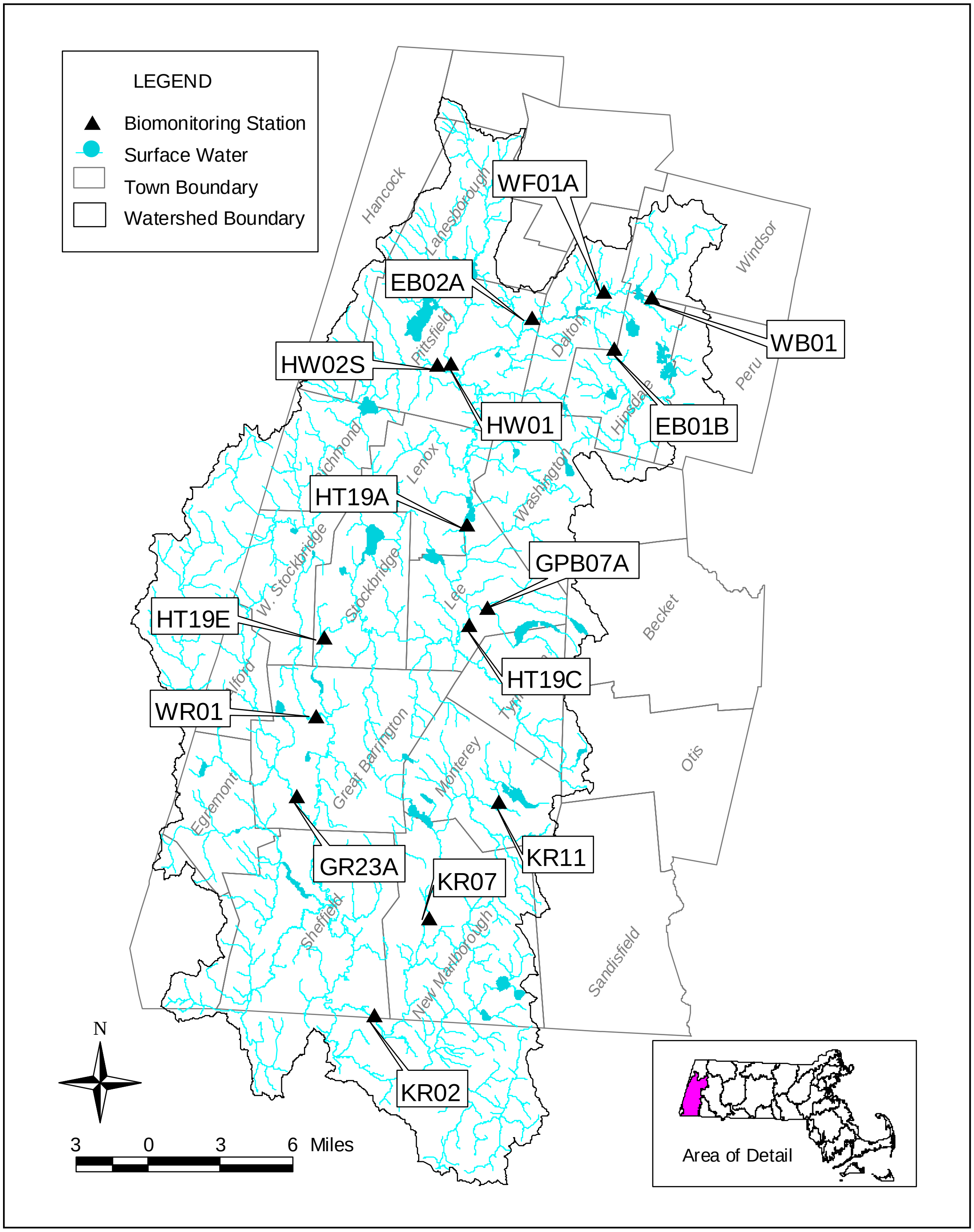
Vials were shaken to get uniform samples before subsampling. Filamentous algae were removed first, identified separately and then the remainder of the sample was examined. An Olympus BH2 compound microscope with Nomarski optics was used for the identifications. Slides were typically examined under 200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

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

Table 2 **2002 HOUSATONIC RIVER PERIPHYTON SAMPLING**
Location of Sampling Stations

Station	***Mainstem Locations***		***Station***	***Tributary Locations***
EB01B	East Branch Housatonic River at Jericho Rd., Hinsdale		WB01	Windsor Brook at Old Windsor Rd., Windsor
EB02A	E. Branch Housatonic, upstream from Hubbard Ave., Pittsfield		WF01A	Wahconah Falls Brook, Holiday Farms Rd., Dalton
HW02S	Southwest Branch Housatonic River downstream from Barker Rd., Pittsfield		WR01	Williams River, upstream from Route 41, Great Barrington
HT19AU	Woods Pond, at the foot-bridge, east of Housatonic Street, Lenox		GR23A	Green River at Route 23/41, Great Barrington
HT19A	Housatonic River, downstream Lenox WWTP, upstream from Crescent Mills (Crystal Street), Lenox		KR11	Konkapot River at Bidwell Park, Monterey
HT19C	Housatonic River, downstream of Lee WWTP, Tyringham Rd., Lee		KR07	Konkapot River at Clayton Mill Rd. downstream from Mill River, New Marlborough
HT19E	Housatonic River, near Route 183, Stockbridge		KR02	Konkapot River, Route 124, New Canaan, CT

Figure 1. Location map of MA DWM 2002 Housatonic Watershed Benthic/Habitat and Periphyton Sampling Locations



(MITCHELL 2005)

Results

Chlorophyll a

Table 3 presents the results of the chlorophyll sampling recorded as mg/m^3. The highest chlorophyll a values were measured where the river is impounded at station 19 AU (above the dam at the outlet to Woods Pond), while the remainder of the mainstem stations had low chlorophyll a values in both the July and September sampling events. The range in July was from <1-3.4 mg/m^3 while in September the values ranged from 1.2-3.7 mg/m^3.

Table 3 RESULTS OF 2002 HOUSATONIC RIVER CHLOROPHYLL a SAMPLING
Location, Date, Water Column Chlorophyll a (mg/m^3)

Station	Location	Date	Chlorophyll a	Date	Chlorophyll a
04B	Housatonic River-Holmes St. Bridge, Pittsfield	July 31	3.3	Sept. 25	2.2
04C	Housatonic River-New Lenox Rd. Bridge, New Lenox	July 31	2.2	Sept. 25	1.8
19AU	Housatonic River- At the foot-bridge, above dam at outlet to Woods Pond, east of Housatonic Street, Lenox	July 31	Mean 2 samples 23.6	Sept. 25	14.6
19C	Housatonic River- Tyringham Rd., Lee	July 31	2.5	Sept. 25	3.7
HB	Hop Brook-Meadow St., Lee	July 31	<1	---*	---*
19E	Housatonic River-Route 183, Stockbridge	July 31	2.5	Sept. 25	1.5
20A	Housatonic River-Division Street Bridge (USGS gage), Great Barrington	July 31	3.4	Sept. 25	1.9
20D	Housatonic River-Kellogg Rd. Bridge, Sheffield	July 31	1.8	Sept. 25	1.2

---*-not done

Periphyton and Benthic Algae-Identifications and Percent Cover

Nuisance amounts of algae, which can compromise aesthetics, can be determined by estimating the percent macroalgal cover in a particular habitat (e.g. riffles or pool) (Biggs 1996) (Barbour et al. 1999). Filamentous green algae (macroalgae) that cover more than 40% of the substrata in the riffle of a sampling reach, are described as nuisance amounts of algae (Biggs 1996) (Barbour et al. 1999). Perceptions of the users are needed to determine if the aesthetics are impacted (Biggs 1996) (Barbour et al. 1999).

Percent cover estimates of the algal cover and of the canopy cover were made in the riffle zone of the sampling reach. Both of these estimates are presented in Table 4, which includes a listing of the most abundant genera and the common name of their family grouping (green, yellow-green, diatoms, golden-brown, blue-green) found at each station. Green and yellow-green groups include filamentous macroalgal representatives. Appendix A lists genera found at each station as well as their abundance in the sample.

Several stations had greater than 40% algal cover (Table 4) (Barbour 1999, Biggs 1996). Many of these had macroalgae, particularly green filamentous algae. Prolific algal growth may limit uses of the river site, in particular the Aesthetics and Aquatic Life uses, so the stations with greater than 40% filamentous green benthic algae are first described below. Stations EB01B HW02S and KR11 are not discussed further because they had limited algal growth.

<u>Mainstem</u>

EB02A was located approximately 210 meters downstream of an industrial impoundment on the East Branch of the Housatonic River. Upstream of this site is the urbanized area of Pittsfield, as well as the Crane and Company industrial effluent discharge (MA0000671). The algal cover in the reach sampled for macroinvertebrates was approximately 50%. The riffle was dominated by the filamentous Xanthophyte (yellow green) *Vaucheria* sp., which often is very productive when nutrients are high and water temperatures low (Biggs 1996). Also very abundant in the sample was the diatom *Melosira* sp. that forms loosely linked chains held together by mucilage. It is often found in organically enriched areas (Palmer 1962). *Melosira* sp. chains can break apart easily causing the water to turn gray and turbid. Both the color, which often appears like “gray water” draining from a sink, and the cloudy water caused by the turbidity, can be unattractive and reduce the aesthetics of a reach.

HT19A was located on the mainstem of the Housatonic River at Crescent Mills, Lenox and it had 0% canopy cover and 95% algal cover. The periphyton sample was primarily composed of the green filamentous algae *Rhizoclonium* sp. and *Oedogonium* sp., both of these are filamentous algae that do well in high nutrient areas (Biggs 1996). The nuisance alga, *Hydrodictyon* sp. was also found, but it represented only a small part of the assemblage. Since it is planktonic, the *Hydrodictyon* sp. may have washed in from Woods Pond, the eutrophic impoundment located upstream.

HT19C was located approximately 185 meters downstream of the Lee WWTP outfall on the mainstem of the Housatonic River. The 0% canopy cover allowed plenty of light for photosynthesis and this likely contributed to the 50% algal cover. The green filamentous alga *Rhizoclonium* sp. that was also present at HT19A, was present in very abundant amounts in the material collected in the riffle, while along the margins there were lots of ciliates (*Vorticella* sp.) present as well as fungal hyphae. Both of these are found in areas of organic enrichment. Substrata in the pools had “slime” covering them possibly contributed by the planktonic diatom *Cyclotella* sp. that was also very abundant.

HT19E is another mainstem Housatonic station that was located along Route 183 (near Blue Moon Kennels), downstream of the Glendale Dam, Stockbridge. It was a reference station for macroinvertebrate sampling conducted along the mainstem, although it had 0 % canopy cover and 100 % algal cover (Table 4), and the green, filamentous alga *Cladophora* sp. appeared to be very abundant in the sample from the riffle (Appendix A). This alga, which can develop to nuisance amounts (Biggs 1996), likely represented isolated clumps of filaments. Most of the algal cover was composed of a green film that did not appear in the sample provided. These films can be firmly attached to the surface or in crevasses that make them difficult to remove.

<u>Tributaries</u>

WB01 had 60% algal cover, but the algae sample had very few cells present and was mostly amorphous material. Filaments of the cyanobacteria -*Lyngbya* sp. were not very abundant. Visually, *Lyngbya* sp. is not a nuisance unless the growth is prolific, this is particularly evident when it forms mats on the substrata (Komarek et. al. 2003), that break free and float on the surface.

WF01A Eighty percent of the substrata at station WF01A on Wahconah Falls Brook was covered by algae. Located approximately 1.75 miles downstream of Windsor Reservoir (a drinking water reservoir, Dalton), the canopy cover was relatively high (60%) primarily caused by a single line of trees in the riparian zone. According to Mitchell (2005), behind this line of trees were fields and pastures which are potential sources of nutrients. Although the cover of periphyton was high, the biomass was low since it was dominated by the stalked diatom *Synedra* sp. Mitchell (2005) mentions a thin green film and filamentous green algae on the rocks, but no indication of nuisance growth.

GPB07A Goose Pond Brook originates at the outlet of Goose Pond (Tyringham, MA) . Although the shoreline of Goose Pond has many dwellings, the brook passes through a “very undeveloped, forested, landscape” (Mitchell 2005). The trees (Willow (*Salix* sp.), Cottonwood (*Populus deltoides*), and Paper Birch (*Betula papyrifera*)) create a slightly closed canopy cover (30%). But, ambient light and nutrients contributed to the growth of the green filamentous alga *Cladophora* sp. and a film of green coccoid algae. Together, they covered approximately 60 % of the in the riffle areas in this reach.

WR01 was located at the Williams River upstream from Route 41, Great Barrington. According to Mitchell (2005), the Williams River watershed at the point sampled is primarily forested although the nearby landuse is residential. Mitchell's (2005) analysis of 1997 and 2002 macroinvertebrate data indicated that some community changes had occurred over this time period. He suggested that one possible cause could be low flow conditions during 2002. The filamentous green alga *Cladophora* sp. population might have benefited from the lack of disturbance and low flow, but it only covered approximately 30% of the substrata. Pools that were sampled in this reach had some mats of blue-green algae (Table 4) that were still attached to the substrata. Their visual impact would be minimal under these conditions. Widespread algal mats could affect Aquatic life use by "smothering" organisms that inhabit interstitial areas of the benthos.

GR23A At the Green River, station GR23A, the algal cover was 90%. This station was located below the Great Barrington WWTP and was dominated by the green, filamentous algae *Zygnema* sp. and *Mougeotia* sp., both of which are often found in the metaphyton, the drift community. Drift algae can significantly affect an area by reducing sunlight to the benthos, appearing like surface scums, by entangling swimmers especially the ones that are semi-buoyant and float just below the surface. The *Mougeotia* sp. was covered by the diatom *Cocconeis* sp.

KR07 Another tributary, the Konkapot River at KR07, had 80 % algal cover that was dominated in the sample by the green filamentous *Cladophora* sp., but a thin green film represented most of the coverage on the rocks.   The film was composed of an unidentified green coccoid alga. NIWA (2002) describes these thin, green, tightly bound films as occurring in areas with slight nutrient enrichment.

KR02, at the Konkapot River (Route 124, New Canaan, CT), had obvious potential sources of non-point source pollution in its watershed that included dairy farms and fields. There was only a thin buffer (a line of trees) between these sources and the river. Surprisingly, with no canopy cover and with potential nutrient sources, the algal cover was only approximately 25% (Table 4). The green filamentous alga *Cladophora* sp., which often grows to a nuisance amount, was present in the sample (Appendix A), but did not occupy all favorable substrata.

Table 4 **PERIPHYTON HOUSATONIC RIVER-2002**

Habitat, % Canopy Cover, % Algal Cover, Dominant Algal Genera

Station #, Location	Date	Habitat	% Canopy Cover	% Algal Cover	Dominant Algal Genera
	Mainstem Stations				
EB01B-East Branch Housatonic River at Jericho Rd., Hinsdale	Sept. 10	Rock, riffle	70	<1	Green- *Cladophora* sp.
EB02A-E. Branch Housatonic, upstream from Hubbard Ave., Pittsfield	Sept. 10	Rock, riffle	10	50	Yellow-Green-*Vaucheria* sp. Diatoms-*Melosira* sp.
HT19A-Housatonic River at Crescent Mills, Lenox	Sept. 11	Rock, riffle	0	95	Green-*Rhizoclonium* sp. Diatoms-*Tabellaria* sp., *Cocconeis* sp.
HW02S-Southwest Branch Housatonic River downstream fr Barker Rd., Pittsfield	Sept. 10	Rock, riffle	70	0	---*
HT19C-Housatonic River, Tyringham Rd., Lee	Sept.11	Rock, riffle	0	50	Green-*Rhizoclonium* sp. Diatoms-*Cocconeis* sp.
HT19E-Housatonic River, Route 183, Stockbridge	Sept. 9	Rock, riffle	0	100	Green- *Cladophora* sp.
	Tributary Stations				
WB01-Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Rock, riffle	90	60	Blue-green-*Lyngbya* sp.
WB01-Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Pool	90	60	Green-*Spirogyra* sp. Diatoms-*Melosira* sp.
WF01A-Wahconah Falls Brook, Holiday Farms Rd., Dalton	Sept. 10	Rock, riffle	60	80	Diatoms-*Synedra* sp. Diatoms-*Fragilaria* sp.
GPB07A-Goose Pond Brook downstream from Forest St., Lee	Sept. 11	Rock, riffle	30	60	Green- *Cladophora* sp.
WR01- Williams River-upstream from Route 41, Great Barrington	Sept. 9	Cobble, riffle	50	30	Green-*Cladophora glomerata*
WR01-Williams River-upstream from Rte. 41, Great Barrington	Sept. 9	Cobble pool	50	30	Green-*Ulothrix zonata* Blue-green-*Oscillatoria* sp.
GR23A-Green River at Route 23/41, Great Barrington	Sept.9	Rock, riffle	10	90	Green-*Zygnema* sp., *Mougeotia* sp. Diatoms on *Mougeotia* sp. *Cocconeis* sp.
KR11-Konkapot River at Bidwell Park, Monterey	Sept. 11	Rock, riffle	75	<1	Green-*Cladophora* sp. Diatoms-*Melosira* sp., *Cocconeis* sp.

KR07-Konkapot River east of Clayton Mill River Rd., downstream from Mill River, village of Mill River, town of New Marlborough	Sept. 9	Rock, riffle	60	80	Green-*Cladophora* sp. Green-unidentified green coccoid
KR02-Konkapot River, Route 124, New Canaan, CT	Sept.9	Rock, riffle	0	25	Green-*Cladophora* sp. Diatoms-*Tabellaria* sp.

---*-not done

<u>Discussion</u>

Chlorophyll a

The water column chlorophyll a values for the portion of the mainstem Housatonic River sampled were almost all low and are characterized as oligotrophic on both sampling dates (Wetzel 1983). Oligotrophic conditions in flowing waters is described by Wetzel (1983) as having chlorophyll a values of 0.3-4.5 mg/m^3 while eutrophic waters range from 3-78 mg/m^3. The chlorophyll a values at the Housatonic stations ranged from <1 mg/m^3 at Hop Brook to the elevated values at station 19A just below the Woods Pond Dam, Lenox with 23.6 mg/m^3 (mean two samples) in June and 14.6 mg/m^3 in Sept. This is considered to be eutrophic or nutrient enriched.

The chlorophyll values represented the biomass of the phytoplankton in the water column, if light reached the benthos then nutrients could be utilized by the periphyton. Although chlorophyll analysis of the periphyton was not conducted, percent saturation of the dissolved oxygen (DO) was recorded (Mitchell 2006). None of the stations where chlorophyll a was measured had supersaturated DO values (>100 %), but if algal mats were present on the bottom and widespread the 100 % saturation values would be exceeded. Characterization of these stations as oligotrophic cannot be verified by this approach, instead it still needs to be known if turbidity in the water column or color is impeding light from reaching the bottom which would limit overall algal production.

Periphyton

Many of the reaches sampled in the tributaries to the Housatonic River had algal growth and genera that are indicative of nutrient enrichment. The green filamentous alga-*Cladophora* sp.- develops high biomass communities in enriched streams particularly in low velocity runs and pools (Biggs 1996). The percent cover of filamentous macroalgae is a good indication of nuisance aquatic growth (Barbour et al. 1999, Biggs 1996) that can threaten both aesthetics and aquatic life. Stations where nuisance macroalgae were present at amounts that could threaten use included: EB02A-*Vaucheria* sp*.,* HT19A –*Rhizoclonium* sp., and GPB07A on Goose Pond Brook (*Cladophora* sp.).

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Appendix A: PERIPHYTON-Housatonic River 2002 Habitat, Algal Identification and Abundance						
Sta #	Location	Date	Habitat	Family	Genus	Abundance
	Housatonic River					
EB01B	East Branch Housatonic River at Jericho Rd., Hinsdale	Sept. 10	Rock, riffle	Bacillariophyceae	*Gomphonema* sp.	A
				Chlorophyceae	*Chaetophora* sp.	A
				Chlorophyceae	*Cladophora glomerata*	VA
				Cyanophyceae	*Lyngbya* sp.	R
EB02A	E. Branch Housatonic, upstream from Hubbard Ave., Pittsfield	Sept. 10	Rock, riffle	Bacillariophyceae	*Melosira* sp.	VA
				Bacillariophyceae	*Cocconeis* sp.	A
				Bacillariophyceae	*Synedra* sp.	C
				Bacillariophyceae	*Cymbella* sp.	C
				Bacillariophyceae	*Fragilaria* sp.	C
				Chlorophyceae	*Ulothrix* sp.	R
				Cyanophyceae	*Lyngbya* sp.	R
				Xanthophyceae	*Vaucheria* sp.	VA
EB02A	E. Branch Housatonic, upstream from Hubbard Ave. , Pittsfield	Sept. 10	Rock, pool, mat	Bacillariophyceae	*Synedra* sp.	A
				Bacillariophyceae	*Pinnularia* sp.	VA
				Bacillariophyceae	*Cymbella* sp.	VA
				Bacillariophyceae	*Navicula* sp.	VA
				Bacillariophyceae	*Diatoma* sp.	VA
				Bacillariophyceae	*Fragilaria* sp.	VA
				Bacillariophyceae	*Amphirora* sp.	VA
				Bacillariophyceae	*Surirella* sp.	R
				Bacillariophyceae	*Melosira varians*	R
				Chlorophyceae	*Ulothrix* sp.	R
				Cyanophyceae	*Oscillatoria curviceps*	A
				Euglenophyceae	*Phacus* sp.	R
HW02S	Southwest Branch Housatonic River downstream from Barker Rd., Pittsfield	Sept. 10	Rock, riffle		Not done	
HT19A	Housatonic River at Crescent Mills, Lenox	Sept. 11	Rock, riffle	Bacillariophyceae	*Synedra* sp.	R
				Bacillariophyceae	*Fragilaria* sp.	R
				Bacillariophyceae	*Cocconeis* sp.	VA

Appendix A: PERIPHYTON-Housatonic River 2002 Habitat, Algal Identification and Abundance						
Sta #	Location	Date	Habitat	Family	Genus	Abundance
				Chlorophyceae	*Hydrodictyon* sp.	R
				Chlorophyceae	*Closterium* sp.	R
				Chlorophyceae	*Oedogonium* sp.	A
				Chlorophyceae	*Rhizoclonium* sp.	VA
				Cyanophyceae	*Lynbya* sp.	R
GPB07 A	Goose Pond Brook downstream from Forest St., Lee	Sept. 11	Rock, riffle	Chlorophyceae	*Cladophora* sp.	VA
HT19C	Housatonic River, Tyringham Rd., Lee	Sept.11	Rock, riffle	Bacillariophyceae	*Cocconeis* sp.	VA
				Bacillariophyceae	*Navicula* sp.	C
				Bacillariophyceae	*Cyclotella* sp.	VA
HT19C	Housatonic River, Tyringham Rd., Lee	Sept. 11	Rock, pool	Chlorophyceae	*Coleochaete* sp.	VA
				Chlorophyceae	*Rhizoclonium* sp.	VA
HT19C	Housatonic River, Tyringham Rd., Lee	Sept. 11	margins	Bacillariophyceae	naviculoids	VA
				Bacillariophyceae	*Cyclotella* sp.	C
				Chlorophyceae	*Pediastrum* sp.	R
				Cyanophyceae	*Lyngbya* sp.	R
HT19E	Housatonic River, Route 183, Stockbridge	Sept. 9	Rock, riffle	Chlorophyceae	*Cladophora* sp.	VA
	Tributary Stations					
Sta #	Location	Date	Habitat	Family	Genus	Abundance
WB01	Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Rock, riffle	Cyanophyceae	*Lyngbya* sp.	C
WB01	WB01-Windsor Brook at Old Windsor Rd., Windsor	Sept. 10	Pool	Bacillariophyceae	*Melosira* sp.	VA
				Chlorophyceae	*Sirogonium* sp.	C
				Chlorophyceae	*Spirogyra* sp.	VA
WF01A	Wahconah Falls Brook, Holiday Farms Rd., Dalton	Sept.10	Rock, riffle	Bacillariophyceae	*Synedra* sp.	VA
					Gomphonema sp.	C
				Bacillariophyceae	*Surirella* sp.	R
					Scenedesmus sp.	R
				Bacillariophyceae	*Melosira* sp.	C
					Microspora sp.	R
				Bacillariophyceae	*Cymbella* sp.	C
				Bacillariophyceae	*Meridion* sp.	R
				Bacillariophyceae	*Fragilaria* sp.	A
					Oscillatoria	R

					rubescens	

Appendix A: PERIPHYTON-Housatonic River 2002 Habitat, Algal Identification and Abundance

Sta #	Location	Date	Habitat	Family	Genus	Abundance
				Bacillariophyceae	*Nitzchia* sp.	R
					Tetradesmus sp.	R
					Zygnema sp.	C
					Spirogyra sp.	C
WR01	Williams River-upstream from Route 41, Great Barrington	Sept. 9	Cobble, riffle	Chlorophyceae	*Spirogyra sp*.	A
				Chlorophyceae	*Cladophora glomerata*	VA
WR01	Williams River-upstream from Rte. 41, Great Barrington	Sept. 9	Cobble pool	Bacillariophyceae	*Gyrosigma*	R
				Chlorophyceae	*Ulothrix zonata*	VA
				Cyanophyceae	*Oscillatoria curviceps*	C
				Cyanophyceae	*Oscillatoria* spp.	VA
GR23A	Green River at Route 23/41, Great Barrington	Sept.9	Rock, riffle	Chlorophyceae	*Zygnema* sp.	VA
KR11	Konkapot River at Bidwell Park, Monterey	Sept. 11	Rock, riffle	Bacillariophyceae	*Melosira* sp.	VA
				Bacillariophyceae	*Cocconeis* sp.	VA
				Chlorophyceae	*Cladophora* sp.	VA
KR07	Konkapot River east of Clayton Mill River Rd., downstream from Mill River, village of Mill River, town of New Marlborough	Sept. 9	Rock, riffle	Chlorophyceae	*Cladophora* sp.	VA
					Ui green coccoid	VA
KR02	Konkapot River, Route 124, New Canaan, CT	Sept.9	Rock, riffle	Bacillariophyceae	*Tabellaria* sp.	VA
				Chlorophyceae	*Cladophora glomerata*	VA

APPENDIX H

DWM Technical Memorandum (CN 131.0)
TM-21-4

Continuous Temperature Data at Four Locations in the Housatonic River Watershed (July-August, 2002)

Prepared by: Richard Chase and Peter Mitchell
MADEP, Division of Watershed Management

Date: 8/26/2003

Contents:

INTRODUCTION

Cost-efficient, continuous water temperature data can be useful to environmental managers trying to understand surface water temperature dynamics in single waterbodies or at many locations within watersheds. Specifically, validated data can help to determine maximum, minimum and mean daily temperatures, examine the timing of diurnal temperature fluctuations, assess the potential for exceedances of state surface water quality criteria, determine appropriate thermal NPDES permit limits, and assist in waterbody classifications based on temperature (e.g. cold vs. warm water fishery).

Continuous, in-stream temperature data were gathered during summertime, 2002 baseflow conditions in three waterbodies in the Housatonic watershed.

BACKGROUND INFORMATION

Basin Description

The Housatonic River Basin is located in southwestern Massachusetts. It is bordered by the Hoosic River Basin to the north, the Westfield River Basin to the northeast and by the Farmington River Basin to the southeast. The south and west portions of the basin are bordered by the states of Connecticut and New York, respectively. The Housatonic River originates at the confluence of the West and Southwest Branches of the Housatonic River in Pittsfield. The West Branch Housatonic River originates at the outlet of Pontoosuc Lake in Lanesborough and Pittsfield and the Southwest Branch originates from Richmond Pond in the town of Richmond. The East Branch Housatonic River, which originates from Muddy Pond in the town of Washington, soon joins the mainstem Housatonic River. From Pittsfield, the river flows south for 150 miles (approximately 54 river miles in Massachusetts) until it empties into Long Island Sound near Bridgeport, Connecticut. Other major tributaries to the Housatonic River in Massachusetts include the Williams, Green and Konkapot Rivers and Hubbard Brook.

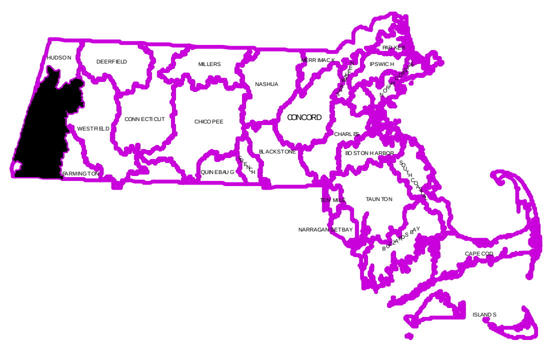


Figure 1. Housatonic River Basin Location.

The drainage basin of the Massachusetts portion of the Housatonic River encompasses 545 square miles, and is located entirely in Berkshire County. The communities of Alford, Becket, Cheshire, Dalton, Egremont, Great Barrington, Hancock, Hinsdale, Lanesborough, Lee, Lenox, Monterey, Mount Washington, New Ashford, New Marlborough, Otis, Peru, Pittsfield, Richmond, Sandisfield, Sheffield, Stockbridge, Tyringham, Washington, West Stockbridge, and Windsor lie wholly or in part within the basin boundaries.

Much of the upper third of the Housatonic River Basin is urbanized, with the city of Pittsfield being the major urban area. The remaining two-thirds of the watershed is primarily rural; large portions of the basin are undeveloped as forest or large wetland systems. The major industries of this region are paper manufacturing and tourism, and both industries have traditionally supported the economy of the area.

Water Quality

The major industrial discharges of wastewater to the river include: Crane Paper Company, General Electric Company, Schweitzer-Mauduit International, Inc. and Mead Paper Company. All of these companies provide treatment for their process wastewater prior to discharge to the river. Major municipal wastewater treatment plants are located at Pittsfield, Lenox, Lee, Stockbridge, and Great Barrington. One additional municipal wastewater treatment plant (WWTP), the West Stockbridge WWTP, discharges into the Williams River.

Water quality problems within the basin include eutrophication due to phosphorous loading, sediment and fecal coliform bacteria, these problems have been overshadowed by the PCB contamination from electrical manufacturing in the upper portion of the watershed. Non-point source pollution that is associated with storm water runoff and failing septic systems is also known to contribute to the basin's water quality problems. Urbanization around lakes and ponds has lead to increased loadings of sediment and nutrients, resulting in eutrophication of these waterbodies.

Waterbody and Fisheries Classifications

The Housatonic watershed contains both cold and warm water fisheries. Class B, Cold-Water Fisheries (CWF) are described as waterbodies "in which the maximum mean monthly temperature generally does not exceed 68°F (20°C)" and that are capable of supporting year-round populations of cold water species, such as trout. Class B, Warm-Water Fisheries (WWF) are described as waterbodies "in which the maximum mean monthly temperature generally exceeds 68°F (20°C)" and that cannot support cold water species. Also, Class C waters (of which there are none designated in the Housatonic)"…shall not exceed 85°F (29.4°C)."

The current waterbody classifications per the Massachusetts State Water Quality Standards (SWQS) are as follows.

Table 1: Current SWQS Waterbody Classifications for Project Segments

Waterbody	Segment	Class B designation
Hubbard Brook	Entire length	CWF (≤ 20 deg. C)
Housatonic River	MA 21-20	WWF (≤ 28.3 deg. C)
Hop Brook	MA 21-TBD	CWF* (≤ 20 deg. C)
Housatonic River	MA 21-19	WWF (≤ 28.3 deg. C)

* This stream is not officially designated as a Cold Water Fishery. However, Hop Brook is stocked with trout and a resident/reproducing trout population was observed during the DWM 2002 Housatonic Fish Population Survey. This survey took place ~ 3-miles upstream from the Stowaway® installation location.

Recent Temperature Monitoring

The headwaters of the Housatonic River are, for the most part, small high-gradient streams with almost complete canopy cover. These cold-water streams stand in contrast to the mainstem of the Housatonic, which is much wider with a lower gradient than the tributaries. It occupies the sandy Housatonic valley floor, allowing the river to meander across the valley and create oxbows and backwaters. The width of the mainstem makes complete canopy cover an impossibility along most of the mainstem's length. This, in turn, allows for increased solar radiation to affect this slower moving water.

In 1997 DWM obtained instantaneous temperature measurements from 12 stations (on four occasions) using a Hydrolab® multi-probe unit. These data are contained in the "Housatonic River Basin 1997/1998 Water Quality Assessment Report" (Kennedy and Weinstein 2000). All stations were located along the Konkapot River. There are no temperature data from that report for the mainstem of the Housatonic River or other tributaries.

In 2002 DWM returned to the Housatonic River and sampled 18 stations for Hydrolab® parameters, including temperature. These stations were sampled during the pre-dawn hours on five occasions. Three of these 2002 watershed monitoring stations (Hubbard Brook 21-15A, Mainstem Housatonic 21-20A, and Hop Brook HB) were also employed for this temperature study.

A private consulting firm (Woodlot Alternatives, Inc.) contracted by the US Environmental Protection Agency (EPA) employed continuous temperature data loggers to examine water temperatures at five stations in the upper Housatonic River in 2000 and 2001. The closest "Woodlot" station was located approximately 13 river miles upstream from DWM sensor Number 3. Although no direct comparisons between these two data sets may be established, similar diurnal fluctuations in temperature have been noted at all locations in both data sets.

PROJECT OBJECTIVES, SAMPLING DESIGN AND QUALITY ASSURANCE

The project **objectives** in gathering continuous temperature data at selected locations in the Housatonic watershed were as follows:

1. document and evaluate the field methods for deployment and data retrievel, and to assess in-situ equipment accuracy, in order to formalize DWM standard operating procedures for continuous temperature monitoring;
2. record "worst case" temperature conditions over a several week period at four separate locations under summertime baseflow conditions; and
3. assist in assessing each waterbody's health with regard to designated uses, including the evaluation of current and future water quality classifications using the Massachusetts Surface Water Quality Standards.

The **data quality objectives (DQOs)** for the project were as follows.

Table 2: Project DQOs.

Analyte	Units	Expected Range	Accuracy (+/-)	Resolution	Overall Precision (Relative percent difference)
Temperature	°C	15-35	0.2	0.15	NA
Time (logger internal clock)	minutes	NA	< 5 minutes over an approximate 1 month deployment	NA	NA

The selection of continuous temperature logging equipment was based on a review of available equipment to purchase, internal DWM experience using continuous temperature sensors, cost and ease of use. Optic Stowaway® Temp sensors and BoxCar Pro 4 software (Onset Computer Corporation, Bourne, Ma.) were used, along with an "optic shuttle" (for portable field data downloading) and an optic "base station" (for data transmittal to a computer).

The seasonal timing of data collection aligned with theoretical "worst case" temperature conditions (late July through August) and was limited by other planned deployments. The recording interval was set at 15 minutes to maximize data quantity while ensuring adequate available storage though the anticipated monitoring period (approx. 1 month). About 82 days of data storage is available using a logger reading interval of 15 minutes.

Logger temperature accuracy and logging capability was tested prior to deployment in the lab. In-situ accuracy was tested by side-by-side comparison against a National Institute of Standards and Technology (NIST)-traceable precision thermometer (Eutechnics 4400 series) at each location on two occasions --- when initially deployed and when retrieved.

Logger time accuracy was limited by the Onset loggers, which can vary up to one hour per year at 20 deg. C. The internal clock of each logger was set at launch (via the BoxCar software) by a DWM office network PC in Worcester, Ma. Due to the relatively short monitoring period and how the data may be used, time errors are considered much less important than potential errors in temperature.

<u>Due to limited staff and scheduling issues, a formal project-specific Quality Assurance Project Plan (QAPP) was not produced for this monitoring</u>. A formal Standard Operating Procedure (SOP) for continuous temperature monitoring was developed in 2002, based in part on insights gained during this project (MassDEP 2002).

The number of continuous temperature sensors deployed was limited to four, based on the number of sensors purchased in May, 2002. Sampling site locations were chosen to coincide with a subset of existing 2002 DWM sampling stations and to assess those stations believed to exhibit unusually high summertime temperatures.

Continuous temperature was monitored at the following **stations.** See also Figures 3-6.

Table 3: Project Monitoring Stations

Sensor #	Station Name & Segment ID	Station ID#	Site Description	Parameters	Frequency
1	Hubbard Brook 21-15	15A	At the Route 7 bridge, Miller Road, Sheffield, MA (left bank, approx. 100' upstream) 42.06.50 / 73.21.03	Temperature	15 minute intervals from 7/25-8/28
2	Housatonic River 21-20	20A	Division Road, Great Barrington, MA (approx. 150' upstream from USGS gage site, left bank) 42.13.53 / 73.21.17	Temperature	15 minute intervals from 7/25-8/24
3	Housatonic River 21-19	NA	Behind HVA offices Route 102, Lee, MA 42.16.39 / 73.16.39	Temperature	15 minute intervals from 7/25-8/28
4	Hop Brook 21-TBD	HB	Meadow Street bridge, Lee, MA (approx. 20 feet upstream from bridge) 42.16.13 / 73.15.03	Temperature	15 minute intervals from 7/25-8/28

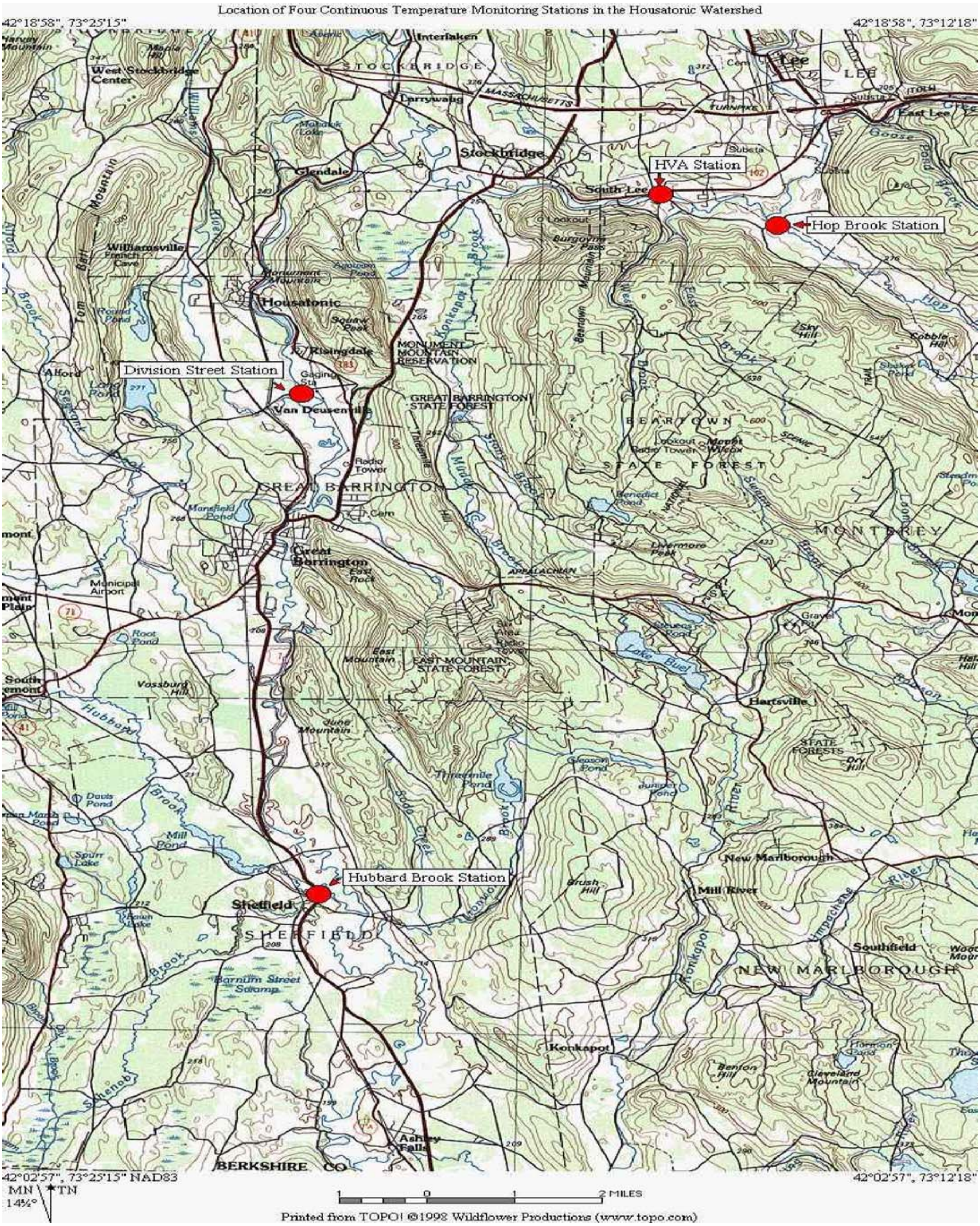


Figure 2: Project Locations


Figure 3: Hubbard Brook (MA21-15) station at Rt. 7 bridge in Sheffield, MA.


Figure 4: Housatonic River (MA21-20) station @ Division Street, Great Barrington, MA.


Figure 5: Hop Brook (MA21-TBD) station at Meadow St. in Lee, MA.

METHODS AND MATERIALS

See Appendix A for temperature logging equipment descriptions and manufacturer specifications. The following materials were used in this project.

Sensing and Data Retrieval Equipment: Optic Stowaway® Temp loggers, optic shuttle, optic base station and BoxCar Pro software (Onset Computer Corp.). The 6" long, sealed polycarbonate optic loggers were initially launched (logging initiated) using the BoxCar program loaded on a DWM computer and tested for logging capability and accuracy over several days. All sensors were deemed fit to use and were re-launched prior to placement in rigid plastic tubes for field use. At the same time, the optic shuttle (used for field downloading without a laptop) and the optic base station (for data transmittal from a logger or the shuttle to the PC) were also tested to make sure they worked. The BoxCar program was also tested and used to look for any potential software problems and none were found. After placement in the plastic tubes, the loggers were anchored at representative stream/river locations at each of the four stations.

Sensor Housing and Anchoring Assembly: Each sensor was placed in a 9-12" long, 2" O.D. plastic pipe with glued, white caps on both ends for protection. Several ¾" holes were drilled into each pipe section so each assembly would sink. Prior to glueing the caps, a small, round rock was placed inside each pipe to reduce buoyancy and guarantee submergence. Also, the white caps were numbered (#1-4) to keep track of which loggers were at which locations. Approximate 10-15' long, 1/8" diameter, flexible steel cables were swage-fitted to each pipe (on one end) and attached to the top loop of 18" long steel screw anchors.

Field Deployment: At each station the anchors were screwed into a stable streambank at the water's edge. The cable was hidden as much as possible and the pipe containing the sensor allowed to drift downstream and sink (or the pipe was secured under large rock). All locations and placements were selected to be representative of typical stream/river conditions. The pipe number, station name and number, exact time and other relevant field data were documented.

Data Analysis: Recorded data were viewed, graphed and analyzed using the BoxCar Pro 4 software (Onset Computer Corp.). Data were also exported to MS Excel.

NIST-traceable accuracy checks: A hand-held digital thermometer (Eutechnics 4400 Series) traceable to a NIST-certified thermometer was used in the field to check logger accuracy at deployment and at retrieval. (This unit was purchased in 6/2001 and came with a National Institute of Standards and Technology traceable calibration certificate; the unit was then checked against a MassDEP NIST-certified thermometer (from Wall Experiment Station) in September, 2002). Based on manufacturer specifications, the Eutechnics unit is accurate within 0-50 deg. C to +/- 0.015 (plus probe tolerance) deg. C. The resolution is listed as 0.01 deg. C, with a one year probe drift of +/- 0.010 deg. C.

RESULTS AND DISCUSSION

The temperature loggers were installed at each location on July 24, 2002 and were retrieved on August 29, 2002. A summary of the data for each station is provided below. **See Appendix B for graphic presentation of the data at each station.**

Continuous Temperature Data

Hubbard Brook (MA 21-15) (Station 15A)

Temperature Range: 17.9-26.8
Mean Temperature (3360 readings over 35 days): 22.6
Avg. daily time MAX reached: 1730
Avg. daily time MIN reached: 0830
Avg. daily duration > 20 deg. C: 21.5 hrs/day
# of days MAX exceeded 20 deg. C: 34/35
Max. Daily Temp. variation: 3.6 C
Mean Daily Temp variation: 2.5 C

Hop Brook (MA21-TBD) (Station HB)

Temperature Range: 17.2-28.5
Mean Temperature (3360 values over 35 days): 22.8
Avg. daily time MAX reached: 1600
Avg. daily time MIN reached: 0900
Avg. daily duration >20 deg. C: 18:45 hrs/day
days MAX >20 deg. C: 34/35
Max Daily Temp variation: 5.7 C
Mean Daily Temp variation: 3.5 C

Housatonic River (MA21-20) (Station 20A, Division St.)

Temperature Range: 19.6-31.0
Mean Temperature (2976 values over 31 days): 24.1
Avg. daily time MAX reached: 1500
Avg. daily time MIN reached: 0900
Avg. daily duration > 20 deg. C: 23.9 hrs/day
# of days MAX > 20 deg. C: 30/31
Max Daily Temp variation: 8.2 C
Mean Daily Temp Variation: 5.0 C

Housatonic River (MA21-19) (Behind HVA).

Temperature Range: 19.2-27.0
Mean Temperature (3360 values over 37 days): 22.3
Avg. daily time MAX reached: 1600
Avg. daily time MIN reached: 1100
Avg. daily duration > 20 deg. C: 23.5 hours
# of days MAX > 20 deg. C: 33/35
Max Daily Temp variation: 3.5 C
Mean daily Temp Variation: 1.5 C

Table 4: Mean Daily Temperature Data at Four Locations in the Housatonic Watershed (7/25-8/28/2002)

Date	Hubbard Brook	Division Street	HVA	Hop Brook
07/25/02	22.93	23.76	22.62	20.73
07/26/02	21.73	22.40	21.86	19.74
07/27/02	21.47	21.83	21.26	19.32
07/28/02	21.55	22.01	21.47	19.87
07/29/02	23.16	23.76	22.81	21.97
07/30/02	24.26	24.51	24.40	23.58
07/31/02	24.54	24.89	24.69	23.92
08/01/02	24.96	25.38	25.34	24.74
08/02/02	24.47	24.96	25.42	24.22
08/03/02	24.10	25.46	23.94	22.73
08/04/02	24.70	25.78	24.93	23.62
08/05/02	24.98	26.03	25.86	24.53
08/06/02	23.47	23.88	23.94	22.74
08/07/02	21.45	22.44	21.87	20.60
08/08/02	20.88	22.46	21.75	19.99
08/09/02	20.36	22.37	21.46	19.61
08/10/02	20.87	22.55	22.28	20.47
08/11/02	21.84	23.47	23.37	21.81
08/12/02	22.86	24.46	24.38	23.05
08/13/02	23.67	25.24	25.16	23.95
08/14/02	24.32	25.80	25.88	25.00

Date	Hubbard Brook	Division Street	HVA	Hop Brook
08/15/02	24.68	25.83	26.16	25.43
08/16/02	25.23	25.90	26.30	25.85
08/17/02	25.13	26.42	26.33	26.13
08/18/02	25.16	26.56	26.41	26.10
08/19/02	24.44	25.79	26.33	25.41
08/20/02	22.88	24.32	25.00	23.50
08/21/02	21.49	23.49	23.47	22.22
08/22/02	20.86	22.20	23.18	21.14
08/23/02	21.08	22.26	22.40	20.96
08/24/02	19.30	20.49	20.68	18.74
08/25/02	19.04		20.09	18.78
08/26/02	19.33		21.50	19.58
08/27/02	20.17		22.03	20.29
08/28/02	19.67		21.73	19.64

Analysis of 2002 Housatonic Watershed Continuous Temperature Data

The summer of 2002 was noteworthy for its lack of rain. Drought conditions plagued the watershed for almost the entire summer. Decreased in-stream flows can exacerbate already elevated in-stream water temperatures. Lower water levels can expose more of the substrate to warm summer air temperatures and solar radiation. Decreases in cold ground water infiltration can also accompany the drought conditions noted in the watershed.

It is noteworthy that the data for Hop and Hubbard Brooks do not seem to support the temperature criteria for cold water fishery designation; mid-late summer continuous temperatures indicates that temperatures generally exceeded 20 deg. C. in both waterbodies.

Although similar diurnal fluxes in water temperature may be seen in both the EPA/Woodlot data and the DWM data, a direct comparison between these two data sets cannot be made. The Woodlot data was collected a year earlier than the DWM data. Also, the closest Woodlot station is 13 miles from the nearest DWM station.

Precipitation and discharge at Division Street, Great Barrington
The temperature sensor station at the Housatonic River, Division Street location was approx. 150' upstream from the USGS Division Street stream gage (Gage # 01197500). See Figure 7.

The closest known precipitation station, located in Pittsfield, MA, and is more than 20 miles upstream from the Division Street sensor station. In general, daily rainfall amounts in the summer of 2002 were low and localized. There are several impoundments between the rainfall gauge and the most upstream sensor station. The rainfall data shows very little relationship to the stream flow at the gage. For example, the 0.55" rain event recorded in Pittsfield on August 13, 2002 shows no impact upon the gage reading. This may be because of the several impoundments between the rainfall event and the gage.

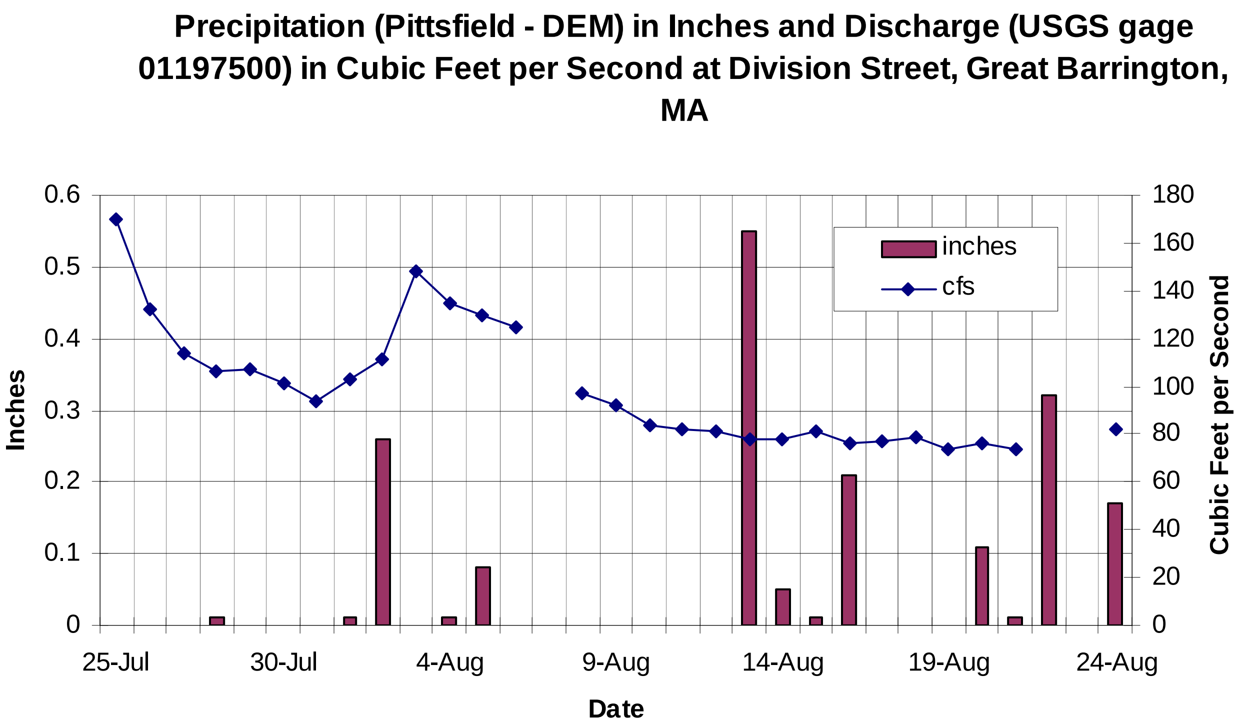


Figure 7: Representative river flow and precipitation data in the area

Fishery Status
While the actual presence of cold water fish can be the most important factor in determining fishery status, habitat-related information, such as temperature data, are also important. Such habitat assessment is especially relevant when the fish surveys indicate little or no use by cold water species, which can be due to a number of factors, including lack of woody debris and cover, elevated temperatures and poor water quality.

The most recent fish population surveys performed by MassDEP/DWM in the project area were in 2002. A station was established on Hop Brook 3.7 miles upstream of the Hop Brook temperature sensor location. The DWM fish population survey (conducted on 20 August 2002) revealed in an in-stream fish community dominated by blacknose and longnose dace. However, five brown trout and one eastern brook trout (obligatory cold-water species) were also captured. In 1998 Massachusetts Division of Fish and Game (MA DFG) collected similar species at this location, and classified this stream as a Cold-Water Fishery.) A station sampled by both groups was located upstream from Merry Brook (Lat: 41.14.51 / Lon: 73.12.24), behind the firehouse in Tyringham. Hop Brook changes dramatically after the confluence with Merry Brook. The gradient disappears as the stream enters the flood plain of the Housatonic River. Also, there is a lack of trees along the banks that could provide shading. These two factors may increase water temperature. The upstream fish population data and the downstream temperature data indicate that Hop Brook might be more accurately classified as a warm water fishery below the confluence with Merry Brook.

The fish population of Hubbard Brook was sampled by MA DFG in 1987, and is classified as a Cold Water Fishery. Although fishery classification involves several factors (most of which concerns the presence / absence of multiple age classes of cold water fishes), the temperature data recorded in this study would support a warm water fishery designation. It may be the case that the fish population survey was performed upstream from the location of the temperature sensor. If so, then Hubbard Brook could be bifurcated into cold water and warm water sections. A return to Hubbard Brook to determine if cold-water species are reproducing throughout the length of the stream would yield more conclusive information.

Quality Control Data

Based on *in-situ*, side-by-side QC checks at deployment and upon retrieval, the data generally met project data quality objectives for temperature and time logging, with minor exception as explained below. At deployment, each logger was within 0.1 deg. C (+/-) of the NIST-traceable hand-held unit. Sensor #2 (Station 20A), however, was only within about 0.25 deg. C. Although the digital precision thermometer was not available at retrieval, QC temperature checks were performed when each logger was re-deployed at other locations within the following week.

Table 5: QC Accuracy Check Data Using Precision NIST-Traceable Thermometer

Sensor #	Station Name	Date	Time	Stowaway Logger Temp (deg. C)	NIST-Traceable Temp (deg. C)	Range
1	Hubbard Brook	7/24	10:35	22.7 *	22.75	0.05
1		*9/5*	*11:30*	*17.58*	*17.45*	*0.13*
2	Housatonic River (20A)	7/24	11:20	24.29	24.03	0.26
2		8/29	14:30	21.23	21.45	0.22
3	Housatonic River	7/24	12:35	22.82	22.93	0.11
3		8/29	14:00	15.66	ND	NA
3		*9/5*	*12:37*	*18.38*	*18.36*	*0.02*
4	Hop Brook	7/24	13:15	22.14	22.18	0.04
4		*9/5*	*12:22*	*25.06*	*25.04*	*0.02*

* interpolated between 15 minute interval readings
ND = No Data
NA = Not Applicable
Italics = upon re-deployment at other sites

Preliminary Hydrolab® temperature data shown below in Table 6 were similar to those obtained from the Stowaway® temperature loggers.

Table 6: Hydrolab® temperature data (for comparison)

Station	Date	Hydrolab (temp and time)	Stowaway (temp and time)
Hubbard Brook	7/30/02	23.98 01:02	23.84 00:57
Housatonic River (20A)	7/30/02	23.96 02:47	23.61 02:42
Hop Brook	7/30/02	22.93 04:42	22.82 04:42

SOP Development for Continuous Temperature Monitoring

Experience gained during this monitoring project (and review of similar-type projects) helped to formulate standard operating procedures (MassDEP 2002) and guidance for DWM's deployment and use of continuous temperature loggers, including analysis of the data. Important considerations for future use of continuous temperature loggers include:

1. Target sampling period consistent with project objectives. For example, if interested in maximum mean monthly temperature(s), deploy sensors long enough to estimate the statistic, and during "worst-case" months (July through August-September) when daytime air temperatures are highest and flows lowest.

2. When evaluating thermal impacts from a discharge, deploy a sufficient number of properly-placed sensors to be able to draw conclusions. Ensure that upstream and downstream sensors are spaced as close as possible (outside mixing zones) to minimize effects of natural heat gain, which complicate the analysis.

3. Perform adequate quality control procedures to increase confidence in the data. Consider duplicate (side-by-side) sensors to better estimate instantaneous mean temperatures for each location (and to estimate sampling precision), as well as more frequent QC accuracy checks using high-quality, NIST-certified/traceable thermometer(s).

4. When analyzing the data, use appropriate tools and data sets based on project objectives and the results of QC sampling. Statistical estimates, such as means, medians and maximums, may vary greatly depending on what data is used. Perform adequate data validation prior to analysis to ensure data is usable.

5. Apply adequate attention to sensor placement at all locations. Loss of data from one sensor, due to vandalism, poor placement or other problem, may seriously compromise project objectives.

6. Provide sufficient time for project documentation (e.g., to prepare the project QAPP, fill out continuous temperature monitoring fieldsheets, report data in a detailed, organized manner, etc.) and for proper implementation of SOP(s). Use of continuous temperature sensors should follow adopted SOPs, but may not require a dedicated QAPP (although it should be discussed in a watershed-based monitoring QAPP, if applicable).

7. Perform standard data management and analysis procedures for continuous temperature data, in order to streamline and focus the reporting of results. Provide validated data to the DWM database manager in an acceptable format (ASCI, comma-delimited, Excel or Access), so that data can be stored and provided to users, including EPA (STORET).

8. Although some projects may require specific data analyses, calculate the following baseline statistics for each location. When comparing upstream-downstream locations, use time-shifts as appropriate to account for time-of-travel between locations (measured or estimated):
    a. monthly (and overall) mean temperature,
    b. daily mean temperature,
    c. maximum and minimum overall temperature,
    d. average daily duration > 20° C,
    e. average daily duration > 28.3° C. (and other "thresholds" as applicable)
    f. T-test for statistically-significant differences in means (as applicable; e.g. mean daily temperatures upstream/downstream of a discharge), and
    g. instantaneous "delta T"s (temperature changes) from one location to another (if applicable).

SUMMARY AND RECOMMENDATIONS

1. Based only on the continuous ("worst case") temperature data collected in this study, it appears that Hubbard Brook (Segment MA21-15) and Hop Brook at Meadow St. (MA21-TBD) would not support CWF designations (subject to additional considerations). These data should be shared with MA DFG to assist in making informed decisions regarding CWF/WWF classifications.

2. Consideration should be given to creating two separate stream segments for Hop Brook, split at the Merry Brook confluence. The upstream segment may be more accurately classified as a CWF, while the downstream segment a WWF. A similar strategy could be applied to Hubbard Brook.

REFERENCES

USGS. 2000. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, WRIR 00-4252

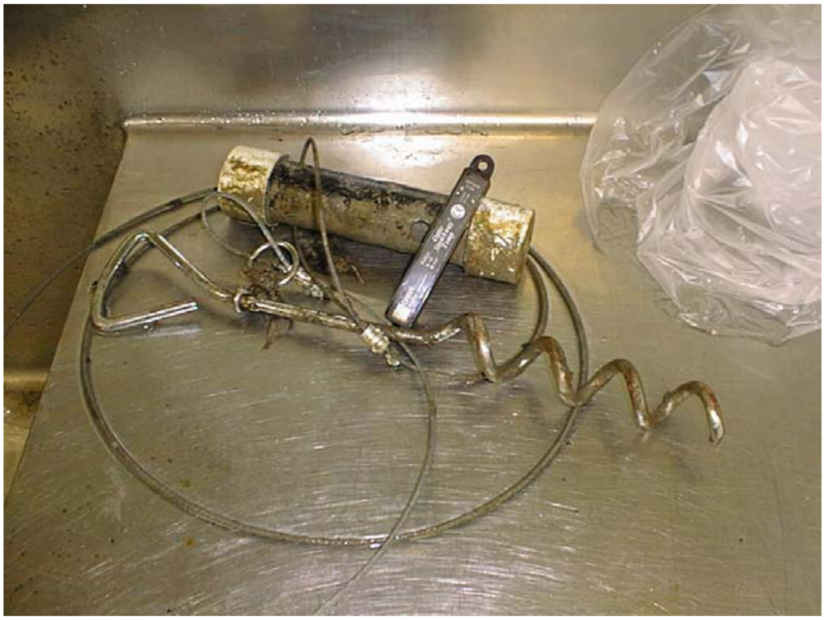
Kennedy, L.E. and M.J. Weinstein. 2000. *Housatonic River Basin 1997/1998 Water Quality Assessment Report.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

Idaho Division of Environmental Quality. 1999. Protocol for Placement and Retrieval of Temperature Data Loggers in Idaho Streams. Report#10

Oregon Dept. of Environmental Quality. 2002. Consolidated Assessment and Listing Methodology for Oregon's Draft 2002 303(d) List and 305(b) Report, Draft

MassDEP. 2002. Standard Operating Procedure for Continuous Temperature Monitoring. CN 103.0. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Appendix A: Temperature Logging Equipment



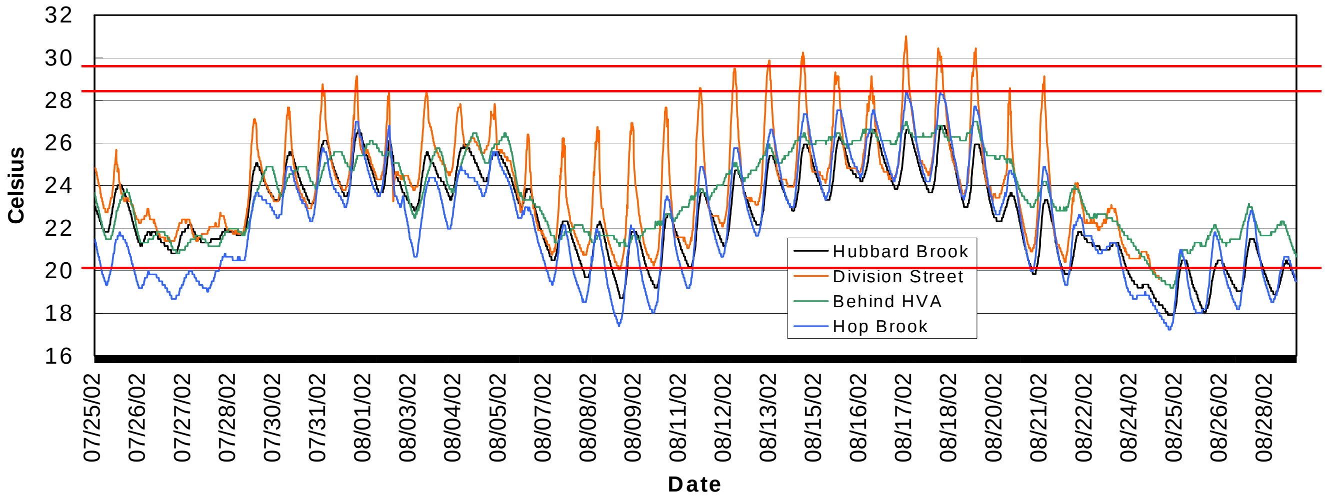
Stowaway sensor, plastic tube and cable/anchoring assembly shown.

Optic Stowaway Temp Specifications: (as provided by Onset Computer Corp.)

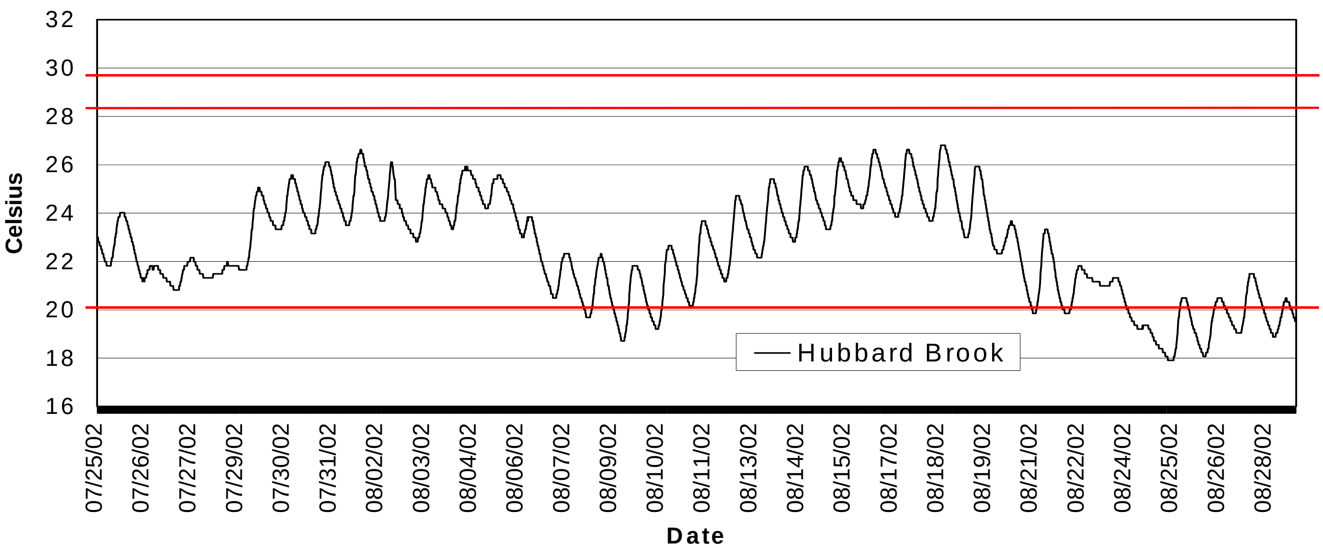
- ◇ *Accuracy* (maximum measurement error, including thermistor error, resistor value errors and quantization errors) for –5 to 37 deg. C unit: 0.2 deg. C at ambient temps of 10-30 deg. C
- ◇ *Resolution* for –5 to 37 deg. C unit: 0.15 deg. C at ambient temps of 10-30 deg. C
- ◇ *Depth Resistance*: >100 feet
- ◇ *Battery Life*: 10 years, but depends on how used…
- ◇ *Time Error*: Up to one hour per year
- ◇ *Storage*: About 82 days of data storage is available using a sensor reading interval of 15 minutes (8K sensor).

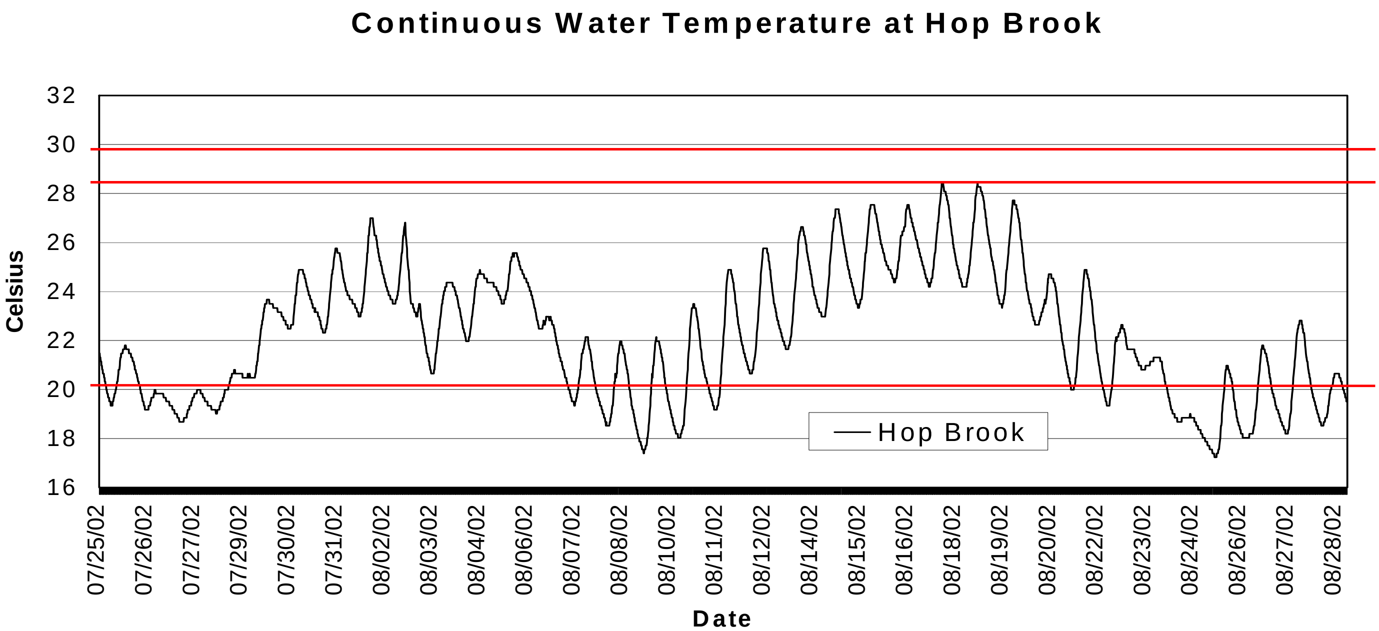
Appendix B: Temperature Data Graphs

Continuous Temperature Data from Four Locations in the Housatonic Watershed



Continuous Water Temperature at Hubbard Brook




Continuous Water Temperature at Hop Brook
Celsius
32
30
28
26
24
22
20
18
16
Hop Brook
07/25/02
07/26/02
07/27/02
07/29/02
07/30/02
07/31/02
08/02/02
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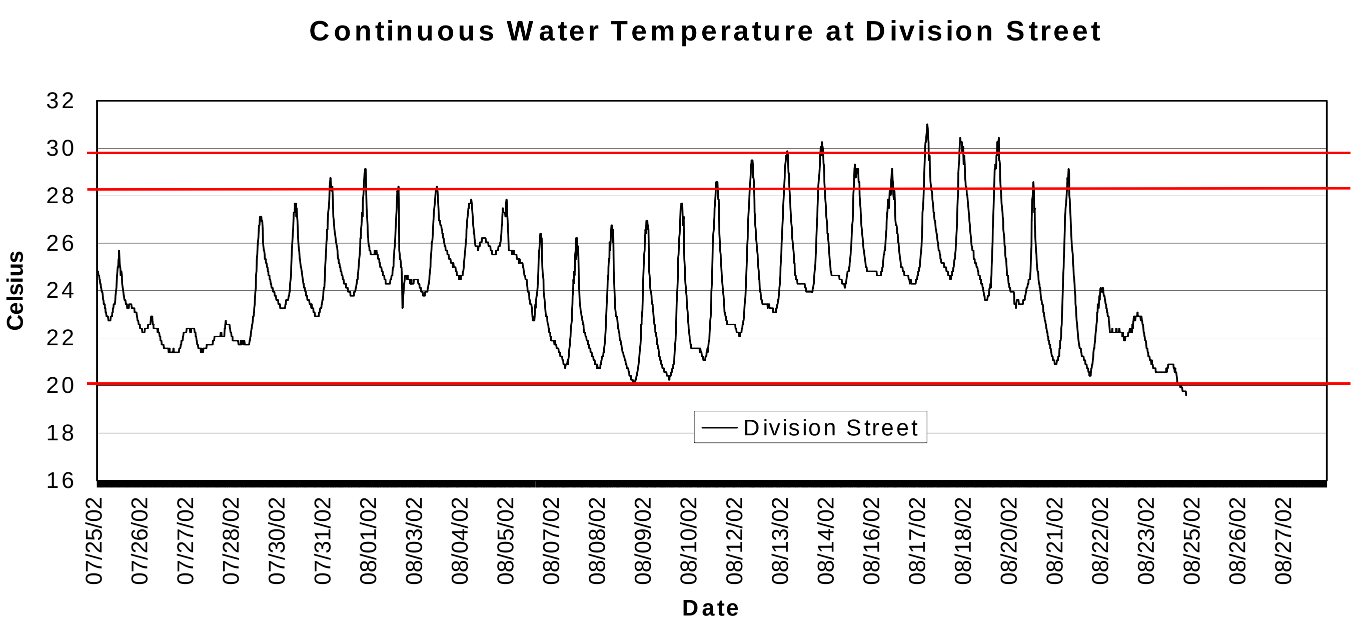
08/28/02
Date


Continuous Water Temperature at Division Street
Celsius
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24
22
20
18
16
Division Street
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07/27/02
07/28/02
07/30/02
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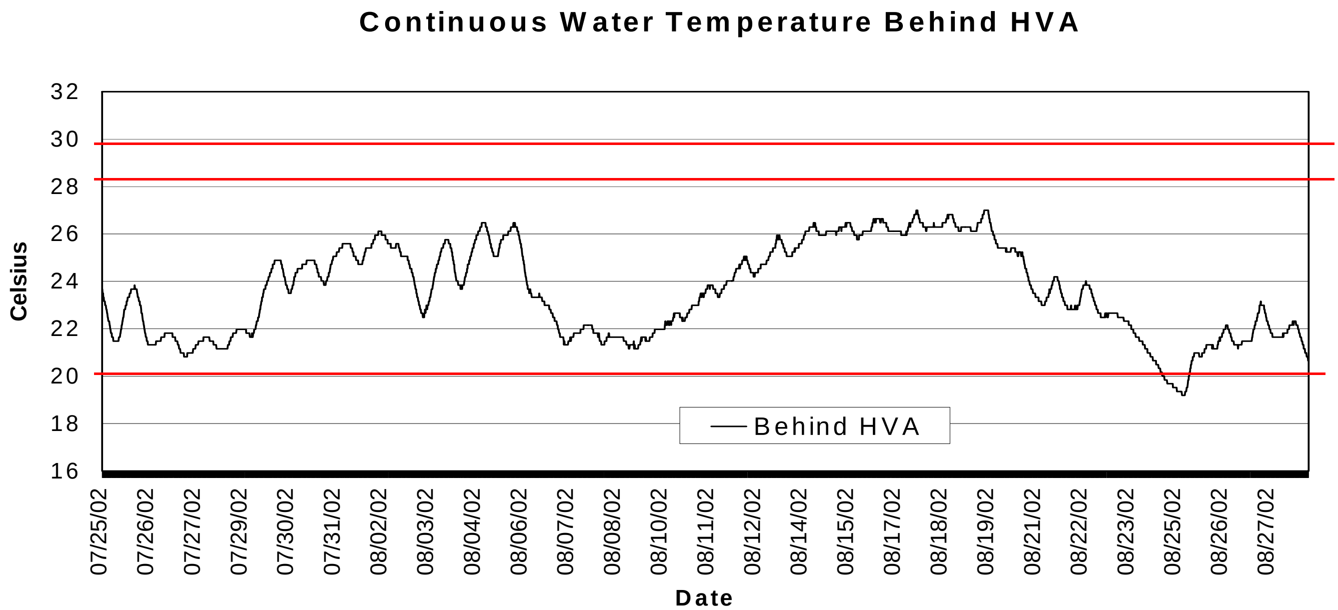
Date


Continuous Water Temperature Behind HVA
Celsius
32
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24
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16
Behind HVA
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07/26/02
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07/29/02
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08/02/02
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08/27/02
Date

APPENDIX I

Division of Watershed Management

Housatonic River Watershed
Year 2002 Water Quality Monitoring Survey

Results of Optical Brightener Sampling

DWM Control Number CN 197.7

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
Division of Watershed Management
Glenn Haas, Director

March, 2006

INTRODUCTION

Optical brighteners are added to laundry detergents to enhance the brightness of colors. They readily adsorb to fabrics particularly cotton. Also referred to as fluorescent whitening agents (FWA's), the optical brighteners are excited by near-ultraviolet (UV) wavelengths (360-365 nm), but they release light in the "blue range" (400-440 nm) (Hagedorn et al. 2005). Optical brightener testing is a way of determining whether or not laundry detergents are entering a waterbody either through a direct discharge or after traveling through the ground from a poorly functioning Title V septic system. The method is being used as a screening tool by MassDEP to identify waterbodies with elevated bacterial counts from human sources (septic systems or cross connections) as opposed to those with bacteria contributed by other warm-blooded animals, domestic or wild. Samples collected from a stream or a pipe are likely to contain human waste if the sample, when held under a UV lamp, gives off a bright, somewhat blue, glow indicating that FWA's are present.

Optical brightener samplers were deployed at two tributaries to the Housatonic River - Goose Pond Brook and Green Water Pond Brook during the 2002 surveys. Station locations and sampling dates are presented in Table 1. Goose Pond Brook was listed in the 1998 303d list of impaired waterbodies for pathogens based on elevated bacterial counts at Goose Pond Brook in 1997 (MassDEP 2000). Upstream sources for the bacteria, which could include its tributary Green Water Pond Brook, were not identified at that time, so sampling in 2002 focused on separating the influence of these two brooks on elevated bacterial counts. Optical brightener sampling was done along with bacterial sampling to try to identify areas where humans might be the source of contamination.

MATERIALS AND METHODS

Optical brightener samplers were composed of unpolished cotton pads that were held upright on a cement block by wire screening. The pads were deployed in-stream and left for a day or two. Following retrieval of the cement block, the pads are removed from the screening, swirled around in the ambient water and placed in a plastic bag. The cotton pads were transported to the lab at DWM-CERO in Worcester for analysis. Light exposure was kept at a minimum to reduce the effect of photodegradation on the optical brighteners. The pads were removed from the plastic bags and hung up to dry. Once dry, the pads were read using a lamp equipped with a long-wave ultraviolet bulb that causes any optical brighteners absorbed to the pads to glow; if the pads were negative for optical brighteners they would appear as dull white surfaces.

RESULTS

Results of the optical brightener sampling are presented in the Table 1. Only the sample collected in September from Greenwater Pond Brook was positive for optical brighteners.

Table 1. Housatonic River Basin - Optical Brightener Sampling - July and September 2002					
Station Number	Location	Dates Deployed	Result	Dates Deployed	Result
07A	Goose Pond Brook, Forest Street, Lee, MA	7/29-7/31	Negative	9/23-9/25	Negative
07A	(Duplicate)	7/29-7/31	Negative	9/23-9/25	NT*
07B	Goose Pond Brook Tyringham Road Lee, MA	NT*	NT*	9/23-9/25	Negative
GWPB	Green Water Pond Brook, Forest Street, Lee, MA	7/29-7/31	Negative	9/23-9/25	Positive
Blank	--	7/31	Negative	9/23-9/25	Negative

*NT – not tested

DISCUSSION

Green Water Pond Brook at GWPB had the highest bacterial counts of the three optical brightener sampling stations in 2002. The *Escherichia coli* counts ranged from 70 to 140 cfu/100 ml (n=5) over May to September 2002, while the two Goose Pond Brook stations had *E. coli* values of <10 to 60 cfu/100 mL (n=7) (Mitchell 2005). Neither of these waterbodies, however, exhibited counts that would cause them to lose their most sensitive use for Class B waters, (i.e., primary contact recreation) (MassDEP 1996).

The only positive sample for optical brighteners was collected on September 25, 2002 at Green Water Pond Brook. This is an indication that material from a septic system may have been reaching the Brook. Materials other than laundry detergents may also cause positive results for FWA's. These include metal particles, bleached materials, cotton dust, or paper products. It is important that the unbleached cotton pads are not exposed to these contaminants via aerial deposition or by physical contact, such as placing the pad down on paper, particularly if either is wet, and allowing the optical brighteners to leach out. The lack of elevated bacterial counts at the sampling station could indicate that the source of the optical brighteners (and bacteria) was a considerable distance from the sampling station or that the discharge of bacteria occurred sometime earlier. At this time more bacterial and optical brightener data would need to be collected to prove or disprove the presence of a human source.

Additional sampling is still needed to determine if Goose Pond Brook could be taken off of the Section 303(d) List or if the actual impaired status could be applied only to Green Water Pond Brook. The low bacterial counts obtained in 2002 are an indication that something was mitigating the sources of bacterial contamination that led to the 1998 listing decision. It is also possible that the lack of precipitation that occurred during July, August and September 2002 in the Housatonic River Basin (Mitchell 2005, USGS 2003) may have lowered groundwater levels enough to keep problem septic systems from affecting surface waters.

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Mitchell, P. 2005. *DRAFT Technical Memorandum TM-21-6 Housatonic River Watershed DWM 2002 Water Quality Monitoring Data.* Massachusetts Division of Watershed Management. Department of Environmental Protection. Worcester, MA.

USGS 2003. *MA Drought Index Maps*. http://ma.water.usgs.gov/drought/drought_index.htm.

APPENDIX J
SUMMARY OF NPDES AND WMA PERMITTING INFORMATION
HOUSATONIC RIVER BASIN

Table J1. Water Management Act (WMA) Registration/Permittees Housatonic River Watershed.							
Permit	Registration#	Water Supply System Name	Registered Volume (MGD)	Registered Withdrawal (Days)	20 Year Permitted Volume (MGD)	Permit Withdrawal (Days)	Segment
	10223602	Berkshire Hills Country Club	Found to be below WMA threshold of 0.1 MGD.				MA21-02 subwatershed
	10211302	Berkshire National Fish Hatchery	0.25	365	0	0	MA21-25
9P210223602		Bousquet Ski Area	0	0	0.25	120	MA21-04
9P210211302	10211304	Butternut Basin Ski Area	0.43	120	0.27	120	MA21-20
	10207002	Crane & Company, Inc.	2.97	365	0	0	MA21-02
	V10215202	Cranwell Conference Center, Inc.	0.02	153	0	0	MA21-19
	10207003	Dalton Fire District	0.67	365	0	0	MA21-10, MA21-11, and MA21119
9P210211301	10211303	Fox River Paper Company	1.04	365	0.46	365	MA21-20
	10211301	Great Barrington Fire District	1.09	365	0	0	MA21-23 and East Mountain Reservoir near MA21-20
9P210213201		Hinsdale Water System	0	0	0.29	365	Belmont Reservoir near MA21-01
	10211306	Housatonic Water Works Company	0.27	365	0	0	MA21062 (upstream of MA21-14)
9P210215004		Lane Construction Company	0		1.3	210	MA21-19
	10214801	Lanesborough Village Water District	0.21	365	0	0	Tributary to MA21083
9P210215003	10215003	Lee Water Department	1.13	365	0	365	MA21-19
	10215201	Lenox Water Department	0.76	365	0	0	MA21-06
	10219301	Lowland Farm	0.04	153	0	0	Tributary to MA21-25
9P10215001	10215001	MW Custom Papers, LLC - Specialty Div.	2.21	365	1.61	365	MA21-19
	10223603	Pittsfield Country Club	0.12	214	0	0	MA21071 (upstream of 21-04)
9P10223601		Pittsfield Generating Company, LP.	0		1.58	365	MA21-02
	10223601	Pittsfield Water Department	13.5	365	0	0	MA21003, MA21033, MA21113, MA21019 and other reservoirs
9P210215002	10215002	Schweitzer Mauduit International, Inc.	6	365	0	365	MA21-19, MA21057
	10226701	Sheffield Water Company	0.13	365	0	0	Tributary to MA21-20
	10228301	Stockbridge Water Department	0.29	365	0	0	MA21006 (upstream of MA 21-29)
	10207001	Wahconah Country Club	Found to be below WMA threshold of 0.1 MGD.				MA21-08

Table J2. Housatonic River Basin Municipal and Sanitary Surface Wastewater Discharges

PERMITTEE TOWN OF GREAT BARRINGTON WWTF	NPDES # MA0101524	SEGMENT MA21-20

The Town of Great Barrington is authorized (May 2000) to discharge a flow of 3.2 MGD (average monthly) of treated sanitary and industrial wastewater from the Great Barrington Waste Water Treatment Facility (WWTF) via Outfall# 001 to the Housatonic River. A draft permit has recently been developed for this facility (public comment period through November 2006).

This conventional activated sludge facility incorporates primary sedimentation, aeration, secondary sedimentation, and disinfection. It should be noted that the secondary sludge is co-thickened in the primary settling tanks and the resulting settled sludge is then sent to gravity thickeners for additional thickening. The thickened sludge is then sent to belt-filter presses for dewatering and ultimate disposal of the sludge cake is incineration by a private contractor. Currently, the total phosphorus concentration in the effluent (April 1 to October 15, 1.0 mg/L average monthly permit limit) is low enough where chemical addition is not performed but is available if needed. Disinfection is performed by the addition of sodium hypochlorite and dechlorination is carried out by the addition of sodium bisulfite (Drumm 2005).

The pH (6.5 to 8.3 SU limits) of the effluent between June 2000 and March 2006 (n=24) ranged from 7.2 to 8.2 SU (TOXTD database). The ammonia-nitrogen concentration of the effluent between June 2000 and March 2006 (n=24) ranged from 0.18 to 14.0 mg/L (TOXTD database). The total residual chlorine (TRC) (April 1 to October 15, 0.135 average monthly and 0.234 maximum daily limits) of the effluent between June 2000 and March 2006 (n=23) ranged from < 0.01 to 0.06 mg/L (TOXTD database). The facility is required to conduct quarterly whole effluent toxicity tests using *Ceriodaphnia dubia* as the test species. The permit limits for whole effluent toxicity are $LC_{50} \geq 100\%$ and C-NOEC (report only). Other permitted parameters include Biochemical oxygen demand (BOD), Total Suspended Solids (TSS), fecal coliform bacteria and Settleable Solids.

Chemistry-water

Hardness: The hardness in the river water between June 2000 and March 2006 (n=24) ranged from 94 to 180 mg/L (TOXTD database).

PERMITTEE GOULD FARM	NPDES # MA0022705	SEGMENT MA21-25

Gould Farm, Monterey, MA (MA0022705) is authorized (August 1975) to discharge a flow of 0.012 MGD (average monthly) of sanitary treatment plant effluent from their facility via Outfall# 001 to Rawson Brook. The facility is a small residential psychological rehabilitation facility with about 100 residents and staff. Wastewater is currently collected in a series of three lagoons. There is no aeration or any additional treatment in the lagoons other than natural biological processes. Chlorine is added to the discharge just prior to discharge for disinfection. The operator manually adjusts the chlorine dosing based on the results of the bacteria sampling. The facility needs to have better control of their chlorine residual. TRC in January 2006 was reported as high as 4.26 mg/L. Although the facility is exploring a groundwater discharge, EPA will be drafting a new permit for this facility.

PERMITTEE LAKESIDE CHRISTIAN CAMP	NPDES # MA0028410	SEGMENT MA21-17

Lakeside Christian Camp (MA0028410) is located in Pittsfield, MA. A letter dated April 20, 1999 from Olga Vergara at EPA addressed to Mark Watkins, Executive Director, Lakeside Christian Camp states that since the Northeast Baptist Conference is connected to the Pittsfield Sewer System, then there is no longer a need for the NPDES permit. The permit was terminated.

PERMITTEE **TOWN OF LEE WWTF**	NPDES # **MA0100153**	SEGMENT **MA21-19**

The Town of Lee is authorized (MA0100153 issued in September 2000) to discharge a flow of 1.0 MGD (rolling annual monthly average) of treated sanitary effluent from an extended aeration wastewater treatment facility via Outfall# 001 to the Housatonic River. In 2002 a phosphorus reduction system was installed (Zerbato 2005). Total phosphorus (May 1 to October 31, 1.0 mg/L average monthly limit) is reduced by the addition of commercial alum prior to secondary sedimentation (Zerbato 2005). Disinfection is accomplished by the addition of gaseous chlorine. Currently, this facility does not serve any industrial users (Zerbato 2005). An upgrade to this facility is in process. The upgrade will increase the annual average daily design flow from 1.0 MGD to 1.25 MGD. Treatment will be accomplished by a sequencing batch reactor. The facility design kinetics anticipated a future NPDES permit that will require nutrient removal so the total phosphorous design effluent quality objective is 0.2 mg/l and total nitrogen is 6.0 mg/l.

The pH (6.5 to 8.3 SU limits) of the effluent between February 2000 and March 2006 ranged from 6.7 to 7.6 SU (n=23)(TOXTD database). The ammonia-nitrogen concentration of the effluent between February 2000 and March 2006 ranged from <0.1 to 24.6 mg/L (n=23)(TOXTD database). The TRC (limits are April 1 to October 31, 0.3 mg/L average monthly and 0.51 mg/L maximum daily) of the effluent between February 2000 and March 2006 were all < 0.05 mg/L except for two measurements (n=23). None of the reported measurements exceeded permit limits(TOXTD database). The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ tested four times per year using *Ceriodaphnia dubia.* Other permitted parameters include BOD, TSS, and fecal coliform bacteria.

Chemistry-water

Hardness: The hardness in the river water between February 2000 and March 2006 ranged from 95 to 184 mg/L (n=23)(TOXTD database).

PERMITTEE **TOWN OF LENOX WWTP**	NPDES # **MA0100935**	SEGMENT **MA21-19**

The Town of Lenox is authorized (MA0100935 issued in November 2001) to discharge a flow of 1.19 MGD (rolling annual monthly average) of treated effluent from an extended aeration activated sludge wastewater treatment plant (WWTP) via Outfall# 001 to the Housatonic River. This facility currently uses gaseous chlorine for seasonal disinfection. Between May 1 and October 31, total phosphorus (1.0 mg/L limit) is reduced by the addition of alum at the effluent of the aeration system (White 2005).

The pH (6.5 to 8.3 SU limits) of the effluent between March 2002 and March 2006 ranged from 7.4 to 7.8 SU (n=17)(TOXTD database). The TRC (permitted April 1 to October 15, average monthly is 0.3 mg/L and maximum daily is 0.51 mg/L) in the effluent between March 2002 and March 2006 were all <0.05 mg/L (n=17)(TOXTD database). The ammonia-nitrogen concentrations in the effluent ranged from less than 0.1 to 11 mg/L. The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ effluent using *Ceriodaphnia dubia* and *Pimephales promelas* as test species on a quarterly basis. Other permitted parameters include BOD, TSS, fecal coliform bacteria and report only for ammonia-nitrogen, TKN, total nitrite and total nitrate.

Chemistry-water

Hardness: The hardness in the river water between March 2002 and March 2006 ranged from 93 to 161 mg/L (n=17)(TOXTD database).

PERMITTEE **TOWN OF LENOX ROOT RESERVOIR WATER TREATMENT FACILITY**	NPDES # **MAG640015**	SEGMENT **MA21094 upstream of MA21-06**

The Town of Lenox Root Reservoir Water Treatment Facility is authorized (MAG640015 issued in April 2001) to discharge 0.012 MGD (average monthly) to Lenox Mountain Brook from their facility located at 471 Reservoir Road in Lenox.

PERMITTEE	NPDES #	SEGMENT
CITY OF PITTSFIELD WWTF	**MA0101681**	**MA21-04**

The City of Pittsfield is authorized (MA0101681 issued in October 2000) to discharge a flow (17.0 MGD average monthly and 28.7 MGD maximum daily limits – rolling annual monthly average) of treated effluent from the advanced wastewater treatment facility (WWTF) via Outfall# 003 to the Housatonic River. Outfall# 001 and Outfall# 002 have not been used since 1974 and 1977, respectively. In 2005 the WWTF upgraded the primary digester by installing a new tank cover. The WWTF unit processes include primary clarification, trickling filters, intermediate clarification (not used), aeration, secondary clarification, chlorination and dechlorination. Sodium aluminate can be added at the head of aeration to reduce the total phosphorus concentration (April 1 to 30, 2.0 mg/L – May 1 to August 30, 1.0 mg/L – all limits are average monthly). A gravity-belt thickener thickens the secondary sludge. Primary sludge and thickened secondary sludge are digested in anaerobic digesters and dewatered with belt-filter presses. The resulting sludge cake is hauled to an incineration facility in Connecticut (Landry 2005). This facility has the ability to add caustic soda for pH control during nitrification. In 2003 the WWTF staff discontinued the use of gaseous chlorine and installed a sodium hydroxide system for disinfection (Landry 2005). Dechlorination is accomplished by the addition of sodium bisulfite.

The ammonia-nitrogen concentration of the effluent (April 1 to 30, 10 mg/L – May 1 to 31, 5.0 mg/L – June 1 to September 30, 1.0 mg/L – all limits are average monthly) between April 2000 and March 2006 ranged from <0.03 to 0.320 mg/L (n=25)(TOXTD database). The pH of the effluent (6.5 to 8.3 SU limits) between April 2000 and March 2006 ranged from 7.4 to 7.6 SU (n=16)(TOXTD database). The TRC of the effluent (April 1 to October 15, 0.0216 mg/L average monthly and 0.0374 mg/L maximum daily limits) between April 2000 and March 2006 were all below the minimum quantification limit of < 0.05 mg/L (n=25)(TOXTD database). The facility's chronic and modified acute toxicity limits are $LC_{50} \geq 100\%$ and C-NOEC is $\geq 50\%$ testing with *Ceriodaphnia dubia* four times per year. Other permitted parameters include: BOD, TSS, fecal coliform bacteria, effluent DO, and copper.

Chemistry-water

Hardness: The hardness in the river water between April 2000 and March 2006 ranged from 67 to 200 mg/L (n=25)(TOXTD database).

PERMITTEE	NPDES #	SEGMENT
PITTSFIELD ECONOMIC DEVELOPMENT AUTHORITY	**MA0040231**	**MA21-02 (Silver Lake)**

Pittsfield Economic Development Authority (PEDA) (MA0040231) has received the transfer of land and outfalls formerly permitted by the General Electric Company, Pittsfield (MA0003891 issued in May 1992). A letter addressed to EPA and MassDEP dated May 2005 from John Novotny, Facility Manager, GE Pittsfield Remediation Programs, states that a transfer of land and improvements including NPDES outfalls 001, 01A, 004, and MAR05A021 (YD3) to PEDA has occurred. A second letter dated June 2005 from Linda Murphy, Director of the Office of Ecosystem Protection co-addressed to Michael Carroll, Pittsfield Remediation Programs, General Electric Company, states that a new NPDES permit (File Number MA0040231) is for PEDA's outfalls 001, 01A*, and 004.

Outfall #001-for a maximum daily flow up to 2.55 MGD of non-contact cooling water and stormwater runoff into Silver Lake,

Outfall #004- for a maximum daily flow up to 2.09 MGD of contact and non-contact cooling water and stormwater runoff into Silver Lake,

*Outfall 01A is a stormwater bypass.

PERMITTEE TOWN OF STOCKBRIDGE WWTP	NPDES # MA0101087	SEGMENT MA21-19

The Town of Stockbridge is authorized (MA0101087 issued in September 2004) to discharge a flow of 0.3 MGD (rolling annual monthly average) of treated effluent from the wastewater treatment plant (WWTP) via Outfall# 001 to the Housatonic River. The WWTP, located on Route 102 – West Stockbridge Road in Stockbridge, only treats municipal wastewater and has recently been upgraded (Campetti 2005). The WWTP operates in the extended aeration mode using oxidation ditches and secondary clarification while ultraviolet light provides disinfection. Secondary sludge is thickened on-site using a rotary screen thickener. The thickened sludge is hauled to Fitchburg for disposal. Total phosphorus (May 1 to October 31, 1.0 mg/L limit) is reduced in the effluent by the addition of aluminum sulfate to the secondary clarifier distribution box (Campetti 2005).

The pH (6.5 to 8.3 SU limits) of the effluent between October 2004 and October 2005 ranged from 7.6 to 7.8 SU (n=3)(TOXTD database). The ammonia-nitrogen concentration of the effluent between October 2004 and October 2005 ranged from 0.20 to 0.24 mg/L (n=3)(TOXTD database). The facility's whole effluent toxicity limits are LC_{50} $\geq$50% using *Ceriodaphnia dubia* and *Pimephales promelas* tested two times per year. Other permitted parameters include: BOD, TSS, and fecal coliform bacteria.

Chemistry-water:
Hardness: The hardness in the river water between October 2004 and October 2005 ranged from 90 to 140 mg/L (n=3)(TOXTD database).

PERMITTEE TOWN OF WEST STOCKBRIDGE WWTP	NPDES # MA0103110	SEGMENT MA21-06

The Town of West Stockbridge is authorized (MA0103110 issued in December 2004) to discharge a 0.076 MGD (rolling annual monthly average flow) of treated effluent from the wastewater treatment facility located on Moscow Road, West Stockbridge, via Outfall# 001 to the Williams River. This advanced wastewater treatment facility utilizes rotating biological contactors (RBC) and anoxic reactors for ammonia-nitrogen reduction. The effluent from the RBC units is directed to a rapid mix tank followed by a flocculation tank where alum is added for total phosphorus reduction (May 1 to October 31, 0.5 mg/L limit). After secondary clarification, caustic soda can be added to a rapid mix tank followed by a flocculation tank for pH adjustment if necessary (Buffoni 2005). Disinfection is accomplished by ultraviolet light.

The ammonia-nitrogen concentration (limits are April 1 to 30, 10 mg/L and May 1 to October 31, 5 mg/L) in the effluent between April 1999 and April 2006 ranged from <0.07 to 4.44 mg/L with the exception of the March 2001 test where the concentration was reported as 25.1 mg/L (n=22)(TOXTD database). The pH (6.5 to 8.3 SU limits) of the effluent between April 1999 and April 2006 ranged from 6.9 to 8.0 SU (n=22)(TOXTD database). The facility's whole effluent toxicity limits are LC_{50} $\geq$100% effluent using *Ceriodaphnia dubia* on a quarterly basis. The use of *Pimephales promelas* as a second test species was discontinued with the issuance of the December 2004 permit. Other permitted parameters include: BOD, TSS, fecal coliform bacteria, effluent DO, and report only for TKN, nitrite-nitrogen, and nitrate-nitrogen.

Chemistry-water
Hardness: The hardness in the river water between April 1999 and April 2006 ranged from 85 to 282 mg/L (n=23)(TOXTD database).

Table J3. Housatonic River Basin Commercial and Industrial Surface Wastewater Discharges

PERMITTEE BERKSHIRE NATIONAL FISH HATCHERY	NPDES # Not currently applicable	SEGMENT MA21-25
In September 1999 Hampshire College and the Western Massachusetts Center for Sustainable Aquaculture (WMCSA) reopened the Berkshire National Fish Hatchery in the village of Hartsville, New Marlborough, MA, for aquaculture and environmental education and research. Presently ten 3,500-gallon fish tanks have been refurbished and are operational (several tanks are stocked with Atlantic salmon, rainbow and brown trout brood stock) and the egg hatch house has been retrofitted with new equipment for hatching rainbow and brown trout. This facility currently does not have an NPDES permit since their average annual production is approximately 2,000 lbs/year (Emmons and Bouchard 2006). The permitting threshold is 20,000 lbs/year (314 CMR 3.16). The Berkshire National Fish Hatchery was previously authorized (MA0005401) to discharge effluent from their facility to the Konkapot River. In August 1981 EPA terminated the individual NPDES permit. The facility was closed down in 1994.		

PERMITTEE CRANE & COMPANY, INC. WWTP	NPDES # MA0000671, MAG250956, and MAG250955	SEGMENT MA21-02
Crane and Company, Inc. is authorized (MA0000671 issued in September 2000) to discharge, from the company-owned and operated wastewater treatment facility (WWTF), treated industrial wastewater via Outfall# 001 to the East Branch of the Housatonic River. This WWTF receives flow from all 6 company-owned facilities (Noel 2005). The WWTF design incorporates a conventional activated sludge process with chemically enhanced influent pH adjustment and solids flocculation for increased solids removal in primary treatment. Sulfuric acid and sodium hydroxide are used for pH control and solids flocculation is assisted by polymer addition (either spent or virgin). The primary and secondary sludge co-settle in the primary settling units. This facility is not required to perform disinfection. Sludge is dewatered on-site and the resulting product is sent to the Springfield Regional WWTF for final treatment (Noel 2005). All sanitary wastewater is conveyed via the Dalton Sewer System to the Pittsfield WWTF. The pH (6.5 to 9.0 SU limits) of the effluent between May 2000 and January 2006 ranged from 6.8 to 8.3 SU (n=23)(TOXTD database). Total phosphorus (1.0 mg/L limit) is reduced during the treatment process by physical and chemical precipitation. The ammonia-nitrogen concentration in the effluent between May 2000 and January 2006 ranged from 0.1 to 26.0 mg/L (n=23)(TOXTD database). The facility's whole effluent toxicity limits are $LC_{50} \geq 100\%$ effluent and the CNOEC $\geq$ 63% effluent using *Ceriodaphnia dubia* on a quarterly basis. Other permitted parameters include: BOD, TSS, total aluminum, total copper, effluent DO, flow, and total nitrogen. <u>Chemistry-water</u> *Hardness:* The hardness in the river water between May 2000 and January 2006 ranged from 39 to 152 mg/L (n=22)(TOXTD database). **<u>MAG250956</u>** was issued in September 1995 for the discharge of non-contact cooling water to the East Branch of the Housatonic River from the Byron Weston Mill, Main Street, Dalton. The permit is being administratively continued until the new general permit for non-contact cooling water is available. **<u>MAG250955</u>** was issued in September 1995 for the discharge of non-contact cooling water to the East Branch of the Housatonic River from the Pioneer Mill, Pioneer Street, Dalton. The permit is being administratively continued until the new general permit for non-contact cooling water is available.		

PERMITTEE FOX RIVER PAPER CO.	NPDES # MAG250281	SEGMENT MA21-20
Fox River Paper Company is authorized (MAG250281 issued in August 2000) to discharge 0.1 MGD (maximum daily discharge) of non-contact cooling water to the Housatonic River via a single outfall from their facility located at 295 Park Street in Housatonic.		

PERMITTEE GENERAL DYNAMICS DEFENSE SYSTEMS	NPDES # MA0035718	SEGMENT MA21-02
General Dynamics Defense Systems (MA0035718), formerly Lockheed Martin, is located at Plastics Avenue, Pittsfield, MA. EPA terminated their permit in February 1999 because all process discharges had been eliminated from Outfall 011. All remaining stormwater discharges will be permitted under the Multi-Sector General Stormwater Permit (MSGSP).		

PERMITTEE GENERAL ELECTRIC COMPANY	NPDES # MA0003891	SEGMENT MA21-02

The General Electric Company (GE Pittsfied) was authorized (MA0003891 issued in May 1992) to discharge via outfalls 005, 007, and 009 to the East Branch of the Housatonic River and Unkamet Brook. (Some of their former discharges are now permitted to Pittsfield Economic Development Authority or PEDA MA0040231). The discharge from these outfalls required toxicity testing of their effluent as stated in the NPDES permit. The permitted outfall descriptions are listed below.

*Outfall #005- for a maximum daily flow up to 1.08 MGD of contact and non-contact cooling water, treated process wastewater, treated groundwater and stormwater runoff into the East Branch Housatonic River,

*Outfall #007- report the maximum daily and average monthly discharge of non-contact cooling water and stormwater runoff into the East Branch Housatonic River with a maximum daily temperature limit of 75°F,

*Outfall #009- report the maximum daily and average monthly discharge of non-contact cooling water, treated process water and stormwater runoff into Unkamet Brook.

*Note: Denotes that a composite sample will be made by combining discharges from these outfalls and outfall #011 in NPDES permit MA0035718 for General Dynamic Defense Systems formerly Lockheed Martin into a 24-hour proportionate-to-flow composite sample. This composite sample shall be tested for acute and chronic toxicity. The acute toxicity tests are to be conducted monthly with a NOAEL (where 90% or more of the test organisms survive after 48 hours) is $\geq$35% effluent. (One acute test per quarter, however, is to be conducted under wet weather conditions -- a monitoring only requirement.) The chronic tests results conducted in July, August, and September are to be reported only (no limit).

It also should be noted that due to the extensive environmental studies and remediation activities on-going at the GE Pittsfield site, the nature of the sources and characteristics discharged via any of the outfall numbers mentioned above may have changed or may be in the process of being changed at the time that this report was prepared.

GE Pittsfield has obtained coverage under the Multi-Sector General Storm Water Permit for Industrial Activities (MSGP) issued in October 30, 2000, for a number of stormwater discharges (GE 2004). GE Pittsfield has executed an agreement with the Pittsfield Economic Development Authority (PEDA) and the City of Pittsfield regarding the transfer of land and improvements including NPDES outfalls 001, 01A, 004, and MAR05A021 (YD3) that discharge into Silver Lake.

Source: GE Pittsfield's new fact sheet to go along with their new draft permit (Janet Labonte@EPA)

<u>Chemistry-water</u>

Hardness: The hardness in the river water between January 2000 and March 2006 ranged from 38 to 528 mg/L (n=82)(TOXTD database).

PERMITTEE MW CUSTOM PAPERS, LLC WWTP LAUREL MILL	NPDES # MA0001716	SEGMENT MA21-19

MW Custom Papers, formerly the Mead Corporation, is authorized (MA0001716 issued in June 2005) to discharge treated industrial wastewater via Outfall# 001 to the Housatonic River from their Laurel Mill wastewater treatment facility (WWTF) located on Pleasant Street in South Lee. The permittee manufactures decorative and overlay papers for laminates used in furniture, flooring, countertops, and cabinets. Laurel Mill's process water source is the river (maximum volume, 2.88 MGD)(Grant 2005). Sources of wastewater include: whitewater recirculation, grade change water, wash-up water, pump and equipment seal discharges, boiler blowdown, water softener backwater, condensate from air compressors and stormwater from roof drains. The WWTF influent pH can be adjusted by chemical addition using either sodium hydroxide or sulfuric acid. Primary clarification is enhanced by the addition of alum and/or polymer for solids removal. Flow is then directed to cooling towers and/or RBCs. Nutrient addition takes place at the RBCs by chemical addition. Flow is then directed to secondary clarification and subsequently to the Housatonic River (Grant 2005). In 2003 the WWTF staff started to recycle 50% of the final effluent flow back to the process intake (Grant 2005). The sludge is dewatered with a belt-filter press and the resulting sludge cake is hauled off-site to a composting facility. All sanitary wastewater is directed to the Lee WWTF for treatment.

The pH of the effluent (6.0 to 9.0 SU limits) between October 2000 and April 2006 ranged from 7.0 to 7.7 SU (n=23)(TOXTD database). The ammonia-nitrogen concentration in the effluent between October 2000 and April 2006 ranged from <0.08 to 0.21 mg/L (n=23)(TOXTD database).

The facility's whole effluent toxicity testing limits are LC_{50} $\geq$100% effluent performed quarterly using *Ceriodaphnia dubia* with a monitor only requirement for chronic toxicity (CNOEC report only). It should be noted that the previous permit required toxicity testing using *Pimephales promelas* as a second species.

The temperature of the effluent has a 90º-Fahrenheit maximum daily limit and there is no requirement for disinfection. Other permitted parameters include BOD and TSS.

<u>Chemistry-water</u>
Hardness: The hardness in the river water between October 2000 and April 2006 ranged from 60 to 154 mg/L (n=23)(TOXTD database).

PERMITTEE MW CUSTOM PAPERS, INC. WWTP WILLOW MILL	NPDES # MA0001848	SEGMENT MA21-19

MW Custom Papers, formerly the Mead Corporation, is authorized (MA0001848 issued in June 2005) to discharge treated industrial wastewater (via Outfall# 001) to the Housatonic River from the Willow Mill wastewater treatment facility (WWTF) located on Willow Street in South Lee. The permittee manufactures decorative and overlay papers for laminates used in furniture, flooring, countertops, and cabinets. Willow Mill is less than 1 mile downstream from Laurel Mill. The Willow Mill maximum daily water withdrawal volume is 2.36 MGD (Grant 2005). The sources of daily water withdrawal are the Willow Mill Boiler House (0.036 MGD from spring-feed water), Willow Mill Basement River (1.87 MGD canal-feed from the Housatonic River) and the East and West Branches of the Bear Town Brook (0.45 MGD)(Grant 2005). The process water sources at Willow Mill are similar to the sources at Laurel Mill. The WWTF primary flocculation clarifier performance is enhanced by chemical addition using polymer and/or alum. A flow equalization tank accepts flow from the primary clarifier and distributes it to RBC units for biological treatment. Secondary clarification completes the treatment process (Grant 2005). All sanitary wastewater is directed to the Lee WWTF for treatment.

The pH of the effluent (6.0 to 9.0 SU limits) between October 2000 and January 2006 ranged from 6.8 to 7.9 SU (n=23)(TOXTD database). The ammonia-nitrogen concentration in the effluent between October 2000 and January 2006 ranged from <0.02 to 0.28 mg/L (n=22)(TOXTD database).

The facility's whole effluent toxicity testing limits are LC_{50} $\geq$100% effluent performed quarterly using *Ceriodaphnia dubia* and *Pimphales promelas* with a monitor only requirement for chronic toxicity (CNOEC report only).

The temperature of the effluent has a 90º-Fahrenheit maximum daily limit and there is no requirement for disinfection. Other permitted parameters include BOD and TSS.

Chemistry-water

Hardness: The hardness in the river water between October 2000 and January 2006 ranged from 44 to 154 mg/L (n=22)(TOXTD database).

PERMITTEE OLDCASTLE STONE PRODUCTS	NPDES # MAR05A083	SEGMENT MA21-19

Oldcastle Stone Products is authorized (MAR05A083) to discharge stormwater from their facility in Lee, MA. In January 2006 EPA terminated the individual NPDES permit MA0001911 (formerly held by Southdown Corp. and prior to that Lee Lime Corp). Oldcastle Stone Products is engaged in the manufacturing of lime and limestone products. According to the plant manager, operations include quarrying, calcining, crushing, screening, drying, mixing and bagging. Outfall#001 consists of storm water collected in the quarry pit and Outfall 002 is the overflow from a settling pond. Storm water from processing areas of the plant is collected and pumped to the settling pond. Both outfalls discharge to an unnamed tributary of the Housatonic River located downstream of the Lee WWTP discharge and upstream of the Housatonic River's confluence with Hop Brook.

PERMITTEE SCHWEITZER-MAUDUIT INTERNATIONAL, INC. WWTF	NPDES # MA0005371	SEGMENT MA21-19

Schweitzer-Mauduit International, formerly the Kimberly-Clark Corporation, is authorized (MA0005371 issued in May 2000) to discharge treated effluent from a wastewater treatment facility located at Columbia Street in Lee via Outfalls # 002 and #003 to the Housatonic River. Other outfalls (#006 and #007) are permitted for discharge of water supply and fire protection storage overflow and Outfall #008 has been eliminated. Fine and lightweight papers are produced at the four company-owned and operated paper mills known as Greylock, Niagara, Eagle, and Columbia. The source of water comes from the Housatonic River (maximum daily volume, 6.0 MGD)(Ryan 2005). The untreated process water from all four mills is sent to one of two WWTFs (Columbia WWTF and Greylock WWTF). The Columbia WWTF treats process water from Niagara, Eagle, and Columbia and discharges to the river via Outfall# 002. The Greylock WWTF treats process water from Greylock and has the option to discharge to the river via Outfall# 003 or the discharge can be directed to the Columbia WWTF for polishing (the latter is the preferred method of operation, Ryan 2005). The Greylock WWTF is an extended aeration activated sludge process with secondary sedimentation that treats wastes biologically. The Columbia WWTF utilizes pre- and post- pH neutralization with the option of adding alum, sodium hydroxide, or potassium hydroxide. Primary treatment is enhanced by the addition of alum and polymer. The total phosphorus concentration in the effluent (April 1 to September 30, 40 lbs./day, average monthly limit) is reduced by the addition of alum. Primary and secondary sludges are blended then dewatered by a belt-filter press before entering a steam-assisted hot air dryer. The final product is hauled off-site for use as landfill cover (Ryan 2005). The sanitary wastewater is sent to the Lee WWTF for treatment.

The pH (7.1 to 8.0 SU limits) of the effluent between September 2000 and March 2006 ranged from 7.1 to 8.0 SU (n=25)(TOXTD database). The facility's whole effluent toxicity test limits using *Ceriodaphnia dubia* are LC_{50} $\geq$100% and C-NOEC $\geq$14% tested four times per year. Other permitted parameters include BOD and TSS.

Chemistry-water

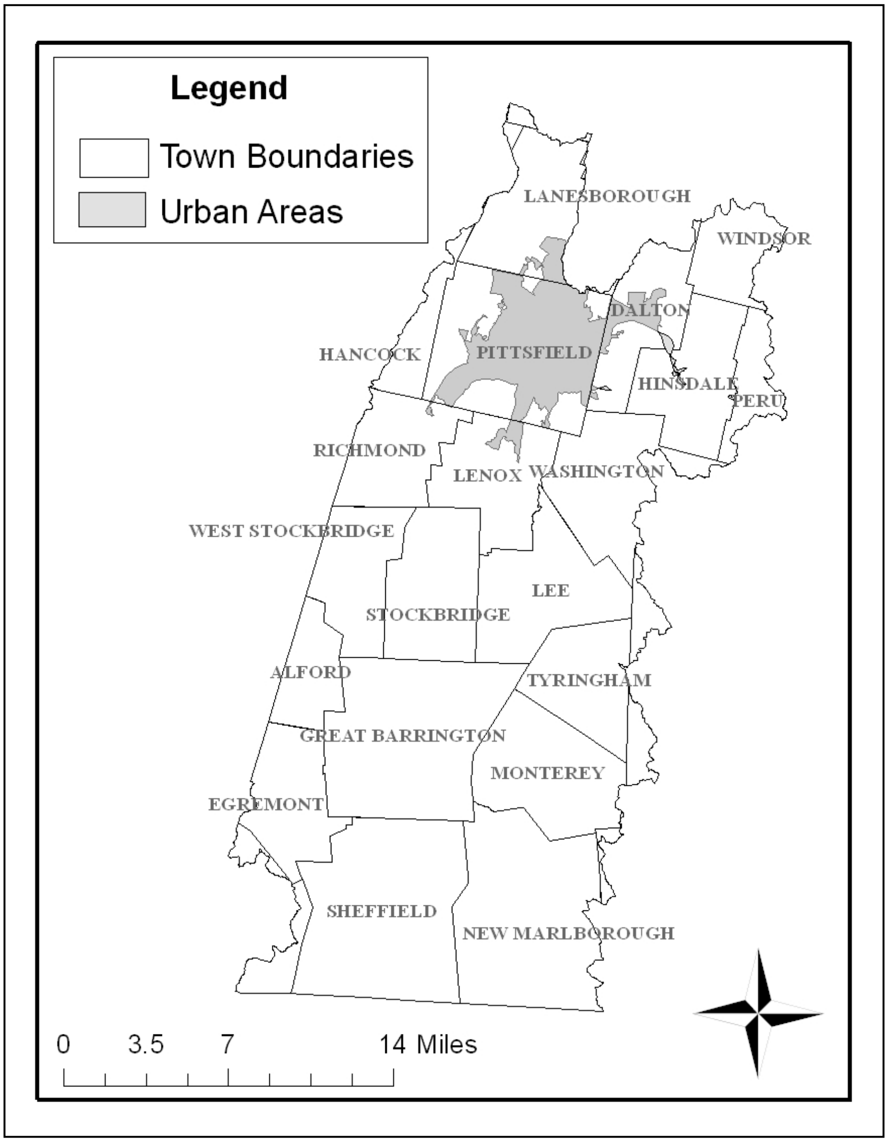
Hardness: The hardness in the river water between September 2000 and March 2006 ranged from 22 to 150 mg/L (n=25)(TOXTD database).

PERMITTEE SHEFFIELD PLASTICS, INC.	NPDES # MAR05B410 and MAR05B411	SEGMENT MA21-15

Sheffield Plastics, Inc. (MAR05B410 and MAR05B411) is located in Sheffield, MA. A letter dated May 1999 from Olga Vergara at EPA addressed to Edward O'Connor, Environmental Manager, terminated the individual NPDES permit (MA0027294). The facility's stormwater discharges were covered under the multi-sector general permits. However, the facility did not reapply in 2000 and the older general permits have expired. The stormwater discharges into Schenob Brook via a ditch and a wetland, respectively (Vergara 1999) which ultimately flow into Hubbard Brook. The facility should reapply for coverage.

STORMWATER

The NPDES Phase II General Permit program requires NPDES permit coverage for stormwater discharges from small municipal separate storm sewer systems (MS4s), and construction activity disturbing one acre or more of land in a mapped "urbanized area" defined and delineated by the US Bureau of Census in 2000 (http://www.epa.gov/npdes/pubs/fact2-2.pdf). Large and medium municipal separate storm sewer systems (MS4s) for populations over 100,000 were permitted during Phase I of the NPDES Stormwater Program. Under EPA's Phase II Program, the definition of "municipal" includes Massachusetts communities, U.S. military installations, state or federal owned facilities such as hospitals, prison complexes, state colleges or universities and state highways. An MS4 is a system that: discharges at one or more a point sources; is a separate storm sewer system (not designed to carry combined stormwater and sanitary waste water); is operated by a public body; discharges to the Waters of the United States or to another MS4; and, is located in an "Urbanized Area". The NPDES Phase II General Permit requires operators of regulated MS4s to develop and implement a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system, which is subsequently discharged into local waterbodies. The NPDES Stormwater Phase II General Permit requires operators of regulated small MS4s to develop a stormwater management program that prevents harmful pollutants from being washed or dumped directly into the storm sewer system, and then discharged into local waterbodies. Certain Massachusetts communities were automatically designated (either in full or part) by the Phase II rule based on the urbanized area delineations from the 2000 U.S. Census.



As a result of the census mapping, six communities in the Housatonic River Watershed were located either totally or partially in the regulated Urbanized Area (see below Figure above). Municipalities that are totally regulated must implement the requirements of the Phase II permit in the entire town, while communities that are partially regulated need to comply with the Phase II permit only in the mapped Urbanized Areas. The towns of Cheshire, Hinsdale, and Lenox received waivers of the Phase II stormwater requirements on May 16, 2003 since the area subject to jurisdiction has a population under 1,000 and otherwise satisfies the criteria identified at 40 CFR 123.35(d) 1. EPA issued stormwater general permits to the municipalities of Dalton, Lanesborough, and Pittsfield after administrative review, and, in coordination with MassDEP, will complete a thorough review of the communities' stormwater management program during the five-year permit term. Phase II stormwater general permits will expire on 1 May 2008 (Domizio 2004). For detailed community maps see http://www.epa.gov/region01/npdes/stormwater/ma.html.

Table J4. NPDES Phase II stormwater permit information for the Housatonic River Watershed communities (Note: Cheshire, Hinsdale, and Lenox were all granted waivers).

Community	Permit #	Permit Issued	Mapped Regulatory area in community
Dalton	MAR041004	11/16/2003	Partial
Lanesborough	MAR041012	10/31/2003	Partial
Pittsfield	MAR041018	12/5/2003	Total

The NPDES Phase I Storm Water Program, in place since 1990, regulates cities and counties with populations of 100,000 that operate a municipal separate storm sewer system (MS4), specific industrial operations (as defined at 40 CFR 122.26(b)(14)), and construction activities that disturb 5 or more acres of land. Information for these permittees can be found online at: http://cfpub.epa.gov/npdes/stormwater/noi/noisearch.cfm.

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