APPENDIX A

Technical Memorandum TM-33-5

DEERFIELD WATERSHED 2000
DWM WATER QUALITY MONITORING DATA

December 2003

DWM Control Number (CN): 189.0

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
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INTRODUCTION AND PROJECT OBJECTIVES

The Deerfield Watershed environmental monitoring plan for 2000 was developed by the monitoring subgroup of the EOEA Deerfield Watershed Team in consultation with DWM. Subwatersheds were evaluated for their water and habitat quality data needs using information gathered by the team in 1999, and monitoring strategies were developed to address those needs. Priority monitoring needs addressed by DWM included sampling for water chemistry, macroinvertebrate biomonitoring, fish population studies, and fish toxics monitoring. This technical memorandum presents the riverine water quality sampling component of the survey. Results of the other monitoring efforts conducted in 2000 by DWM are described in separate memoranda or reports.

The 1995-6 DWM Deerfield Watershed water quality survey identified several segments that lacked sufficient water quality data for evaluation and also flagged several sites with potential water quality problems that needed more water chemistry data for adequate assessment. Several sites were also identified for sampling in order to maintain an historical database to evaluate long-term trends. To address some of these water quality sampling needs, DWM conducted three water quality sampling surveys from July through October 2000 at three sites along the mainstem Deerfield River and 9 sites on five tributaries. Samples were analyzed in the field for D.O., temperature, pH, conductivity, total dissolved solids (TDS), and percent saturation. Samples for alkalinity, nutrients, hardness and total suspended solids (TSS) were collected for analysis at the state's analytical laboratory, the Wall Experiment Station (WES). The Massachusetts EOEA also funded a concurrent water and sediment quality study conducted for the EOEA Deerfield Watershed Team as an annual workplan project. The study was conducted by Environmental Sciences Inc. (ESS) and involved six water quality sampling surveys from August through November at two sites on the mainstem Deerfield and 19 stations along a number of its tributaries. Six of the sampling sites were the same as DWM stations. Samples were analyzed for fecal coliform bacteria, temperature, pH, conductivity, and turbidity. ESS also collected sediment sampling behind six of the impoundments on the mainstem Deerfield River. Samples were analyzed for selected metals, PCBs, PAHs, TPH, % TOC, % volatile solids, and % water. Results from the ESS, Inc. study are published in a separate report (ESS, Inc. 2002).

QUALITY ASSURANCE AND QUALITY CONTROL

A QAPP was not written for the Deerfield water quality sampling surveys in 2000, however, procedures used were consistent with the prevailing DWM sampling protocols that are described in the *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure* (MA DEP 1999a; CN 1.0). While no field audits were performed in 2000, wade-in grab samples were assumed to be representative and to have been taken consistent with DWM SOPs (in lieu of information to the contrary). For all water quality surveys, quality control samples (field blanks and sample splits) were taken at a minimum of one each per crew per survey. All water quality samples were delivered to the WES laboratory for analysis.

DWM quality assurance and database management staff reviewed lab data reports and all Hydrolab multi-probe data. The data were validated and finalized per data validation procedures outlined in DWM SOP CN 56.0 (MA DEP, 2001). In general, all water sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). A complete summary of censoring and qualification decisions for 2000 DWM data is provided in the DWM 2000 Data Validation Report (MA DEP, 2003; CN 83.0). Appendix A1 of this technical memorandum contains data censoring/qualification decisions for 2000 Deerfield data. Definitions for the data qualifiers are also included in Appendix A1. This information was excerpted from the DWM 2000 Data Validation Report (MA DEP, 2003; CN 83.0).

SURVEY METHODS

DWM personnel performed *in-situ* water quality measurements for D.O., temperature, pH, conductivity, TDS, and percent saturation with a *Hydrolab® Series 3 Multiprobe* and collected water samples for alkalinity, nutrients, hardness and TSS for laboratory analysis at 12 stations (Table A1 and Figure A1) on July 25, 2000, August 29, 2000 and October 17, 2000. Each survey crew also took a minimum of one ambient field blank and one field split sample for quality control purposes. Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure* (MA DEP, 1999a; CN 1.0) and *Hydrolab® Series 3 Multiprobe, Standard Operating Procedure* (MA DEP 1999b; CN 4.0). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were transported on ice to WES where they were analyzed by methods according to the WES Standard Operating Procedure (SOP).

Table A1. 2000 DEP-DWM Deerfield River Watershed survey. Location of sites sampled for water quality analysis on July 25, 2000, August 29, 2000 and October 17, 2000.

STREAM	STATION (UNIQUE ID)	SEGMENT NO.	DESCRIPTOR
Deerfield River	UD01 (4)	MA 33-01	approximately 800 feet below Fife Brook Dam, Florida
Chickley River	CH (40)	MA 33-11	upstream of Tower Road bridge (approximately 100 feet upstream of confluence with Deerfield River), Charlemont
Deerfield River	DR03 (761)	MA 33-02	at USGS gage #01168500, south of Mohawk Trail (Route 2) between Heath Road and Burrington Road, Charlemont
North River	NR03 (21)	MA 33-06	under Rt 112 bridge south of Griswoldville, Colrain
North River	NR04 (22)	MA 33-06	upstream of Adamsville Road bridge, Colrain
Green River	GR07 (7)	MA 33-28	USGS gage #01170100, north of East Colrain
Green River	GR07A	MA 33-28	duplicate sample - USGS gage north of East Colrain
South River	SO05 (756)	MA 33-08	under bridge at Bullit Road, Ashfield
South River	SO-8 (9)	MA 33-08	upstream of bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway
Deerfield River	DR10 (757)	MA 33-04	downstream of Rt 5 – 10 bridge, Deerfield (southern channel of river)
Green River	GR03 (759)	MA 33-29	approximately 60 feet downstream of dam under Mill Street, Greenfield
Green River	GR03A	MA 33-30	duplicate sample – 60 feet downstream of dam under Mill Street, Greenfield
Green River	GR02 (758)	MA 33-30	midstream, approximately 150 feet upstream of confluence with Deerfield River, Greenfield
Unnamed Tributary to Green River (aka Maple Brook)	MB01 (760)	Trib. to MA 33-30	behind trailer park approximately 75 feet downstream of rock face where culverted stream emerges, Greenfield

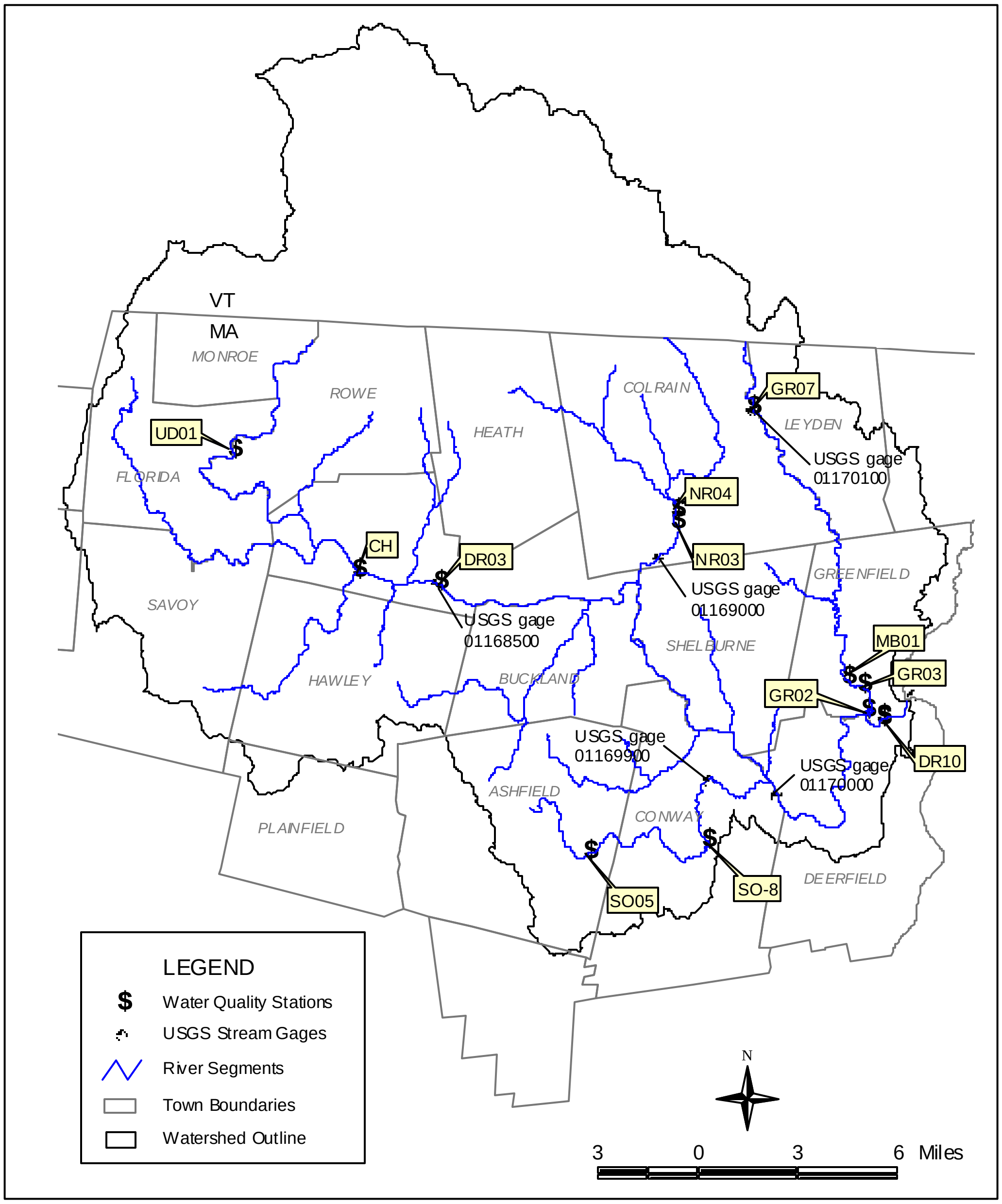

Figure A1. Location of 2000 MA DEP water quality sampling stations and USGS gaging stations in the Deerfield River Watershed.

SURVEY CONDITIONS

Conditions prior to each survey were characterized by analyzing precipitation and streamflow data. Rainfall data from two DEM Office of Water Resources precipitation stations (Greenfield station #203 and Heath station MWRC #201), one NOAA/National Weather Service precipitation station (Ashfield station) was reviewed for the five days prior to and on the sampling dates (Table A2) (MA DEM 2000). Streamflow data (Tables A3 – A7) used to estimate hydrological conditions for the water quality sampling events were obtained from two USGS stream gages on the Deerfield River (No. 01170000 at West Deerfield and No. 01168500 in Charlemont), one on the North River (No. 01169000 at Shattuckville), one on the South River (No. 01169900 in Conway) and one on the Green River (No. 01170100 in Colrain) as reported in the USGS 2000 and 2001 water year compilations. Locations of the gages are illustrated in Figure A1. Streamflow statistics for these gages are available from USGS (Socolow *et al.* 2001 and 2002 and USGS 1998). It should also be noted that flows in the mainstem Deerfield River are heavily regulated by hydropower facilities, including minimum flow requirements and white-water boating releases. Tributary flows may also be affected by dams (including beaver), therefore data should be interpreted with caution. Streamflow conditions were also compared in relation to the 7-day, 10-year (7Q10) low flow estimates.

Survey conditions are described below for each DWM sampling event:

July 25, 2000: This survey was conducted during and following relatively dry weather (Table A2). A small amount of precipitation was recorded in Greenfield (0.21 inches) and fell on the third antecedent day of the sampling event. Streamflow recorded on the sampling date at USGS gages in the South River (#01169900) and North River (#01169000) was above the monthly averages for their respective periods of record, but significantly below the monthly average recorded for July (Tables A4 and A5). Streamflow recorded at the Green River gage (#01170100) was similar to the monthly average for the period of record, but lower than the July monthly mean flow (Table A7). Flows on the sampling date at the tributary gages were substantially above the 7Q10 low flow estimates (9 – 15 times higher). Flows at all except the Deerfield mainstem gages were declining during the five days prior to the sampling event. Streamflow on the mainstem Deerfield is highly regulated and variable, but it should be noted that flow recorded on the sampling date from the mainstem West Deerfield gage (#01170000) was almost three times higher than the average monthly period of record flow and at the Charlemont gage (#01168500) they were over twice as high, but again the flows on the sampling date were much lower than the July monthly average (Tables A3 and A6). What likely contributed to the high July monthly flow averages was an unusual weather phenomenon recorded by the National Weather Service that occurred in the northern part of Berkshire County near the Vermont border on the 16th of July (nine days before the sampling event). Radar estimated that nearly 9 inches of rain fell in less than 8 hours. Severe flash flooding occurred in Heath and Rowe. In Colrain, as a result of this storm, the North River crested about one half foot above flood stage. Based on maps contained in the Rainfall Frequency Atlas for the Northeast (U.S. Department of Commerce), this event appears to have been on the order of a 100-year 24-hour rainfall (L. Marler, MA DRC, personal communication). Data collected during this survey are interpreted as being representative of dry weather conditions

August 29, 2000: This survey was conducted during and following relatively dry weather (Table A2). A small amount of precipitation fell (0.33 inches) at the Greenfield site on the fifth day prior to the survey. Streamflow recorded on the sampling date at USGS gages in the North River (#01169000), South River (#01169900) and Green River (#01170100) was above the monthly averages for their respective periods of record, but significantly below the monthly average recorded for August (Tables A4, A5, and A7). Flows on the sampling date at the tributary gages were substantially above the 7Q10 low flow estimates (12 – 14 times higher). Flows at all except the Deerfield mainstem gages were declining during the five days prior to the sampling event. Streamflow on the mainstem Deerfield is highly regulated and variable, but it should be noted that flow recorded on the sampling date from the mainstem West Deerfield gage (#01170000) was almost three times higher than the average monthly period of record flow and at the Charlemont gage (#01168500) they were over twice as high (Tables A3 and A6). Data collected during this survey are interpreted as being representative of dry weather conditions.

October 17, 2000: The weather conditions during, and five-days prior to the sampling event were variable. A small amount of rainfall (0.08”) was recorded at the Heath site 5 days prior to the survey and 0.21” fell in Ashfield one day before the survey. On the day of the survey 0.21” of rain was recorded in Greenfield (Table A2). Streamflow recorded on the sampling date at USGS gages in the North River (#01169000) and South River (#01169900) was similar to the October monthly mean and the monthly averages for their respective periods of record (Table A4 and A5). However, the discharge at the Green River gage (#01170100) was significantly less than the October monthly mean and the monthly average for the period of record (Table A7). Flows at all three tributary gages were 12% to 36% higher on the sampling date than the flows recorded two days prior to the sampling event and were substantially above the 7Q10 low-flow estimates (5 – 16 times higher). Streamflow on the mainstem Deerfield is highly regulated and variable, but it should be noted that flows at both gages (#01170000 and #01168500) exceeded the average monthly period of record flow and the mean monthly flow for October (Tables A3 and A6). Because of only slight increases in streamflow at the tributary gages on the date of sampling and the small amount of recorded precipitation that fell prior to and on the day of sampling at only one of the three observation sites, data collected during the survey are being interpreted as representative of predominately dry weather conditions.

Table A2: Deerfield River Basin 2000 Precipitation Data Summary (reported in inches of rainfall)																		
Survey Dates	5 Days Prior			4 Days Prior			3 Days Prior			2 Days Prior			1 Day Prior			Sample Date		
	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld	Hth	Afld	Gfld
25 Jul	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29 Aug	0.00	MFR	0.33	0.00	MFR	0.00	0.00	MFR	0.00	0.00	MFR	0.00	0.00	MFR	0.00	0.00	MFR	0.00
17 Oct	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.21

MFR-Missing from record, T= trace amounts, DEM Office of Water Resources precipitation stations: Hth = Heath; Gfld = Greenfield, NOAA/NWS precipitation station: Afld = Ashfield

Table A3: Deerfield River at Charlemont, MA-USGS Flow Data Summary
Discharge in Cubic Feet per Second (cfs)
USGS Gage # 01168500

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	794	869	795	550	1090	988	1353	454
29 Aug	1340	1190	1180	1110	832	1070	1374	461
17 Oct	782	666	362	314	455	1050e	626	606

7Q10 @ USGS, Gage 01168500 = 34 cfs,
*Period of Record: 1913 - present (mean annual discharge = 902 cfs), e = estimated

Table A4: North River at Shattuckville, MA-USGS Flow Data Summary
Discharge in Cubic Feet per Second (cfs)
USGS Gage # 01169000

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	222	173	155	127	108	97	316	69.5
29 Aug	343	184	141	137	103	90	285	52.4
17 Oct	94	86	81	76	80	104	129	101

7Q10 @ USGS, Gage 01169000 = 6.3 cfs,
*Period of Record: 1940 - present (mean annual discharge = 299 cfs), e = estimated

Table A5: South River near Conway, MA-USGS Flow Data Summary
Discharge in Cubic Feet per Second (cfs)
USGS Gage # 01169900

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	43	39	51	35	30	28	80.7	22.6
29 Aug	70	44e	36	32	30	29	91.9	18.8
17 Oct	19	18	17	16	17	25	24.3	29.5

7Q10 @ USGS, Gage 01169900 = 2.0 cfs,
*Period of Record: 1966 - present (mean annual discharge = 53.4 cfs), e = estimated

Table A6: Deerfield River near West Deerfield, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01170000								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	1500e	1200e	900e	800e	1600e	1500e	1955	586
29 Aug	1880	1590	1400	1380	992	1320	1911	573
17 Oct	977	937	498	418	582	955	835	842
7Q10 @ USGS, Gage 01170000 = 39 cfs, *Period of Record: 1904 - present (mean annual discharge = 1318 cfs), e = estimated								

Table A7: Green River near Colrain, MA-USGS Flow Data Summary Discharge in Cubic Feet per Second (cfs) USGS Gage # 01170100								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Sample Date	Monthly Mean	POR* Mean
25 July	67	54	49	40	36	32	84.2	36.5
29 Aug	127	75	61	53	47	42	126	27.9
17 Oct	12	13	14	15	16	17	55.9	49.8
7Q10 @ USGS, Gage 01170100 = 3.6 cfs, *Period of Record: 1968 - present (mean annual discharge = 90.4 cfs), e = estimated								

WATER QUALITY DATA

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

Table A8. 2000 MA DEP Deerfield River Watershed *in-situ* Hydrolab® Data.
Temperature, pH, Conductivity, Total Dissolved Solids, Dissolved Oxygen, % Saturation (Data qualifiers listed in Appendix A1)

UNNAMED TRIBUTARY (Saris: 9253500)
Station: MB01, Mile Point: 0.1, Unique ID: 760
Description: Unnamed tributary to Green River approximately 75 feet from bottom of rock face where culverted stream (locally known as Maple Brook) emerges, south of Colrain Street, Greenfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(mS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0207	0641	0.2	16.4	7.5 c	606	388	9.1	91
8/29/2000	33-0231	0651	0.2	17.1	7.6 c	563	360	8.9	90
10/17/2000	33-0239	0634	0.3	13.2	7.4 c	379	243	9.0	83

DEERFIELD RIVER (Saris: 3312900)
Station: UD01, Mile Point: 38.9, Unique ID: 4
Description: Approximately 800 feet below Fife Brook Dam, Florida

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(mS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0208	0410	0.7	16.1	6.2	36.6	23.4	9.1	90
8/29/2000	33-0216	0354	0.4	17.0	5.8	33.7	21.5	8.5	86
10/17/2000	33-0240	0408	0.4	12.7	6.5	35.2	22.5	9.8	90

Table A8 (continued)

DEERFIELD RIVER (Saris: 3312900)
Station: DR03, Mile Point: 25.9, Unique ID: 761
Description: At USGS gage #01168500, south of Mohawk Trail (Route 2) between Heath Road and Burrington Road, Charlemont

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0210	0528	0.6	15.6	6.7	43.1	27.6	9.3	91
8/29/2000	33-0218	0506	0.5	16.7	6.4	37.8	24.2	9.6	97
10/17/2000	33-0242	0522	0.6	11.2	6.8	39.5	25.3	10.7	95

DEERFIELD RIVER (Saris: 3312900)
Station: DR10, Mile Point: 1.1, Unique ID: 757
Description: Downstream/east of Rte. 5/10 Bridge, Deerfield (southern channel of river)

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0202	0506	0.5	17.9	6.8	63.3	40.5	9.2	95
8/29/2000	33-0226	0519	0.6	18.7	6.9	68.8	44.0	8.9	93
10/17/2000	33-0234	0507	0.4	11.9	7.1 c	81.2	52.0	10.5	94

GREEN RIVER (Saris: 3312925)
Station: GR07, Mile Point: 14.2, Unique ID: 7
Description: At USGS gage # 01170100, north of East Colrain, Colrain

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0213	0713	0.4	15.3	7.7 c	87.1	55.8	9.4	91
8/29/2000	33-0221	0640	0.4	16.0	7.3 c	101	64.7	9.9	98
10/17/2000	33-0245	0719	0.5	8.1	7.7 c	94.7	60.6	11.6	95

GREEN RIVER (Saris: 3312925)
Station: GR03, Mile Point: 1.5, Unique ID: 759
Description: Approximately 60 feet downstream/southeast from dam under Mill Street, Greenfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0204	0617	0.4	19.2	7.4 c	142	90.8	9.2	97
8/29/2000	33-0228	0624	0.6	18.3	7.4 c	147	93.9	9.4	97
10/17/2000	33-0236	0609	0.5	9.8	7.5 c	147	94.1	10.9	93

GREEN RIVER (Saris: 3312925)
Station: GR02, Mile Point: 0.03, Unique ID: 758
Description: Midstream, approximately 150 feet upstream/northeast of confluence with Deerfield River, Greenfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0203	0540	0.3	19.0	7.4 c	145	92.7	9.1	96
8/29/2000	33-0227	0549	0.3	18.8	7.5 c	149	95.0	9.1	95
10/17/2000	33-0235	0539	0.5	10.1	7.5 c	148	94.5	11.0	95

SOUTH RIVER (Saris: 3313650)
Station: SO05, Mile Point: 11.1, Unique ID: 756
Description: Under bridge at Bullitt Road, Ashfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	(m)	(°C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/25/2000	33-0200	0343	** I	14.8	7.5 c	160	102	10.0	96
8/29/2000	33-0225	0359	** I	14.9	7.4 c	157	100	9.9	96
10/17/2000	33-0233	0356	** I	8.2	7.5 c	152	97.0	11.6	96

Table A8 (continued)

SOUTH RIVER (Saris: 3313650)
Station: SO-8, Mile Point: 5.1, Unique ID: 9
Description: At bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	**(m)**	**(C)**	**(SU)**	**(µS/cm)**	**(mg/l)**	**(mg/l)**	**(%)**
7/25/2000	33-0201	04:21	0.1 i	17.0	7.4 c	138	88.0	9.4	95
8/29/2000	33-0225	04:33	0.2	16.9	7.4 c	139	89.1	9.3	93
10/17/2000	33-0233	04:23	0.3	9.0	7.4 c	145	92.7	11.3 u	95 u

NORTH RIVER (Saris: 3314100)
Station: NR04, Mile Point: 3, Unique ID: 22
Description: Adamsville Road bridge, Colrain

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	**(m)**	**(C)**	**(SU)**	**(µS/cm)**	**(mg/l)**	**(mg/l)**	**(%)**
7/25/2000	33-0212	06:33	0.9	15.2	7.3 c	84.6	54.2	9.4	92
8/29/2000	33-0220	06:02	0.4	16.3	7.1 c	90.8	58.1	9.8	97
10/17/2000	33-0244	06:28	0.5	8.4	7.3 cu	84.7	54.2	11.4	94

NORTH RIVER (Saris: 3314100)
Station: NR03, Mile Point: 2.6, Unique ID: 21
Description: Route 112 bridge south of Griswoldville, Colrain

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	**(m)**	**(C)**	**(SU)**	**(µS/cm)**	**(mg/l)**	**(mg/l)**	**(%)**
7/25/2000	33-0211	06:08	0.4	15.5	7.4 c	119	76.2	9.3	91
8/29/2000	33-0219	05:40	0.1 i	16.6	7.1 cu	105	67.2	9.7	97
10/17/2000	33-0243	06:04	0.4	8.5	7.4 c	110	70.3	11.5	96

CHICKLEY RIVER (Saris: 3315425)
Station: CH, Mile Point: 0, Unique ID: 40
Description: Tower Road bridge (approximately 100 feet upstream of confluence with Deerfield River), Charlemont

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25°C	TDS	DO	Saturation
		(24hr)	**(m)**	**(C)**	**(SU)**	**(µS/cm)**	**(mg/l)**	**(mg/l)**	**(%)**
7/25/2000	33-0209	05:05	0.2	14.9	7.2 c	53.8	34.4	9.3	90
8/29/2000	33-0217	04:41	** i	15.8	6.9 u	48.4	31.0	10.0	98
10/17/2000	33-0241	04:50	0.3	8.2	7.1 cu	47.9	30.7	11.6	95

Field Blank Sample
Station: BLANK
Description: QAQC: Field Blank Sample

Date	OWMID	QAQC	Time	Fecal Coliform
			24hr	**(cfu/100ml)**
8/29/2000	83-0222	BLANK	09:26	<10
8/29/2000	83-0233	BLANK	11:20	<10
9/18/2000	83-0246	BLANK	10:07	<5
9/18/2000	83-0257	BLANK	11:30	<5

Table A9. 2000 MA DEP Deerfield River Watershed Instream Physico/Chemical Data.
Alkalinity, Hardness, Total Suspended Solids (TSS), Turbidity, Ammonia Nitrogen, Nitrate-Nitrite Nitrogen, Total Phosphorus (Data qualifiers listed in Appendix A1)

Field Blank Sample
Station: BLANK
Description: QAQC: Field Blank Sample

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0206	BLANK	06:17	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
7/25/2000	33-0215	BLANK	07:13	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
8/29/2000	33-0230	BLANK	06:24	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
8/29/2000	33-0223	BLANK	06:40	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
10/17/2000	33-0238	BLANK	06:12	<2	<0.66	<1.0	<0.1	<0.02	<0.02	<0.010
10/17/2000	33-0247	BLANK	07:19	23 b	28 b	<1.0	1.3 b	<0.02	<0.02	** m

Unnamed Tributary
Station: MB01, Mile Point: 0.1, Unique ID: 760
Description: Unnamed tributary to Green River approximately 75 feet downstream from bottom of rock face where culverted stream (locally known as Maple Brook) emerges, south of Colrain Street, Greenfield

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0207		06:41	85	130	1.1	2.7	0.10	1.9	0.050
8/29/2000	33-0231		06:51	79	140	<1.0	1.6	0.14	2.2	0.039
10/17/2000	33-0239		06:34	60	88	2.6	6.0	<0.02	1.6	0.18

DEERFIELD RIVER (Saris: 3312900)
Station: UD01, Mile Point: 38.9, Unique ID: 4
Description: Approximately 800 feet below Fife Brook Dam, Florida

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0208		04:10	4	8.3	2.3	2.4	<0.02	0.12	0.013
8/29/2000	33-0216		03:53	5	7.6	<1.0	1.3	<0.02	0.09	0.012
10/17/2000	33-0240		04:08	3 b	8.2 b	1.2	1.2 b	<0.02	0.11	0.012

DEERFIELD RIVER (Saris: 3312900)
Station: DR03, Mile Point: 25.9, Unique ID: 761
Description: At USGS gage #01168500, south of Mohawk Trail (Route 2) between Heath Road and Burrington Road, Charlemont

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0210		05:28	4	10	1.4	1.7	<0.02	0.12	0.014
8/29/2000	33-0218		05:06	6	8.9	1.8	1.1	<0.02	0.10	<0.010
10/17/2000	33-0242		05:22	7 b	10 b	1.9	1.2 b	<0.02	0.10	0.011

DEERFIELD RIVER (Saris: 3312900)
Station: DR10, Mile Point: 1.1, Unique ID: 757
Description: Downstream/east of Route 5-10 bridge, Deerfield (southern channel of river)

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	TKN	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0202		05:06	11	17	5.7	3.0	0.23	<0.02	0.25	0.022
8/29/2000	33-0226		05:19	15	19	3.4	1.3	0.19	<0.02	0.24	0.020
10/17/2000	33-0234		05:07	17	23	1.4	0.69	0.19	<0.02	0.22	0.018

Table A9 (continued)

GREEN RIVER (Saris: 3312925)
Station: GR07, Mile Point: 14.2, Unique ID: 7
Description: At USGS gage #01170100, north of East Colrain, in Colrain

Date	OWMID	QAQC	Time (24hr)	Alkalinity (mg/l)	Hardness (mg/l)	TSS (mg/l)	Turb (NTU)	NH3-N (mg/l)	NO3-NO2-N (mg/l)	TPhos (mg/l)
7/25/2000	33-0213	33-0214	07:13	32	36	<1.0	0.25	<0.02	0.06	<0.010
7/25/2000	33-0214	33-0213	07:13	31	36	<1.0	0.20	<0.02	0.04	<0.010
8/29/2000	33-0221	33-0222	06:40	36	43	<1.0	0.20	<0.02	0.07	<0.010
8/29/2000	33-0222	33-0221	06:40	38	44	<1.0	0.20	<0.02	0.07	<0.010
10/17/2000	33-0245	33-0246	07:19	26 bd	41 b	<1.0	0.45 b	<0.02	<0.02	<0.010
10/17/2000	33-0246	33-0245	07:19	35 bd	42 b	<1.0	0.35 b	<0.02	<0.02	<0.010

GREEN RIVER (Saris: 3312925)
Station: GR03, Mile Point: 1.5, Unique ID: 759
Description: Approximately 60 feet downstream/southeast from dam under Mill Street, Greenfield

Date	OWMID	QAQC	Time (24hr)	Alkalinity (mg/l)	Hardness (mg/l)	TSS (mg/l)	Turb (NTU)	NH3-N (mg/l)	NO3-NO2-N (mg/l)	TPhos (mg/l)
7/25/2000	33-0204	33-0205	06:17	41	49	4.4	2.2	<0.02	0.20	0.016
7/25/2000	33-0205	33-0204	06:17	41	49	3.9	2.6	<0.02	0.20	0.020
8/29/2000	33-0228	33-0229	06:24	43	53	2.9	1.4	<0.02	0.19	0.014
8/29/2000	33-0229	33-0228	06:24	40	52	2.2	1.5	<0.02	0.20	0.014
10/17/2000	33-0236	33-0237	06:09	45	53	1.8	1.1	<0.02	0.24	0.011
10/17/2000	33-0237	33-0236	06:09	46	53	1.6	1.1	<0.02	0.24	0.012

GREEN RIVER (Saris: 3312925)
Station: GR02, Mile Point: 0.03, Unique ID: 758
Description: Midstream, approximately 150 feet upstream/northeast of confluence with Deerfield River, Greenfield

Date	OWMID	QAQC	Time (24hr)	Alkalinity (mg/l)	Hardness (mg/l)	TSS (mg/l)	Turb (NTU)	NH3-N (mg/l)	NO3-NO2-N (mg/l)	TPhos (mg/l)
7/25/2000	33-0203		05:40	41	49	3.6	2.0	<0.02	0.26	0.015
8/29/2000	33-0227		05:49	42	53	1.8	1.2	0.33 r	0.20	0.013
10/17/2000	33-0235		05:39	44	53	1.8	1.2	<0.02	0.25	0.013

SOUTH RIVER (Saris: 3313650)
Station: SO05, Mile Point: 11.1, Unique ID: 756
Description: Under bridge at Bullitt Road, Ashfield

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0200		03:43	38	49	<1.0	0.55	<0.02	0.54	0.016
8/29/2000	33-0224		03:59	37	49	<1.0	0.55	<0.02	0.46	0.016
10/17/2000	33-0232		03:56	38	48	<1.0	0.26	<0.02	0.38	<0.010

SOUTH RIVER (Saris: 3313650)
Station: SO-8, Mile Point: 5.1, Unique ID: 9
Description: At bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0201		04:21	38	45	<1.0	0.60	<0.02	0.34	0.011
8/29/2000	33-0225		04:33	39	47	<1.0	0.35	<0.02	0.30	0.010
10/17/2000	33-0233		04:25	43	49	<1.0	0.60	<0.02	0.19	<0.010

Table A9 (continued)

NORTH RIVER (Saris: 3314100)
Station: NR04, Mile Point: 3, Unique ID: 22
Description: Adamsville Road bridge, Colrain

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0212		06:33	22	28	1.8	3.1	<0.02	0.36	0.017
8/29/2000	33-0220		06:02	26	32	<1.0	0.50	<0.02	0.30	<0.010
10/17/2000	33-0244		06:28	27 b	31 b	<1.0	0.88 b	<0.02	0.15	<0.010

NORTH RIVER (Saris: 3314100)
Station: NR03, Mile Point: 2.6, Unique ID: 21
Description: Route 112 bridge south of Griswoldville, Colrain

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0211		06:08	24	29	2.1	2.8	<0.02	0.50	0.038
8/29/2000	33-0219		05:40	27	32	5.4	0.55	<0.02	0.36	0.020
10/17/2000	33-0243		06:04	27 b	32 b	<1.0	1.2 b	<0.02	0.19	0.019

CHICKLEY RIVER (Saris: 3315425)
Station: CH, Mile Point: 0, Unique ID: 40
Description: Tower Road bridge (approximately 100 feet upstream of confluence with Deerfield River), Charlemont

Date	OWMID	QAQC	Time	Alkalinity	Hardness	TSS	Turb	NH3-N	NO3-NO2-N	TPhos
			(24hr)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
7/25/2000	33-0209		05:05	16	20	<1.0	0.20	<0.02	0.12	0.031
8/29/2000	33-0217		04:41	15	18	<1.0	0.20	<0.02	0.10	<0.010
10/17/2000	33-0241		04:50	13 b	18 b	<1.0	0.35 b	<0.02	<0.02	<0.010

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APPENDIX A1
Quality Assurance/Quality Control Data Validation for the Deerfield Watershed 2000 Water Quality Survey

Excerpted from:
Data Validation Report for Year 2000 Project Data (CN 083.0)

March 5, 2003

Department of Environmental Protection
Division of Watershed Management

5.0 2000 Discrete Water Sample Data

5.1 QA/QC Objectives and Criteria for 2000 Discrete Water Sample Data

The collection and analysis of discrete water samples in 2000 followed the DWM Standard Operating Procedure for grab sampling (CN# 1.0) and analyte-specific WES SOPs. This included the use of rinsed plastic buckets at drop locations and the taking of split samples for estimation of overall precision (QC).

Using the following criteria, as well as other considerations and input from data reviewers, individual datum were accepted, accepted with qualification or censored. In cases where poor quality control (eg. blank/cross contamination, lab accuracy) affected batched analyses or entire surveys, censoring/qualification decisions were applied to groups of samples (eg. a specific crew's samples, a specific survey's samples or all samples from a specific batch analysis).

Criteria for acceptance of discrete water quality samples were as follows:

- For simplicity, samples that were "lost", "missing", "spilled" and "not analyzed" were 'censored' using the 'm' (method not followed) qualifier.

- Sampling/Analysis Holding Time: Each analyte has a standard holding time that has been established to ensure sample/analysis integrity. Refer to DWM Standard Operating Procedure CN# 1.1 for a complete listing. If the standard holding time was exceeded, this criterion is violated and the data may be censored, depending on the extent of exceedance. For very minor exceedances (eg. < than 10% of the holding time), the data is typically qualified ("h" for minor holding time violation).

- Quality Control Sample Frequency: At a minimum, one field blank and one replicate must be collected for every ten samples by any given sampling crew on any given date. If less than 10% blanks and/or replicates were collected, the data may be censored or qualified, based on a review of crew member experience, training and history, as well as other factors relevant to the specific survey.

- Field Blanks: Field blanks were prepared at the DWM Worcester Laboratory. Reagent grade water was transported into the field in a sample container where it was transferred into a different sample container and fixed where necessary using the same method as its corresponding field sample. All blanks were submitted to the WES laboratory "blind". If the field blank results were greater than the MDL, the data may be censored or qualified, depending on extent and other factors.

- Field Replicates: In 2000, field replicate samples were taken as "split" samples, where two independent samples were created from a larger volume sample (not sequential duplicates or co-located duplicates). Both samples were submitted to WES laboratory "blind". In order for this data quality criterion to be met, the results must generally be:

- <20% Relative Percent Difference (RPD) for method detection limits >1mg/L, or
- <30% RPD for method detection limits <1mg/L.

or meet more specific criteria contained in a 2000 QAPP. If the criteria are not met, the data may be censored or qualified, depending on extent of exceedance and other factors. In most cases, poor precision of field split samples reflects potential poor reproducibility for entire surveys and/or analytical batch runs, and may lead to the censoring/qualification of same.

- Laboratory assessment of analytical precision and accuracy: The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. WES staff release discrete water sample data when their established QA/QC criteria have been met. When the following criteria cannot be met, data are qualified as "estimated" (using a "j value) if appropriate, or no data ("ND") is reported:

- Low Calibration Standards – Checks the stability of the instrument's calibration curve; analyzes the *accuracy* of an instrument's calibration within a 5% range.

- Reference Standards – Generally, a second source standard (a standard different from the calibration stock standard) that analyzes the method *accuracy.*

- Laboratory Reagent Blank/Method Blank (LRB) – Reagent grade water (de-ionized) extracted with every sample set used to ensure that the system is free of target analytes (< MDL) and to assess potential blank contamination.

- Duplicate Sample – Measures the *precision* (as Relative Percent Difference or RPD) of the analytical process. The acceptable laboratory %RPD range is typically ≤ 25%.

- Spike Sample (Laboratory Fortified Blank - LFB, Laboratory Fortified Matrix - LFM)– Measures the *accuracy* (% Recovery) of an analytical method. The acceptable laboratory % recovery range is typically between 80 – 120% for LFB samples and 70 –130% for LFM discrete water samples.

5.2 2000 Censored/Qualified Discrete Water Sample Data (by watershed)

All Year 2000 data for discrete water samples that have been censored or qualified are listed below for the Deerfield Watershed, except for missing data. Additional sample information is also provided as needed for accepted data in need of further elaboration/ discussion.

Deerfield Watershed 2000 Censored/Qualified Discrete Water Sample Data

Watershed/ Water body	Sample Date	OWMID #s	Analyte	Censored/ Qualified	Reason
Deerfield	8/29	33-0230, 231, 224, 225, 226, 227, 228 and 229	TP	***Qualify (b)***	Exceedance of MDL for ambient field blank; same crew survey data qualified; (slight exceedance of DQO for RPD for 33-0228 and 229 insufficient for (d) qualifier)
Deerfield	7/25	33-0204 and 205	TP	accept	Slight exceedance of RPD; insufficient for qualification
Deerfield	8/29	33-0228 and 0229	TSS	accept	Slight exceedance of RPD; insufficient for qualification
Deerfield	10/17	33-0240, 241, 242, 243, 244, 245, 246 and 247	ALK	***Qualify (b)***	Ambient field blank >> MDL; associated survey crew samples qualified
Deerfield	10/17	33-0240, 241, 242, 243, 244, 245, 246 and 247	Hardness	***Qualify (b)***	Ambient field blank >> MDL; associated survey crew samples qualified
Deerfield	10/17	33-0240, 241, 242, 243, 244, 245, 246 and 247	Turbidity	***Qualify (b)***	Ambient field blank >> MDL; survey crew samples qualified.
Deerfield	10/17	33-0247	TP	***Censor (m)***	Sample lost at WES
Deerfield	10/17	33-0245, 0246	ALK	***Qualify (d)***	DQO for RPD duplicate (split) precision exceeded.
Deerfield	8/29	33-0227	NH3-N	***Qualify (r)***	Sample may not be representative of field conditions.
Deerfield	7/25	33-0213, 0214	Turbidity	accept	Slight exceedance of DQO for RPD precision due to low number effect; insufficient evidence to censor or qualify
Deerfield	7/25	33-0213, 0214	NO3-N	accept	Slight exceedance of DQO for RPD precision; insufficient evidence to censor or qualify

2000 Data Symbols and Qualifiers (excerpted from CN 83.0, Appendix A)

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and Hydrolab® data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data, including the magnitude or extent of the problem(s).

General Symbols (applicable to all types):

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

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

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

Hydrolab®-specific Qualifiers:

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

Qualification Criteria for Depth (i):

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

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

“ **m ”** = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, 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 **s**heet recorded data were used to accept data, not data electronically recorded in the Hydrolab® surveyor unit, due to operator error or equipment failure.

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

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

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

Sample-specific Qualifiers:

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

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

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

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

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

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

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

" **m "** = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (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 **p**reserved per SOP or analytical method requirements.

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

APPENDIX B

***Technical Memorandum* TM-33-3**

DEERFIELD RIVER WATERSHED 2000 BIOLOGICAL ASSESSMENT

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Date: 21 October 2002

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INTRODUCTION

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

As part of the Massachusetts Department of Environmental Protection/ Division of Watershed Management's (MA DEP/DWM) 2000 Deerfield River watershed assessments, aquatic benthic macroinvertebrate and fish biomonitoring was conducted to evaluate the biological health of various portions of the watershed. A total of fourteen biomonitoring stations were sampled to investigate the effects of various nonpoint and point source stressors on the aquatic communities of the watershed. Some stations sampled during the 2000 biomonitoring survey were previously "unassessed" by DEP, while historical DEP biomonitoring stations—most recently assessed in 1988 and 1995 (Fiorentino 1997)—were reevaluated to determine if water quality and habitat conditions have improved or worsened over time. To minimize the effects of temporal (seasonal and year to year) variability, sampling was conducted at approximately the same time of the month as the 1988 and 1995 biosurveys. Sampling locations, along with station identification numbers and sampling dates for fish and benthos monitoring, are noted in Table 1. Sampling locations are also shown in Figure 1.

To provide additional information necessary for making basin-wide aquatic life use-support determinations required by Section 305(b) of the Clean Water Act, all Deerfield River watershed macroinvertebrate biomonitoring stations were compared to a regional reference station most representative of the "best attainable" conditions in the watershed. Use of a regional reference station is particularly useful in assessing nonpoint source pollution and nutrient/BOD loadings originating from multiple and/or unknown sources in a watershed, as well as nonpoint source pollution impacts (e.g., physical habitat degradation) at upstream control sites and downstream sites suspected as chemically-impacted from known point source stressors (Hughes 1989). Regional reference stations were established in the Cold River (fourth-order) and Bear River (third-order). Both stations were situated upstream from all known point sources of water pollution, and they were also assumed (based on topographic map examinations and field reconnaissance) to be relatively unimpacted by nonpoint sources. The decision of which reference station to use for comparisons to a study site was based on comparability of stream morphology, flow regimes, and drainage area.

During "year 1" of its "5-year basin cycle", problem areas within the Deerfield River watershed were better defined through such processes as coordination with appropriate groups (EOEA Deerfield River Watershed Team, local watershed associations, DEP/DWM, DEP/WERO), assessing existing data, conducting site visits, and reviewing NPDES and water withdrawal permits. Following these activities, the 2000 biomonitoring plan was more closely focused and the study objectives better defined. Table 2 includes a summary of the perceived problems/issues—both historical and current—addressed during the 2000 Deerfield River watershed biomonitoring survey.

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

1. Conduct benthic macroinvertebrate and fish population sampling at locations throughout the Deerfield River watershed;

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

3. Using the benthic macroinvertebrate data, fish population data, and supporting water chemistry (when available) and field/habitat data:

- assess the types of water quality and/or water quantity problems that are present.
- make recommendations for remedial actions.
- provide macroinvertebrate, fish population, and habitat data to DEP/DWM's Environmental Monitoring and Assessment Program for assessments of aquatic life use-support status required by Section 305(b) of the Federal Clean Water Act (CWA).
- provide macroinvertebrate, fish population, and habitat data for other informational needs of Massachusetts regulatory agencies, as well as the Executive Office of Environmental Affairs (EOEA) Massachusetts Watershed Initiative (MWI) Deerfield River Watershed Team.

Table B1. List of biomonitoring stations sampled during the 2000 Deerfield River watershed survey, including station identification number, mile point (distance from confluence with Deerfield River), drainage area, station description, sampling date, and type of sampling (i.e., biota sampled) conducted. Due to limited resources, benthos sampling was not conducted at PH00. Due to equipment constraints, fish sampling was not conducted at GR01, GR02, NOR01, VP11BEA, and LDR01.

Station ID	Mile Point	Drainage Area (mi^2)	**Deerfield River Watershed** Site description	Sampling Date- Biota Sampled
CR01*	0.80	29.72	Cold River, upstream from Trout Brook, Charlemont, MA	25 Sep. 2000- Benthos 26 Sep. 2000- Fish
VP11BEA*	1.70	9.97	Bear River, upstream from Shelburne Falls Road, Conway, MA	27 Sep. 2000- Benthos
PB01	0.25	13.60	Pelham Brook, upstream from Rowe Road, Charlemont, MA	25 Sep. 2000- Benthos 26 Sep. 2000- Fish
DM00	0.10	3.07	Davis Mine Brook, upstream from Mill Brook, Charlemont, MA	25 Sep. 2000- Benthos 27 Sep. 2000- Fish
MB01	1.10	11.16	Mill Brook, downstream from Harris Mtn. Road, Charlemont, MA	25 Sep. 2000- Benthos 27 Sep. 2000- Fish
CH01	0.75	27.07	Chickley River, upstream from Deerfield River, Charlemont, MA	25 Sep. 2000- Benthos 26 Sep. 2000- Fish
NOR01*	0.80	90.51	North River, upstream from Rt. 112, Shattuckville, Colrain, MA	26 Sep. 2000- Benthos
NOR02A*	9.40	50.08	East Branch North River, downstream from Rt. 112, Colrain, MA	26 Sep. 2000- Benthos 27 Sep. 2000- Fish
TB00	0.20	5.16	Taylor Brook, upstream from Heath Road, Colrain, MA	26 Sep. 2000- Benthos 27 Sep. 2000- Fish
SOR01*	2.50	24.12	South River, upstream from Truce Road, at USGS gage, Conway, MA	27 Sep. 2000- Benthos 28 Sep. 2000- Fish
PH00	0.20	1.50	Pumpkin Hollow Brook, upstream from Academy Hall Road, Conway, MA	28 Sep. 2000- Fish
GR01*	0.75	57.42	Green River, downstream from footbridge off Rt. 5-10, Greenfield, MA	27 Sep. 2000- Benthos
GR02*	7.0	20.19	Green River, downstream from Eunice Williams Drive, Greenfield, MA	26 Sep. 2000- Benthos
LDR01*	8.0	374.40	Deerfield River, upstream from Interstate 91, Deerfield, MA	27 Sep. 2000- Benthos

* Macroinvertebrate biomonitoring conducted here by DEP in 1988 and 1995 (Fiorentino 1997).

Table B2. List of perceived problems addressed during the 2000 Deerfield River watershed biomonitoring survey. Specific biomonitoring stations addressing each problem are also listed.

Deerfield River Watershed Station	**Issues/Problems**
Cold River (CR01)*	Potential NPS (road runoff, campground) Reference condition[4]
Bear River (VP11BEA)*	Miscellaneous NPS (road and golf course runoff)[1] Reference condition[4]
Pelham Brook (PB01)	Upstream landfill (uncapped, unlined)[1] Unassessed for aquatic life[2]
Davis Mine Brook (DM00)	Acid mine drainage/pH impairment[1, 3] Habitat alteration[3] Unassessed for aquatic life[2]
Mill Brook (MB01)	Acid mine drainage via Davis Mine Brook[1] Miscellaneous NPS Unassessed for aquatic life[2]
Chickley River (CH01)	Agricultural/livestock runoff[1] Unassessed for aquatic life[2] 303(d)-listed impoundments upstream[3]
North River (NOR01)*	Miscellaneous NPS (agricultural/road runoff, erosion)[1, 3] Industrial discharge upstream, aesthetics (color)[1,2, 3] Recent acid spill upstream[5]
East Branch North River (NOR02A)*	Colrain landfill (uncapped, unlined)[1] Miscellaneous NPS (agricultural/road runoff, yard waste)[1]
Taylor Brook (TB00)	Potential impacts from upstream housing development[1] Road runoff Unassessed for aquatic life[2]
South River (SOR01)*	Miscellaneous NPS (agricultural runoff)[1] Habitat alteration[3]; Sewage treatment (Ashfield) upgrades[6] Potential landfill impacts via Pumpkin Hollow Brook[1]
Pumpkin Hollow Brook (PH00)	Upstream landfill (inactive, unlined)[1] Miscellaneous NPS (agricultural/road runoff)[1] Unassessed for aquatic life[2]
Green River (GR01)*	Urban runoff (stormwater, road runoff)[1,4,6] Illicit sewer connections/dry weather discharges[5] Metals[3]; Habitat degradation[4]
Green River (GR02)*	Miscellaneous NPS (agricultural/road runoff)[1] Unassessed for aquatic life[2]
Deerfield River (LDR01)*	Flow regulation/alteration[4] Unknown NPS impacts Upstream point source discharges[4]

* Macroinvertebrate biomonitoring conducted here by DEP in 1988 and 1995 (Fiorentino 1997)

[1] (EOEA 1999)

[2] (MA DEP 2000)

[3] (MA DEP 1999)

[4] (Fiorentino 1997)

[5] (Duerring, EOEA Deerfield River Watershed Team, personal communication)

[6] (MA DEP 1997)

DEERFIELD RIVER WATERSHED
BIOMONITORING STATIONS

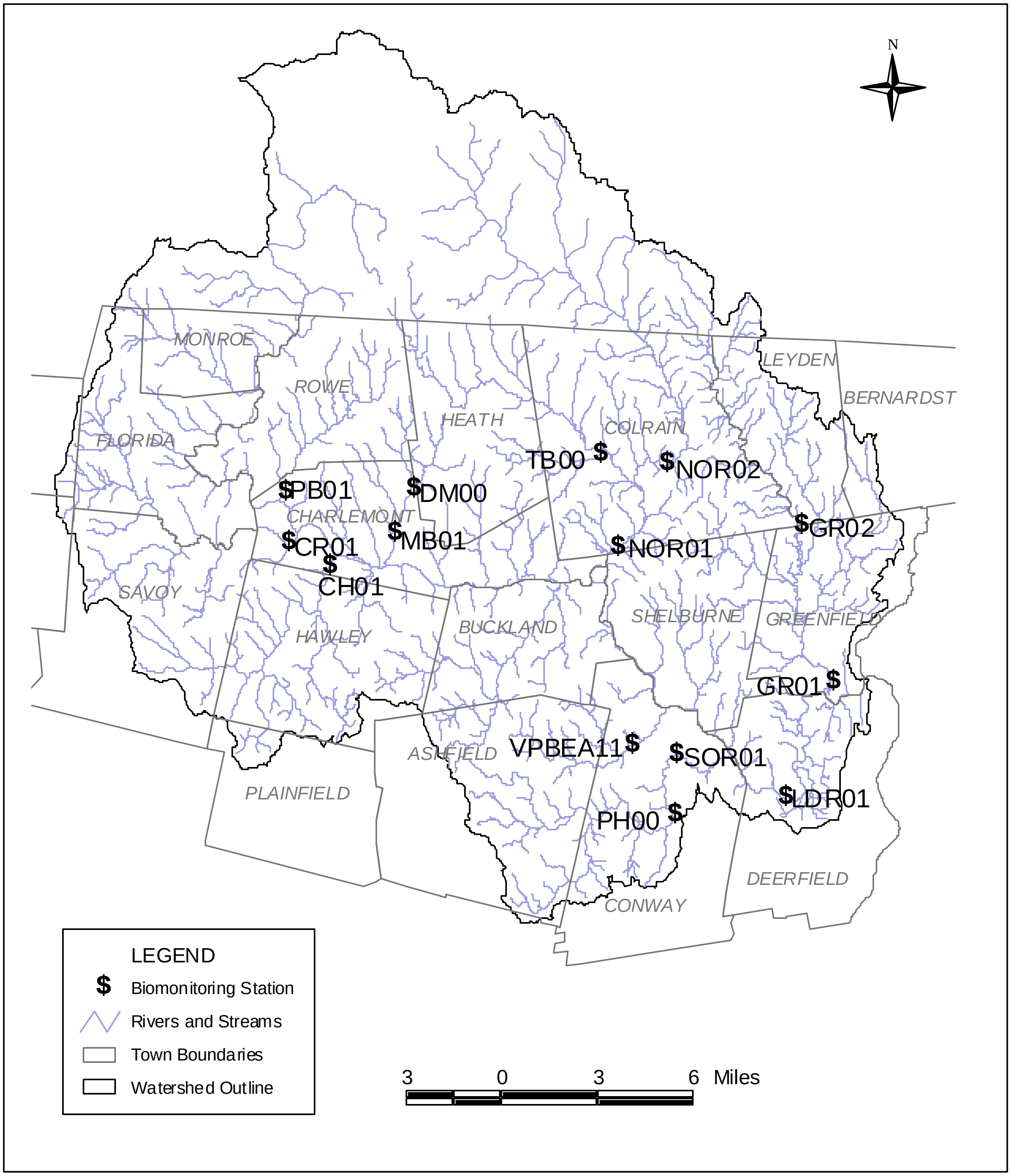

Figure B1. Location of DEP/DWM biomonitoring stations for the 2000 Deerfield River watershed survey.

METHODS

Macroinvertebrate Sampling - RBPIII

The macroinvertebrate sampling and processing procedures employed during the 2000 Deerfield River watershed biomonitoring survey are described in the standard operating procedures (Nuzzo 1999a), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Barbour et al. 1999). The macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream (Figure 2). Sampling activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) for benthic macroinvertebrate biomonitoring (Fiorentino 2002). Sampling was conducted by DEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the DEP/DWM lab for further processing.

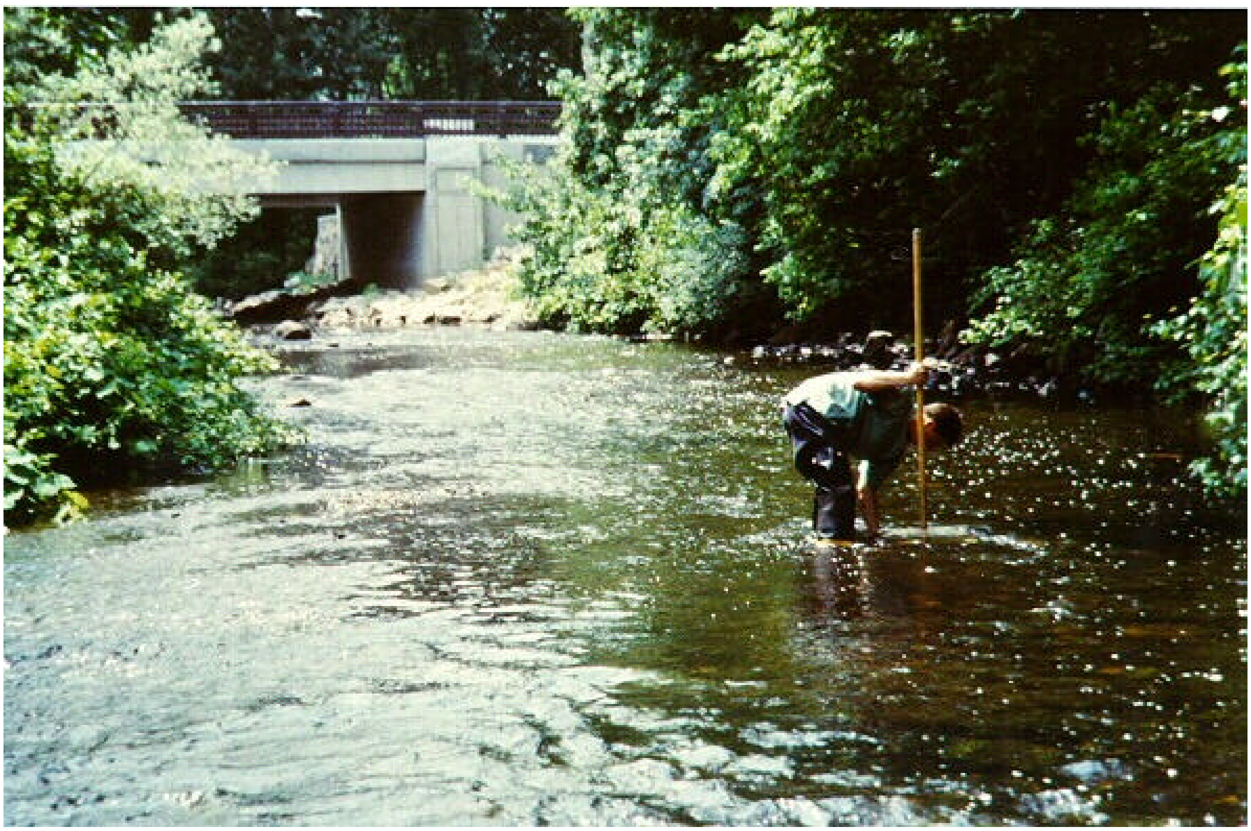

Figure B2. MA DEP/DWM biologist collecting macroinvertebrates using the "kick-sampling" technique.

Fish Population Sampling

The fish sampling and processing procedures employed during the 2000 Deerfield River watershed biomonitoring survey are described in Method 003/11.20.95 Fish Collection Procedures (MA DEP 2002b), and are similar to Rapid Bioassement Protocol V (RBPV) as described originally by Plafkin (1989) and later Barbour et al. (1999). Sampling activities also included a habitat assessment component modified from that described in the aforementioned document.

Fish populations were sampled by electrofishing using a Smith Root Model 12 battery powered backpack electrofisher. A reach of between 80 m and 100 m in length was sampled by passing a pole-mounted anode ring nside to side through the stream channel and in and around likely fish cover. All fish fished were netted and held in buckets. Sampling proceeded from an obstruction or constriction at the downstream end of the reach to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle at the upstream end of the reach. Following completion of a sampling run, all fish were identified to species, measured, weighed, and released.

Macroinvertebrate Sample Processing and Analysis

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

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

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

3. Biotic Index—Based on the Hilsenhoff Biotic Index (HBI), this is an index designed to produce a numerical value to indicate the level of organic pollution (Hilsenhoff 1982). Organisms have been assigned a value ranging from zero to ten based on their tolerance to organic pollution. Tolerance values currently used by DEP/DWM biologists were originally developed by Hilsenhoff and have since been supplemented by Bode et al. (1991) and Lenat (1993). A value of zero indicates the taxon is highly

intolerant of pollution and is likely to be found only in pollution-free waters. A value of ten indicates the taxon is tolerant of pollution and may be found in highly polluted waters. The number of organisms and the individually assigned values are used in a mathematical formula that describes the degree of organic pollution at the study site. The formula for calculating HBI is:

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

where
xi = number of individuals within a taxon
ti = tolerance value of a taxon
n = total number of organisms in the sample

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

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

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

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

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

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

Fish Sample Processing and Analysis

The RBP V protocol (Plafkin et al. 1989; 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 exists for Massachusetts' surface waters, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of 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 Plafkin et al. (1989), 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 Meixler (2000) modified regionally following discussions with MA DEP and MA Division of Fisheries and Wildlife (DFW) biologists.

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

Habitat Assessment

An evaluation of physical and biological habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2000 Deerfield River watershed biosurveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and the immediate riverfront area. Most parameters evaluated are instream physical attributes often related to overall land-use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a reference station to provide a final habitat ranking.

RESULTS AND DISCUSSION

The biological and habitat data collected at each sampling station during the 2000 biosurveys are attached as an Appendix (Tables A1 – A5). Fish population data were collected at eight of the thirteen stations where macroinvertebrates were collected and at one additional station not sampled for macroinvertebrates. Included in the macroinvertebrate and fish taxa lists (Table A1 and A5) are total organism counts, the functional feeding group designation (FG) for each macroinvertebrate taxon, the habitat and trophic class for each fish taxon, and the tolerance value (TV) of each taxon (macroinvertebrates and fish).

Summary tables of the RBP III macroinvertebrate data analyses, including biological metric calculations, metric scores, and impairment designations, are included in the Appendix as well. Table A2 is the summary table for those biomonitoring stations that used the Cold River (CR01) as the regional reference station. Table A3 is the summary table for station comparisons to the Bear River reference site (VP11BEA). Habitat assessment scores for each station are also included in the summary tables, while a more detailed summary of habitat parameters is shown in Table A4.

The 2000 biomonitoring data for the Deerfield River watershed generally indicate good overall water quality and biological health at most of the stations investigated. Impairment of resident biota was most severe at the Davis Mine Brook station (DM00), where suspected toxic effects resulting from acid mine drainage were evident and appear to persist farther downstream in Mill Brook (MB01). Other anthropogenic perturbations affecting biological integrity were detected in the Chickley (CH01) and East Branch North (NOR02A) rivers, where the presumed effects of organic enrichment probably related to agricultural/livestock runoff resulted in impacts to the aquatic community. The non-impacted benthic communities observed at stations in the South (SOR01) and Green (GR01) rivers were encouraging, as these stations were clearly impacted by nonpoint source pollution during DEP's 1995 Deerfield River watershed survey (Fiorentino 1997). Reference-quality biomonitoring stations in the Bear (VPBEA11) and Cold (CR01) rivers continue to support diverse and well-balanced aquatic communities expected in a "least-impacted" stream system.

Deerfield River Watershed

The Deerfield River, a tributary to the Connecticut River, drains 663 square miles of northwestern Massachusetts and south central Vermont. More than one-half of the Deerfield River watershed, 347 square miles, is in Massachusetts and includes most of Franklin County and parts of Berkshire and Hampshire Counties. The beginning of the Deerfield River in Massachusetts is at the Vermont-Massachusetts border, which intersects the Sherman Reservoir on the Massachusetts side at Monroe and Rowe. It then flows 44 miles to its confluence with the Connecticut River.

Most of the Deerfield River watershed drainage area is in the Berkshire Hills physiographic province where the topography consists of narrow river valleys bordered by steep hill slopes. The southeastern part of the watershed is part of the Connecticut Valley Lowlands physiographic province where the topography is flatter than the Berkshire Hills. Land surface altitudes in the watershed range from 120 feet above sea level in the Connecticut Valley Lowlands to 2,841 feet above sea level in the Berkshire Hills. Average annual precipitation ranges from 44 inches in the low altitudes of the southeast to 50 inches in the high altitudes in the western part of the watershed.

The watershed is bordered in Massachusetts by the Hoosic, Westfield, and Connecticut River watersheds. Major tributaries to the Deerfield River, in order of decreasing drainage area are: the North River (92.9 square miles), the Green River (89.8 square miles), the Cold River (31.7 square miles), the Chickley River (27.4 square miles), the South River (26.3 square miles), and Clesson Brook (21.2 square miles).

The watershed area covers all or a part of twenty municipalities: Heath, Monroe, Florida, Savoy, Rowe, Charlemont, Hawley, Colrain, Buckland, Plainfield, Ashfield, Conway, Shelburne, Leyden, Bernardston, Greenfield, Deerfield, Goshen, North Adams, and Adams. In 1990, the population in this rural watershed was about 35,300, with more than 50 percent of the population in the City of Greenfield (18,666 people) in the Connecticut Valley lowlands. Land-use in the watershed consists of forest (81%), agriculture and open land (13%), urban development (4%) and surface water (2%).

The steep gradient of the Deerfield River has been extensively utilized in the production of hydroelectric power. Seven hydroelectic dams regulate flows along the mainstem Deerfield River in Massachusetts, although these provide only a small amount of the stored water used to generate electricity. Most of the water used to operate the generating stations is stored in reservoirs on the headwaters of the Deerfield River in Vermont. Balancing hydroelectric power generation with other uses such as recreational and ecological has resulted in a newly negotiated Federal Regulatory Energy Commission (FERC) relicensing agreement between power companies and the States of Massachusetts and Vermont and the Deerfield Compact, an *ad hoc* group representing local interests.

There are currently seven permitted NPDES discharges in the Deerfield River watershed, including the non-contact cooling water permit for the Yankee Atomic Electric Company. The largest is the Greenfield wastewater treatment plant, which is being renovated. Among the renovations is the relocation of the discharge point from the Green River to the Deerfield River. The downtown section of Ashfield has been sewered and the sewage is being treated in a newly-built Solar Aquatics alternative wastewater treatment facility, which discharges to the groundwater.

Water released from the dams affects the entire range of stream flow and causes mulitple daily stream stage fluctuations. The river gradient averages 28.4ft/mi from the Vermont border to the streamflow-gaging station at West Deerfield, a distance of about 33 river miles. The United States Geological Survey (USGS) currently maintains five flow monitoring stations in the Massachusetts portion of the watershed; two of these on the mainstem Deerfield River. The other three are located on the North, South and Green Rivers. Flow information recorded at each USGS gaging station during the 2000 DEP/DWM biomonitoring survey period (25 to 28 September) is available online (USGS 2002), and can be found in Table 3.

Table B3. Flow data (stream discharge) recorded at each of five USGS flow-gaging stations in the Deerfield River watershed during the 2000 biomonitoring survey from 25 to 28 September. Data are available online (USGS 2002).

Gaging Station	Gage Location	Date (2000)	Daily Mean Stream Flow (cubic feet/sec)
01168500	Deerfield River, at Charlemont, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	220 250 325 273
01170000	Deerfield River, near West Deerfield village, Deerfield, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	452 417 476 449
01169000	North River, at Shattuckville village, Colrain, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	100 84 81 74
01169900	South River, near Conway, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	22 21 26 21
01170100	Green River, near Colrain, MA	25 Sept. 26 Sept. 27 Sept. 28 Sept.	46 39 37 33

Cold River

From its headwaters near Florida State Forest and just upstream from Blackstone Road in Florida, the Cold River flows in a generally southeasterly direction before joining the mainstem Deerfield River in Charlemont. The minimally developed Cold River subwatershed drains numerous tributaries and small ponds, many of which lie within Savoy Mountain and Mohawk Trail State forests. The steep gradient of much of this fourth-order river and its tributaries provides dramatic scenery and offers excellent recreational opportunities, especially fishing, hiking, and kayaking.

CR01—Cold River, mile point 0.80, upstream from Trout Brook, 250 m downstream from entrance to Mohawk Trail State Forest campground, Charlemont, MA.

Habitat

The CR01 sampling reach began approximately 250 m downstream from the access road to the Mohawk Trail State Forest campground. Almost completely open-canopied, the reach was approximately 14 m wide, with a relatively uniform depth of 0.40 m throughout much of its riffle-dominated length. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Rocky substrates, subjected to swift current velocity, provided excellent riffle habitat for epifaunal macroinvertebrates. In addition, large boulders provided stable cover and good fish habitat throughout the reach (though pool habitat was somewhat limited). Instream vegetation was absent; however, a thin coating of filamentous green algae covered much of the substrates. Riparian and bank parameters generally scored well. Banks were well-vegetated with shrubs (witch-hazel, *Hamamelis virginiana*) and herbaceous (ferns and mosses) growth before giving way to a forest-dominated (alder, *Alnus* sp.; hemlock, *Tsuga canadensis*; maple, *Acer* spp.) riparian zone. Riparian growth was undisturbed along the right (west) bank, while a dirt road/path resulted in minor disturbance near the left (east) bank.

Nonpoint source pollution was not evident in the sampling reach; however, runoff from the upstream campground and small footpaths (probably used by fishermen) adjacent to the reach offered potential inputs. In addition, the road (Route 2) adjacent to this portion of the Cold River—while adequately buffered from the CR01 reach—may be a potential source of road salt and sediment inputs farther upstream, especially where it crosses the river.

CR01 received a composite habitat score of 178/200—one of the higher habitat evaluations received by a biomonitoring station in the Deerfield River watershed (Table A4). This was used as the primary reference station for comparisons to biomonitoring stations in the mainstem Deerfield River (LDR01), North River (NOR01, NOR02A), Chickley River (CH01), South River (SOR01), and Green River (GR01, GR02)—all of which are predominately open-canopied reaches with comparable flow regimes, instream habitat, and upstream drainage areas. Designation of CR01 as a reference condition was based on its high habitat evaluation, historically good water quality (MA DEQE 1979; MA DEP 1989; MA DEP 1997), minimal NPS pollution inputs, and minimal upstream/adjacent land-use impacts (i.e., absence of point source inputs, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well-vegetated riparian zone).

Benthos

The Cold River biomonitoring station was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community, with metric values indicative of good water quality and "least-impacted" conditions (Table A2). In particular, those attributes that measure components of community structure (i.e., Taxa Richness, Biotic Index, EPT Index)—which display the lowest inherent variability among the RBP metrics used (Resh 1988)—scored well, further corroborating the designation as a reference station. An extremely low Biotic Index (3.48—one of the lowest of all the Deerfield River watershed biomonitoring stations), a high (second highest value in the survey) EPT Index, and low dominance of a single taxon relative to other biomonitoring stations in the survey indicated a dominance of pollution-sensitive taxa among the CR01 benthos assemblage, and good overall community balance. And while chironomids were fairly well represented here, the dominant midge taxon, *Polypedilum aviceps*, is considered a "clean water" indicator—assigned a low tolerance value and rarely associated with impacted waters (Bode and Novak 1998). The CR01 benthic community received a total metric score of 42 out of a possible score of 42 (Table A2).

Fish

Fish sampling efficiency at CR01 was rated poor. This was mostly due to the width of the stream and the presence of extensive riffle/run type habitat. It was difficult to keep fish ahead of the electrical field—many fish were seen escaping downstream and to the sides of the electrofishing crew. Fish species captured, in order of abundance, included Atlantic salmon (*Salmo salar*), blacknose dace (*Rhinichthys atratulus*), longnose dace (*Rhinichthys cataractae*), and brown trout (*Salmo trutta*) (Table A5). The presence of three intolerants, as well as two-year classes of Atlantic salmon, is indicative of excellent water and habitat quality. It is unclear as to what effect, if any, the stocking of Atlantic salmon fry and the presence of brown trout may be having on brook trout, which were not collected within this reach.

Bear River

The headwaters of this third-order stream begin in Ashfield just east of Ridge Hill. The newly formed river flows through a golf course where it is impounded and then continues in a southeasterly direction until it passes into Conway. There it changes direction, flowing to the northeast and receiving the drainages of Sids and Drakes brooks. After passing under Shelburne Falls Road, the river enters a very steep valley before its confluence with the Deerfield River in Conway. With the exception of the golf course and a few sand/gravel pits, the Bear River subwatershed is relatively undisturbed and forested, with minimal residential development.

VP11BEA—Bear River, mile point 1.70, 100 m upstream from Shelburne Falls Road, Conway, MA.

Habitat

The VP11BEA sampling reach began approximately 100 m upstream from Shelburne Falls Road and meandered through a hemlock (*Tsuga canadensis*) and red maple (*Acer rubrum*) dominated forest that provided a mostly (>75%) closed canopy. This portion of the stream was approximately 10 m wide, ranging in depth from 0.30 m in the riffles to 0.50 m in the deepest pool areas. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Well-developed riffle areas with a variety of stable hard substrates (boulder/cobble, submerged logs) offered exceptional habitat for fish, and especially, macroinvertebrates. Dense bryophyte cover on much of the rock substrates provided additional productive microhabitat for macroinvertebrates. Thin layers of periphyton covered substrates in almost half of the sampling reach. Embeddedness and sediment deposition were virtually nonexistent. Bank stability was excellent along the well-vegetated (ferns and mosses) left (west) bank, while the steepness of the right (east) bank led to small areas of sloughing (i.e., "healed-over" bank). The majority of the east bank was stabilized with massive boulders and large tree roots. The dense forest along the west side of the stream provided an unlimited and undisturbed riparian vegetative zone throughout the reach. And despite the close proximity of Shelburne Falls Road, the east bank's riparian zone was well-buffered with shrubs (mountain laurel, *Kalmia latifolia*; witchhazel, *Hamamelis virginiana*) and tree growth. There were no signs of nonpoint source pollution in the immediate area.

VP11BEA received a composite habitat score of 176/200 (Table A4). This was used as the primary reference station for comparisons to biomonitoring stations in Mill Brook (MB01), Davis Mine Brook (DM00), Taylor Brook (TB00), Pelham Brook (PB01), and Pumpkin Hollow Brook (PH00, habitat comparisons only)—all of which are mostly closed-canopied reaches with comparable flow regimes, instream habitat, and drainage area. In addition, VP11BEA was used as a secondary reference station for CH01 and SOR01—stations within larger drainage areas, yet comparable to the Bear River in terms of stream order. Designation of VP11BEA as a reference condition was based on its high habitat evaluation, historically good water quality (MA DEQE 1979; MA DEP 1997), minimal nonpoint source pollution inputs, and minimal upstream/adjacent land-use impacts (i.e., absence of point source inputs, lack of channelization, minimal development and agricultural activity nearby, undisturbed and well-vegetated riparian zone).

Benthos

VP11BEA was characterized by a diverse, taxa-rich (taxa richness=31) assemblage that included a number of highly intolerant EPT taxa (Table A3). In fact, the Plecoptera, generally considered the most pollution-sensitive insect order, was represented by four families among the VP11BEA biota. The Ephemeroptera, another sensitive insect order, was also well represented and included the numerically dominant taxon *Rithrogena* sp., which has a tolerance value of zero and requires well-oxygenated water. In general, the benthic community here was well-balanced—a Percent Dominant Taxon of 12% was very low relative to the other tributary stations in the survey—with all major trophic groups represented.

VP11BEA received a total metric score of 42 (Table A3). The optimum community and trophic structure exhibited in the macroinvertebrate assemblage here suggest that this portion of the Bear River is indeed indicative of the "best-attainable" conditions in the Deerfield River watershed.

Pelham Brook

Pelham Brook originates in the hills of northern Rowe, flowing southward into Pelham Lake. From the outlet of Pelham Lake the stream continues in a southwesterly direction, receiving the drainages from several first-order tributaries before joining the Deerfield River just upstream from the Cold River. Land-use throughout much of the Pelham Brook subwatershed consists of relatively undeveloped forest or light residential development. Pelham Lake and its shoreline are used for recreational activities. The Town of Rowe maintains an active (uncapped, unlined) landfill located on Zoar Road and in close proximity to Pelham Brook (EOEA 1999).

PB01—Pelham Brook, mile point 0.25, 200 m upstream from Rowe Road, Charlemont, MA.

Habitat

PB01 began approximately 200 m upstream from Rowe Road in a mostly forested area of hemlocks (*Tsuga canadensis*) and various hardwoods (birch, *Betula* spp.; maple, *Acer* spp.; alder, *Alnus rugosa*), and some light residential development. The 7 m wide sampling reach was dominated by fast water (i.e., riffles) ranging in depth from 0.25 – 0.50 m, with occasional pools as deep as 0.75 m. A variety of rocky substrates—especially boulder and large cobble—and varying velocity-depth combinations provided excellent benthic habitat for macroinvertebrates. Fish habitat was also optimal, with boulders and submerged woody material in both riffles and deep pools providing ample cover throughout the mostly (60%) shaded reach. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Instream vegetation and algae were absent. Both stream banks were stabilized with large boulders (naturally occurring, not “rip-rap”) along the entire length of the sampling reach. Banks were well-vegetated with herbaceous (ferns and mosses) growth before giving way to the densely forested riparian zone.

Two single-family homes were situated adjacent to the stream near the top and bottom of the reach; however, trees provided an adequate riparian buffer between the stream channel and the homes. No other potential sources of nonpoint pollution were observed.

PB01 received a total habitat assessment score of 187/200, which was higher than most of the Deerfield River watershed biomonitoring stations, including both the Bear River and Cold River references stations (Table A4). The riparian zone along the left bank, which was somewhat reduced due to the adjacent residences, was the only habitat parameter scoring less than optimal.

Benthos

The PB01 benthic community received a total metric score of 38, representing 90% comparability to reference conditions at VP11BEA and resulting in a biological assessment of “non-impacted” (Table A3). Although total taxa richness was slightly reduced compared to the VP11BEA assemblage, richness of the pollution sensitive EPT taxa was equal to that of the reference station. And the Biotic Index here was actually lower than the reference community, due in large part to the abundance of the highly sensitive (TV=0) perlodid stonefly, *Sweltsa* sp. The EPT/Chironomidae and Scrapers/Filterers metrics also performed better than the benthic community observed at VP11BEA—in fact, an EPT/Chironomidae metric value of 7.36 was the highest of all the biomonitoring stations in the 2000 survey and suggests good community balance.

Based on the biological assessment of the macroinvertebrate community encountered at PB01, it appears that water quality effects related to the upstream landfill and/or impoundment are absent or imperceptible here. The resident benthos, instead, appear to reflect the diverse and high quality habitat afforded them in this portion of Pelham Brook.

Fish

Fish sampling efficiency at PB01 was rated excellent. Fish species captured in order of abundance included slimy sculpin (*Cottus cognatus*), longnose dace, Atlantic salmon, brook trout (*Salvelinus fontinalis*,), blacknose dace, and brown trout (Table A5). The presence of five intolerants, two-year classes of Atlantic salmon, and the dominance of slimy sculpin are indicative of excellent water and habitat quality. It is possible and likely that the stocking of Atlantic salmon fry is having a negative effect on the number of brook trout present; however, at the present time the large amount of instream fish cover in the form of boulders may provide enough habitat for both species. Long-term monitoring of the Atlantic salmon and brook trout populations at this site would be valuable.

Mill Brook/Davis Mine Brook

A third-order stream, Mill Brook originates in western Heath near the Rowe border. The stream flows in a southerly direction, joining the mainstem Deerfield River in Charlemont center just downstream from Route 2. Along its course, major discharge contributions come from Maxwell and Davis Mine brooks. The Mill Brook subwatershed is mostly forested, with some light residential development mainly located along Route 8A and additional commercial activity near its mouth in downtown Charlemont. Davis Mine Brook has historically received the acid drainage of the now-defunct Davis Mine, which was an important source of iron pyrite (used for the manufacturing of sulfuric acid) during the late nineteenth century (Franklin County 2002).

DM00—Davis Mine Brook, mile point 0.10, 200 m upstream from Mill Brook, Charlemont, MA.

Habitat

The sampling reach in this extremely high-gradient second-order stream began almost immediately upstream from its confluence with Mill Brook in a densely forested portion of the subwatershed. A series of cascades and plunge pools, the partially (50%) shaded stream was approximately 4 m wide, with depths of 0.10 – 0.50 m in the riffles and pools about 0.50 m deep. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Boulder and cobble substrates provided excellent macroinvertebrate habitat in the riffle areas, while a variety of submerged woody materials (snags and submerged logs) provided potential instream fish cover throughout the reach. Instream vegetation was minimal and consisted mainly of mosses, while occasional mats of green and brown algae were observed in both pool and riffle areas. Much of the hard instream substrates—especially cobble, gravel, and sand—appeared reddish in color, probably the result of ferric inputs from upstream mining activities. Both stream banks were well-vegetated with herbaceous (ferns and mosses) and shrubby growth, and stability was good despite the steep nature of the embankment. Riparian growth was undisturbed along the right (west) bank, consisting of a dense evergreen/deciduous forest dominated by hemlock (*Tsuga* sp.), birch (*Betula* sp.), beech (*Fagus* sp.), and red maple (*Acer rubrum*). Riparian vegetative growth was greatly disrupted along the left (east) bank, however, due to an encroaching residential property. Nonpoint source pollution associated with this property poses a serious threat to this portion of Davis Mine Brook, as it serves as a “junkyard” for numerous cars and trucks (including school buses), auto-parts, appliances, and other forms of scrap metal and debris. The early-model automobiles observed here suggest dumping has occurred at this site over the course of several years—possibly decades.

DM00 received a total habitat assessment score of 174/200 (Table A4). The extremely reduced riparian vegetative zone width along the east bank affected the total score most negatively.

Benthos

Most striking at DM00 was the low diversity and depauperate nature of the resident benthos assemblage. In fact, even after spending an inordinate (i.e., several hours) amount of time “picking” the DM00 benthos sample, it was impossible to attain a 100-organism subsample from the original sample due to the extremely low densities of organisms present. As a result of the small subsample size, direct metric comparisons to the reference community were not appropriate. Even without conducting a RBPIII analysis of the DM00 community, however, the macroinvertebrate assemblage encountered here clearly reflects the effects of severe environmental stress and possibly toxic impacts.

Water quality impacts to Davis Mine Brook—specifically low pH values—related to the acid-mine drainage of Davis Mine have historically been documented by DEP (MA DEP 1997, 1999, and 2000). Hall et al. (1980) suggest that acidification affects aquatic organisms in the following ways: (1) directly through changes in physiology; (2) indirectly by the increase of trace metal concentrations that may be toxic to many organisms—often resulting in reduced total abundance and species richness; and (3) indirectly through food availability, that is, by reduced primary production and/or reduced bacterial decomposition.

The impoverished (i.e., low species richness and abundance) nature of the DM00 biota appears typical of aquatic communities residing in the receiving waters of acid mine runoff (or airborn acidification for that matter) (Wiederholm 1984). In addition, other aspects of the trophic and community structure of the macroinvertebrate assemblage are consistent with past studies of acidified streams. Scrapers and filter-feeders, usually very common in virtually all types of lotic stream systems of varying water quality, were conspicuously absent from the DM00 sample. According to Smith et al. (1990), these functional groups are more susceptible to the effects of acidification than other groups such as shredders which comprised almost half of the DM00 subsample (Table A1). This may be, in part, the result of acid-induced reductions in organic food resources normally made available through primary production and bacterial decomposition of plant/algal matter. Also noticeably absent were the Ephemeroptera (mayflies), an insect group known to be highly sensitive to acidification (Johnson et al. 1993).

Although mining activities associated with the Davis Mine were terminated in the early 1900s, the effects of mining appear to linger in this portion of the Davis Mine Brook/Mill Brook subwatershed. The persistence of specific or cumulative acid-mine impacts—most notably, low pH, high concentrations of heavy metals, and ferric hydroxide precipitation—will undoubtably continue to be reflected in the aquatic community of Davis Mine Brook for many more years. In fact, studies suggest that the complete recovery of macroinvertebrate communities in areas affected by acid-mine drainage may require several decades (Wiederholm 1984).

Fish

Despite very stable fish habitat in the form of boulders, cobble, and submerged woody materials (snags and submerged logs), not a single fish was captured or observed in Davis Mine Brook. It appears, then, that the severe water quality problems originating from Davis Mine and reflected in the macroinvertebrate community here have impacted the fish populations as well—completely eliminating them from this stream. In light of the fact that Davis Mine Brook may be causing negative impacts to the Mill River, restoration of this stream should be a Deerfield River watershed priority.

MB01—Mill Brook, mile point 1.10, 500 m downstream from Harris Mountain Road (adjacent to Route 8A), Charlemont, MA

Habitat

Station MB01 began approximately 500 m downstream from Harris Mountain Road in Charlemont and closely paralleled Route 8A. The mostly (70%) shaded reach was approximately 8 m wide and dominated by fast water, with riffle areas ranging in depth from 0.10 – 0.50 m. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. An abundance of boulder and cobble substrates offered excellent epifaunal habitat for benthic macroinvertebrates, while deep (0.50 – 0.75 m) pools containing boulders and fallen trees provided excellent cover and habitat for fish. With the exception of some instream mosses, aquatic vegetation was absent, as was algal growth. Both stream banks were well-vegetated with ferns, mosses and trees before giving way to a forested riparian zone dominated by evergreens (hemlock, *Tsuga canadensis*; white pine, *Pinus strobus*) and occasional birches (*Betula* spp.). Banks were moderately unstable, with 30-60% of the steep embankments in the sampling reach exhibiting areas of erosion. There were no signs of nonpoint source pollution in the reach. And despite the close proximity of the adjacent road (Route 8A) near the right (west) bank, it was well buffered with riparian vegetation.

MB01 received a total habitat assessment score of 181/200, which was higher than most of the Deerfield River watershed biomonitoring stations, including both the Bear River and Cold River reference stations (Table A4). Only the habitat parameter for bank stability scored less than optimal. Observed areas of bank instability and erosion appeared to be naturally occurring—probably the result of high spring flows and exacerbated by the steepness of the banks.

Benthos

Despite the high-quality habitat available, the MB01 macroinvertebrate community received a biological assessment of "slightly impacted". A total metric score of 30 was 71% comparable to the reference community in the Bear River (Table A3). Metrics for Taxa Richness, EPT/Chironomidae, and Percent Dominant Taxon all performed worse than the reference station. Most pronounced were point reductions for the EPT Index metric, the lowest value (10)—with the exception of DM00—of all the biomonitoring stations in the Deerfield River watershed survey. Interestingly, taxa most sensitive to organic pollutants—most notably plecopterans such as *Sweltsa* sp (TV=0; 25 individuals recorded in sample), were well-represented and contributed to a low Biotic Index (3.49). This suggests that water quality perturbations other than organic/nutrient loadings may compromise biological integrity in this portion of Mill Brook. The abundance (n=17) of the chironomid *Eukiefferiella claripennis* gr. in the MB01 benthos sample may be significant, as this taxon has been associated with toxic wastes (Bode and Novak 1998). As the MB01 biomonitoring station is only about 2 km downstream from the Davis Mine brook confluence, it is possible that the effects of the acid mine drainage observed at DM00 continue to persist here as well—though not to the extent seen at Davis Mine Brook where the dilution capacity is probably considerably less than in this portion of Mill Brook. That taxa most vulnerable to acidified conditions (e.g., scrapers, mayflies) are well represented at MB01 corroborates the improved water quality conditions here compared to the degradation observed upstream at Davis Mine Brook. And while the acid-mine drainage originating from Davis Mine Brook is one obvious potential source of water quality impacts, other stressors may exist as well. Already mentioned as a threat to water quality and biological potential is the dumping occurring near the mouth of Davis Mine Brook. And while much of the upper portion of the Mill Brook subwatershed is relatively undeveloped, other potential sources of anthropogenic perturbation may exist as well.

As water quality, rather than habitat quality, appears to limit biological integrity in this portion of Mill Brook, additional monitoring of various physico-chemical parameters would be instrumental in determining the specific types of water quality degradation present here.

Fish

Fish sampling efficiency at MB01 was rated as good (70% pickup). The sampling reach included stable habitat for fish in the form of boulders, rocky runs, and isolated pools; however, there was very little habitat in the slow/deep category. Fish species captured in order of abundance included Atlantic salmon, brook trout, and blacknose dace (Table A5). Overall numbers were relatively low with a total of 55 fish being collected. Although three of the species collected are classified as intolerant, the low numbers and absence of slimy sculpin and longnose dace should be noted. Two-year classes of Atlantic salmon dominated the fish community with brook trout outnumbered almost 2.5 to 1. Salmon and brook trout may be competing for a limited amount of space. In addition, the inflow of Davis Mine Brook located just upstream from this station may be contributing to fish community impacts (e.g., low densities) at MB01.

Chickley River

The Chickley River originates just south of Borden Mountain in Savoy Mountain State Forest. A third/fourth-order stream, it receives the drainage of several small tributaries as it flows eastward into Hawley and Kenneth Dubuque State Forest. After receiving considerable discharge contributions here from Fuller, King, and Basin brooks, the river veers north along Route 8A. After its confluence with Mill Brook, the river continues north until it joins the mainstem of the Deerfield River in Charlemont. Much of the Chickley River subwatershed is extensively forested and undeveloped. Residential development is light and mainly confined to the Route 8A corridor. Numerous small farms are located along the river—agricultural activity is most common in the Hawley portion of the subwatershed. Agricultural runoff from livestock has historically contributed to water quality degradation in the Chickley River near its mouth (MA DEP 1997; MA DEP 1999). The EOEA Deerfield River Watershed Team has been working with local farmers and conservation commissions to address this problem (EOEA 1999). Some grant-funded BMP implementation has occurred in the lower portion of the Chickley River since the last DEP/DWM water quality survey conducted in 1995.

CH01—Chickley River, mile point 0.75, 900 m upstream from confluence with Deerfield River, Charlemont, MA.

Habitat

Near the mouth of the Chickley River, the sampling reach began immediately upstream from a driveway crossing located just off Route 8A in Charlemont. The 12 m-wide open-canopied (<5% shaded) reach meandered through an area densely forested along the left (west) bank and with some field/pasture near the right (east) bank. Riffle areas dominated the reach, including deep (0.90 m) rapids where bedrock slabs constricted channel width. Rocky substrates subjected to varying (0.10 – 0.90 m) depths of swift water, provided excellent instream macroinvertebrate habitat throughout much of the station, though the marginal channel flow status (channel <75% full) resulted in a fair amount of exposed epifaunal substrates along the margins of the stream. Fish habitat was also good, with boulders and bedrock ledges providing the majority of the cover. Aquatic vegetation was absent and algal growth was minimal, consisting mainly of small patches of filamentous green forms on rock substrates. Both banks were well-vegetated with ferns, mosses, and herbaceous (including Japanese knotweed, *Polygonum cuspidatum*) growth. The steep nature of the banks, however, led to small erosional areas along the west bank and more severe instability along the east bank. Riparian vegetation was well-established along both banks, and was especially extensive along the forested (hemlock, *Tsuga canadensis*; American beech, *Fagus grandifolia*; red maple, *Acer rubrum*) left (west) bank.

Nonpoint source pollution inputs were not evident at CH01; however, sediment deposition—consisting of substantial sand-bar formation—affected much of the sampling reach. Origins of instream sedimentation here are unknown, although an active sand pit is located just upstream (off of Pudding Hollow Road). In addition, Route 8A crosses the river at several upstream points in the Chickley River subwatershed. CH01 received a total habitat assessment of 163/200 (Table A4). Sediment deposition, bank (east bank) erosion, and low base-flow affected habitat quality most negatively.

Benthos

The CH01 benthos assemblage received a total metric score of 32, representing 76% comparability to its primary reference station, CR01, and resulting in a biological assessment of “slightly impacted” (Table A2). Metric comparisons to the secondary reference station, VP11BEA, resulted in only 67% comparability to the “best-attainable” conditions and again a “slightly impacted” bioassessment (Table A3).

Most notable in the CH01 benthos analysis was the low value (0.04; score=0 relative to both reference stations) for the Scraperer/Filterer metric, suggesting an overabundance of FPOM in the CH01 sampling reach. Indeed, net-spinning forms of caddisflies (e.g., Hydropsychidae; Philopotamidae) were well-represented in the benthos sample (Table A1). These filter-feeders use silken nets to strain fine organic particulates from the water column. In addition, the reduced EPT/Chironomidae metric value relative to both the Bear River and Cold River reference stations indicates the displacement of pollution sensitive forms of EPT taxa by chironomids, generally considered more tolerant of conventional organic pollutants and corroborating the effects of organic enrichment in this portion of the river. Chironomids, specifically the numerically dominant *Polypedilum aviceps*, were the primary cause of point reductions for the Percent Dominant Taxon metric (Tables A1 and A2). In addition, the abundance of *P. aviceps* may reflect the low base-flow conditions observed during the biosurvey here, as this species is known to survive dry conditions or periods of reduced base-flow (Bode, NY DEC, personal communication).

Agricutural runoff—most notably from livestock, which have been observed wading in the river just upstream from CH01 (MA DEP 1997)—has been historically documented by MA DEP (1997) as the cause of high fecal coliform bacteria counts in the lower portion of the Chickley River. In other rural western Massachusetts watersheds, DWM has witnessed similar nonpoint source pollution inputs (e.g., cows wading in the stream channel or grazing nearby) just upstream from biomonitoring reaches that have resulted in similarly impacted (i.e., reduced EPT/Chironomidae and EPT Index metric values) benthic communities (Nuzzo 1999b).

In addition to agriculture-related organic inputs, the effects of enrichment seen in the biota at CH01 may result from its location downstream from numerous upstream impoundments. Productive conditions in these waterbodies may account for the delivery of FPOM to downstream communities such as CH01.

Fish

Fish sampling efficiency at CH01 was rated as poor. The presence of deep pools and fast-moving deep runs, as well as heavy downpours during the fish survey, limited both visibility and accessibility in much of the reach. Several habitat types were present for fish, including stable cover in the form of boulders, ledges, and deep pools. Fish species captured in order of abundance included Atlantic salmon, slimy sculpin, longnose dace, blacknose dace, brown trout and rainbow trout (*Onchorynchus mykiss*) (Table A5). Overall numbers were relatively low with a total of 44 fish being collected. All trout collected were large specimens that may have been stocked. The presence of two-year classes of Atlantic salmon was consistent with other streams in the watershed that receive fry stocking annually. Two of the three remaining species collected are classified as intolerant. In light of the presence of many intolerant species and despite the poor sampling efficiency it appears that the Chickley River is supporting a balanced fish community. It is unclear what effect the stocking of trout (and salmon) is having on the fish community in this segment.

North River

The fourth/fifth-order North River is formed by the confluence of its East and West Branches at the village of Griswoldville in the Town of Colrain. From here it flows south about three miles to its confluence with the Deerfield River. Both branches and the mainstem North River are similar, flowing through narrow, steep valleys. The flow is on a steep gradient and is shallow, rapid, and turbulent. Land-use in the North River subwatershed is dominated by mostly undeveloped forestland and light residential development. Agricultural (i.e., small-scale farming) activities are common along the North River and its East Branch—in many cases crops are planted immediately adjacent (i.e., minimally buffered) to the river. Streambank erosion, exacerbated by agriculture-related riparian disruption, has been documented by MA DEP (1997) at the East and West Branch confluence and has been addressed with BMP implementation (Duerring, EOEA Deerfield River Watershed Team, personal communication 2000). In addition, BBA Nonwovens possesses a NPDES permit for the discharge of industrial waste to the North River in the village of Griswoldville (MA DEP 2002a). Formerly permitted as Veratec, Inc., BBA is currently engaged in the manufacturing of non-woven products, as well as the bleaching and dyeing of woven/knitted fabrics. In addition, the facility treats the sanitary waste from nearby residences. There are two discharges from the BBA plant: 1) The biological wastewater (comprised of the process wastewater as well as the sanitary wastewater from the nearby residences) treatment system discharge; and 2) The Filter Backwash discharge. Effluent from the BBA discharge(s) (and Veratec, Inc. prior to that) has historically compromised instream aesthetics (water color) in this portion of the river (Fiorentino 1997; MA DEP 1999).

The USGS maintains a flow-gaging station in the village of Shattuckville (Colrain). Stream flow was 84 cubic feet/second (cfs) during the macroinvertebrate biomonitoring surveys at NOR01 and NOR02A (Table 3). Flow at the gage was 81 cfs during the fish population survey at NOR02A (Table 3).

NOR01—North River, mile point 0.80, 100 m upstream from Route 112, Colrain, MA.

Habitat

The NOR01 biomonitoring station began approximately 100 m upstream of Route 112 and about 1 km upstream of the confluence with the Deerfield River in the Shattuckville section of Colrain. Here the stream was approximately 10 m wide and 0.30 - 1 m deep. The open-canopied (<5% shaded) sampling reach meandered through a hemlock-dominated forest that was especially dense along the left (east) bank of the channel. The right (west) bank, consisting of a dense profusion of flood plain vegetation, was fairly well buffered from the road (approximately 50 m away). The dramatic series of rapids throughout the NOR01 reach provided macroinvertebrates with excellent habitat, with an abundance of rock substrates (cobble and boulder) and a variety of velocity/depth combinations. Deep riffles and pools with occasional submerged logs offered stable cover for fish as well. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Substrate embeddedness and sediment deposition were fairly minimal and confined to the slower pool areas that dominated the middle of the reach. Considerable algal growth was observed on cobble substrates throughout the reach, consisting of thin layers of green algae (i.e., periphyton) covering 90% of the stream bottom. Both stream banks were stable and well-vegetated with ferns, grasses, and other herbaceous (Japanese knotweed, *Polygonum cuspidatum*; smartweed, *Polygonum* sp.) growth. Riparian vegetation was undisturbed along the left (south) bank and well-established between the left bank and a nearby field. Riparian growth consisted of a shrubby (witch hazel, *Hamamelis* sp.; willow, *Salix* sp.) layer along the banks giving way to a forest of mostly hemlock (*Tsuga canadensis*), maple (*Acer* spp.), sycamore (*Platanus occidentalis*), elm (*Ulmus* sp.), and ash (*Fraxinus* sp.) trees.

Nonpoint source pollution was not observed in the sampling reach; however, sediment inputs were observed nearby. Road runoff is diverted to the river from Route 112 via a paved drainage swale, which enters the river just downstream from the bottom of the sampling reach. Here substantial deposits of sand were observed both instream and along the right (west) bank, where a small "beach" has developed (although some of this sand may be naturally occurring flood plain soil).

NOR01 received a habitat assessment score of 187, which was one of the highest scores received by a biomonitoring station during the 2000 survey (Table A4). Instream deposition and the adjacent agricultural activities (plowed field) compromised the overall habitat assessment only slightly.

Benthos

The macoinvertebrate community sampled at NOR01 received a total metric score of 36, representing 86% comparability to the Cold River (CR01) reference station and resulting in a "non-impacted" assessment for biological condition (Table A2). Despite slight reductions in the number of EPT taxa present in the NOR01 benthos assemblage, total taxa richness was higher here than at CR01. Relative abundance of the EPT taxa was also high (EPT/Chironomidae score=6), and coupled with a low Percent Dominant Taxon metric value (14%), indicates good community balance at NOR01.

It appears, then, that discharge loads generated from the BBA facility are assimilated by the North River before appreciable impacts are detected in the downstream biota, as reflected by the healthy macroinvertebrate assemblage observed at NOR01. Likewise, the effects of potential nonpoint source stressors (e.g., agriculture-related runoff and bank erosion) that may originate farther upstream from the sampling reach appear negligible or absent in this portion of the river.

Results of the 2000 biological assessment of the benthic community at NOR01 are consistent with those found in 1995, when the DEP biomonitoring efforts yielded a diverse, well-balanced macroinvertebrate community considered to be "non-impaired" (Fiorentino 1997).

NOR02A—North River (East Branch), mile point 9.40, 500 m downstream from Route 112, Colrain, MA.

Habitat

The NOR02A sampling station began approximately 500 m downstream from Route 112 in Colrain center. Land-use in the immediate area was mainly undeveloped forest, with some light residential and commercial development associated with the village of Colrain as well. This portion of the East Branch is minimally shaded (<5%) and wide (13 m), with depths of 0.30 – 0.90 m in the riffle-dominated sampling reach. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. An abundance of boulder and cobble substrates subjected to swift current velocity provided macroinvertebrates with excellent epifaunal habitat. Fish habitat was also optimal, with large boulders in deep pockets of water providing good cover. Instream algal cover was substantial—thin layers of green algae covered virtually all available hard substrates in both riffles and slower areas. Both stream banks were well-vegetated with ferns, mosses, and a shrub layer dominated by witchhazel (*Hamamelis virginiana*). Despite their steepness, banks were highly stable—the result of large boulders and established root masses along the margins of the stream channel. Riparian vegetative zone width was good, especially along the right (north) bank where a dense hardwood (elm; *Ulmus* sp.; sycamore, *Platanus occidentalis*; alder, *Alnus rugosa*; hop hornbeam, *Ostrya virginiana*) forest provided an unlimited buffer. Riparian growth was slightly compromised along the left (south) bank of the upper half of the reach due to an encroaching residential property. Yard waste (grass clippings, leaves, brush) and trash associated with this property provided a potential source of nonpoint pollution inputs to NOR02A. Road runoff originating from the Route 112 crossing just upstream from NOR02A is also a potential pollution source.

NOR02A received a total habitat assessment score of 190/200—higher than both reference stations in the Deerfield River watershed (Table A4). Only one other station scored better during the 2000 biomonitoring survey.

Benthos

The NOR02A benthos assemblage received a total metric score of 34, which was 81% comparable to the CR01 community and placed the benthos intermediate to the “non-” and “slightly impacted” categories for biological condition (Table A2).

Coupled with a slightly reduced metric value for EPT Index and a somewhat elevated Biotic Index, the reduced EPT/Chironomidae metric value (score=2) relative to the CR01 reference station indicates the displacement of pollution sensitive forms of EPT taxa by chironomids, generally considered more tolerant of conventional organic pollutants. *Polypedilum* spp. were particularly abundant at NOR02A, comprising more than 25% of the sample (Table A1). Interestingly, this genus was also well-represented in the 1995 macroinvertebrate sample taken here by DEP (Fiorentino 1997). The numerical dominance of the NOR02A benthos by the chironomid *Polypedilum flavum*, which can be numerous in streams with high concentrations of suspended organic particulates (Bode and Novak 1998), further corroborates the slightly enriched nature of this stream system. That similar enrichment effects were not observed in the benthic community farther downstream at NOR01 may be due in part to the increased assimilative capacity of the North River after receiving considerable discharge contributions from the West Branch North River.

Other metrics performed comparably to reference conditions. Most notably, Taxa Richness was higher at NOR02A than at the Cold River station. And high scores (score=6) for both the Scraper/Filterers and Percent Dominant Taxon metrics suggest generally good community balance and trophic structure here despite the abundance of *Polypedilum* spp.

Fish

Fish sampling efficiency at NOR02A was rated as poor. The presence of wide, deep stretches and fast-moving runs made sampling difficult in the reach. All habitat types were present. Fish species captured in order of abundance included Atlantic salmon, longnose dace, blacknose dace, banded killifish (*Fundulus diaphanous*), tessellated darter (*Etheostoma olmstedi*), and yellow bullhead (*Ameiurus natalis*) (Table A5). Overall numbers were relatively low with a total of 30 fish being collected. The presence of Atlantic salmon is consistent with other streams in the watershed that receive fry stocking annually. Due to poor sampling efficiency, it is unclear whether this reach is supporting a balanced fish community. It is also unclear what effect, if any, the stocking of salmon is having on the fish community in this segment.

Taylor Brook

A small, second/third order stream, Taylor Brook is formed by the merger of Kinsman and Davenport brooks near the Colrain-Heath border. The stream flows east through mainly undeveloped forest (with the exception of the Heath Estates residential development) before joining the North River’s West Branch near the Adamsville section of Colrain, approximately two miles upstream from the mainstem North River.

TB00—Taylor Brook, river mile 0.20, 100 m upstream from Heath Road, near mouth, Colrain, MA.

Habitat

The TB00 biomonitoring station began 100 m upstream from Heath Road and approximately 0.20 miles upstream from Taylor Brook's confluence with the West Branch of the North River. The fully (100%) shaded, high-gradient stream reach was approximately 5 m wide, with a depth of 0.10 – 0.50 m. Cobble substrates and riffle-dominated flow regimes provided excellent epifaunal habitat for benthic organisms, while submerged woody materials and boulders offered optimal cover for fish. Some substrates were unavailable as fish and macroinvertebrate habitat, however, as marginal channel flow status (channel only 50% full) resulted in cobble/gravel bars mid-channel and a fair amount of exposed substrates along the margins of the stream.

Both stream banks were well-vegetated with ferns and mosses before giving way to wide riparian zones. The riparian buffer was especially extensive along the right (south) bank, consisting of a dense evergreen/deciduous forest of shrubs (mountain laurel, *Kalmia latifolia*; witchhazel, *Hamamelis virginiana*) and stands of hemlock (*Tsuga Canadensis*), yellow birch (*Betula alleghaniensis*), slippery elm (*Ulmus* sp.), and white ash (*Fraxinus* sp.).

Bank stability was good within the reach; however, serious bank erosion resulting in "raw" areas and obvious bank sloughing was observed immediately upstream from the sampling reach along the right (south) bank. In addition, a large area of erosion was noted further upstream of the sampling reach on the southern bank under a power line crossing. Bank erosion, which to some degree may be naturally-occurring, may be at least partially responsible for the considerable instream sediment deposition and slight turbidity observed at TB00. Upstream road crossings (Heath Road intersects Taylor Brook numerous times along its course) may contribute sediment loads as well.

TB00 received a total habitat assessment score of 157/200—the third lowest score received by a biomonitoring station during the 2000 survey (Table A4). Instream habitat constraints related to low base-flow and sedimentation compromised habitat quality the most here.

Benthos

The benthos assemblage at TB00 received a total metric score of 38, which was highly (90%) comparable to the reference condition at VP11BEA and resulted in a "non-impacted" assessment for biological condition (Table A3). Pollution sensitive EPT taxa were well represented in the TB00 benthos sample, while total taxa richness was slightly higher than the reference station. Affinity to the reference station was extremely high—in fact, a Reference Affinity of 84% was the highest of all biomonitoring stations being compared to VP11BEA. And although the Percent Dominant Taxon metric suffered point reductions, this was mainly the result of high densities of the mayfly *Serratella* sp., a highly intolerant taxon that requires well-oxygenated waters.

Potential nonpoint source pollution inputs (e.g., septic leachate) originating from Heath Estates do not appear to influence biological integrity in this portion of Taylor Brook, as evidenced by the diverse and well-balanced macroinvertebrate community observed. Rather, the greatest threat to the resident benthos at TB00 is probably instream sedimentation—presumably originating from streambank instability (i.e., erosion) and/or road runoff. Sand and other fine sediments drastically reduce macroinvertebrate microhabitat by filling the interstitial spaces of epifaunal substrates. In addition, the filling of pools with sediment reduces fish cover and may be detrimental to fish spawning habitat and egg incubation. While it is possible that the high-gradient nature of Taylor Brook allows for the "flushing through" of sediments before they can be a significant impediment to the integrity of resident biota, future biological impairment related to increased sediment loads here, as well as impacts farther downstream in the West Branch North River, should be considered.

Fish

Fish sampling efficiency at TB01 was rated as good (70% pickup). The reach included stable habitat for fish in the form of boulders, shallow and deep riffles, isolated small pools, and some woody debris. Pools located on the stream margins appeared to be filled with fine sediment. A total of 71 fish were collected. Species presence and relative abundance has been documented; however, the original field sheets are no longer available. The fish community at TB01 was dominated by intolerant fishes, including slimy sculpin, Atlantic salmon, longnose dace, and eastern brook trout. Longnose dace, brown trout, blacknose dace, and white sucker were also present (Table A5). Continued sedimentation of this stream reach threatens habitat, which may in turn have a negative effect on overall numbers of fish this reach is able to support. As is the case with all the other reaches that are stocked with Atlantic salmon, it is unclear what effect, if any, fry stocking is having on the other fish present.

South River

The third-order South River originates as the outlet from Ashfield Pond in Ashfield. The river flows east approximately seven miles to Conway. The gradient is generally steep, and the velocity accordingly rapid—the exception being two swampy areas that briefly break the gradient. After receiving discharge contributions from Pumpkin Hollow Brook, a first-order stream in Conway, the South River turns almost directly north and flows north and then east for six miles at a steep gradient to the Deerfield River—near-stream, small-scale agriculture is common along its course and has historically compromised and/or threatened water quality in this portion of the river (Fiorentino 1997; MA DEP 1997; MA DEP 1999). This stretch of the South River is swift-flowing and is not interrupted by any breaks in the gradient. The South River indirectly receives the treated effluent (via groundwater discharge) of the Ashfield WWTP—an alternative technology (Solar Aquatics) wastewater treatment facility (MA DEP 2002a). Much of the light residential and commercial development in the South River subwatershed is concentrated in the centers of Conway and Ashfield.

The USGS maintains a flow-gaging station in Conway. Stream flow was 26 cfs during the macroinvertebrate biomonitoring survey at the nearby SOR01 station. During the fish population survey at SOR01, flow was 21 cfs (Table 3).

SOR01—South River, mile point 2.50, 50 m upstream from Truce Road and USGS gage, Conway, MA.

Habitat

SOR01 began approximately 50 m upstream of Truce Road and the USGS gaging station, where the stream meanders through a forest of hemlock and mixed hardwoods. This mostly (60%) shaded portion of the South River was approximately 9 m wide with an average depth of 0.25 m in the riffle areas and 0.40 m in the pools. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. Substrates were dominated by cobble, boulder, and gravel, providing generally good habitat for macroinvertebrates; however, epifaunal microhabitat was somewhat reduced due to substrate embeddedness and instream sediment deposition. A considerable amount of sand had also been deposited along the left (north) bank in the vicinity of the gaging station just below the sampling reach, probably the result of runoff from Truce Road. Fish habitat was also optimal—in addition to large boulders, submerged logs and snags provided a mix of stable cover. Instream aquatic vegetation was absent, although thin layers of periphyton covered the substratum in most of the reach.

Riparian and bank structure were good—both banks were well stabilized with vegetation (moss, ferns, grasses) and boulders, with only occasional areas of erosion observed along the steep right (south) bank. Riparian vegetation was well established along both sides of the stream—grasses and herbaceous (ferns) growth dominated the stream margins, giving way to shrubs (witchhazel, *Hamamelis virginiana*) and trees (white ash, *Fraxinus* sp.; elm, *Ulmus* sp.; hemlock, *Tsuga canadensis*; red maple, *Acer rubrum*; yellow birch, *Betula allaghaniensis*) farther from the banks.

SOR01 received a total habitat assessment score of 170/200 (Table A4). Though overall instream habitat was considered good in the sampling reach, sediment deposition and associated substrate embeddedness continue to threaten benthic habitat quality here—as was noted during the previous DEP biomonitoring survey conducted in 1995 (Fiorentino 1997).

Benthos

Unlike the 1995 bioassessment conducted here, CR01 was used as the primary reference station for the SOR01 benthic community, with benthos metric comparisons resulting in an assessment of "non-impacted" based on 95% comparability to the reference (Table A2). When using the Bear River station as a reference—as was the case in 1995—the SOR01 benthic community was again found to be "non-impacted" and highly comparable (90%) to reference conditions (Table A3).

Several metric values for the SOR01 benthos assemblage—most notably Taxa Richness and EPT Index—equaled or outperformed those for both reference stations. Richness metric values almost doubled those calculated here during the 1995 biosurvey (Fiorentino 1997). In addition, community structure (composition and dominance) at SOR01 in 2000 appeared markedly better than during the previous survey. Better trophic balance was also evident in the macroinvertebrate community sampled here in 2000 compared to the 1995 community—filter-feeders, in particular, were less numerically dominant here than during the previous biosurvey, indicating the importance now of food resources other than FPOM in this portion of the South River. That the 2000 survey found a reduction in the number of filter-feeding taxa—and to a lesser extent, algal scrapers—suggests the effects of organic/nutrient enrichment may not be as pronounced here as during the 1995 biomonitoring survey.

The apparent improvements in water quality and associated biological integrity here may be the result of agricultural BMP implementation upstream, elimination of failing septic systems through sewering, and/or upgrades to the Ashfield WWTP since the 1995 biosurvey. In addition, effects from the instream habitat degradation documented in 1995—though still an ongoing threat to aquatic habitat potential here—may have also been reduced

Fish

Fish sampling efficiency at SOR01 was rated poor. This was mostly due to the width of the stream and the presence of extensive riffle/run type habitat. It was difficult to keep fish ahead of the electrical field and many fish were seen escaping downstream and to the sides of the electrofishing crew. Overall numbers of fish collected were low (n=53). Fish species captured in order of abundance included blacknose dace, Atlantic salmon, common shiner (*Luxilus cornutus*), longnose dace, and creek chub (*Semotilus atromaculatus*) (Table A5). The presence of two intolerants is indicative of good water and habitat quality; however, the sample was dominated by more tolerant species and may be indicative of higher productivity or watershed nonpoint source impacts such as agriculture. It is unclear as to what effect, if any, the stocking of Atlantic salmon fry may be having on brook trout, which were not collected within this reach.

Pumpkin Hollow Brook

PH00—Pumpkin Hollow Brook, mile point 0.20, 100 m upstream from Academy Hill Road, Conway, MA.

The PH00 sampling reach began approximately 150 m upstream from Academy Hill Road in the center of Conway. The fully (100%) shaded reach was located just upstream of a baseball field. The stream was only about 3 m wide with an average depth of 0.25 m in the riffle areas and up to 0.50 m in the deepest "plunge" pools. Channel flow status was optimal, with water reaching the base of both banks and leaving very little exposed substrates. The cobble-dominated stream bottom and swift current velocity offered good habitat for macroinvertebrates; however, occasional instream deposits of silt/sand and associated substrate embeddedness was problematic. Instream mosses provided additional epifaunal microhabitat. Other forms of aquatic vegetation and algae were absent. Fish habitat was slightly less than optimal, with snags and small pools providing most of the stable cover. Pool areas, while of adequate depth, were affected by sediment deposition and bar formation.

Both stream banks were fairly well-vegetated with mosses and herbaceous growth. Bank instability was observed along the left (west) bank, where the steep nature of the bank resulted in small areas of erosion. Bank erosion was most severe at the downstream end of the 100 m sampling reach. Riparian vegetation grew undisturbed along the left (west) bank, with riverbank grape (*Vitis* sp.) along the stream margin giving way to various hardwoods (maple, *Acer* sp.; ash, *Fraxinus* sp.; cherry, *Prunus* sp.). A narrow layer of trees and herbaceous (blackberry, *Rubus allegheniensis*; greenbrier, *Smilax rotundifolia*) understory vegetation provided a riparian buffer from the adjacent ball field along the right (east) bank.

PH00 received a total habitat assessment score of only 146/200—the second lowest habitat score received by a biomonitoring station during the 2000 survey (Table A4). Instream sediment deposition and substrate embeddedness clearly affect overall habitat quality most negatively here. Sediment inputs may originate from erosional areas along the left (west) bank of the sampling reach or farther upstream where severe bank erosion (i.e., "landslides") was observed, in addition to agricultural activities farther upstream (near Maple Street and Old Cricket Hill Road) where heavy siltation was observed during spring field reconnaissance.

Fish

Fish sampling efficiency at PH00 was rated as excellent (>80% pickup). The reach included stable habitat for fish in the form of boulders, isolated small pools, and some woody debris. Some of the pools contained deposits of fine sand, and moderate embeddedness of cobble substrate was noted. A total of 315 fish were collected. In addition, young of the year creek chub and common shiner were noted as being too numerous to count. The fish community at PH00 was dominated by moderately tolerant (creek chub and common shiner), and tolerant (blacknose dace) species. Brook trout, Atlantic salmon, and longnose dace were also present, however their numbers were very low. (Table A5). The relative scarcity of Atlantic salmon is to be expected as this reach is not stocked with fry. Fish numbers were extremely high which leads one to suspect that nutrient enrichment from upstream nonpoint sources (e.g., agriculture, landfill) may be having an effect on this reach. Continued sedimentation of this stream reach threatens habitat, especially in the pool areas.

Deerfield River

The Massachusetts portion of the fifth-order Deerfield River begins from the Vermont-Massachusetts border, which intersects the Sherman Reservoir on the Massachusetts side at Monroe and Rowe. From here the Deerfield River meanders south and west through the narrow valley forming the border first between Monroe and Rowe and then Rowe and Florida. In this stretch it flows over the dam at Sherman Reservoir and New England Power Dam #5 at Monroe Bridge. About five miles farther downstream, the hydroelectric Fife Brook Dam impounds the river and releases water from the hypolimnion. As the river reaches the eastern portal of the Hoosac Tunnel it turns south and east entering Charlemont where the gradient lessens. The river continues eastward, receiving considerable discharge contributions from the Cold River near Route 2 in the Mohawk Trail State Forest, Charlemont.

From the confluence with the Cold River in Charlemont the Deerfield River flows about a mile and a half before being joined by the Chickley River in Charlemont. Approximately one mile below Charlemont center the river becomes the boundary between Buckland and Charlemont flowing east about four miles through a fairly broad valley. As the river passes under Route 2 it turns north flowing over a hydroelectric dam and is joined at the top of its northward loop by the North River at the border of Charlemont, Buckland and Shelburne.

From the confluence with the North River, the Deerfield River heads due south through the towns of Buckland and Shelburne Falls. It then resumes a southeasterly course passing over three hydroelectric dams in the next three miles. The river continues to form the boundary between Buckland and Shelburne and then Conway and Shelburne and finally Conway and Deerfield before entering Deerfield. In this stretch the river is joined by the Bear and South rivers. In Deerfield, the river enters a broad valley where the bedrock changes from metamorphic and igneous rock to sedimentary sandstone and shale. The velocity in this stretch slows due to low gradient and backwater from the Connecticut River. As the river passes under Interstate 91, it meanders north again through South and North Meadows paralleling the highway. At the border between Deerfield and Greenfield the river turns east again and is joined by the Green River at the golf course in south Greenfield.

The USGS maintains flow-gaging stations in Charlemont and in the village of West Deerfield (Deerfield). At the West Deerfield gage, which is approximately 1.5 miles upstream from the macroinvertebrate biomonitoring station at LDR01, flow was 476 cfs during the time of the biosurvey (Table 3).

LDR01—Deerfield River, mile point 8.0, 400 m downstream from Stillwater Bridge, Deerfield, MA.

Habitat

LDR01 was located approximately midway between the Stillwater Bridge and Interstate 91, in a relatively undeveloped portion of the Deerfield River. A wide (35 m) and open-canopied (<5% shaded) portion of the Deerfield River, the LDR01 sampling reach ranged in depth from 0.30 m – 1 m. Channel flow status was good, with water easily reaching the base of both banks. An abundance of cobble and boulder substrates, subjected to a variety of velocity/depth combinations provided excellent epifaunal habitat for macroinvertebrates. Deep riffles and pools with large boulders offered stable cover and good habitat for fish. Instream algal cover was substantial, with a thin layer of periphyton covering most rocky substrates and occasional patches of filamentous green algae present as well.

Bank and riparian habitat parameters scored highly. Banks were well-vegetated with herbaceous vegetation (especially Japanese knotweed, *Polygonum cuspidatum*) and stabilized with large boulders and root masses. A forested riparian zone—comprised of shrubs (rose, *Rosa* sp.; dogwood, *Cornus stolonifera*; buckthorn, *Rhamnus* sp.) and deciduous trees (maple, *Acer* spp.; sycamore, *Platanus occidentalis*; elm, *Ulmus* sp.)—extended undisturbed from the left (north) bank and provided a good vegetative buffer from the nearby road (Stillwater Road) along the right (south) bank. There was no evidence of nonpoint souce pollution.

LDR01 received a habitat assessment score of 192/200, which was higher than that received by the Cold River reference site. In fact, habitat at LDR01 rated higher than any other biomonitoring station in the 2000 Deerfield River watershed (Table A4).

Benthos

The macroinvertebrate community observed at LDR01 reflected the excellent aquatic habitat afforded it. The benthos assemblage received a total metric score of 38, representing 90% comparability to the Cold River reference station and resulting in an assessment of “non-impacted” for biological condition (Table A2).

In is unclear if biological integrity has improved or remained the same here since the 1995 biosurvey, when the LDR01 benthos assemblage was found to be “non-impacted” compared to an upstream reference station not sampled during the 2000 biosurvey (Fiorentino 1997). However, community structure appears better here than during the 1988 biosurvey, when benthos comparisons at that time were made to reference conditions on the Cold River and found the LDR01 community to be “slightly impaired” (Fiorentino 1997). Two filter-feeding taxa (*Isonychia* sp., *Hydropsyche morosa* gr.) comprised more than half the assemblage sampled in 1988—the number of these and other filter-feeders was greatly reduced in the 2000 benthos sample observed here, replaced instead by scraping forms indicative of more balanced trophic structure and a shift towards a periphyton-based macroinvertebrate community. Indeed, thin layers of periphyton were observed on virtually all available rocky substrates in the LDR01 sampling reach during the 2000 biosurvey.

Green River

The fourth-order Green River rises in Vermont and flows south to Massachusetts. In Massachusetts it flows generally south, with Colrain on the west and Leyden on the east, to the City of Greenfield. It then continues in a southerly direction through Greenfield to its confluence with the Deerfield River in Greenfield.

In its upper reaches the Green River is a shallow, swift, and turbulent mountain stream. Soon after it enters Greenfield, the gradient begins to level off—the velocity drops off and the river becomes deeper. Water quality becomes increasingly degraded as the river receives urban runoff from Greenfield. Downstream from Interstate 91, the Green River flows through a fairly flat section at a low velocity. About one-half mile downstream from the Route 2A bridge near the center of Greenfield, the gradient again steepens and the river flows quickly for a mile before it encounters the backwater from the Deerfield River in its last half mile. Effluent from the Greenfield WWTP is discharged into this last portion of the Green River (MA DEP 2002a).

The USGS maintains a flow-gaging station in the village of West Leyden (Colrain). Stream flow was 39 cfs during the macroinvertebrate biomonitoring survey at GR02 and 37 cfs during the biosurvey at GR01 (Table 3).

GR01—Green River, river mile 0.75, 150 m downstream from footbridge off Route 5-10, Greenfield, MA

Habitat

Sampling was conducted approximately 150 m downstream from an unnamed footbridge off Route 5/10, approximately midway between the Meridian Street bridge and the confluence with the Deerfield River. The partially (50%) shaded sampling reach was approximately 16 m wide and 0.30 - 0.80 m deep. Unlike the dammed portions of the Green River immediately upstream, adequate current velocity and an abundance of hard substrates (cobble and gravel) provided macroinvertebrates with overall excellent habitat throughout the sampling reach. Moderate embeddedness did compromise epifaunal habitat, however, especially in the slower run areas where substrates were almost 50% surrounded by fine materials. Fish habitat was also good, especially in the occasional pool areas where boulders and woody material provided stable cover. Less than optimal channel flow status (channel <75% full) resulted in a fair amount of exposed substrates along the margins of the stream.

Some areas of severe erosion were observed along the steeper portions of both banks. The considerable bank instability may be exacerbated by the removal of bank vegetation, which has resulted in areas of bare soil on both sides of the channel. Potential nearby sources of nonpoint source pollution were the residences along the left (east) bank, and the playing fields and parking lot adjacent to the right (west) bank. Riparian vegetation, consisting of a thin layer of trees (silver maple, *Acer saccharinum*; elm, *Ulmus* sp.), shrubs/vines (riverbank grape, *Vitis* sp.; bittersweet, *Celastrus* sp.) and grasses provided only a very narrow buffer from these disturbances. In addition, trash deposits were observed in the sampling reach during the biosurvey.

GR01 was located downstream of downtown Greenfield and a number of potential water quality stressors associated with its urban setting. Urban runoff and industrial activities have historically degraded water quality and biological integrity in this portion of the Green River (Fiorentino 1997; MA DEP 1989; MA DEP1997; MA DEP 1999). Discharge points from numerous storm drains enter the river a short distance upstream from the sampling station; however, it is anticipated that improvements in stormwater management (e.g., BMPs such as StormTreat™) in the City of Greenfield, including the elimination of dry-weather stormdrain discharges, may reduce the effects of stormwater runoff. Instream turbidity was noted during the biosurvey here.

GR01 received a total habitat assessment score of 135/200—the lowest habitat evaluation for a Deerfield River watershed biomonitoring station (Table A4). Degraded bank (i.e., bank vegetation and stability) and riparian habitat parameters contributed most to the low overall assessment.

Benthos

Despite the habitat constraints observed in the GR01 sampling reach, the benthic community received a total metric score (38) that was highly (90%) comparable to its reference station at CR01 (Table A2). In fact, metrics calculated for the GR01 benthos outperformed those for CR01 for all but two metrics, and suffered point reductions for only one metric (EPT Index). Most surprising was total Taxa Richness—38 was the highest received by any biomonitoring station in the 2000 survey, including both reference stations (Tables A2 and A3). In addition, a Scraper/Filterer metric value of 1.70—the highest of all the biomonitoring stations—coupled with a low percentage (14%) for the Dominant Taxon (*Glossosoma* sp., which has a TV of only 0), indicate balanced community structure and trophic structure in the GR01 macroinvertebrate community.

The resulting 2000 biological assessment of GR01, "non-impacted", was considerably better than the assessments received following both the 1988 and 1995 DEP biosurveys here. In 1988, comparisons of the GR01 benthos to the reference station (CR01) resulted in a bioassessment of "moderately impaired", with an assemblage structured in response to possible toxic effects (Fiorentino 1997). The 1995 biomonitoring efforts here again found a "moderately impaired" macroinvertebrate community that was highly dissimilar to the reference community; and while toxic impacts were thought to have diminished, continued water quality degradation related to urban runoff and productive upstream impoundments was inferred (Fiorentino 1997). More than one-third of the benthos assemblage sampled in 1995 consisted of filter-feeding hydropsychid caddisflies, indicating an unbalanced community and an overabundance of the FPOM food resource in this portion of the river. Metric values calculated for the 2000 benthos suggest GR01 has returned to more balanced conditions in terms of community composition and trophic structure—richness metrics have more than doubled since the 1995 biosurvey, and scrapers such as elmid beetles and the highly sensitive glossosomatid caddisfly, *Glossosoma* sp. (TV=0), have displaced filter-feeders as the dominant trophic guild. In fact, only 9 hydropsychids were recorded in the 2000 benthos sample (Table A1).

Comparisons of the 2000 benthos data at GR01 to previous sampling years should be made with caution due to the potential for metric variability attributable to natural (e.g., temporal) factors. However, this most recent biological assessment of the GR01 aquatic community—based on comparisons to current reference conditions—is encouraging, and is strongly suggestive of improvements in water quality in this portion of the Green River, possibly the result of improved stormwater management and controls of other nonpoint source pollution associated with urban runoff. In fact, habitat quality at GR01 may now be more limiting to the resident biota than water quality factors. The urbanized nature of this portion of the Deerfield River watershed continues to undermine habitat quality and biological potential at GR01, particularly with regard to riparian and instream habitat parameters.

GR02—Green River, river mile 7.0, 200 m downstream from Eunice Williams Drive and covered bridge, Greenfield, MA

Habitat

The GR02 sampling reach began approximately 200 m downstream from the dam at Eunice William Drive in Greenfield. This portion of the river was wide (15 m) and relatively shallow (0.20 – 0.40 m), dominated by fast water and with a completely open (0% shaded) canopy. Instream substrates were mainly comprised of cobble, providing excellent epifaunal habitat for macroinvertebrates. Channel flow status was optimal, with water reaching the base of both banks and leaving virtually no exposed substrates. The somewhat homogeneous nature of these substrates, however, and a lack of other types (e.g., boulders, snags, logs, etc.) of stable cover and flow regimes (e.g., pools, etc.), led to less than optimal habitat conditions for fish.

Both stream banks were well-vegetated with grasses, ferns, and various herbaceous growth. In addition to vegetative growth, boulders provided good bank stability. A forested (white birch, *Betula populifolia*; sycamore, *Platanus occidentalis*) riparian zone grew undisturbed along the right (west) bank. Along the left (east) bank, a shrub layer of staghorn sumac (*Rhus typhina*) and additional trees provided an adequate vegetative buffer from an adjacent field. Nonpoint source pollution inputs were not observed, although the upstream road crossing was a potential source of runoff.

GR02 received a total habitat assessment score of 169/200 (Table A4). The shallow nature of the sampling reach, along with somewhat limited fish cover, contributed most to point reductions during habitat scoring. Channel alterations associated with the upstream bridge abutments and nearby dam also affected the overall habitat evaluation.

Benthos

The GR02 benthic community received a total metric score of 42—the only study station in the 2000 Deerfield River watershed survey to receive the maximum-attainable total metric score. This high (100%) comparability to the Cold River reference station resulted in a “non-impacted” assessment for biological condition (Table A2). Virtually all metrics outperformed those for the reference community. In fact, an EPT Index of 18 was higher than any other biomonitoring station in the Deerfield River watershed survey, while a Biotic Index of 3.01 was the lowest—indicating an assemblage dominated by pollution sensitive taxa. In addition, the high scoring Scraper/Filterer metric value indicates balanced trophic structure and the importance of a periphyton-based macroinvertebrate community here. Indeed, thin layers of algae (probably diatoms) were observed on much of the rocky substrates in the sampling reach, providing an important food resource for algal grazers such as heptageniid mayflies which were abundant in the GR02 benthos sample (Table A1).

Prior to the 2000 biosurvey, GR02 was last sampled by DEP in 1988, when the benthic community was found to be “non/slightly impaired” relative to the reference station located in the Cold River at CR01 (Fiorentino 1997). It is not clear whether the discrepancy in assessments between the two sample years is a result of improved water quality since the 1988 biosurvey, or community differences attributable to temporal variability.

SUMMARY AND RECOMMENDATIONS

Cold River

CR01

Benthos: Watershed reference for study stations in third to fifth-order streams.
Habitat: Watershed reference for study stations in third to fifth-order streams.

The CR01 benthic community was thought to represent the “best attainable” conditions in the watershed with respect to biological integrity, habitat quality, and water quality. As a reference condition, biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005, especially if evaluations of third to fifth-order stream biota are again planned. Fish population sampling, using multiple crews or a barge-mounted electrofishing unit due to the wide nature of this sampling reach, should accompany the macroinvertebrate sampling effort.

Despite good water quality and a healthy aquatic community, the extent of algal cover at CR01 was surprising. An investigation of the waste disposal practices at the upstream campground is recommended.

Bear River

VP11BEA

Benthos: Watershed reference for study stations in first to third-order streams.
Habitat: Watershed reference for study stations in first to third-order streams.

The VP11BEA benthic community was thought to represent the “best attainable” conditions in the watershed with respect to biological integrity, habitat quality, and water quality. As a reference condition, biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005, especially if evaluations of first to third-order stream biota are again planned. Fish population sampling, which has not historically been performed by DEP at this station, should accompany the macroinvertebrate sampling effort.

Runoff associated with the nearby road threatens water quality, habitat quality and biological potential at VP11BEA. As the riparian buffer between Shelburne Falls Road and this portion of the Bear River is thin, road salting/sanding during winter months should be kept to a minimum here.

Pelham Brook

PB01

Benthos: "Non-impacted" compared to reference station.
Habitat: 100% comparable to reference station.

Several of the metrics calculated for the PB01 benthos assemblage outperformed those for the reference community. Based on the biological assessment of the macroinvertebrate and fish community encountered at PB01, it appears that water quality effects related to the upstream landfill and/or impoundment are absent or imperceptible here. The resident biota, instead, appear to reflect the diverse and high quality habitat afforded them in this portion of Pelham Brook.

Davis Mine Brook

DM00

Benthos: "Severely impacted" compared to reference station.
Habitat: 99% comparable to reference station.

While this stream is currently 303(d)-listed due to pH and habitat alteration (MA DEP 1999), toxicity should be considered as an additional pollutant/stressor for its entire segment. Water quality degradation, particularly as it relates to the acid mine drainage upstream, is clearly having a dramatic, and probably toxic, effect on aquatic life in Davis Mine Brook. In addition to obvious impairment of the macroinvertebrate community at DM00, the fish community has been completely eliminated—no fish were collected or observed during the fish population survey here. Options will need to be explored with regard to the cessation of acid mine drainage in this subwatershed. If the Aquatic Life use of Davis Mine Brook is to be supported in the future, restoration of this stream—including a "clean-up" at its source—should be a Deerfield River watershed priority.

Additional threats to resident biota at DM00, and farther downstream in Mill Brook, exist in the form of riparian disruptions associated with a private landfill located immediately adjacent to the DM00 sampling reach. An investigation of the landfill and its contents is highly recommended, especially to determine the presence/absence of hazardous materials. Outreach efforts are recommended to educate the abutting landowner on how improper yard waste and trash disposal can impact aquatic life "in his/her own back yard," as well as the importance of maintaining a riparian buffer zone.

Mill Brook

MB01

Benthos: “Slightly impacted” compared to reference station.
Habitat: 100% comparable to reference station.

Water quality perturbations other than organic loadings may compromise biological (fish and macroinvertebrates) integrity in this portion of Mill Brook. As the MB01 biomonitoring station is only about 2 km downstream from the Davis Mine Brook confluence, it is possible that the effects of the acid mine drainage observed at DM00 persist here as well—though not to the extent seen at Davis Mine Brook. Cessation of further acid mine drainage, if determined to be feasible, will likely do much to improve biological conditions in Mill Brook below the Davis Mine Brook confluence. In addition, the dumping of trash (mentioned above) near the confluence of Davis Mine Brook threatens water quality and biological integrity in this portion of Mill Brook and should be addressed through site-visits (especially to determine the presence/absence of hazardous waste materials) and outreach.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling should accompany the macroinvertebrate sampling effort. As water quality rather than habitat quality appears to limit biological integrity in this portion of Mill Brook, additional monitoring of various physico-chemical parameters would be instrumental in determining the specific types of water quality degradation present here.

Chickley River

CH01

Benthos: “Slightly impacted” compared to both primary (CR01) and secondary (VP11BEA) reference stations.
Habitat: 92% comparable to primary reference station; 93% comparable to secondary reference station.

Water quality appears to limit biological potential here, as reflected in a macroinvertebrate community structured in response to organic enrichment. Nutrient/organic loadings associated with upstream agricultural runoff and/or productive upstream impoundments are a likely source of water quality degradation in this portion of the watershed. Outreach on nonpoint source pollution associated with agricultural practices (e.g., fertilizers and other runoff, bank erosion in crop areas) is warranted, especially for those farms minimally buffered from the stream. BMPs to control livestock-related nonpoint source pollution may be necessary at some of the farms located upstream from the CH01 sampling station. BMPs already in place may require an evaluation of their effectiveness.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling, which proved difficult during the 2000 biosurvey due to deep water and heavy downpours, should accompany the next macroinvertebrate sampling effort. Fish population assessments should be conducted using multiple crews or a barge-mounted electrofishing unit. In addition, water quality monitoring throughout the Chickley River subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.

North River

NOR01

Benthos: "Non-impacted" compared to reference station.
Habitat: 100% comparable to reference station.

Despite the excellent aquatic health observed at NOR01, biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess the potential impacts of the industrial discharge upstream, as well as various nonpoint source effects related to agriculture and urban runoff in this portion of the North River subwatershed. In addition to benthic macroinvertebrate biomonitoring, attempts should be made to conduct fish population sampling as well. Due to the wide and deep nature of the NOR01 sampling reach, fish population sampling should employ multiple crews or a barge-mounted electrofishing unit.

East Branch North River

NOR02A

Benthos: "Non/Slightly impacted" compared to reference station.
Habitat: 100% comparable to reference station.

The displacement of pollution sensitive forms of EPT taxa by chironomids—most notably the midge *Polypedilum flavum*, which can be numerous in streams with high concentrations of suspended organic particulates (Bode and Novak 1998)—is evidence of the slightly enriched nature of this stream system. Nutrient/organic loadings originating from various forms of runoff (especially upstream agriculture, road crossings, and NPS inputs originating from Colrain center) probably contribute to the productive conditions in this portion of the East Branch. A thorough investigation of land-use practices in this subwatershed, and the need for BMP implementation or other controls of nonpoint source pollution, is recommended. Outreach on nonpoint source pollution associated with agricultural practices (e.g., fertilizers and other runoff, bank erosion in crop areas) is warranted, especially for those farms minimally buffered from the stream. Despite the threat of nonpoint source pollution impacts to the NOR02A biota, the presence of a well-balanced fish community dominated by intolerant species suggests this stream continues to fully support its Aquatic Life use.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling should accompany the macroinvertebrate sampling effort. In addition, water quality monitoring throughout the East Branch subwatershed—especially nutrient and bacteria sampling—may help to isolate sources of nutrient/organic loads.

Taylor Brook

TB00

Benthos: "Non-impacted" compared to reference station.
Habitat: 89% comparable to reference station.

Although the resident biota at TB00 were found to be non-impacted, instream and riparian habitat degradation was observed. The greatest threat to the macroinvertebrate and fish community in this portion of Taylor Brook is probably instream sedimentation—presumably originating from streambank instability (i.e., erosion) and/or road runoff. While it is possible that some streambank erosion is naturally occurring in this subwatershed, erosion may be exacerbated by areas of riparian and bank deforestation—particularly where high-tension power lines cross the stream. In addition, an investigation of all upstream road crossings should be made to determine the need for BMPs.

It is possible that the high-gradient nature of Taylor Brook allows for the "flushing through" of sediments before they can be a significant impediment to the health of resident biota. However, biomonitoring (fish and macroinvertebrates) is recommended here during the next DEP Deerfield River watershed survey in 2005 to assess potential impacts related to increased sediment loads here. Potential impacts farther downstream in the West Branch North River, should also be considered.

South River

SOR01

Benthos: "Non-impacted" compared to both primary (CR01) and secondary (VP11BEA) reference stations.
Habitat: 96% comparable to primary reference station. 97% comparable to secondary reference station.

Though the fish assemblage observed here suggests some degree of instream productivity, the benthic community appeared considerably more healthy than during the previous biosurvey conducted here in 1995. The apparent improvements in water quality, habitat quality, and associated biological integrity documented here may be the result of agricultural BMP implementation upstream, elimination of failing septic systems through sewering, and/or upgrades to the Ashfield WWTP since the 1995 biosurvey. While this portion of the river appears to fully support the Aquatic Life use, DEP/DWM's Assessment Program should conduct a review of current water quality data (if available) collected here during the 2000 watershed survey to determine if this segment should be removed from the Massachusetts Section 303(d) List of waters.

Macroinvertebrate biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005. Fish population sampling, using multiple crews or a barge-mounted electrofishing unit, should accompany the macroinvertebrate sampling effort.

Pumpkin Hollow Brook

PH00

Fish only: "Slightly impacted" based on best professional judgement.
Habitat: 83% comparable to the reference station.

The numerical dominance of moderately tolerant fish species here suggests the effects of organic enrichment in this portion of Pumpkin Hollow Brook. Poorly buffered agricultural areas just upstream from the sampling reach are probably a major source of organic/nutrient inputs, while the upstream landfill may contribute pollutants as well.

In addition to water quality effects at PH00, habitat degradation appears to limit biological potential as well. Sediment deposition in pools and instream substrate embeddedness resulting from bank erosion and runoff at road crossings compromise both fish and macroinvertebrate habitat.

A thorough investigation of land-use practices in this subwatershed, and the need for BMP implementation or other controls of nonpoint source pollution, is recommended. Outreach on nonpoint source pollution associated with agricultural practices (e.g., fertilizers and other runoff, bank erosion in crop areas) is warranted, especially for those farms minimally buffered from the stream. Macroinvertebrate biomonitoring, which was not conducted here in 2000 due to limited resources, is recommended here during the next DEP Deerfield River watershed survey in 2005. In addition, water quality monitoring throughout the Pumpkin Hollow Brook subwatershed—especially nutrient and bacteria sampling—may help to isolate potential sources of nutrient/organic loads. Fish population sampling should again be conducted.

Green River

GR01

Benthos: “Non-impacted” compared to reference station.
Habitat: 76% comparable to reference station.

Despite the poorest habitat evaluation received by a Deerfield River watershed biomonitoring station, GR01 supported a surprisingly diverse and non-impacted benthic community. This bioassessment is dramatically different than the one received following the 1995 biosurvey conducted here, when filter-feeders tolerant of organic enrichment dominated the benthos assemblage and contributed to a “moderately impaired” assessment of biological condition. Nevertheless, the urbanized nature of this portion of the Deerfield River watershed continues to impact habitat quality (especially with riparian disturbances and instream deposition) and threaten biological potential at GR01. While it may be difficult to locate or isolate all sources of urban inputs, streambank stabilization and restoration of an adequate riparian zone may help to alleviate some nonpoint source inputs (e.g., road and parking lot runoff) associated with urban runoff in this portion of the river. In addition, a stream clean-up effort would address the trash deposits that compromise aesthetics here.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this low-gradient portion of the Green River, where both upstream agricultural activities and the urbanized nature of Greenfield potentially influence water quality and biological integrity. Fish population sampling, which has not historically been performed by DEP in the Green River, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the GR01 sampling reach, the fish population survey may require multiple crews or a barge-mounted electrofishing unit.

GR02

Benthos: “Non-impacted” compared to reference station.
Habitat: 95% comparable to reference station.

GR02 was characterized by a healthy and non-impacted benthic macroinvertebrate community, with the highest number of pollution sensitive taxa (i.e., EPTs) of all the Deerfield River watershed biomonitoring stations. In fact, it is possible that biological integrity has improved here since DEP’s last biosurvey conducted in 1988, when slight impairment of the benthic community was detected.

Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this portion of the river, where its high-gradient nature dominates from here to the Vermont-Massachusetts border. Fish population sampling, which has not historically been performed by DEP at this station, should accompany the macroinvertebrate sampling effort. Due to the wide nature of the GR02 sampling reach, fish population sampling should employ multiple crews or a barge-mounted electrofishing unit.

LDR01

Benthos: “Non-impacted” compared to reference station.
Habitat: 100% comparable to reference station.

Habitat and biological quality appear excellent here, as has historically been documented (MA DEP 1989, MA DEP 1997). Biomonitoring is recommended here during the next DEP Deerfield River watershed survey in 2005 to continue to assess biological health in this lower portion of the Deerfield River. Fish population sampling, which has not historically been performed by DEP in the Deerfield River, should accompany the macroinvertebrate sampling effort. Due to the extremely wide nature of the mainstem Deerfield River, fish population sampling will require multiple crews or a barge-mounted electrofishing unit.

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APPENDIX

Macroinvertebrate and fish taxa lists, RBPIII benthos analyses, and Habitat evaluations

Table A1. Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2000 Deerfield River watershed survey between 25 and 27 September 2000. Refer to Table 1 for a complete listing and description of sampling stations.

Taxon	FG[1]	TV[2]	CR01[3]	VP11BEA[3]	DM00	GR01	GR02	LDR01	MB01	NOR01	NOR02A	PB01	SOR01	TB00	CH01
Ferrissia sp.	SC	6				1									
Nais alpina	GC	8											1		
Nais behningi	GC	6		1		1					1				
Nais communis	GC	8		1						3	1				
Lumbriculus variegatus	GC	5	1	2	2	1		3					4		1
Hydrachnidia	PR	6				2							1	2	
Baetidae	GC	4		3		2		3	3		1			4	
Baetis sp. (2 cerci)	GC	6		7		2		3	5	13		27	7		
Baetis sp. (subeq. term. filaments)	GC	6		10		2		4	8	3			5	6	
Baetidae (2 cerci)	GC	6					1				1				8
Baetidae (short terminal filament)	GC	6	3												
Baetidae (subeq. terminal filaments)	GC	6	1												
Caenis sp.	GC	6					1								
Ephemerellidae	GC	1	3				4	6		4			3	2	
Attenella sp.	GC	1				2					8				
Ephemerella sp.	GC	1				1	5			10	4	3	2		14
Eurylophella sp.	GC	2				1									
Serratella sp.	GC	2		12			3		10					21	
Heptageniidae	SC	4	1			1	1						2		
Epeorus sp.	SC	0	8	2			7	1	2		2	3	1	2	1
Rhithrogena sp.	GC	0		12			1	5		7			3	1	2
Stenonema sp.	SC	3				1	7				1				
Isonychia sp.	GC	2				4	10	5		3	1	2	1		
Leptophlebiidae	GC	2					1				3				1
Leptophlebia sp.	GC	4	4												
Paraleptophlebia sp.	GC	1		5						1		3	2		
Ophiogomphus sp.	PR	1					1								
Allocapnia sp.	SH	3													1
Sweltsa sp.	PR	0	2	4	7				25	1		16		4	
Leuctra sp.	SH	0					1								
Paraleuctra sp.	SH	0							1			1			
Leuctridae/Capniidae	SH	2		1											
Tallaperla sp.	SH	0		1					1						
Perlidae	PR	1		1							1		1		
Acroneuria sp.	PR	0				1	1							1	
Agnetina sp.	PR	2	1										1	1	1
Hansonoperla sp.	PR	1										2			
Neoperla sp.	PR	3					1								
Paragnetina sp.	PR	1	1										1	2	
Perlodidae	PR	2		1		2									
Diura sp.	PR	2										1			
Isogenoides sp.	PR	0											1		
Isoperla sp.	PR	2	3							3		4	1	2	5

Table A1 (cont.)

Taxon	FG[1]	TV[2]	CR01[3]	VP11BEA[3]	DM00	GR01	GR02	LDR01	MB01	NOR01	NOR02A	PB01	SOR01	TB00	CH01
Pteronarcys sp.	SH	0												1	1
Nigronia sp.	PR	0					1							1	
Micrasema sp.	SH	2						1							
Glossosoma sp.	SC	0	2	1		13	1	4			3	1			
Helicopsyche borealis	SC	3									1				
Cheumatopsyche sp.	FC	5	5			3	12	1		2			1		3
Diplectrona sp.	FC	0							1					2	
Hydropsyche morosa gr.	FC	6	11	5		6	5	15	3	6	6	5	14	7	15
Lepidostoma sp.	SH	1	1				1	2		1		2		2	1
Pycnopsyche sp.	SH	4			1										
Chimarra sp.	FC	4						5							
Dolophilodes sp.	FC	0	7	6			2	1	4		3	7	4	3	8
Polycentropus sp.	PR	6			1		1								
Rhyacophila sp.	PR	1	2	3	2					1	1	4	1	4	
Optioservus sp.	SC	4				11	2			2	1		6		
Optioservus ovalis	SC	4		1											
Oulimnius latiusculus	SC	4						4	1			1			
Promoresia sp.	SC	2						1							
Stenelmis sp.	SC	5	1			5	1	2							
Stenelmis crenata gr.	SC	5						1					1		
Psephenus herricki	SC	4				2	1	1					1		
Diptera	na	na			1										
Atherix sp.	PR	4		1										1	
Probezzia sp.	PR	6	1		1						1		2	1	1
Stilobezzia sp.	PR	6											1		1
Chironomus sp.	GC	10									2			1	
Cryptochironomus sp.	PR	8				1				1					
Einfeldia sp.	GC	9								1					
Microtendipes pedellus gr.	FC	6				1				1			1		
Microtendipes rydalensis gr.	FC	6										1			
Polypedilum angulum	SH	6		1	3				1		1			2	
Polypedilum aviceps	SH	4	17	4			13	5	1	14	12		10	2	20
Polypedilum flavum	SH	6	1			5	1	6		2	14				
Polypedilum scalaenum	SH	6									1				
Cladotanytarsus sp.	FC	5				1				1					
Micropsectra sp.	GC	7		1	1					3	1			4	1
Rheotanytarsus sp.	FC	6						4							
Rheotanytarsus distinctissimus gr.	FC	6	5			4		6		1	6	1	1		
Rheotanytarsus exiguus gr.	FC	6				1		2							
Tanytarsus sp.	FC	6		1		1					1				
Brillia sp.	SH	5			9									1	
Cardiocladius sp.	PR	5				1				1	1				
Chaetocladius sp.	GC	6										1			
Corynoneura sp.	GC	4	3	1		1						1			
Cricotopus sp.	SH	7											1		
Eukiefferiella sp.	GC	6	1							2					
Eukiefferiella brehmi gr.	GC	4	1												
Eukiefferiella brevicalcar gr.	GC	4												2	
Eukiefferiella claripennis gr.	GC	8		2	2	2			17	1		1	1	3	1
Eukiefferiella devonica gr.	GC	4								2					
Lopescladius sp.	GC	4		1			3			1	2		7		
Metriocnemus sp.	GC	5	2												

Table A1 (cont.)

Taxon	FG[1]	TV[2]	CR01[3]	VP11BEA[3]	DM00	GR01	GR02	LDR01	MB01	NOR01	NOR02A	PB01	SOR01	TB00	CH01
Nanocladius sp.	GC	7													1
Orthocladius sp.	GC	6				2		4							1
Parachaetocladius sp.	GC	2		1										1	
Parametriocnemus sp.	GC	5	1			1			2	2	2				
Psilometriocnemus sp.	GC	4			1										
Synorthocladius sp.	GC	6				1									
Thienemanniella sp.	GC	6					1	1	1						
Tvetenia sp.	GC	5				1		1			1				
Tvetenia bavarica gr.	GC	5		8	2		1		6	1	4	6	5	2	5
Tvetenia vitracies gr.	GC	5	1				1	1			3				
Conchapelopia sp.	PR	6						1		1					
Pentaneura sp.	PR	6	1												
Thienemannimyi a sp.	PR	6				1									
Chelifera sp.	PR	6													1
Clinocera sp.	PR	6												1	
Hemerodromia sp.	PR	6				2					1		1	1	
Simulium sp.	FC	5		1		3		1	1				2	1	
Antocha sp.	GC	3				1				2			2		
Dicranota sp.	PR	3				2								1	
Hexatoma sp.	PR	2	1	1			1	1	3						1
Molophilus sp.	SH	3			1										
Pseudolimnophila sp.	SH	3			1										

[1]Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.

[2]Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant.

[3] Reference station

Table A2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Deerfield River watershed survey between 25 and 27 September 2000. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Cold River reference station (CR01), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**CR01**		**CH01**		**NOR01**		**NOR02A**		**GR01**		**GR02**		**SOR01**		**LDR01**	
STREAM	Cold River		Chickley River		North River		E. Branch North River		Green River		Green River		South River		Deerfield River	
HABITAT SCORE	178		163		187		190		135		169		170		192	
TAXA RICHNESS	29	*6*	24	*6*	30	*6*	31	*6*	38	*6*	30	*6*	34	*6*	28	*6*
BIOTIC INDEX	3.48	*6*	3.61	*6*	4.02	*6*	4.13	*4*	4.09	*6*	3.01	*6*	4.16	*4*	4.18	*4*
EPT INDEX	16	*6*	13	*4*	12	*2*	13	*4*	12	*2*	18	*6*	16	*6*	13	*4*
EPT/CHIRONOMIDAE	1.67	*6*	2.10	*6*	1.57	*6*	0.71	*2*	1.71	*6*	3.30	*6*	1.96	*6*	1.81	*6*
SCRAPER/FILTERER	0.43	*6*	0.04	*0*	0.18	*4*	0.50	*6*	1.70	*6*	1.05	*6*	0.48	*6*	0.40	*6*
% DOMINANT TAXON	18%	*6*	21%	*4*	14%	*6*	15%	*6*	14%	*6*	14%	*6*	14%	*6*	15%	*6*
REFERENCE AFFINITY	100%	*6*	92%	*6*	76%	*6*	78%	*6*	72%	*6*	73%	*6*	78%	*6*	85%	*6*
TOTAL METRIC SCORE	*42*		*32*		*36*		*34*		*38*		*42*		*40%*		*38*	
% COMPARABILITY TO REFERENCE	100%		76%		86%		81%		90%		100%		95%		90%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**SLIGHTLY IMPACTED**		**NON-IMPACTED**		**NON/ SLIGHTLY IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**		**NON-IMPACTED**	

Table A3. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Deerfield River watershed survey between 25 and 27 September 2000. Shown are the calculated metric values, metric scores (in italics) based on comparability to the Bear River reference station (VP11BEA), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**VP11BEA**		**PB01**		**MB01**		**DM00**		**TB00**		**CH01**		**SOR01**	
STREAM	Bear River		Pelham Brook		Mill Brook		Davis Mine Brook		Taylor Brook		Chickley River		South River	
HABITAT SCORE	176		187		181		174		157		163		170	
TAXA RICHNESS	31	*6*	22	*4*	19	*4*	15		32	*6*	24	*4*	34	*6*
BIOTIC INDEX	3.15	*6*	3.05	*6*	3.49	*6*	3.94[1]		3.27	*6*	3.61	*6*	4.16	*4*
EPT INDEX	15	*6*	15	*6*	10	*0*	4		15	*6*	13	*4*	16	*6*
EPT/CHIRONOMIDAE	3.70	*6*	7.36	*6*	2.25	*4*	0.61		3.61	*6*	2.10	*4*	1.96	*4*
SCRAPER/FILTERER	0.31	*6*	0.36	*6*	0.33	*6*	None Present		0.15	*4*	0.04	*0*	0.48	*6*
% DOMINANT TAXON	12%	*6*	29%	*4*	26%	*4*	26%		23%	*4*	21%	*4*	14%	*6*
REFERENCE AFFINITY	100%	*6*	76%	*6*	69%	*6*	46%		84%	*6*	74%	*6*	74%	*6*
TOTAL METRIC SCORE		*42*		*38*		*30*				*38*		*28*		*38*
% COMPARABILITY TO REFERENCE	100%		90%		71%		Not Valid[2]		90%		67%		90%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE***		**NON-IMPACTED**		**SLIGHTLY IMPACTED**		**SEVERELY IMPACTED[3]**		**NON-IMPACTED**		**SLIGHTLY IMPACTED**		**NON-IMPACTED**	

*Primary reference for PB01, MB01, DM00, and TB00; Secondary reference for CH01 and SOR01.

[1]Does not include undetermined dipteran tolerance value.

[2]Direct comparisons to reference station metrics invalid due to low (<100 organisms) subsample number.

[3]Based on best professional judgement and supporting fish data (fish absent).

Table A4. Habitat assessment summary for biomonitoring stations sampled during the 2000 Deerfield River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**VP11BEA***	**CR01***	**DM00**	**CH01**	**MB01**	**NOR01**	**NOR02A**	**SOR01**	**PH00**	**PB01**	**LDR01**	**GR01**	**GR02**	**TB00**
PRIMARY PARAMETERS (range is 0-20)	**SCORE**													
INSTREAM COVER	18	17	18	19	19	19	19	17	15	19	19	16	11	17
EPIFAUNAL SUBSTRATE	19	20	18	18	20	20	20	17	18	20	20	19	20	18
EMBEDDEDNESS	20	18	19	17	19	17	20	15	7	20	20	12	20	18
CHANNEL ALTERATION	20	20	19	18	20	20	20	17	19	20	20	17	14	20
SEDIMENT DEPOSITION	18	18	16	13	18	15	17	13	7	19	20	17	17	7
VELOCITY-DEPTH COMBINATIONS	15	16	17	19	19	20	18	15	16	19	15	18	13	13
CHANNEL FLOW STATUS	16	16	16	9	16	19	19	17	15	18	18	13	18	8
SECONDARY PARAMETERS (range is 0-10 for each bank)	**SCORE**													
BANK VEGETATIVE PROTECTION left right	10 9	9 10	10 10	10 10	10 9	10 10	10 10	10 10	9 8	10 10	10 10	6 3	10 9	10 10
BANK STABILITY left right	10 7	8 10	9 10	8 4	5 5	10 9	10 9	10 9	6 9	9 9	10 10	3 5	10 9	10 8
RIPARIAN VEGETATIVE ZONE WIDTH left right	10 4	6 10	2 10	10 10	10 10	10 8	8 10	10 10	9 8	5 9	10 10	3 3	8 10	8 10
TOTAL SCORE	176	178	174	165	180	187	190	170	146	187	192	135	169	157

*Reference station

Table A5. Fish population data collected by DWM at nine biomonitoring stations in the Deerfield River watershed between 26 and 28 September 2000. Sampling stations were at: Pelham Brook (PB01); Cold River (CR01); Chickley River (CH01); Mill Brook (MB01); Davis Mine Brook (DM00); Taylor Brook (TB01); Pumpkin Hollow Brook (PH00); East Branch North River (NOR02A); and South River (SOR01). Refer to Table 1 for a complete listing and description of sampling stations.

TAXON		Habitat Class[1]	Trophic Class[2]	Tolerance Class[3]	PB01	CR01	CH01	PH00	MB01	DM00	TB00	SOR01	NOR02A
common shiner	*Luxilus comutus*	FDR	GF	M	-	-	-	85	-	-	-	7	-
blacknose dace	*Rhinichthys atratulus*	FS	GF	T	5	29	5	60	3	-	*	29	3
longnose dace	*Rhinichthys cataractae*	FS	BI	M	26	4	7	2	-	-	*	7	4
creek chub	*Semotilus atromaculatus*	MG	GF	M	-	-	-	165	-	-	-	6	-
white sucker	*Catostomus commersoni*	FDR	GF	T	-	-	-	-	-	-	*	-	-
longnose sucker	*Catostomus catostomus*	MB	BI	I	-	-	-	-	-	-	*	-	-
yellow bullhead	*Ameiurus natalis*	MG	GF	T	-	-	-	-	-	-	-	-	1
Atlantic salmon	*Salmo salar*	FS	TC	I	22	39	19	2	38	-	-	13	20
brown trout	*Salmo trutta*	FS	TC	I	1	1	3	-	-	-	-	-	-
brook trout	*Salvelinus fontinalis*	FDR	TC	I	7	-	-	1	14	-	*	-	-
rainbow trout	*Onchorynchus mykiss*	FDR	TC	I	-	-	2	-	-	-	-	-	-
banded killifish	*Fundulus diaphanous*	MG	WC	T	-	-	-	-	-	-	-	-	1
tessellated darter	*Etheostoma olmstedi*	FS	BI	M	-	-	-	-	-	-	-	-	1
slimy sculpin	*Cottus cognatus*	FS	BI	I	33	-	8	-	-	-	-	-	-

[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)

* species was present, but numbers unknown due to loss of field sheets

APPENDIX C

Technical Memorandum TM-33-1

1988 and 1995 Deerfield River Watershed Benthic Macroinvertebrate Biomonitoring

To: Deerfield River Basin Team
From: John Fiorentino, DEP DWM
Date: 28 August 1997
Cc: Arthur Johnson, DEP DWM
Richard McVoy, DEP DWM
Bob Nuzzo, DEP DWM
Christine Duerring, DEP DWM
Gary Bogue, DEP DWM
Lawrence Golonka, DEP WERO

INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts on the aquatic community. Resident biota (e.g. benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic as well as cumulative pollution and habitat alteration (Plafkin et al. 1989, Barbour et al. 1995). Biological surveys and assessments are the primary approaches to biomonitoring.

Robert Nuzzo and I conducted biomonitoring based on United States Environmental Protection Agency Rapid Bioassessment Protocols (USEPA RBP) at 6 sites requested by the Massachusetts Department of Environmental Protection (MADEP) Deerfield River Basin Team as part of the 1995 watershed survey. A biosurvey, which focused on the standardized sampling of benthic macroinvertebrates, was supplemented with a habitat assessment to evaluate water quality and habitat quality at each study site. In addition, the basin team conducted monthly trend monitoring over a twelve month period at these stations (and one other) for general water quality variables, metals, nutrients, and bacteria. The sampling sites were in: Deerfield River (UDR01, LDR01), North River (NOR01), South River (SOR01), Bear River (BR01), and Green River (GR01)--all in Massachusetts. All of these sites, with the exception of BR01, were sampled during a previous biomonitoring survey conducted in this watershed by DEP (Macroinvertebrate Rapid Bioassessment, or MRB survey, 1988). Results of the 1988 survey will be discussed briefly, with particular emphasis placed on those stations sampled again in 1995. While a direct comparison of 1988 and 1995 stations is inadvisable, it will at least be possible to determine whether biological integrity has improved or worsened at a site over time. Data from those sites in the 1988 survey not sampled in 1995 will be presented only in tabular form.

METHODS

Macroinvertebrate biomonitoring was conducted at 6 stations during the 1995 survey, as described in Table 1 and noted in Figure 1. A total of 10 stations, also described in Table 1, were sampled during the 1988 survey. The macroinvertebrate collection procedure utilized kick sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms downstream with an aquatic net. Sampling was conducted in riffle/run areas with fast currents and cobble and gravel substrates--generally the most productive habitats, supporting the most diverse communities in the stream system. A kick net with an opening approximately 0.45 m wide and a mesh size of 590 microns was used to collect a sample from an approximately 1 m^2 area. Two 1 m^2 samples were collected at each station--one from an area of fast current velocity and one from an area of slower current velocity. The two samples were then composited in the field and preserved with 95% ethanol before processing.

Table 1. Biomonitoring station locations in the 1988/1995 Deerfield River basin survey

Station	Station Description	Survey date
UDR01	Deerfield River (upper) Upstream from Florida Bridge/Zoar Road Florida-Charlemont, Massachusetts	26 September 1995 18 July 1988
LDR01	Deerfield River (lower) Downstream from Stillwater Bridge, Deerfield, Massachusetts	28 September 1995 19 July 1988
LDR02	Deerfield River (lower) At Route 2 (and USGS guage) Charlemont, Massachusetts	19 July 1988
NOR01	North River Upstream from Route 112 Colrain, Massachusetts	26 September 1995 19 July 1988
NOR02	North River-East branch At Elm Grove off Route 112 Colrain, Massachusetts	19 July 1988
SOR01	South River Upstream from Reeds Bridge Road Conway, Massachusetts	28 September 1995 20 July 1988
SOR02	South River At Emmet's Road Ashfield, Massachusetts	20 July 1988
GR01	Green River Downstream of footbridge off Route 5-10 Greenfield, Massachusetts	28 September 1995 19 July 1988
GR02	Green River At Green River Road Greenfield, Massachusetts	20 July 1988
CR01	Cold River At entrance to Mohawk State Forest Charlemont, Massachusetts	18 July 1988
BR01	Bear River Upstream from Shelburne Falls Road Conway, Massachusetts	26 September 1995

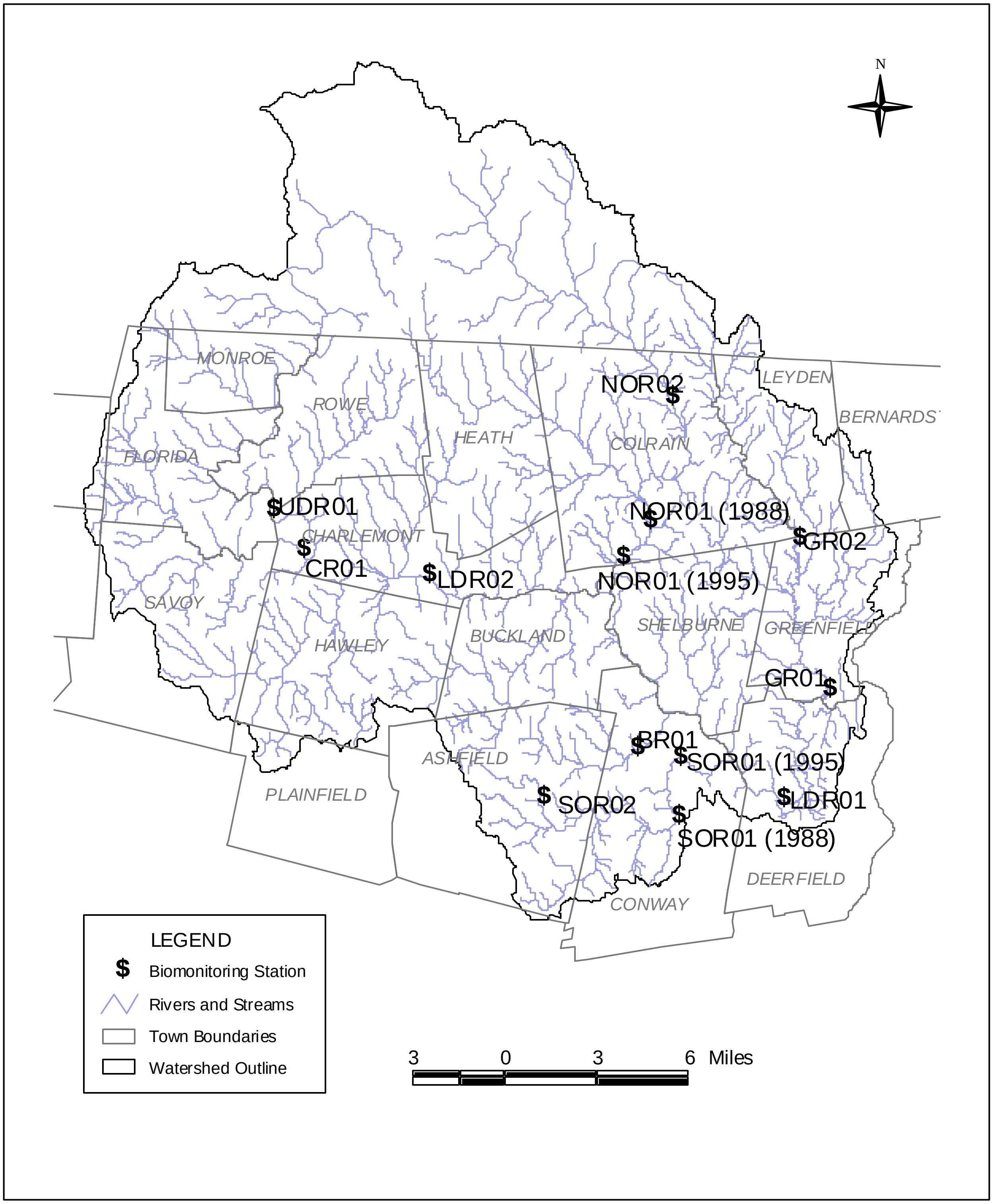

Figure 1. Location of biomonitoring stations for the 1998 and 1995 Deerfield River Watershed survey.

In the laboratory, a 100 macroinvertebrate randomized subsample was separated from the original sample collected at each site, and specimens were identified to family (Rapid Bioassessment Protocol II, or RBP II) to the extent their condition allowed. Based on this family-level taxonomy, various community, population, and functional parameters, or "metrics," are calculated which allow us to measure important aspects of the biological integrity of the community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated. Deficiency of any one metric should not invalidate the entire approach (Plafkin et al. 1989). The percent comparability of study site metric scores to those for a selected unimpaired reference station (i.e. "best attainable situation") yields an impairment score for each site. RBP II analysis separates sites into three categories: non-impaired, moderately impaired, and severely impaired. Impairment of the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Plafkin et al. 1989).

RBP II also utilizes a habitat assessment matrix for rating habitat quality, an integral component in the final evaluation of impairment. The habitat assessment is intended to support the biosurvey and enhance the interpretation of the biological data. The matrix used to assess habitat quality is based on key physical characteristics of the water body and surrounding land use. All parameters evaluated are related to overall land use and are potential sources of limitation to the aquatic biota (Plafkin et al. 1989). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, velocity/depth combinations, channel alteration, bottom scouring and deposition, pool/riffle ratio, right and left (when facing downstream) bank vegetative stability, right and left bank stability, streamside cover. The habitat parameters included in the matrix were evaluated at all sites sampled in the Deerfield River Basin. Ratings were then totaled and compared to a regional and/or upstream reference station to provide a final habitat ranking. Sites receive one of four possible habitat evaluations: comparable to reference conditions, supporting, partially supporting, and non-supporting.

It is important to recognize that Rapid Bioassessment Protocol II is primarily a semi-quantitative screening tool which allows users to evaluate a large number of sites with relatively limited time and effort. The protocol is best used to prioritize sites for more intensive evaluation, such as RBP III, toxicity testing, or quantitative replicate sampling. The information derived from RBP II provides a basis for ranking sites as non, moderately, or severely impaired. This classification can then be used to focus on additional study or remediation (e.g., regulatory action).

Two of the study sites investigated in the 1995 Deerfield River Basin survey received RBP II scores indicating moderate impairment (Appendix A: Table 3). Because this category offers a wide-ranging and somewhat ambiguous assessment, it was my recommendation that more information be gathered on the aquatic invertebrate assemblage at these stations. This was achieved by applying Rapid Bioassessment Protocol III (RBP III), a more rigorous bioassessment technique than RBP II, which allows detection of more subtle degrees of impairment. By increasing the level of taxonomic resolution; that is, by performing taxonomic identification to the lowest practical level, the ability to discriminate the level of impairment is enhanced. While this additional taxonomy (species-level identification) requires considerably more time, discrimination of four levels of impairment--non, slight, moderate, and severe--becomes possible following recalculation of the metrics.

RESULTS & DISCUSSION

1995 Biosurvey:

The taxonomic list of macroinvertebrates obtained from subsamples taken from each site is attached as an appendix (Appendix A). Table A1 includes the family-level taxonomic list of macroinvertebrates from all sites sampled, while Table A2 is a species-level taxonomic list of macroinvertebrates obtained from those sites that scored moderately impaired following RBP II analysis. Included in both taxa lists are total organism counts, and the functional feeding group (FFG) and tolerance value (TV) of each taxon.

Summary tables of the RBP data analyses, including biological metric calculations, metric scores, and impairment scores, are also included in the appendix. Table A3 is the summary table for all sites when RBP II analysis is applied. Table A4, the RBP III data analysis summary, includes metric calculations and impairment scores for those stations which were found to be moderately impaired following RBP II analysis. Habitat assessment scores for each station are also included in the summary tables.

1988 Biosurvey:

Data compiled from the 1988 biosurvey are attached as Appendix B. As samples collected from the 1988 survey were speciated (RBPIII), Table B1 is a species-level taxonomic list of macroinvertebrates. Included in the taxa list are total organism counts, and the functional feeding group (FFG) and tolerance value (TV) of each taxon.

Summary tables of the RBP data analyses, including biological metric calculations, metric scores, and impairment scores, are also included in the appendix. Table B2 is the RBP analysis table when using DE06 as the regional reference station for all sites. Table B3 is the data analysis summary for those stations being compared to an upstream reference station (DE05A, DE10, DE15, or DE16).

BR01--Bear River, Conway, MA (26 September 1995)

HABITAT

The BR01 sampling reach began approximately 100 m upstream from Shelburne Falls Road and meandered through a heavily wooded hemlock forest. This portion of the stream was approximately 2 m wide and 0.25 m deep. Well developed riffle areas with a variety of stable hard substrates offered exceptional habitat for fish, and especially, invertebrates. Dense bryophyte cover on much of the rock substrates provided additional productive microhabitat for macroinvertebrates. Embeddedness and deposition were virtually nonexistent. Bank stability was excellent, and the dense forest on both sides of the stream provided an unlimited and undisturbed riparian vegetative zone throughout the reach. BR01 received a total habitat assessment score of 123 out of a possible 135. Sampling was confined to the rocky substrates--cobble/gravel and boulder--which were predominant throughout the reach. Those larger boulders which would not move required gentle hand-rubbing to remove attached organisms.

BR01 was designated a regional reference station for the Deerfield River Basin by virtue of its high habitat evaluation, and minimal upstream and surrounding land use impacts (e.g., absence of point source inputs, lack of nearstream agriculture and channelization activity, minimal development, undisturbed riparian zones with woody vegetation, lack of other anthropogenic impacts) relative to the overall watershed. As a third/fourth order stream, BR01 served as a primary reference station for those study sites in streams with a comparable drainage area (NOR01, SOR01, GR01); however, the lower Deerfield River station LDR01--a fifth order stream--required an upstream control (UDR01), offering a more comparable drainage area. Differences in riparian and instream characteristics also made comparisons between BR01 (partially closed canopy, shredder/particulate organic matter-dominated) and LDR01 (open canopy, grazer/periphyton dominated) inappropriate.

Since both the quality and quantity of available habitat affect the structure and composition of resident biological communities, effects of such features can be minimized by sampling similar habitats at all stations being compared (Plafkin et al. 1989). Sampling highly similar habitats will also reduce metric variability, attributable to factors such as current speed and substrate type. Furthermore, unless basically similar physical habitat is sampled at all stations, community differences attributed to a degraded habitat will be difficult to separate from those resulting from water quality degradation. The discrepancy in habitat, then, between BR01 and the Deerfield River stations would probably be reflected in the invertebrate assemblages found there as well; however, it would be impossible to determine whether water quality or habitat quality is limiting to the biological integrity of the study site. Habitat and benthos descriptions for Deerfield River biomonitoring stations will be discussed later.

BENTHOS

The family level and species level taxonomic list of macroinvertebrates collected at BR01 can be found in Tables A1 and A2 respectively. Because BR01 is a reference station, it does not receive an impairment score for the aquatic community found there. However, the metric values (Tables A3 and A4) calculated as part of the RBP analyses reflect the healthy benthic community one would expect to find in a "least impacted" stream. In particular, those parameters that measure components of community structure (taxa richness, biotic index, and EPT index)--which dsplay the lowest inherent variability among the RBP metrics used (Resh 1988)--scored well and corroborate the designation as a reference station. BR01 received a total metric score of 42 out of a possible 42 following both RBP analyses. This station was not sampled during the 1988 biosurvey.

NOR01--North River, Colrain, MA (26 September 1995)

Sampling was conducted at NOR01 to investigate possible water quality degradation effects originating from Veratec Incorporated (NPDES # MA0003697), a division of International Paper located approximately 2000 m upstream from the sampling reach. Formerly permitted as Kendall Company, Veratec is currently engaged in the manufacturing of non-woven products (e.g. cleaning wipes and pads, milk filters, coverstock for diapers and feminine hygiene products, industrial grade fabrics); the bleaching of cotton and gauze fibers, and woven/knitted fabrics; and the dyeing of woven/knitted fabrics. In addition, the facility treats the sanitary waste from nearby residences. There are two discharges from the Veratec plant: 1) The biological waste water (comprised of the process wastewater as well as the sanitary wastewater from the nearby residences) treatment system discharge (004) and 2) The Filter Backwash discharge (005). Of particular interest, is the presence of lead, silver, ammonia, and chlorine in the Veratec effluent--all which potentially threaten biological integrity downstream of the discharge. Furthermore, the very low hardness in the receiving portion of the North River indicates that this portion of the river may be particularly sensitive to these and other discharged pollutants.

HABITAT

NOR01 was located approximately 100 m upstream of Route 112 and about 1000 m upstream of the confluence with the Deerfield River. Here the stream was approximately 5 m wide and 0.5 m deep. The sampling reach meandered through a hemlock-dominated forest that was especially dense along the left bank of the channel. The right bank, consisting of a profusion of flood plain vegetation, was fairly well buffered from the road (approximately 50 m away). During heavy rain, road runoff is diverted to the river from the road via a drainage ditch, which enters the river below the sampling reach. Here substantial deposits of sand were observed both instream and along the right bank, where a small "beach" has developed (although some of this sand may be naturally occurring flood plain soil). The dramatic series of rapids throughout the NOR01 reach provided macroinvertebrates with excellent habitat, with an abundance of rock substrates (cobble and boulder) and a variety of velocity/depth combinations. Deep riffles and pools, with occasional submerged logs, offered stable cover for fish as well. Substrate embeddedness and sediment deposition were virtually nonexistent, as were signs of channel alteration. Although a few small areas of erosion were observed along the stream banks, bank vegetative stability and streamside cover were very good. NOR01 received a habitat assessment score of 123, which was highly comparable to the "best attainable" conditions of the regional reference station BR01. Since habitat quality is similar at both sites, detected impacts--if any--at the NOR01 study site, can be attributed to water quality factors.

BENTHOS

NOR01 received a total metric score of 33, representing a 92% comparability to reference conditions and placing the study site in the non-impaired category for biological integrity (Table A3). In fact, most metrics--including those for richness (taxa richness, EPT index), which generally increase with increasing water quality--scored better than all other study sites in the survey (Table A3). Thus, a diverse macroinvertebrate assemblage dominated by intolerant forms, coupled with a low biotic index (3.18), indicates both a balanced trophic structure and optimum community structure, precluding the presence of organic or toxic pollutants in this portion of the North River.

It appears, then, that discharge loads from Veratec Incorporated are assimilated by the North River before impacts are seen in the benthic community downstream, as reflected by the healthy macroinvertebrate community found there. It should be noted, however, that dramatic color change has been observed at NOR01 by members of the Deerfield River Basin Team during routine monthly (July and August 1995) water quality surveys. Dark reddish brown discharges originating from Veratec, while apparently not impacting the macroinvertebrate community, may pose a threat to the fish population along this portion of the river. As fish rely heavily on visual stimuli, temporal changes in water color may have pronounced effects on activities such as foraging.

1988

The 1995 NOR01 station was sampled during the 1988 biomonitoring survey as well. To bracket the effects of the Veratec discharge, NOR01 was compared to an upstream reference station (site-specific control) representative of the "best attainable" conditions in the waterbody. This alternative to the regional reference site approach is recommended when assessing a known impact site (Plafkin et al. 1989). NOR02, the upstream control, was located in the East Branch North River near the Route 112 Bridge in Colrain, approximatly 4000 m upstream of Veratec Incorporated. NOR01 received a total metric score of 32, representing an 84% comparability to the upstream control and placing the study site in the non-impaired category for biological integrity (Table B3). In fact, several of the metrics (biotic index, EPT index, EPT/Chironomidae, scraper/filterer) for the NOR01 invertebrate assemblage scored as well as, or better than, those of the reference site. It should also be noted that a comparison to the regional reference site found the aquatic community of NOR02 to be non-impaired. A total metric score of 36 was 86% comparable to "least impacted" conditions (Table B2) in the Cold River, corroborating the use of NOR02 as an upstream reference station for NOR01.

The macroinvertebrate community at NOR01 was also compared to a regional reference station in the Cold River during the 1988 survey. CR01 was located in the Mohawk Trail State Forest just above the confluence with the Deerfield River in Charlemont, and received minimal anthropogenic influence, thus, serving as a good regional reference site for all biomonitoring stations in the 1988 survey. When using the CR01 station as a reference site, NOR01 received a total metric score of 30, representing a 71% comparability to reference conditions and placing the benthic community in the slightly impaired category (Table B2). While the evaluation suffered slightly when using CR01 as a reference (as opposed to when compared to the site-specific control), several metrics did score better than those for reference conditions--biotic index, EPT/Chironomidae, and scraper/filterer.

Regardless, of which reference station is used, it appears that the discharge effects of Veratec Incorporated had only a minimal--if any--impact on the downstream macroinvertebrate community in 1988. Water/habitat quality degradation, and subsequent benthos impairment, was even less evident at this site in 1995, when biological integrity was found to be highly comparable to reference conditions.

SOR01--South River, Conway, MA (28 September 1995)

SOR01 was located in the South River, a third order stream, approximately 2500 m upstream from the confluence with the Deerfield River. Sampling was conducted to investigate a variety of anthropogenic impacts originating upstream--most notably, failed septic systems in the vicinity of Conway and Ashfield (most homes are situated close to the river), and agricultural activities adjacent to much of the river between Conway and the sampling station.

HABITAT

This portion of the South River was approximately 5-10 m wide with a depth of 0.25 m. Kick samples were taken from both fast and slower riffles approximately 50 m upstream of Reeds Bridge Road, where the stream meandered through a forest of hemlock and mixed hardwoods (sugar maple, birch, hickory).

Shrubs (witch hazel) and grasses were abundant along the left bank as well. Substrates were dominated by cobble and gravel; however, macroinvertebrate microhabitat seemed somewhat reduced due to substrate embeddedness. A lack of velocity/depth combinations, particularly deep areas, further reduced the quality and diversity of benthic habitat. The deposition of sand--especially in pools--coupled with a lack of stable cover in pools and riffles, provided fish with only fair habitat and cover. A considerable amount of sand had also been deposited along the left bank (just below the sampling reach), probably the result of road runoff from Reeds Bridge Road. Riparian and bank structure were good--banks were well stabilized with vegetation and boulders, with only occassional areas of erosion observed.

SOR01 received a habitat assessment score of 79, which was only 64% comparable (assessment category= “partially supporting”) to habitat at the Bear River station. This was the lowest habitat evaluation received by a biomonitoring station in the Deerfield River Basin survey.

BENTHOS

SOR01 received a total metric score of 24 following RBP II analysis. This represents a 57% comparability to the regional reference station, placing the aquatic community in the moderately impaired category (Table A3). The EPT index--which generally increases with increased water quality--scored particularly poorly (score=0), as did the community similarity metric (score=0). Because of the ambiguity of the overall impairment score, RBP III analysis was completed to improve the resolution of the impairment range and increase the reliability of the assessment. Following recalculation of biological metrics based on genus/species level taxonomy, SOR01 received a total metric score of 20, representing a 48% comparability to the reference site. Again, this placed the SOR01 macroinvertebrate community in the moderately impaired category (Table A4).

Due to the very low habitat comparability to the BR01 reference site, it is difficult to determine whether habitat constraints or water quality factors are limiting to biological integrity at SOR01. While biological effects may be due to a combination of water quality and habitat degradation, the use of physicochemical data and water quality data collected by the Deerfield River Basin Team should aid in the interpretation of the biomonitoring data.

1988

The lower portion of the South River (SOR01) was sampled during the 1988 biosurvey; however, sampling was conducted approximately 2500 m upstream from the 1995 SOR01 station, where Reeds Bridge Road again crosses the river. The SOR01 station was compared to both the regional reference station CR01, and an upstream reference station (SOR02) located at Emmet’s Road in Ashfield. Regardless of which reference was used, SOR01 received a total metric score of 28, representing a 67% comparability to “best attainable” conditions and placing the aquatic community in the slightly impaired category for biological integrity (Tables B2 and B3).

While it is difficult to determine the primary cause of impairment, it appears that biological integrity has been slightly degraded in the lower South River since 1988. Likely causes of habitat degradation, particularly sediment deposition and subsequent microhabitat depletion, are runoff from nearby Shelburne Falls Road/Bardwell Road and additional sediment erosion from upstream agricultural activities--especially along the flood plain in areas lacking adequate vegetative buffers. In addition, the presence of a small dam structure (Kimball, MADEP, personal communication) just upstream of SOR01 may result in scouring and subsequent deposition in the sampling reach. Sedimentation at SOR01 may contribute to the lack of EPT taxa and overall species richness, as studies have demonstrated that the primary effect of sediment addition to a stream is to initiate drift of animals from the affected site (Wiederholm 1984). Agricultural practices and associated runoff (e.g. pesticides, fertilizers, organic inputs) are also potential sources of water quality degradation, as are failing septic systems in the vicinity of Ashfield and Conway. It is imperative that macroinvertebrate sampling be conducted at SOR01 during future basin surveys, as construction of the Ashfield Treatment Plant (NPDES #MA0100749)--an alternative tertiary waste treatment facility--was completed in 1996.

GR01--Green River, Greenfield, MA (28 September 1995)

GR01 was located downstream of downtown Greenfield and a number of potential water quality stressors associated with its urban setting. Urban runoff and industrial activities have historically threatened biological integrity in this portion of the Green River; Discharge points from numerous storm drains enter the river a short distance upstream from the sampling station; however, it is anticipated that the town of Greenfield's recent installation of new stormwater technology--the StormTreat System--may reduce the effects of stormwater runoff. In addition, coal tar globules have historically been observed in the storm drain lines and in one of the storm drain outfalls at Mead Street in the vicinity of the Berkshire Gas Company--site of a decommisioned coal-gasification plant. Dense coal tar globules were also observed in the Green River sediments, primarily in the impounded portion of the river adjacent to the Berkshire Gas Company property. Other potential nonpoint source pollution inputs are the numerous road, highway, and railroad crossings in the vicinity of downtown Greenfield.

HABITAT

Sampling was conducted immediately downstream from an unnamed footbridge off Route 5/10, approximately midway between the Meridian Street bridge and the confluence with the Deerfield River. The sampling reach was approximately 5 m wide and 0.25-0.5 m deep. Unlike the dammed portions of the Green River immediately upstream, adequate current velocity and an abundance of hard substrates (cobble and gravel) provided macroinvertebrates with excellent habitat throughout the sampling reach. Fish habitat was considerably less optimal, however, as limited pool areas were shallow and lacked stable cover. Some areas of erosion were observed along the steep portions of both banks, although instream deposition and embeddedness was minimal. Potential nearby sources of nonpoint source pollution were the residences along the left bank, and the playing fields and parking lot adjacent to the right bank; however, an abundance of sugar maples and vines (bittersweet) provided a good vegetative buffer along both banks. Dense algal growth (filamentous, blue-green) was observed on much of the instream substrate throughout the reach, indicative of organic enrichment in the water column.

GR01 received a total habitat assessment of 98, representing an 80% comparability to the regional reference station. Based on this evaluation (assessment category= "supporting"), GR01 was expected to support a relatively high quality benthic community.

BENTHOS

Following RBP II analysis, GR01 received a total metric score of 18, representing only a 43% comparability to the reference site (Table A3). Although this was the lowest benthos evaluation received in the survey, the moderate impairment score warranted additional analysis. RBP III analysis and recalculation of metrics again found the GR01 aquatic community to be moderately impaired. A total metric score of 14 was 33% comparable to the BR01 site (Table A4)--the lowest percent comparability to reference conditions in the survey.

The "supporting" habitat evaluation infers that water quality factors are resposible for the low impairment score for biological integrity at GR01. A worse than expected community composition--most notably the low species richness (score=2) and the loss of pollution sensitive EPT taxa (score=0)--is particularly indicative of water quality degradation. The numerical dominance of the filterer *Hydropsyche morosa* gr., and the scrapers *Optioservus* sp. and *Psephenus* sp., indicates an abundance of both suspended Fine Particulate Organic Material (FPOM) and algal food recources--both of which (especially FPOM) may suggest organic enrichment effects. The biotic index, developed as a means of detecting organic pollution, also scored poorly (score=2). It should be noted, however, that the strong representation by *Psephenus* sp., *Optioservus* sp. (a "riffle beetle"), and *Hydropsyche* sp. would not occur if dissolved oxygen levels were excessively low, as is often the case in areas with high algal densities and organic enrichment.

1988

GR01 was sampled in 1988 in the same location as during the 1995 survey. When using the regional reference station CR01, GR01 received a total metric score of 22, representing a 52% comparability to reference conditions (Table B2). The impairment designation, which was intermediate to the ranges for moderately impaired and slightly impaired, improved to slightly impaired when using an upstream control (GR02) as a reference site--a total metric score of 24 represented a 57% comparability to the “least impacted” reference on the Green River upstream from Greenfield (Table B3).

As with the 1995 survey, community composition was worse than expected at GR01. A reduction of EPT taxa and other intolerant forms, coupled with an increase in percent contribution of tolerant and dominant taxa, indicates water quality degradation. The high biotic index (6.83) and high percent contribution of dominant taxa (30%) are due to the numerical dominance of the chironomid *Cricotopus bicinctus*. The Chironomidae tend to become increasingly dominant in terms of relative abundance along a gradient of increasing enrichment or toxicity (Plafkin et al. 1989). The high density of *Cricotopus bicinctus* may indicate toxicant stress, as this species has been known to become numerically dominant in habitats exposed to metal discharges where EPT taxa are not abundant (Winner et al. 1980). The Hydropsychidae taxa, while abundant, are not dominant taxa as they are in the 1995 assemblage. According to Cummins (1987), filtering collectors--such as *Hydropsyche morosa gr*.--are sensitive to toxicants bound to fine particles and may decrease in abundance when exposed to sources of such bound toxicants. Cursory studies (IEP Incorporated 1990) of contamination effects on benthic macroinvertebrates in the Green River in the vicinity of Berkshire Gas Company suggested that toxic discharges might have originated from a storm drain outfall near the Berkshire facility at Mead Street.

It appears, then, that water quality in the vicinity of GR01 has continued to degrade since the 1988 survey. While it is difficult to target specific nonpoint source stressors, storm drains located upstream in the vicinity of Berkshire Gas Company and elsewhere are potential sources of inorganic/organic loadings associated with urban runoff. The impounding of the river--between Mill Street and Meridian Street--adjacent to several storm drains futher increases the potential for enrichment upstream of the sampling station. When these lentic systems are subjected to increasingly eutrophic conditions and/or excessive organic inputs--either from precipitation or land-based anthropogenic inputs--the resulting effects of enrichment (i.e. increased algal, plant, and DOM production) can be seen not only in the lentic fauna, but also the aquatic communities immediately downstream (Wiederholm 1984). The rich filter-feeding and grazing invertebrate assemblage at GR01 appears to reflect the effects of only mild enrichment (Wiederholm 1984), as those Hydropsychidae taxa--and for that matter, Elmidae (*Optioservus sp.*) and Psephenidae (*Psephenus* sp.)--would not be found in an oxygen-depleted zone of gross organic or inorganic pollution typically dominated by Chironomidae and Oligochaeta. The lack of substantial detrital accumulation, as determined by the habitat assessment, also corroborates the preclusion of excessive eutrophication and/or organic pollution in the sampling reach. Toxic pollutants--a perceived problem during the 1988 survey--no longer appear to contribute to water quality impairment at GR01, as reflected in the lack of indicator species (e.g. *Cricotopus bicinctus*) and abundance of filter-feeders (e.g. *Hydropsychidae* spp.) found there during the 1995 biosurvey. It is advised that biomonitoring be conducted at GR01 during future basin surveys, especially with the town of Greenfield’s recent implementation of the StormTreat system, which treats the first flush at the end of the storm pipe.

UDR01--Deerfield River (upper), Florida, MA (26 September 1995)

UDR01 was the more upstream of the two sampling stations in the mainstem Deerfield River. Biomonitoring was conducted here, and furthur downstream at LDR01 to investigate the two primary threats to biological integrity in the Deerfield River:

Wastewater Treatment

The Charlemont WWTP and the Shelburne Falls WWTP are the two largest wastewater treatment facilities on the Deerfield River. The Charlemont WWTP (NPDES# MA0103101), which provides treatment for portions of the town of Charlemont, exceeded NPDES permit conditions for BOD approximately one month before biomonitoring was conducted. In addition, the clogging of the sand filter beds (due to inadequate grain size) has been a persistent maintenence problem. The Shelburne Falls WWTP (NPDES# MA0101044), a larger facility, lies approximately 2.4 mi downstream from Charlemont and receives wastewater from the town of Shelburne Falls and the town of Buckland. The lower Deerfield River biomonitoring station (LDR01) lies approximately 7 miles downstream of the Shelburne Falls WWTP.

Although UDR01 served as an upstream reference site for LDR01, it too was downstream of a point source discharge. The Monroe WWTP (NPDES# MA0100188), a relatively small facility, is approximately 8-10 river miles upstream from the UDR01 biomonitoring station. The plant receives 100% domestic waste from 30 homes in the town of Monroe. Treatment consists of one Rotational Biological Contactor (RBC) with tertiary treatment, which replaced an extended aeration system in January 1995.

Flow Regulation

The primary perceived problem in the Deerfield River Basin is related to flow alterations controlled by power companies along the entire length of the river. Flow changes are regulated by the Federal Energy Regulatory Commission (FERC), which has recently relicensed the New England Power Company's (NEP) Deerfield River Hydroelectric Project (eight developments; 15 generating units) and Western Massachusetts Electric Company's (WMEC) Gardners Falls Hydroelectric Project (one development). Because of major changes to the flow regimes in the river resulting from the power company's authority to impound and release water for power generation, establishing a new water quality baseline is imperative.

Flow regime and current velocity are important hydrologic determinants of benthic community structure. Flow volume and velocity/depth combinations can have effects on substrate composition and stability, the amount of channel under water, and food availability (Minshall 1984). Current plays a crucial role in the distribution of benthic macroinvertebrates--current velocity affects an insect's ability to gather food, meet respiratory requirements, avoid competition and predation, and colonize or vacate certain habitats (Minshall 1984). Short-term flow fluctuations may modify aquatic insect communities in several ways, most notably by stranding aquatic insect in pockets of standing water or on exposed substrates. Mayflies are particularly susceptible to stranding and are relatively intolerant of exposure (Ward 1984). Increasing and decreasing discharge may induce drift of aquatic insects; that is, the downstream transport by current of benthic animals as a means of escape or dispersal (Wiley and Kohler 1984; Ward 1984). Populations of certain lotic forms may thus be depleted in streams below dammed impoundments because drift from upstream lotic reaches is unable to replenish the individuals lost from the regulated or fluctuating flow segment.

In addition to altered flow effects to the downstream lotic environment, the impoundment of a previously free-flowing river by damming--and subsequent hypolimnetic releases--may affect downstream temperature regimes. An unfortunate consequence of these altered temperature regimes may be the elimination of many species of aquatic insects (Ward 1984). On the other hand, the altered trophic structure below impounded segements--due to food sources of a lentic origin (e.g. phytoplankton)--may result in dense populations of taxa usually not found in unimpounded and oligotrophic lotic systems. Thus, the impoundments and releases created by stream regulation may affect downstream aquatic community composition and structure in a variety of ways.

HABITAT

With a width of approximately 15-20 m and a depth of 0.5-1 m, UDR01 was located approximately 300 m upstream from the Florida Bridge (Zoar Road) near the Florida-Savoy-Charlemont town lines. The majority of the land in this portion of the basin consists of undeveloped forest, with the village of Monroe Bridge being the only area of concentrated residential land use between Charlemont and the Vermont border. Potential sources of NPS pollution were the railroad and Zoar Road, which run very close to each side of the river in this portion of the watershed. Bottom substrates were considered excellent for macroinvertebrates, consisting of mostly boulder and cobble with virtually no embeddedness. Much of these substrates were covered with slimy and/or filamentous algae. As sampling was conducted before the scheduled flow releases from the Fife Brook Dam and Deerfield #5 Dam, deep riffle/pool areas were limited, providing fish with less than optimal habitat and macroinvertebrates with low habitat diversity. Both stream banks appeared stable and well vegetated--providing a good buffer from the nearby road and railroad.

BENTHOS

The UDR01 biomonitoring station served as an upstream reference for LDR01; however, anthropogenic impacts upstream (i.e. Monroe WWTP, NEP stream regulation) may preclude the validity of this designation. Nevertheless, the absence of comparable "reference quality" sites elsewhere in the basin, in terms of habitat and discharge, led to the selection of UDR01 as the reference. It was, unfortunately, impossible to establish the UDR01 biomonitoring station upstream of the Monroe WWTP, as the river here is impounded (NEP's Sherman Development). Because UDR01 is a "least impacted" site and is not compared to an additional reference station, it does not receive an impairment score for biological condition; however, the macroinvertebrate assemblage found there will be briefly discussed in qualitative terms.

Biological metric values for the UDR01 benthos are included in Table A3. Most striking is the low scraper/filterer ratio, which is unexpectedly low. While most large (fourth or fifth order) and open-canopied rivers are dominated by a scraper based assemblage (i.e. a periphyton-based trophic structure), filterers are the predominant feeding group at UDR01 (Table A1). In fact, almost 70% of the organisms identified are filtering collectors, with the Oligoneuriidae mayflies and Hydropsychidae caddisflies the most numerically dominant. According to Plafkin et al. (1989), the predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source. In this case, the overabundance of FPOM--an important food item for filterers such as Hydropsychidae and Oligoneuriidae--is likely a result of organic enrichment or eutrophication. In addition to increasing phytoplankton production for filtering collectors, this enrichment is probably responsible for the dense filamentous algae cover on substrates at UDR01. In lieu of other sources of inorganic/organic loading to this portion of the basin, the Monroe WWTP seems a likely origin. Compounding the effects of enrichment are the NEP impoundments between Sherman Reservoir and the sampling station. Here phytoplankton becomes a primary source of autochthonous organic matter before being transported downstream as an available food resource for primary consumers (Merritt et al. 1984).

The abundance of Ephemeroptera (62 individuals) at UDR01 indicates that stranding effects caused by hydrologic control in this portion of the river are probably not a factor, at least in the sampling reach. Indeed, very few instream substrates were exposed during the time of sampling--which occurred prior to a scheduled dam release during a "very dry" summer. Likewise, those lotic taxa most dependent on current for respiration and food aquisition--most notably the EPT taxa--are numerous, suggesting that discharge-induced drift (caused by sudden dam releases) has not resulted in the depletion of rheophilic taxa in this portion of the river. In fact, both taxa richness and EPT index at UDR01 were higher than the 1988 survey's DE06 reference, which was used as a reference for the Deerfield River sampling stations during that survey.

1988

UDR01 was sampled during the 1988 biomonitoring survey as well. Again the station served as an upstream reference for sampling stations furthur downstream (LDR02, LDR01). In addition, UDR01 was compared to the regional reference station CR01.

UDR01 received a total metric score of 34, which represents an 81% comparability to CR01 and places biological status intermediate to the ranges for slight impairment and non-impairment (Table B2). Like the community sampled in 1995, overall richness was somewhat lower than expected (taxa richness=22), although EPT taxa were diverse (EPT index=11). Again, an assemblage dominated by filtering collectors (61%), and a high biotic index (5.45) suggests significant sources of FPOM and associated organic enrichment upstream. Enrichment effects were also seen in the dense algal cover on much of the instream substrate. It should be mentioned that low flow during sampling resulted in considerable substrate exposure, especially throughout the center of the channel. In addition, water temperatures here were high (24^{o}C) relative to most sampling stations in the basin.

LDR01--Deerfield River (lower), Deerfield, MA (28 September 1995)

HABITAT

LDR01 was located approximately midway between the Stillwater Bridge and Interstate 91, in a relatively undeveloped portion of the Deerfield River. Like the upper Deerfield River station, canopy cover throughout the sampling reach was open, with a forested riparian zone (sugar maple, red maple, butternut, sycamore) on both sides of the channel. Depth (0.5-1 m) and width (15-20 m) in this portion of the river were also similar to the upstream station. Grasses and shrubs (false bamboo, dogwood) occupied the margins of the left bank as well. Nonpoint source inputs were absent, with the exception of potential runoff from the bridges above and below the sampling reach. An abundance of cobble and boulder substrates, subjected to a variety of velocity/depth combinations provided excellent epifaunal habitat for macroinvertebrates. Deep riffles and pools with large boulders offered stable cover and good habitat for fish. Bank stability was excellent, and the forested riparian zone provided a good vegetative buffer from the nearby road (Stillwater Road).

LDR01 received a habitat assessment score of 126, which was actually higher than that received by the upstream reference site. In fact, habitat at LDR01 rated higher than any other biomonitoring station in the 1995 survey of this watershed.

BENTHOS

LDR01 received a total metric score of 30, representing a 77% comparability to the upstream reference station UDR01 and placing the aquatic community in the non-impaired category (Table A3). Most metric values (taxa richness, EPT index, scrapers/filterers, percent contribution of dominant taxa) were actually better than those of the reference conditions. A notable exception was the EPT/Chironomidae metric, whose value was “skewed” by the numerical dominance of filter-feeding EPT taxa (probably resulting from FPOM abundance) and much higher at UDR01 (98). In fact, lower densities of filterers at LDR01--and a subsequently higher scraper/filterer metric value (1.59)--suggests a more periphyton-based community composition, which is less indicative of upstream enrichment than the assemblage at UDR01. The higher richness and EPT index values at LDR01, also suggest that water quality may be less limiting to biological integrity here than at the upstream reference station.

It appears from the RBP analysis that the effects of point source discharges or stream regulation (NEP Developments 1-3 are in the vicinity of Shelburne Falls) are not seen in the relatively diverse and EPT taxa-rich benthic community in this portion of the river. However, a conservative approach should be taken when attempting to interpret the resulting benthos evaluation at LDR01, as known anthropogenic impacts to the UDR01 sampling station make it a somewhat unreliable reference site. Unfortunately, time restraints made locating and sampling a suitable regional reference station for this site impossible, and using the shredder-based closed canopy Bear River station (BR01) as a reference site is inadvisable due to differences in trophic structure and drainage area. It may be worth mentioning, however, that both taxa richness and the EPT index at LDR01 were higher than the 1988 survey’s DE06 station, which was used as a regional reference for the Deerfield River sampling stations during that survey.

It is imperative that use of an appropriate reference station (e.g., Cold River; Green River-upstream of Greenfield) be used in future biosurveys conducted on the mainstem Deerfield River, as water quality impacts related to point source discharges and stream regulation will continue to be important issues in this waterbody.

1988

As in the 1995 survey, comparisons to the upstream reference station found the macroinvertebrate community at LDR01 to be non-impaired. A total metric score of 36 represented an 86% comparability to the “best attainable” conditions upstream (Table B3). Biological integrity at LDR01 decreased slightly when compared to the regional reference station; A total metric score of 32, representing a 76% comparability to CR01 placed the LDR01 macroinvertebrate community in the slightly impaired category (Table B2). That biological impairment is detected in the LDR01 aquatic community when using the Cold

River site (CR01) as a reference, but not when using the upstream control (UDR01) as a reference, suggests that UDR01 may not be a reliable reference station for downstream study sites in the Deerfield River--corroborating those results of upstream-downstream comparisons made in 1995.

SUMMARY/RECOMMENDATIONS

BR01 (Bear River)--As a designated regional reference station, it is not surprising that habitat and biological integrity were considered excellent at BR01. The diverse macroinvertebrate assemblage, dominated by intolerant taxa, contained species (*Isogenoides* sp., *Lopescladius* sp.) previously unobserved in past biomonitoring surveys conducted by MADEP. While BR01 served as an adequate reference station for NOR01, SOR01, and GR01, it was inappropriate as a reference for those stations in the Deerfield River--a considerably larger drainage area offering a much different habitat than BR01.

NOR01 (North River)--Habitat here was highly comparable to reference conditions, although nonpoint source inputs in the form of sand deposition have impacted habitat quality downstream of the sampling reach. Implementation of better road runoff control is recommended, as sand appears to be entering the river from the road. Water quality effects from Veratec Inc. were not observed in the macroinvertebrate community found here, which was diverse and pollution sensitive. Water color changes, observed during routine water quality surveys, may have detrimental effects on fish ecology in this portion of the river.

Biological integrity at NOR01 seems to have improved since the 1988 biosurvey, when slight impairment to the aquatic communtiy was detected relative to the regional reference station.

SOR01 (South River)--It was difficult to discern the primary source of moderate impairment to the aquatic community at SOR01--habitat degradation in the form of sediment deposition in the sampling reach, or water quality factors upstream. An investigation into possible sources of sediment input is advised, as is macroinvertebrate sampling during future basin surveys--especially with the recent installation of an alternative technology wastewater treatment facility upstream.

Biological condition in the lower South River has degraded slightly since the 1988 survey. However, macroinvertebrate sampling in the 1988 survey was conducted upstream of possible sources of habitat degradation to the 1995 sampling station, which was located further downstream and below a small dam structure and some minor agricultural activity.

GR01 (Green River)--Moderate impairment to the aquatic community at GR01, as reflected in the low diversity and lack of EPT taxa in the macroinvertebrate assemblage sampled there, was due to water quality factors associated with its urban setting. Storm drains immediately upstream of the sampling station have historically been a source of organic/inorganic inputs to the river. Enrichment effects may be compounded by the presence of impoundments upstream, where a rich supply of FPOM has led to a predominantly filter-feeding macoinvertebrate community at GR01.

While biological condition rated better in 1988 than 1995, the numerically dominant toxic indicator *Cricotopus bicinctus* was not present in the 1995 sample. Biomonitoring should be conducted here in the future, especially with the recent implementation of new stormwater technology by the town of Greenfield.

UDR01 (Deerfield River)--UDR01 served as the upstream reference station for LDR01. While a qualitative benthos assessment found the macroinvertebrate assemblage to be fairly diverse and intolerant, an abundance of filterers suggested substantial sources of FPOM (and associated enrichment) upstream. Anthropogenic impacts upstream suggest that UDR01 may not be a reliable control for study sites downstream. Comparison to an appropriate regional reference site during future surveys is recommended.

Comparisons to a regional reference station during the 1988 survey found the upper Deerfield River aquatic community to be intermediate to the slight/non-impairment categories for biological impairment.

LDR01 (Deerfield River)--The LDR01 macroinvertebrate community, a more diverse assemblage (in terms of richness and EPT index) than that collected at the upstream control site, rated non-impaired for biological integrity. According to upstream-downstream comparisons, then, the primary perceived anthropogenic impacts to the Deerfield River--wastewater discharges and stream regulation--have not affected biological potential in this portion of the river. Likewise, results of the 1988 biosurvey found the macroinvertebrate community in this portion of the river to be non-impaired when compared to the upstream control site; slight/non-impairment was detected when compared to the regional reference station.

To better assess the effects of stream regulation and point source inputs to the Deerfield River, it is recommended that an appropriate regional reference site--either in the Cold River or the Green River (upstream from Greenfield)--be utilized for future biosurveys.

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APPENDIX A

BENTHIC MACROINVERTEBRATE DATA FROM THE 1995
DEERFIELD RIVER WATERSHED SURVEY

Table A1. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Deerfield River Basin between 26 and 28 September 1995. Sampling stations were in: Deerfield River (UDR01, LDR01), North River (NOR01), South River (SOR01), Bear River (BR01), and Green River (GR01)--all in Massachusetts.

TAXON	TV	FFG	UDR01	NOR01	SOR01	BR01	LDR01	GR01
Lumbricina	8	GC	2					
Hydracarina	6	PR			3			
Baetidae	4	GC	5	13		5	24	
Oligoneuriidae	2	FC	32	8	1	2	3	
Heptageniidae	4	SC	16	5	1	13	13	5
Ephemerellidae	1	GC	4	14	1	11	3	
Leptophlebiidae	2	GC	1			13		
Gomphidae	5	PR	1					
Perlidae	1	PR	2	1	1	8	1	
Perlodidae	2	PR				1		
Chloroperlidae	1	PR		1		3		
Corydalidae	5	PR		1		1		
Philopotamidae	3	FC	13	2		7	4	
Polycentropodidae	6	FC		1	1	1	2	
Hydropsychidae	4	FC	23	17	25	6	17	31
Rhyacophilidae	0	PR	1	1		2		
Glossosomatidae	0	SC		1	3	2	4	
Hydroptilidae	4	GC	1	1				
Brachycentridae	1	FC					1	
Lepidostomatidae	1	SH				2	1	
Limnephilidae	4	SH		1	1	1		
Odontoceridae	0	SH		1				
Psephenidae	4	SC		6	26	3	5	14
Elmidae	4	SC	1	25	21	6	14	33
Tipulidae	3	SH			2	1		2
Ceratopogonidae	6	PR			1	1		
Chironomidae	6	GC	1		2	7	6	4
Athericidae	2	PR		1		3		
Hydrobiidae	8	SC					1	
Ancylidae	7	SC			3		6	4
Pisidiidae	6	FC	1					
TOTAL			104	100	92	99	105	93

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

Table A2. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Deerfield River Basin between 26 and 28 September 1995. Sampling stations were in: Deerfield River (UDR01, LDR01), North River (NOR01), South River (SOR01), Bear River (BR01), and Green River (GR01)--all in Massachusetts

TAXON	TV	FFG	SOR01	BE01	GR01
Ferrisia fragilis	6	SC	1		4
Hydracarina	6	PR	3		
Baetidae	4	GC		5	
Isonychia sp.	2	FC	1	2	
Heptageniidae	4	SC		9	3
Rhithrogena sp.	0	SC		3	
Stenonema sp.	3	SC		1	2
Ephemerellidae	1	GC		11	
Ephemerella sp.	1	GC	1		
Leptophlebiidae	2	GC		10	
Paraleptophlebia sp.	1	GC		3	
Acroneuria sp.	0	PR		6	
Agtetina sp.	2	PR		1	
Neoperla sp.	3	PR		1	
Paragnetina sp.	1	PR	1		
Haploperla sp.	0	PR		3	
Isogenoides sp.	0	PR		1	
Nigronia sp.	0	PR		1	
Dolophiloides sp.	0	FC		7	
Polycentropodidae	6	FC		1	
Polycentropus sp.	4	PR	1		
Hydropsyche morosa gr.	6	FC	14	6	25
Cheumatopsyche sp.	5	FC	11		5
Macrostemum sp.	3	FC			1
Rhyocophila sp.	1	PR		2	
Glossosoma sp.	0	SC	3	2	
Lepidostoma sp.	1	SH		2	
Limnephilidae	4	SH	1	1	
Psephenus sp.	4	SC	27	3	14
Elmidae	4	GC	1		
Optioservus sp.	4	SC	20	5	28
Promoresia sp.	2	SC		1	
Stenelmis sp.	5	SC			3
Tipulidae	3	SH			1
Antocha sp.	3	GC	2	1	1
Probezzia sp.	6	PR		1	
Stilobezzia sp.	6	PR	1		
Conchapelopia sp.	6	PR		1	
Cricotopus tremulus gr.	7	SH			2
Cricotopus/Orthocladius sp.	7	SH			2

TAXON	TV	FFG	SOR01	BE01	GR01
Lopescladius sp.	4	GC		1	
Tvetenia bavarica gr.	5	GC	1	2	
Polypedilum aviceps	6	SH		2	
Stenochironomus sp.	5	GC		1	
Rheotanytarsus exiguus gr.	6	FC	1		
Atherix sp.	4	PR		3	
Hemerodromia sp.	6	PR	1		
TOTAL			92	102	91

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

Table A3. Summary of RBP II data analysis for macroinvertebrate communities sampled at six stream sites (BR01, NOR01, SOR01, GR01, UDR01, LDR01) in the Deerfield River Basin between 26 and 28 September 1995. Seven biological metrics were calculated and scored (in parentheses) for taxa collected at each station. Scores were totaled and compared to the regional reference site (BR01) or the upstream control site (UDR01). The percent comparability to the reference station yields a final impairment score for each study site.

STATION #	BR01[1]		NOR01		SOR01		GR01		UDR01[2]		LDR01	
STREAM	Bear River		North River		South River		Green River		Deerfield River (upper)		Deerfield River (lower)	
HABITAT SCORE	123		123		79		98		104		126	
TAXA RICHNESS	22	(6)	18	(6)	15	(3)	7	(0)	15	(6)	16	(6)
BIOTIC INDEX	2.79	(6)	3.18	(6)	3.98	(3)	4.15	(3)	3.13	(6)	3.98	(3)
EPT INDEX	15	(6)	14	(6)	8	(0)	2	(0)	10	(6)	11	(6)
EPT/CHIRONOMIDAE	11	(6)	67/0	NA	17	(6)	9	(6)	98	(6)	12.17	(0)
RIFFLE COMMUNITY: SCRAPERS/FILTERERS	1.71	(6)	1.32	(6)	1.03	(6)	1.81	(6)	.25	(6)	1.59	(6)
% CONTRIBUTION (DOMINANT FAMILY)	13%	(6)	25%	(6)	28%	(6)	35%	(3)	31%	(3)	23%	(6)
COMMUNITY SIMILARITY	100%	(6)	48%	(3)	28%	(0)	26%	(0)	100%	(6)	46%	(3)
TOTAL METRIC SCORE		42		33		24		18		39		30
% COMPARABILITY TO REFERENCE STATION			92%		57%		43%				77%	
BIOLOGICAL CONDITION - DEGREE IMPAIRED	*REFERENCE*		NON-IMPAIRED		MODERATELY IMPAIRED		MODERATELY IMPAIRED		*REFERENCE*		NON-IMPAIRED	
					RBPIII NEEDED		RBPIII NEEDED					

[1] Regional reference site for NOR01, SOR01, GR01
[2] Upstream reference site for LDR01

Table A4. Summary of RBP III data analysis for macroinvertebrate communities sampled at three stream sites (BR01, SOR01, GR01) in the Deerfield River Basin between 26 and 28 September 1995. Seven biological metrics were calculated and scored (in parentheses) for taxa collected at each station. Scores were totaled and compared to the regional reference site (BR01). The percent comparability to the reference station yields a final impairment score for each study site.

STATION #	BR01[1]		SOR01		GR01	
STREAM	Bear River		South River		Green River	
HABITAT SCORE	123		79		98	
TAXA RICHNESS	32	(6)	18	(2)	13	(2)
BIOTIC INDEX	2.39	(6)	4.30	(2)	4.74	(2)
EPT INDEX	20	(6)	9	(0)	5	(0)
EPT/CHIRONOMIDAE	11	(6)	17	(6)	9	(6)
RIFFLE COMMUNITY: SCRAPERS/FILTERERS	1.50	(6)	1.86	(6)	1.74	(6)
% CONTRIBUTION (DOMINANT FAMILY)	11%	(6)	29%	(4)	31%	(2)
COMMUNITY SIMILARITY	100%	(6)	20%	(0)	19%	(0)
TOTAL METRIC SCORE		42		20		18
% COMPARABILITY TO REFERENCE STATION			48%		43%	
BIOLOGICAL CONDITION - DEGREE IMPAIRED	*REFERENCE*		MODERATELY IMPAIRED		MODERATELY IMPAIRED	

[1] Regional reference site for NOR01, SOR01, GR01

APPENDIX B

MACROINVERTEBRATE DATA FROM THE 1988 DEERFIELD RIVER WATERSHED SURVEY

Table B1. Taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Deerfield River Basin between 18 and 20 July 1988. Sampling stations were in: Deerfield River (DE05, DE08, DE17), Cold River (DE06), North River (DE10, DE11), South River (DE15, DE16), Green River (DE18, DE19A).

TAXON	FFG	TV	DE05	DE06	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
Amnicola limosa	SC	5	3									
Physidae	GC	8	3			1	1					
Ferrissia sp.	SC	6	4		1					3		3
Pisidiidae	FC	6	12									
Lumbriculus sp.	GC	8		1							4	
Baetidae	GC	6			5							1
Acentrella sp.	SC	4							1			
Baetis sp.	GC	6		1		2	6	8				
Isonychia sp.	FC	2	2			4				25	2	2
Heptageniidae	SC	3				1						
Stenonema sp.	SC	3			10					2	7	1
Ephemerellidae	GC	2										
Attenella attenuata	GC	1	1									
Drunella cornuta	GC	0		1		2		9				
Serratella sp.	GC	2		3	17	2	28					
Serratella serrata	GC	2							2	2		
Serratella serratoides	GC	2									1	
Tricorythodes sp.	GC	4					2				1	
Caenis sp.	GC	7									10	
Paraleptophlebia sp.	GC	1										
Potamanthus sp.	GC	4									1	
Ophiogomphus sp.	PR	1			1				1		5	
Pteronarcys sp.	SH	0		1	1		1				4	
Leuctra sp.	SH	0						1				
Perlidae	PR	3				2						
Acroneuria sp.	PR	0								1		
Perlesta placida	PR	5	1	11	14	1			3	5	4	9
Phasganophora capitata	PR	0		6	1		3		2			
Isoperla sp.	PR	2						1				
Chloroperlidae	PR	0						3				
Sialis sp.	PR	4									1	
Nigronia sp.	PR	0									2	
Chimarra sp.	FC	4	3									
Dolophilodes sp.	FC	0	1	1		9		2				
Nyctiophylax sp.	PR	5			1							
Phylocentropus sp.	FC	6		1								

TAXON	FFG	TV	DE05	DE06	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
Cheumatopsyche sp.	FC	5	10	2		2	1			4		2
Hydropsyche betteni	FC	6	1									
Hydropsyche morosa gr.	FC	6	17	13	14	13	19	7	16	20	6	14
Macrostemum sp.	FC	3	1									
Rhyacophila sp.	PR	1	1					6				
Glossosoma sp.	SC	0			2		5		4	3		
Protoptila sp.	SC	1			1					1		
Agraylea sp.	GC	8										2
Brachycentrus sp.	FC	1					1			1		
Micrasema sp.	SH	2	2									
Psilotreta sp.	SC	0		1								
Oecetis sp.	PR	5			1							
Dineutus sp.	PR	4			5							
Psephenus herricki	SC	4							1		4	1
Optioservus sp.	SC	4						11	8	1		1
Promoresia sp.	SC	2	1									
Stenelmis sp.	SC	5				2	1		1	2		
Antocha sp.	GC	3										2
Dicranota sp.	PR	3						7				
Hexatoma sp.	PR	2		2		1		3	10		1	
Tipula sp.	SH	4						1				
Ceratopogonidae	PR	6		1	2				1			
Simulium fibrinflatum	FC	6								2		
Simulium venustum	FC	5						7				
Tanypodinae	PR	7		1					1		1	
Conchapelopia sp.	PR	6		8	2	2		1	1		7	3
Meropelopia sp.	PR	6										1
Thienemannimyia gr.	PR	6	2	1								1
Diamesa sp.	GC	5						2	1			
Pagastia sp.	GC	1	1	8				8	1			
Potthastia gaedii gr.	GC	2		1								
Potthastia longimanus	GC	2						2				
Cardiocladius albiplumus	PR	5							1			
Cricotopus sp.	GC	7					2					
Cricotopus/Orthocladius sp.	GC	7				1	1				3	4
Cricotopus bicinctus	GC	7	4	5		1	11	1			4	30
Cricotopus bicinctus gr.	GC	7				1						
Cricotopus tremulus gr.	SH	7		1								
Cricotopus trifascia gr.	SH	6										4
Cricotopus vierriensis	SH	7	8	1			1					1
Eukiefferiella claripennis gr.	GC	8						1				
Nanocladius sp.	GC	3										1
Orthocladius sp.	GC	6						1				

TAXON	FFG	TV	DE05	DE06	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
Parametriocnemus sp.	GC	5						1	3			
Rheocricotopus sp.	GC	6										1
Synorthocladius sp.	GC	6					1					
Thienemanniella sp.	GC	6				1						
Tvetenia bavarica gr.	GC	5						10				
Tvetenia vitracies gr.	GC	5	6	2		1			7			1
Cryptochironomus sp.	PR	8							1			
Microtendipes sp.	FC	6									1	
Microtendipes pedellus	FC	6		3	6	6			4		2	
Microtendipes rydalensis gr.	FC	6				6					1	
Nilothauma sp.	GC	2									1	
Polypedilum sp.	SH	6					1					
Polypedilum aviceps	SH	6		5		8	1	4	1		1	
Polypedilum convictum	SH	6		6	7	12	3		22	1		
Cladotanytarsus sp.	FC	7			1							
Micropsectra sp.	GC	7				4			2			
Rheotanytarsus distinctissimus gr.	FC	6		1						2		
Rheotanytarsus exiguus gr.	FC	6	10	5	2	6	2				10	
Sublettea sp.	FC	4			2				1			1
Tanytarsus sp.	FC	6		2		3	1				4	1
Tanytarsus guerulus gr.	FC	6										1
Protoplasa fitchii	PR	5			1							
Atherix sp.	PR	4									2	
Chelifera sp.	PR	6						4				
Hemerodromia sp.	PR	6									1	9
TOTAL			94	96	97	97	94	100	97	93	91	99

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

Table B2. Summary of RBP III data analysis for macroinvertebrate communities sampled at 10 stream sites in the Deerfield River watershed between 18 and 20 July 1988. Seven biological metrics were calculated and scored for taxa collected at each station. Scores were then totaled and compared to the regional reference station DE06. The percent comparability to the reference station yields a final impairment score for each station.

STATION #	DE06	DE05	DE08	DE10	DE11	DE15	DE16	DE17	DE18	DE19A
STREAM	Cold River	Deerfield River	Deerfield River	North River	North River	South River	South River	Deerfield River	Green River	Green River
TAXA RICHNESS	28	22	22	25	21	23	25	18	26	24
BIOTIC INDEX	4.60	5.45	4.23	4.81	4.27	3.54	4.65	3.85	4.92	6.83
EPT INDEX	12	11	10	10	10	8	7	12	9	7
EPT/CHIRONOMIDAE	0.84	1.30	3.40	0.79	2.70	1.20	6.63	27	1.03	0.60
RIFFLE COMMUNITY: SCRAPERS/FILTERERS	0.07	0.14	0.16	0.04	0.29	1.30	0.71	0.22	0.42	0.29
% CONTRIBUTION DOMINANT FAMILY	14%	18%	18%	13%	30%	11%	23%	27%	11%	30%
COMMUNITY SIMILARITY	100%	31%	44%	48%	36%	26%	37%	24%	37%	36%
TOTAL METRIC SCORE	42	34	34	36	30	34	28	32	34	22
% COMPARABILITY TO REFERENCE STATION		81%	81%	86%	71%	81%	67%	76%	81%	52%
BIOLOGICAL STATUS - DEGREE IMPAIRMENT	*Reference*	Slight-Non	Slight-Non	Non	Slight	Slight-Non	Slight	Slight	Slight-Non	Moderate-Slight

Table B3. Summary of RBP III data analysis for macroinvertebrate communities sampled at 9 stream sites in the Deerfield River watershed between 18 and 20 July 1988. Seven biological metrics were calculated and scored for taxa collected at each station. Scores were then totaled and compared to the upstream reference station. The percent comparability to the reference station yields a final impairment score for each station.

STATION #	DE05[1]	DE08	DE17	DE10[2]	DE11	DE15[3]	DE16	DE18[4]	DE19A
STREAM	Deerfield River	Deerfield River	Deerfield River	North River	North River	South River	South River	Green River	Green River
TAXA RICHNESS	22	22	18	25	21	23	25	26	24
BIOTIC INDEX	5.45	4.23	3.85	4.81	4.27	3.54	4.65	4.92	6.83
EPT INDEX	11	10	12	10	10	8	7	9	7
EPT/CHIRONOMIDAE	1.30	3.40	27	0.79	2.70	1.20	6.63	1.03	0.60
RIFFLE COMMUNITY: SCRAPER/FILTERERS	0.14	0.16	0.22	0.04	0.29	1.30	0.71	0.42	0.29
% CONTRIBUTION DOMINANT FAMILY	18%	18%	27%	13%	30%	11%	23%	11%	30%
COMMUNITY SIMILARITY	100%	18%	30%	100%	25%	100%	18%	100%	24%
TOTAL METRIC SCORE	42	36	36	38	32	42	28	42	24
% COMPARABILITY TO REFERENCE		86%	86%		84%		67%		57%
BIOLOGICAL STATUS- DEGREE IMPAIRED	*Reference*	Non	Non	*Reference*	Non	*Reference*	Slight	*Reference*	Slight

[1]Upstream reference for DE08, DE17
[2]Upstream reference for DE11
[3]Upstream reference for DE16
[4]Upstream reference for DE19A

APPENDIX D

Technical Memorandum

DEERFIELD RIVER WATERSHED - 2000 PERIPHYTON DATA

Prepared by Joan Beskenis
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June 2003

During the summer of 2000, MA DEP personnel collected periphyton (attached algal community) samples from stations in the Deerfield River basin. Sampling was limited to sites chosen for macroinvertebrate investigations and was conducted as part of the macroinvertebrate/habitat assessment. It consisted of random scrapes of the substrate within the riffle zone for algal identifications and estimations of the percent cover of the algae within the reach. Occasionally other habitats, such as pools, were included for investigation. The aquatic communities (macroinvertebrates, periphyton and fish) are assessed, in part, to determine if the designated uses (Massachusetts Surface Water Quality Standards, 1996) are being supported, threatened or lost in particular segments. The Deerfield River segments included in this study are all Class B, but both Warm Water and Cold Water Fisheries are represented. Periphyton data can be used to evaluate two uses of the Deerfield River: Aquatic Life and Aesthetics.

Aquatic life evaluations are used to 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. Important components of the food chain, which are vital for use support, may be lost from this alteration. In addition, the large amounts of biomass from macroalgae when they deteriorate and die can fill in the interstitial sites in the substrate and degrade this habitat for the benthic invertebrates, thus further compromising the aquatic life use support. Nuisance growths of algae can compromise the substrates and alter water chemistry (e.g., dissolved oxygen values).

Nuisance amounts of algae can be determined by gathering estimates of the percent cover as well as determining the relative amounts of both macroalgae (visible with naked eye) or microalgae (examined microscopically) in a particular habitat (e.g. riffles or pool) (Biggs, 1996, Barbour et al., 1999). The percent cover by filamentous green algae (macroalgae) greater than 40% is an indication that nuisance amounts of algae are present and that use of the benthic habitat by aquatic life may be threatened (Biggs 1996, Barbour et al., 1999).

The algal data are also used to determine if aesthetics have been impacted. Floating rafts of previously attached benthic mats can make an area visually unappealing, as can large areas of the bottom substrates covered with long streamers of algae.

The focus of this memo is to document if nuisance amounts of algal growth are present. This is based upon percent cover of the algal population as well as determination of the type and form of the algae that were present. Other objectives of the periphyton sampling were to learn more about the biota in the streams and rivers, to offer a means of comparing biological communities in conjunction with the macroinvertebrate and habitat information, and to examine community changes over time.

MATERIALS and METHODS

Periphyton Identifications and Relative Abundance

Periphyton data were gathered along with the macroinvertebrate and habitat data using methods described in Barbour et al. (1999). Sampling was done by John Fiorentino (MA DEP) and consisted of randomly scraping rocks and cobble substrates, typically within the riffle area, with a knife and collecting the material in a labeled glass vial. The samples were transported to the lab (MA DEP-DWM-Worcester) without refrigeration, but once at the lab they were refrigerated until identifications were completed.

The vial was shaken before subsampling to get a uniform sample. If filamentous algae comprised most of the sample they 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. Either a Palmer drop cell or a Sedgwick-Rafter cell were used in the examinations. If higher magnifications were needed then a water mount was prepared on a pre-cleaned glass slide. A modified method for periphyton analysis developed by Bahls (1993) was used. The scheme for determining abundance 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.

This determination of abundance provides a relative approximation of the taxa that contribute the most to the biomass in the riffle or pool habitats. Information obtained from the algal identifications and relative abundance is combined with information obtained in the habitat assessment. Typically, a minimum of 10 fields are examined, but if only “rare” species are found then the entire slide will be scanned and after reshaking the sample, a second slide is prepared to make certain that clumping or some other non-uniform sampling error had not occurred.

RESULTS

Table 1 lists the locations, percent algal cover as well as the dominant algal type and final determination whether nuisance algal amounts were present. Periphyton taxa and relative abundance are presented in the appendix for each sampling station. No stations exhibited nuisance amounts of algae (i.e., no green macroalgae covered more than 40% of the bottom) using the system based on percent algal cover as outlined by Biggs (1996) and Barbour et al. (1999). In fact, filamentous or green macroalgal cover was less than 5%, and in some cases was less than 1%, at many sites supporting these forms of algae.

Table 1. Deerfield River Watershed Periphyton - 2000

Station Locations	Date	% Canopy Cover	% Algal Cover	Dominant Algal Type/ Forms - Habitat	Nuisance Algal Growth
Deerfield River (VI06ROA) near Mt Cutler, Williard, VT	26-Sep-2000	95	<1	Greens/filamentous - riffle	No
Cold River (CR01) at Mohawk Trail State Forest, upstream from Trout Brook, Charlemont	25-Sep-2000	0	60	Greens/filamentous -thin film riffle (thin coverage with some dense clumps)	No
Chickley River (CH01) approx. 900 m upstream from confluence with Deerfield River, Charlemont	25-Sep-2000	1	<1	Greens/diatoms/ filamentous -riffle-pool	No
Davis Mine Brook (DM00) upstream from Mill Brook, Charlemont	25-Sep-2000	50	<5	Greens/mat-riffle-pool	No
Taylor Brook (TB00) upstream from Heath Road, Colrain	26-Sep-2000	100	<5	Greens/thin film -riffle	No
North River (NOR01) upstream from Route 112 Shattuckville, Colrain	26-Sep-2000	<1	90	Blue-greens/ thin film - riffle	No
East Branch North River (NOR02A) downstream from Route 112, Colrain	26-Sep-2000	<1	100	Greens/ thin film/riffle-pool	No
Bear River (VP11BEA) approx. 100 m upstream from Shelburne Falls Road, Conway	27-Sep-2000	75	50	Greens/filamentous 1%, thin film 50%-riffle	No
South River (SOR01) upstream from Truce Road, Conway	27-Sep-2000	60	90	Diatoms/thin film -riffle	No
Deerfield River (LDR01) upstream from I-91 and downstream from Stillwater River Bridge, Deerfield	27-Sep-2000	0	90	Greens/ thin film -riffle	No
Green River (GR01) downstream from footbridge off of Route 5-10, Greenfield	27-Sep-2000	50	1	Blue-greens -riffle	No
Green River (GR02) downstream from Eugene Williams Drive, Greenfield	26-Sep-2000	0	ND	Blue-greens -riffle	No

ND-not determined or data missing

DISCUSSION

Based on the algal assemblage and the percent cover at each site the Aesthetics use does not appear to be threatened and the nonpoint sources contributing to the Deerfield River - such as those listed in the

Technical Memorandum - Deerfield River Watershed 2000 Biological Assessment (Fiorentino and Maietta, 2002) - do not appear to be severely impacting the algal community at this time.

The algal identifications (see appendix) offer limited information for the evaluation of Aquatic Life use support, especially since diatoms were not cleared and the number of samples was also limited. Some of the green filamentous algae found at stations in the Deerfield River basin such as *Mougeotia* sp., *Spirogyra* sp. and *Cladophora* sp., can grow to nuisance amounts, however, the biomass represented by these genera is currently small and would just provide habitat for invertebrate larvae or shelter for small organisms. The one station where examination of the changes in the algal community constituents and percent cover will be most informative is CR01 on the Cold River in Charlemont. Although this is a reference station for the macroinvertebrate analysis, and was not found to be impaired, some algal community alteration may be occurring in response to the nutrient provided by the local non-point sources including road runoff and the nearby campground (Fiorentino and Maietta, 2002). The algal cover at this location is described on the field sheets as a thin cover of green algae on rock surfaces with occasional dense clusters. The algal coverage was 60%. If the algal coverage in the riffle was entirely by the green filamentous alga (*Oedogonium* sp.) this station would likely be characterized as having nuisance aquatic growth which could be impairing the use of this reach. *Oedogonium* sp. is known for developing "higher-biomass" communities, particularly in low-velocity runs and pools (Biggs, 1996). At this time, however, this station's habitat scores highly (Fiorentino and Maietta, 2002) and it is only noteworthy because it "appeared" to be more productive than other areas.

The Deerfield River, at this time, does not appear to have nuisance amounts of algal biomass and the periphyton coverage would not restrict the stations evaluated from meeting the criteria for Aesthetic and Aquatic life uses.

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Appendix

Deerfield River Watershed 2000 Periphyton Data

Date	Habitat	Class	Genus	Abundance
Location: Deerfield River near Mt Cutler, Willard, VT (Station VI06ROA)				
09/26/2000	rock/riffle	Chlorophyceae	*Rhizoclonium* (*heiroglyphyium*)	VA
Location: Cold River upstream from Trout Brook, Charlemont (Station CR01)				
09/26/2000	rock/riffle/margin	Chlorophyceae	*Bulbochaete* sp.	C
		Chlorophyceae	*Oedogonium* sp.	A
09/25/2000	rock/riffle/midstream	Chlorophyceae	*Mougeotia* sp.	VA
		Chlorophyceae	*Spirogyra* sp.	C
Location: Chickley River upstream from confluence with Deerfield River, Charlemont (Station CH01)				
09/25/2000	cobble/riffle	Bacillariophyceae	*Fragilaria* sp.	VA
		Bacillariophyceae	ui stalked pennate diatoms	VA
		Chlorophyceae	*Cladophora* sp.	R
		Chlorophyceae	green filament, *Hyalotheca*	VA
	cobble/pool	Chlorophyceae	*Cladophora* sp.	R
		Chlorophyceae	*Spirogyra* sp.	A
		Chlorophyceae	*Ulothrix* sp.	C
Location: Davis Mine Brook upstream from Mill Brook, Charlemont (Station DM00)				
09/25/2000	rocks/riffle	Chlorophyceae	*Ulothrix* sp.	R
Location: Taylor Brook upstream from Heath Road, Colrain (Station TB00)				
09/26/2000	rock/riffle	Bacillariophyceae	*Nitzchia* sp.	C
		Cyanophyceae	*Oscillatoria* sp.	R
Location: North River upstream from Route 112 Shattuckville, Colrain (Station NOR01)				
09/26/2000	rock/riffle	Cyanophyceae	*Oscillatoria* sp.	R
Location: East Branch North River downstream from Route 112, Colrain (Station NOR02A)				
09/26/2000	rock/riffle	Chlorophyceae	ui parenchymatous material	R
Location: Bear River approx. 100 m upstream from Shelburne Falls Road, Conway (Station VP11BEA)				
09/27/2000	rock/riffle	Bacillariophyceae	*Cocconeis* sp.	A
		Chlorophyceae	*Mougeotia* sp.	VA
Location: South River upstream from Truce Road, Conway (Station SOR01)				
09/27/2000	rock/riffle	Bacillariophyceae	ui pennate diatoms	A
		Chlorophyceae	ui parenchymatous green	C
		Cyanophyceae	*Calothrix* sp.	R
		Cyanophyceae	ui filamentous	C
Location: Deerfield River upstream from I-91 and downstream from Stillwater River Bridge, Deerfield (Station LDR01)				
09/27/2000	rock/riffle	Chlorophyceae	*Mougeotia* spp.	VA
Location: Greenfield River downstream from footbridge, off Rte 5-10, Greenfield (Station GR01)				
09/27/2000	rock/riffle	Bacillariophyceae	*Melosira* sp.	A
		Cyanophyceae	*Oscillatoria* sp.	VA
Location: Green River downstream from Eugene Williams Drive, Greenfield (Station GR02)				
09/26/2000	rock/riffle/run	Cyanophyceae	*Oscillatoria* sp.	VA
			fungal hyphae	A

APPENDIX E - MA DEP OWM/DWM FISH TOXICS MONITORING IN THE DEERFIELD RIVER WATERSHED 1995 AND 2000

INTRODUCTION

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

Fish toxics monitoring in the Deerfield River Watershed was conducted by MA DEP DWM personnel between 1995 and 2000 in Sherman Reservoir (an impoundment of the Deerfield River) at the Monroe/Rowe, Massachusetts/Whitingham, Vermont State Line, Bog Pond in Savoy, and a reach of the Deerfield River in Greenfield.

PROJECT OBJECTIVES

Fish tissue monitoring is typically conducted to assess the levels of toxic contaminants in freshwater fish, identify waterbodies where those levels may impact human health, and identify waters where toxic chemicals may impact fish and other aquatic life. Nonetheless, human health concerns have received higher priority and, therefore, fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding groups (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals, Polychlorinated biphenyls (PCB) and chlorinated pesticides. In 2000, MA DEP DWM Fish Toxics Monitoring was conducted under an EPA-approved Fish Contaminant Monitoring Quality Assurance Project Plan (MA DEP 2002). Data Quality Objectives are presented in the above-mentioned QAPP. There were no deviations from the QAPP.

METHODS

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing, and shipping fish collected for the fish toxics monitoring. Fish were collected from Sherman Reservoir on 11 October 1995 with boat mounted electroshocking gear, gill nets and trotlines (Figure E1). In 2000, fish were collected from Bog Pond on 8 November using gill netting and electroshocking gear. The Deerfield River (beginning one mile from the confluence with the Connecticut River and continuing upstream for approximately two miles) was sampled on 24 October 2000 using boat mounted electroshocking gear. Fish selected for analysis were placed in an ice filled cooler and brought back to the OWM/DWM laboratory for processing. Processing included measuring lengths and weights and visually inspecting fish for tumors, lesions, or other indications of stress or disease. Scales, spines, or pectoral fin ray samples were obtained from each sample to determine the approximate age of the fish. Fish were filleted (skin off) with stainless steel knives on glass cutting boards.

1995 fish toxics

Details related to the collection, handling, and processing of samples collected from Sherman Reservoir were excerpted from the report entitled *1995 Public Request Fish Toxics Monitoring Surveys* (Maietta 1995).

> Fillets targeted for metals analysis were placed in VWR high density polyethylene (HPDE) cups with covers. The opposite fillets were wrapped in aluminum foil for % lipids, PCB and organochlorine pesticide analysis. In the case of composite samples, two or three fillets from like-sized individuals of the same species were wrapped together in aluminum foil or stored in the single sample container. Samples were tagged and frozen for subsequent delivery to WES. All equipment used in the filleting and storage process was rinsed in accordance with USEPA procedures (1993). Methods used at WES for metals analysis include a cold vapor method using a VGA hydride generator for mercury and Varian 1475 flame atomic absorption for all remaining

metals. PCB/organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector.

2000 fish toxics

Details related to the collection, handling, and processing of samples collected from Bog Pond and the Deerfield River were excerpted from the report entitled *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000).

> 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 32-ounce high density polyethylene (HDPE) cups with covers. Composite samples ranged from two to five fillets from like-sized individuals of the same species (occasionally the same genus). Samples were tagged and frozen for subsequent delivery to the Department's Wall Experiment Station (WES).
>
> Methods used at WES for metals analysis include the following:
> Mercury is 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 are analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emission Spectrophotometer. Arsenic and selenium are 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."

According to standard practice, all laboratory analytical results were forwarded to the Massachusetts Department of Public Health.

RESULTS

The results of MA DEP Deerfield River Watershed fish toxics monitoring surveys are described below for each sampling event (MA DEP 1995, MA DEP 2000, and Maietta and Colonna-Romano 2000). Data for these surveys are presented in tables E1 and E2 and sampling locations are depicted in Figure 1. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in databases at the MA DEP Division of Watershed Management office in Worcester (MA DEP 1995 and MA DEP 2000). Quality assurance data are available in the *Data Validation Report for Year 2000 Project Data* (MA DEP 2003).

Quality Assurance Quality Control and Data Validation for Fish Contaminant Monitoring Data

Due to the need to disseminate information quickly, DWM/WES generated/lab-validated fish contaminant data are typically used directly (upon receipt from the lab) by several groups (including DWM) without extensive external data validation. DWM does not (*ex post facto*) censor or qualify fish contaminant data once it has been used. Rather, specific comments are provided where poor field and/ or analytical accuracy/precision may have occurred. Additional discussion and QC sample data for fish contaminants from 1995-2000 can be found in the Data Validation Report for Year 2000 Project Data (MA DEP 2003).

1995 Fish Toxics

Sherman Reservoir F0001

Samples of brown bullhead, fallfish, longnose sucker, white sucker, and yellow perch were collected from Sherman Reservoir on 11 October 1995 (MA DEP 1995). Three, three-fillet composites of yellow perch, white sucker, and longnose sucker and an individual yellow perch and fallfish were analyzed at the Wall Experiment Station for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB arochlors and congeners, and pesticides. An individual brown bullhead sample was analyzed for percent lipid, PCB arochlors and congeners, and pesticide analysis.

Mercury in the fish tissue from Sherman Reservoir ranged from 0.204 to 0.785 mg/kg wet weight. The mercury data triggered a site-specific advisory against the consumption of fish from Sherman Reservoir (MDPH 1996).

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

Selenium levels ranged from 0.138 to 0.327 mg/kg wet weight. PCB arochlors and congeners, pesticides, cadmium, arsenic, and lead were not detected in the edible fillets of all samples analyzed from Sherman Reservoir.

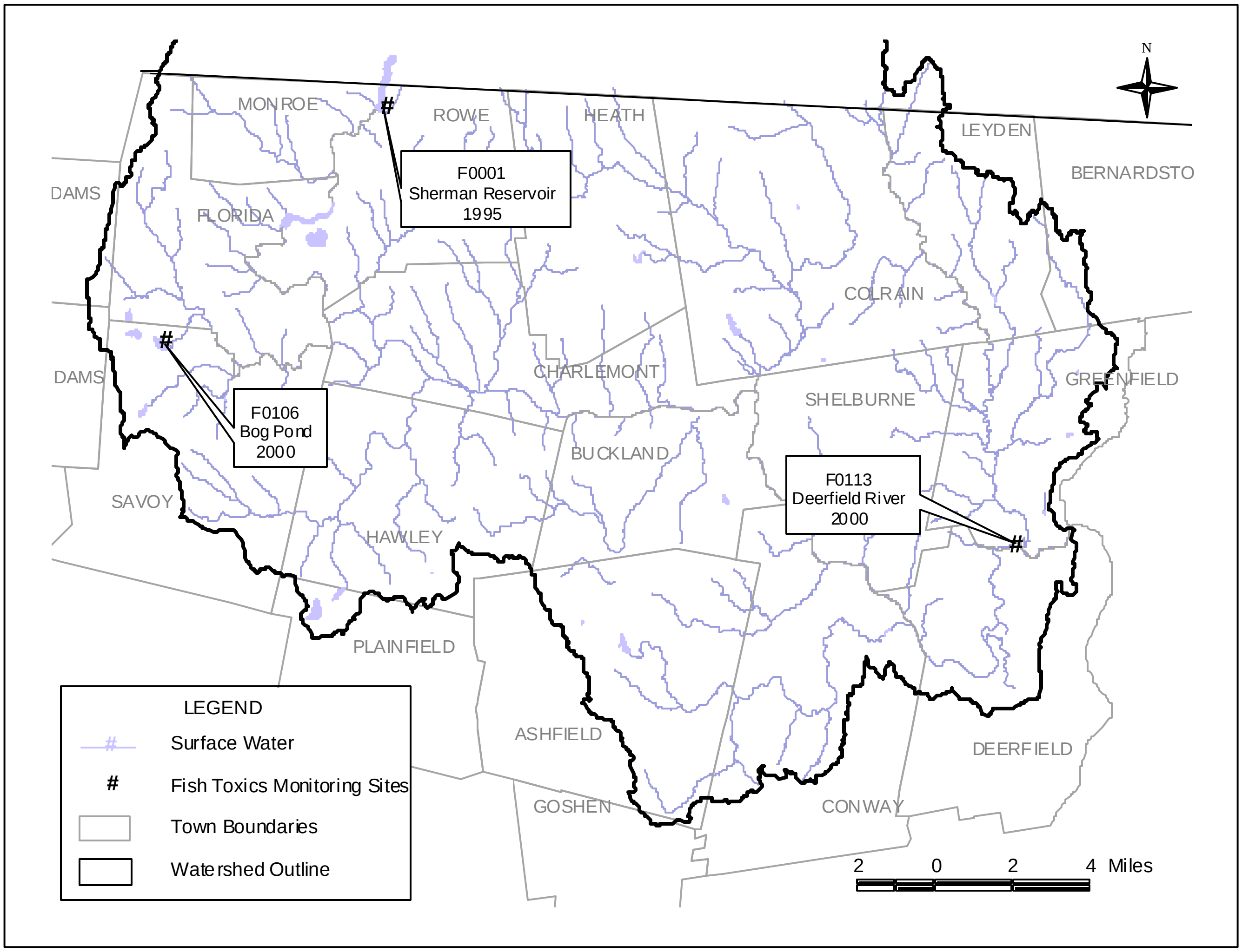

Figure E1. 1995 and 2000 MA DEP DWM fish toxics monitoring sites in the Deerfield River Watershed

2000 Fish Toxics

The results of MA DEP 2000 Deerfield River Watershed fish toxics monitoring surveys described below are excerpted from *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000).

Bog Pond F0106

This 40-acre shallow pond is located within the Savoy State Forest in the Town of Savoy. The watershed is relatively undeveloped with one state campground and associated facilities located in the watershed.

Gill netting and electrofishing at Bog Pond resulted in the collection of three yellow perch (*Perca flavescens*) and three brown bullhead (*Ameiurus nebulosus*).

Mercury ranged from 0.14 mg/kg in the composite sample of brown bullhead (Bog00-04-06) to 0.38 mg/kg in the yellow perch composite sample (Bog00-01-03). Due to the fact that predator fishes tend to be highest in mercury worst case conditions have not been assessed. Predatory fish from Bog Pond may contain mercury in concentrations at or near the MDPH ‘trigger level’ of 0.5 mg/kg. Cadmium, lead, and arsenic were below MDLs (minimum detection limits) in all samples analyzed and selenium concentrations were consistent with those found in waterbodies throughout the Commonwealth. Selenium does not appear to be of concern.

PCBs and organochlorine pesticides were below method detection limits (MDLs) in two samples analyzed from Bog Pond.

Deerfield River F0113

The Deerfield River was sampled in its lower reaches starting at about one mile from the confluence with the Connecticut River and then continued upstream for approximately two miles.

Electroshocking the Deerfield River in Deerfield resulted in the collection of three white suckers.

Mercury in the white sucker composite sample (0.15mg/kg) was well below the MDPH “trigger level”. Arsenic was detected at a concentration (0.048 mg/kg) just above the detection limit of 0.04 mg/kg. Cadmium and lead were below MDLs. The selenium concentration (0.232 mg/kg) was consistent with those concentrations found in other waterbodies within the Commonwealth and does not appear to be of concern.

PCBs and organochlorine pesticides were below method detection limits (MDLs) in the composite of white sucker analyzed from the Deerfield River.

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Maietta, R. J. and J. Colonna-Romano. 2000. *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

MDPH. 1996. *Freshwater Fish Consumption Advisory List.* Massachusetts Department of Public Health. Boston, MA.

Table E1. 2000 DEP DWM Deerfield River Watershed fish toxics monitoring data excerpted from *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys* (Maietta and Colonna-Romano 2000). Results, reported in wet weight, are from individual fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Bog Pond, Savoy, Deerfield River Watershed (F0106)													
BOG00-01	11/8/00	YP	23.9	180	2000069 (L2000454-1 metals) (L2000455-1 organics)	<0.020	<0.20	0.38	<0.040	0.196	0.17	ND[2]	ND
BOG00-02	11/8/00	YP	22.5	150									
BOG00-03	11/8/00	YP	24.1	180									
BOG00-04	11/8/00	BB	20.0	100	2000070 (L2000454-2 metals) (L2000455-2 organics)	<0.020	<0.20	0.14	<0.040	0.041	0.50	ND	ND
BOG00-05	11/8/00	BB	18.5	80									
BOG00-06	11/8/00	BB	18.7	80									
Deerfield River, Deerfield, Deerfield River Watershed (F0113)													
DRF00-01	10/24/00	WS	30.6	370	2000068 (L2000444-1)	<0.020	<0.20	0.15	0.048	0.232	0.70	ND	ND
DRF00-02	10/24/00	WS	29.8	300									
DRF00-03	10/24/00	WS	30.1	340									

[1] Species: brown bullhead (BB) *Ameiurus nebulosus,* white sucker (WS) *Castomus commersoni,* yellow perch (YP) *Perca flavescens*
[2] ND - not detected or the analytical result is at or below the established method detection limit (MDL) as follow:

PCB Arochlor and Pesticide Method Detection Limits (ug/g)

PCB A1242 – 0.26
PCB A1254 – 0.37
PCB A1260 – 0.11

PCB Arochlor and Pesticide Method Detection Limits (ug/g)

Chlordane – 0.11
Toxaphene – 0.59
a-BHC – 0.009
b-BHC- 0.011
Lindane – 0.009
d-BHC- 0.043
Hexachlorcyclopentadienne – 0.33
Trifluralin – 0.18
Hexachlorobenzene – 0.18
Heptachlor –0.012
Heptachlor Epoxide – 0.015
Methoxychlor – 0.029
DDD – 0.011
DDE – 0.010
DDT – 0.011
Aldrin – 0.016

PCB Toxic Congener Method Detection Limits (ug/g). Congeners are listed according to a numbering system developed by Ballshmiter and Zell (BZ#).
BZ#81 – 0.0005
BZ#77 – 0.0005
BZ#123 – 0.0011

PCB Toxic Congener Method Detection Limits (ug/g). Congeners are listed according to a numbering system developed by Ballshmiter and Zell (BZ#).

BZ#118 – 0.0025
BZ#114 – 0.0008
BZ#105 – 0.0019
BZ#126 – 0.0004
BZ#167- 0.0009
BZ#156 – 0.0007
BZ#157 – 0.0007
BZ#180 – 0.0007
BZ#169 – 0.0003
BZ#170 – 0.0007
BZ#189 – 0.0007

Table E2. Analytical results for 1995 Deerfield River Watershed Fish Toxics Monitoring Year 2 Watershed Surveys. Results, reported in wet weight, are from individual or composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Sample Type[2]	Length (cm)	Weight (g)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids %	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Sherman Reservoir (Deerfield River Impoundment) (F0001)													
SRF95-1	10/11/95	WS	C	36.4	600								
SRF95-2	10/11/95	WS	C	38.7	700	<0.20	<1.00	0.204	<0.040	0.206	0.87	ND[3]	ND
SRF95-3	10/11/95	WS	C	36.1	550								
SRF95-4	10/11/95	LNS	C	34.0	530								
SRF95-5	10/11/95	LNS	C	33.7	470	<0.20	<1.00	0.785	<0.040	0.138	0.49	ND	ND
SRF95-6	10/11/95	LNS	C	33.5	500								
SRF95-7	10/11/95	YP	C	19.2	70								
SRF95-8	10/11/95	YP	C	17.8	70	<0.20	<1.00	0.606	<0.040	0.195	0.08	ND	ND
SRF95-9	10/11/95	YP	C	21.4	130								
SRF95-10	10/11/95	YP	I	32.0	470	<0.20	<1.00	2.45	<0.040	0.327	0.42	ND	ND
SRF95-11	10/11/95	FF	I	38.0	670	<0.20	<1.00	0.622	<0.040	0.161	0.48	ND	ND
SRF95-12	10/11/95	BB*	I	21.7	130						**	**	**

Notes: [1] Species
- brown bullhead (BB) *Ameiurus nebulosus*
- fallfish (FF) *Semotilus corporalis*
- longnose sucker (LNS) *Rhinichthys cataractae*
- white sucker (WS) *Castomus commersoni*
- yellow perch (YP) *Perca flavescens*

[2] Sample Type (All samples were fillets with skin off.)
- composite (C)
- individual (I)

[3] ND = Not Detected

* Submitted for PCB and organochlorine pesticide analysis only.

** Sample lost during extraction process.

APPENDIX F
DWM LAKES SURVEY DATA
IN THE DEERFIELD RIVER WATERSHED 1995 AND 2000

1995

In the Deerfield River Watershed, DWM conducted synoptic surveys at 14 lakes during the 1995 field season. Observations, from at least one access point on each lake (multiple access points on larger lakes) were recorded on standardized field sheets. An attempt was made to observe the entire surface area of each lake to determine the extent of aerial macrophyte cover. At each sampling location general water quality conditions, identification and abundance of aquatic and wetland macrophyte plant species, and estimates of total percent aerial coverage were recorded (Table F1). Macrophyte visual observations were augmented at each station by identifying plant specimens collected from the lake bottom. Specimens were retrieved using a “rake” (a short handled, double-sided garden rake on a 50 foot line) thrown to its maximum extension in multiple directions at each station. Macrophytes collected in the “rake” were identified (in-situ or in the laboratory) and recorded on the field sheets. Transparency was measured where possible using a standard 20-centimeter diameter Secchi disk. Where Secchi disk measurements were not feasible, transparency was estimated as being above or below 1.2 meter (the MDPH bathing beach standard). Trophic status was estimated primarily using visual observations of macrophyte cover and phytoplankton populations. A more definitive assessment of trophic status would require more extensive collection of water quality and biological data.

Table F1. 1995 Deerfield River Watershed lake observations and trophic status estimates.

Lake, Town	Waterbody Identification Code (WBID)	Trophic Status Estimate	Survey Observations (Objectionable Conditions)
Ashfield Pond, Ashfield	MA33001	Mesotrophic	Good water clarity, some silt deposition on rocks, green algal bloom in cove, clean gravel shoreline, <25% abundance of *Potamogeton* sp. and *Elodea* sp., <10% emergent
Bear Swamp Pumped Storage, Rowe	MA33026	Undetermined	Slightly brown stained water, no aquatic plants observed, 100% rock shoreline, water ~15 feet below high water mark
Bog Pond, Savoy	MA33003	Undetermined	Slight brown stained water, >50% of pond covered by shrub islands, >75% of open water covered by floating plants, *Myriophyllum* sp. noted
Burnett Pond, Savoy	MA33005	Mesotrophic	Slight brown tint to water, some organic floc on bottom at dam, >50% of pond covered by plants
Goodnow Road Pond, Buckland	MA33007	Eutrophic	Slightly cloudy water, greenish algal blooms present, >50-75% aquatic plant cover
Hallockville Pond, Hawley/Plainfield	MA33009	Mesotrophic	Slightly turbid water, lots of decaying vegetation, >75% cover of floating leaf, submergent, and emergent plants
Lower Reservoir, Rowe/Florida	MA33028	Undetermined	Very good clarity, dusty film on surface, no aquatic plants observed, low water level
McLeod Pond, Colrain	MA33012	Eutrophic	Slightly turbid water with brownish-green tint, 75-100% aquatic plant cover
North Pond, Florida	MA33014	Undetermined	Very good clarity, sandy bottom, <10% aquatic plant density

Table F1 (continued). 1995 Deerfield River Watershed lake observations and trophic status estimates.

Lake	Waterbody Identification Code (WBID)	Trophic Status Estimate	SURVEY OBSERVATIONS (Objectionable Conditions)
Pelham Lake, Rowe	MA33016	Undetermined	Brownish/cloudy water, <25% aquatic plant cover, Secchi disk off dam 2.1 meters
Plainfield Pond, Plainfield	MA33017	Mesotrophic	Slightly turbid water, 25-50% aquatic plant cover
Sherman Reservoir, Rowe, MA / Monroe, MA / Whitingham, VT	MA33018	Mesotrophic	Slightly green/yellow stained water, algae mats on bottom (possibly blue-green algae), <10% aquatic plant cover
South Pond, Savoy	MA33019	Undetermined	Good water clarity, slightly brownish, some organics on pond bottom, <10% aquatic plant cover
Tannery Pond, Savoy	MA33020	Undetermined	Turbid, brownish water, 100% aquatic plant cover, <1 acre of standing water, old dam/ beaver dam washed out quite a while ago, small stream channel through bushy old pond outline

All waterbodies are class B
WBID – Waterbody Identification code.
Trophic State: E= Eutrophic, M= Mesotrophic, U= Undetermined.
Note: M. sp. – Possible *Myriophyllum heterophyllum*, requires further confirmation when flowering heads are evident.
Little Mohawk Road Pond, Shelburne (MA33027) and Schneck Brook Pond, Conway (MA33029) were surveyed but were found to be wetlands.

2000
In the Deerfield River Watershed, baseline lake surveys were conducted in July, August, and September 2000 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Two waterbodies, Pelham Lake and Plainfield Pond were sampled three times each (generally at monthly intervals). A technical memorandum by Dr. Mark Mattson entitled *Baseline Lakes 2000 Technical Memo* provides details of sample collection methods, results, data, and weed maps for the lakes surveyed in the Deerfield, Millers, Shawsheen, Ipswich, Islands, and Buzzards Bay watersheds in 2000 (MA DEP 2000).

In situ measurements using the Hydrolab® (measures dissolved oxygen, water temperature, pH, conductivity, and depth and calculates total dissolved solids and % oxygen saturation) were recorded. At deep hole stations measurements were recorded at various depths creating profiles. In-lake samples were also collected and analyzed for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the *Grab Collection Techniques for DWM Water Quality Sampling Standard Operating Procedure* and the *Hydrolab® Series 3 Multiprobe Standard Operating Procedure* (MA DEP 1999a and MA DEP 1999b). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES Standard Operating Procedure (SOP). Both quality control samples (field blanks, trip blanks, and split samples) and raw water quality samples were transported on ice to WES on each sampling date; they were subsequently analyzed according to the WES SOP. Information about data quality objectives (accuracy, precision, detection limits, holding times, representativeness and comparability) is also presented in Appendix A. Apparent color and chlorophyll *a* were measured according to standard procedures at the MA DEP DWM office in Worcester (MA DEP 1999c and MA DEP 1999d). An aquatic macrophyte survey was conducted at each lake. The aquatic plant cover (native and non-native) and species distribution was mapped and recorded. Details on procedures used can be found in the *Baseline Lake Survey Quality Assurance Project Plan* (MA DEP DWM 1999e). Data was excerpted from the *Baseline Lake Survey 2000 Technical Memo* and presented in tables F2 and F3.

Table F2. 2000 DEP DWM Deerfield River Watershed Baseline Lakes *in-situ* Hydrolab® data

Pelham Lake (Palis: 33016) Unique_ID[1]: 766 Station: A
Description: western lobe of lake, Rowe

Date	OWMID[2]	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/19/2000									
	LB-1006	12:36	** m	**m	**m	**m	--	**m	--
		12:39	** m	**m	**m	**m	--	**m	--
		12:42	** m	**m	**m	**m	--	**m	--
		12:46	** m	**m	**m	**m	--	**m	--
		12:49	** m	**m	**m	**m	--	**m	--
8/15/2000									
	LB-1049	13:13	** m	**m	**m	**m	--	**m	--
		13:16	** m	**m	**m	**m	--	**m	--
		13:22	** m	**m	**m	**m	--	**m	--
		13:26	** m	**m	**m	**m	--	**m	--
		13:29	** m	**m	**m	**m	--	**m	--
		13:33	** m	**m	**m	**m	--	**m	--
9/14/2000									
	LB-1091	11:30	0.1	21.1	6.7	27.9	--	8.6	--
		11:33	0.5	21.0	6.7	27.9	--	8.6	--
		11:36	1.0	20.9	6.7	27.8	--	8.6	--
		11:40	1.5	20.9	6.7	27.9	--	8.6	--
		11:43	2.0	20.4	6.6	27.9	--	8.5	--
		11:47	2.5	20.4	6.6	28.0	--	8.5	--
		11:52	3.0	20.4	6.6	28.1	--	8.5	--

Plainfield Pond (Palis: 33017) Unique_ID: 765 Station: A
Description: northeast quadrant of pond, Plainfield

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/19/2000									
	LB-1010	10:42	** m	**m	**m	**m	--	**m	--
		10:45	** m	**m	**m	**m	--	**m	--
	LB-1010	10:48	** m	**m	**m	**m	--	**m	--
		10:51	** m	**m	**m	**m	--	**m	--
8/15/2000									
	LB-1053	11:08	** m	**m	**m	**m	--	**m	--
		11:12	** m	**m	**m	**m	--	**m	--
		11:16	** m	**m	**m	**m	--	**m	--
		11:19	** m	**m	**m	**m	--	**m	--
		11:22	** m	**m	**m	**m	--	**m	--
		11:25	** m	**m	**m	**m	--	**m	--
9/14/2000									
	LB-1095	10:02	0.1	20.3	6.7	29.5	--	8.3	--
		10:06	0.5	20.3	6.7	29.4	--	8.3	--
		10:09	1.0	20.1	6.7	29.4	--	8.2	--
		10:13	1.5	20.0	6.7	29.5	--	8.3	--

[1]Unique ID = unique station identification number.
[2]OWMID = sample tracking number.
" ** " = Censored or missing data (i.e., data that should have been reported)
" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.
" -- " = No data (i.e., data not taken/not required)

Table F3. 2000 DEP DWM Deerfield River Watershed Baseline Lakes *physico-chemical* data.

Pelham Lake (Palis: 33016) Unique_ID[1]: 766 Station: A

Description: western lobe of lake, Rowe

Date	Secchi	Secchi Time	Station Depth	OWMID[2]	QAQC	Time	Sample Depth	Alkalinity	TP	Colo r	Chl a
	(m)	24hr	(m)			24hr	(m)	(mg/l)	(mg/l)	PCU	(mg/m3)
7/19/00	1.3	12:30	3.0								
				LB-1001	LB-1002	**	0.5	<2	0.043d	29d	--
				LB-1002	LB-1001	**	0.5	2	0.027d	17d	--
				LB-1003	BLANK	**	--	<2	<0.005	<15	--
				LB-1004		**	** - **[3] m	--	--	--	1.4 m
				LB-1005		**	**m	3m	0.082 m	29m	--
8/15/00	>3.0	13:09	3.0								
				LB-1043	LB-1044	**	0.5	4	0.013	35	--
				LB-1044	LB-1043	**	0.5	4	0.013	--	--
				LB-1045	DUP	**	0.5	4	0.018	29	--
				LB-1046	BLANK	**	--	<2	<0.005	<15	--
				LB-1047		**	2.5	5	0.015	35	--
				LB-1048		**	0 - 2.5	--	--	--	** m
9/14/00	2.9	11:26	3.0								
				LB-1085	LB-1086	**	0.5	5	0.012	38d	--
				LB-1086	LB-1085	**	0.5	6	0.010	<15d	--
				LB-1087	DUP	**	0.5	4	0.009	31	--
				LB-1088	BLANK	**	--	<2	<0.005	<15	--
				LB-1089		**	2.5	4	0.022	39	--
				LB-1090		**	0 - 2.5	--	--	--	1.6 h

Plainfield Pond (Palis: 33017) Unique_ID: 765 Station: A

Description: northeast quadrant of pond, Plainfield

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Alkalinity	TP	Color	Chl a
	(m)	24hr	(m)			24hr	(m)	(mg/l)	(mg/l)	PCU	(mg/m3)
7/19/2000	>2.2	10:36	2.2								
				LB-1007		**	0.5	4	0.009	<15	--
				LB-1008		**	**m	4m	0.037m	29m	--
				LB-1009		**	**m	--	--	--	1.0 m
8/15/2000	>2.6	11:05	2.6								
				LB-1050		**	0.5	5	0.010	21	--
				LB-1051		**	2.1	5	0.014	29	--
				LB-1052		**	0 - 2.1	--	--	--	3.9
9/14/2000	>2.5	10:00	2.5								
				LB-1092		**	0.5	3	0.007	<15	--
				LB-1093		**	2.0	5	0.009	24	--
				LB-1094		**	0 - 2.0	--	--	--	4.1 h

[1]Unique ID = unique station identification number.
[2]OWMID = sample tracking number.
[3]depth of integrated sample not recorded on field sheet.
" ** " = Censored or missing data (i.e., data that should have been reported)
" -- " = No data (i.e., data not taken/not required)
" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected
" h " = holding time violation (usually indicating possible bias low)
" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

References

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

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

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

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

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

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

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

APPENDIX G
OWM/DWM WATER QUALITY MONITORING DATA
DEERFIELD RIVER WATERSHED 1995 THROUGH 1997

Based on a review of the water quality reports and in view of the water quantity regulation, it was determined that a year long monitoring study was needed for a better understanding of water quality and hydrology in the Deerfield River Basin and to establish a baseline of data for future trend analysis. The following general objectives were outlined for the 1995/1996 Deerfield River Basin survey:

- To define areas impacted by pollution,
- To determine if impacts are caused by point or nonpoint sources,
- To determine the need for permit reissuance or modification for WMA and NPDES permits, and
- To determine the need for Best Management Practices (BMPs) to minimize nonpoint source pollution.

Modifications were made to the monitoring plan over the course of the 1995/1996 sampling period as more was learned about specific problems in the watershed, as the team became more familiar with the watershed, and as local groups and agencies made suggestions. The following issues were addressed, at least partially, in the modified monitoring plan:

- Agricultural nonpoint runoff in the Chickley River, Clesson Brook, and South River basins,
- Stormwater runoff in Greenfield,
- Failing septic systems in Ashfield,
- Erosion problems on the North River,
- Acid mine drainage from the Davis Mine in Rowe,
- Industrial discharge toxicity and coloring agent affecting the North River, and
- Mercury contamination of fish in Sherman Reservoir.

The 1995/1996 Deerfield River Basin survey required the assistance and cooperation of various local groups and agencies (Deerfield Compact, Green River Watershed Preservation Alliance, Franklin County Conservation District), the US EPA and the Greenfield Wastewater Treatment Plant, which analyzed the bacteria samples. The water quality sampling matrix for the DWM 1995/1996 Deerfield River Basin survey is summarized in Table G1. Instream water quality sampling included the following:

- Pathogens-- Monthly sampling at seven permanent stations from June 1995 - June 1996. Less frequent sampling was conducted on most of the major tributaries during both wet and dry weather. Special surveys were conducted on the South River, Chickley River, Clesson Brook, Bear River, Mill Brook, and the Green River.
- pH-- Davis Mine Brook was sampled during July 1996 to investigate the impact of acid mine drainage.
- Nutrients and general water chemistry-- The seven permanent stations were sampled monthly and samples were collected from the major tributaries on one sampling date.

Conditions prior to each synoptic survey were characterized by analyzing precipitation and streamflow data. Two weather stations, DEM's Heath Station 201 and Plainfield2 Station 205, were used to determine precipitation and weather conditions prior to the sampling dates: data for these stations was provided by DEM Office of Water Resources. Discharge, (hereinafter refereed to as streamflow) and duration data were obtained from the continuous United States Geological Survey (USGS) stream gages. USGS maintains six flow monitoring stations in the Massachusetts portion of the basin; three on the mainstem Deerfield River: 01168151 Deerfield River downstream of Fife Brook Dam, Rowe, 01168500 Deerfield River downstream from confluence with the Chickley River, Charlemont and 01170000 Deerfield River downstream from confluence with the South River, West Deerfield. The other three are located on the North River (01169000) in Shattuckville, South River (01169900) near Reeds Bridge, Conway and Green River (01170100) near Colrain. The data from these gages was used to calculate streamflow characteristics for the period of record. These statistical analyses can be found in *Water Resources Data Massachusetts and Rhode Island, Water Year 1995* (Socolow *et al.* 1996). Stream discharge was measured at two additional stations by DEP DWM personnel according to standard operating procedures (MA DEP 1990) using a Swoffer meter (model 2100) or a Price Type AA meter with polymer buckets using a bridge board; one station (BE) on the Bear River in Conway and one station on the Green River (5-10) upstream of the Greenfield WWTP in Greenfield. Field data were recorded on standard flow gauging field sheets. Data reduction and stream discharge calculations were performed at the DWM office in Worcester.

Additionally, *in-situ* water quality monitoring was conducted by DWM in 11 streams in 1996/1997 in the Deerfield River Watershed as part of the 104b(3) Numeric Biocriteria Development Project surveys. Water quality sampling was restricted to *in-situ* Hydrolab® measurements of depth, pH, dissolved oxygen, conductivity, temperature, total dissolved solids, and turbidity.

MATERIALS AND METHODS

Procedures used for sampling technique and sample handling are outlined in the *BASINS PROGRAM Standard Operating Procedures River and Stream Monitoring* (MA DEP 1990). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied bottles and field preservatives for all sampling, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES standard operating procedures (SOP) with the exception of the fecal coliform and fecal streptococci samples. Quality control samples generally included field blanks and sample splits or field replicates. Water temperature, dissolved oxygen and pH measurements were made *in situ* at each station using a pre-calibrated Scout 2 Hydrolab multi-parameter meter. With the exception of the 20 July 1995 bacteria samples analyzed at WES, the fecal coliform and fecal streptococci samples were delivered to the Greenfield Wastewater Treatment Facility laboratory for analysis where all testing was done in accordance with Standard Methods 18th edition, Sec. 9222D and Sec. 9230.

QUALITY ASSURANCE AND QUALITY CONTROL

In general, monitoring surveys in the Deerfield River Watershed in 1995/1996 were performed with attention to maintaining quality assurance and control of field samples and field-generated data. Field monitoring activities followed accepted DWM standard operating procedures. Where strict procedures were not in place or necessary, it is assumed that DWM field staff exercised best professional judgment.

With the exception of fecal coliform sampling where no field blanks were taken, the majority of water quality surveys included quality control samples (field blanks and sample splits) at a minimum of one each per crew per survey during the entire 1995/1996 Deerfield River Watershed survey.

The water quality sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). Data not meeting general data quality objectives of DWM were censored (no data were qualified). Data validation for the 1995/1996 DWM water quality surveys is available in a Memorandum - *1994, 95 & 96 QA/QC Assessment Report* (MA DEP 2000). Specific decisions pertaining to the Deerfield River Watershed data were excerpted from this memorandum and appear in Table G2. Three bacteria samples (OWMID numbers 33-0038, 33-0039 and 33-0040) were also censored because the stations/times of collection couldn't be verified on the laboratory reports and laboratory errors were responsible for two additional bacteria samples (OWMID numbers 33-0129 and 33-0133) being censored. Insufficient sample volumes resulted in one TKN sample (OWMID 33-0117), three alkalinity samples (OWMID numbers 33-003, 33-004, and 33-005), and one chloride sample (OWMID 33-002) being censored. All Hydrolab® multi-probe data were validated using multi-staff review. Data symbols (e.g., ** for censored/missing data) were applied to Hydrolab® data as necessary (see Table G3).

RESULTS

Synoptic water quality surveys were conducted in the Deerfield River Watershed at the stations identified in Figure G1. Table G1 provides the sampling matrix summary for water quality surveys conducted in the Deerfield River Watershed between 1995 and 1997. *In-situ* Hydrolab® data from the 1995/1996 Deerfield River Watershed Monitoring surveys and the 1996/1997 104b(3) Numeric Biocriteria Development Project sites are presented in Table G3. Water quality data from the 1995/1996 Deerfield River Watershed Monitoring survey can be found in Table G4 and DWM generated flow data are in Table G5.

Table G1. Sampling Matrix for 1995/1996 DWM Deerfield River Watershed Water Quality Surveys.

STATION ID	UNIQUE ID	1995 JUNE	1995 JULY	1995 AUG.	1995 SEPT.	1995 OCT.	1995 NOV.	1995 DEC.	1996 FEB.	1996 MAR.	1996 APR.	1996 MAY	1996 JUNE	1996 JULY
UD01	W0004	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W				B,H,N,W	B,H,N,W	B,H,N,W	
UD02	W0003							B,H,N,W	B,H,N,W	B,H,N,W				
LD	W0002	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	
5-10	W0001				B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W,	B,H,N,W	B,H,N,W,	B,H,N,W	B,H,N,W	
GR07	W0007			B,H										
GR08	W0006			B,H										
GR	W0005	B,H,N,W	B,H,N,W	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	
SO-1	W0015		B,H											
SO-2	W0016		B,H											
SO-3	W0014		B,H											
SO-4	W0013		B,H											
SO-5	W0012		B,H											
SO-6	W0011		H											
SO-7	W0010		B,H											
SO-8	W0009		B,H											
SO	W0008	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	
BR03	W0019				B,H									
BR02	W0018				B,H									
BE	W0017		B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	B,H,N,W, F	
NR04	W0022			B,H										
NR03	W0021			B,H										
NO	W0020	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	B,H,N,W	
NR01	W0023			B										
EBNR06	W0024			B,H										
WBNR05	W0025			B,H										
SH01	W0028				B,H									
CL02	W0027				B,H									
CL	W0026				B,H	B,H	B,H	B,H		B,H	B,H,N,W	B,H	B,H	
CK	W0029						B,H	B,H			B,H,N,W	B,H	B,H	
CL03	W0030				B,H									
UB01	W0031				B,H									
MB-A	W0363													H
MB-B	W0361													H
MIL2	W0032				B,H									
MI	W0033				B,H		B,H	B,H			B,H,N,W			
DMB-1	W0366													H

Table G1 continued. Sampling Matrix for 1995/1996 DWM Deerfield River Watershed Water Quality Surveys.

STATION ID	UNIQUE ID	1995 JUNE	1995 JULY	1995 AUG.	1995 SEPT.	1995 OCT.	1995 NOV.	1995 DEC.	1996 FEB.	1996 MAR.	1996 APR.	1996 MAY	1996 JUNE	1996 JULY
UKN	W0364													H
DMB-2	W0365													H
DMB-B	W0362													H
MIL3	W0034				B,H									
BO	W0035				B,H		B,H	B,H			B,H,N,W			
CH5	W0039				B,H									
CH4	W0038				B,H									
CH3	W0037				B,H									
CH7	W0036				B,H									
CH	W0040				B,H	B,H	B,H	B,H		B,H	B,H,N,W	B,H	B,H	
CH2	W0041				B,H									
CH6	W0042				B,H									
CO	W0043				B,H	B,H	B,H	B,H		B,H	B,H,N,W		B,H	
PE	W0044						B,H	B,H			B,H,N,W			

STATION ID	UNIQUE ID	September 1996	September 1997	October 1997
VP05HIN	W0274	H		H
VP05HIN	W0275	H		
VP02SHN	W0276	H		
W0277	W0277	H		
VP01DRG	W0278	H		
VP12BEA	W0279	H	H	
VP11BEA	W0280	H	H	
VP13DRK	W0281	H	H	
VP07FOU	W0282	H		H
VP08TIS	W0283	H		H
VP10CLE	W0284	H		
VP09CLA	W0285	H		H
VP04SMI	W0286	H		

B= Fecal coliform bacteria; H= Hydrolab meter (pH, temperature, dissolved oxygen, specific conductance); N= Nutrients (total phosphorus, ammonia nitrogen, nitrate nitrogen, total Kjeldahl nitrogen); W= Water chemistry (alkalinity, hardness, chloride, total suspended solids, turbidity); F= Flow measurement.

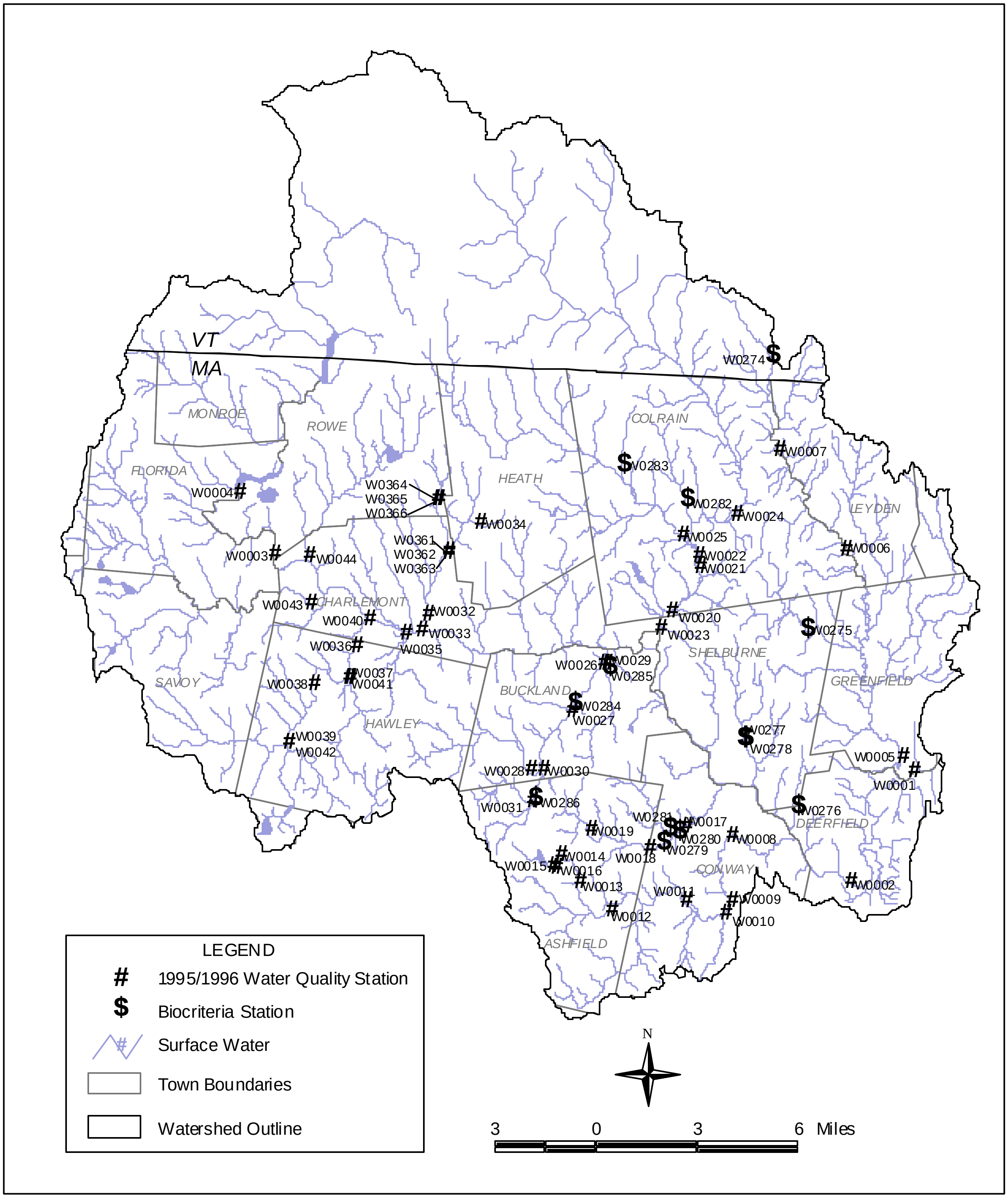

Figure G1. 1995/1996/1997 Biocriteria and Water Quality Monitoring Stations in the Deerfield River Watershed.

Table G2. 1995/1996 DWM Data Decisions for Deerfield River Watershed Discrete Sample Data (excerpted from MA DEP 2000).

OWMID	
33-0177-183 **33-0172**:	TKN had been analyzed outside of the established holding time of 28 days. Samples were collected on 6/19/96 and analyzed on 7/24/96. Data censored.
33-0164-171 **33-0160**:	Hardness had been analyzed outside of the established holding time of 14 days. Samples were collected on 5/15/96 and analyzed on 6/6/96. Data censored.
33-0144-149:	Suspended Solids had been analyzed outside of the established holding time of 7 days (see condition "a"). Samples were collected on 4/11/96 and analyzed on 4/18/96. Data censored.
33-0130-137 **33-0126**:	TKN had been analyzed outside of the established holding time of 28 days. Samples were collected on 3/20/96 and analyzed on 4/18/96. Data censored.
33-0117-125:	Hardness had been analyzed outside of the established holding time of 14 days. Samples were collected on 2/28/96 and analyzed on 3/14/96. Data censored.
33-111-116 **33-0109** **33-0101**:	Hardness had been analyzed outside of the established holding time of 14 days. Samples were collected on 12/06/95 and analyzed on 12/22/95. Data censored.
33-0015-023:	Fecal Coliform had been analyzed outside of the established holding time of 6 hrs. Samples were collected on 7/20/95 and analyzed on 7/21/95. Data censored.
33-0007:	Failed to meet TKN, Ammonia and Nitrate field blank and field replicate data quality objectives for the 6/7/95 sampling survey. Since two data quality objectives were violated, all associated TKN, Ammonia and Nitrate data by that sampling crew on that day (**33-0001-0007)** are censored.

Notes:

1) The DWM QA Program was not fully established during the 1994, 95 and 96 sampling surveys. In addition, DWM relied on WES to supply the reagent water for field blanks. DWM staff members were not always supplied with contaminant-free reagent water. If the field blank objective was violated the associated survey data are not necessarily suspect unless a trend is found or there is documented evidence that aberrant collection, handling or analysis procedures were used. If, however, two or more data quality objectives were violated than all associated data by that sampling crew on that day are to be censored.

2) Statistically, slight differences between replicate values at or near a low MDL will result in an increase in relative percent difference (%RPD) values. This increase can create a false impression that replicate data are not meeting their set quality control limits. For replicate values at or near method detection limits ($\leq$1 mg/L), a 30% RPD data quality objective was applied to help counter this statistical effect. Replicate values > 1mg/L were reviewed independently against other quality control factors (i.e. field blank data, documentation) and a decision made on their validity.

Table G3. 1995/1996 Deerfield River Watershed *in-situ* Hydrolab® data.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
DEERFIELD RIVER									
Station: UD01, Mile Point: 38.9, Unique ID[2]: W0004									
Description: in Florida, approximately 800 feet below Fife Brook Dam									
33-0001	06/07/95	10:22	0.2	15.9	6.5	45	29.0	9.3	94
33-0008	07/06/95	10:42	0.3	20.0	6.7	45	29.0	8.3	90
33-0024	08/16/95	10:09	0.5	21.4	6.8	48	31.0	8.8	99
33-0041	09/13/95	09:59	0.2	17.5	7.0	47	30.0	9.1	95
33-0071	10/04/95	10:27	0.4	15.4	6.8	46	29.0	9.4	94
33-0084	11/08/95	09:30	**i	8.6	6.6	37	24.0	11.5	99
33-0138	04/11/96	09:22	0.4	3.4	**	50	32.0	12.1	92
33-0160	05/15/96	10:22	1.0	7.7	6.0	30	19.1	11.7	97
33-0172	06/19/96	10:32	**m	**m	**m	**m	**m	**m	**m
DEERFIELD RIVER									
Station: UD02, Mile Point: 33.5, Unique ID: W0003									
Description: approximately 1/4 mile above the Florida Bridge, this is an alternate station to UD01 used in December, February and March.									
33-0101	12/06/95	10:39	0.4	3.7	6.2	37	24.0	12.5	94
33-0117	02/28/96	10:08	**i	1.9	6.2	41	26.0	13.1	96
33-0126	03/20/96	09:59	**i	1.7	6.1	44	27.9	13.1	95
DEERFIELD RIVER									
Station: LD, Mile Point: 8, Unique ID: W0002									
Description: in Deerfield located approximately 2000 feet below Stillwater Bridge, sampled off south bank.									
33-0004	06/07/95	13:35	0.2	19.7	7.3	84	54.0	8.6	95
33-0012	07/06/95	14:12	0.3	26.2	8.3	90	58.0	8.7	106
33-0029	08/16/95	13:11	0.4	26.0	8.3	95	61.0	8.8	108
33-0048	09/13/95	13:44	0.4	17.5	7.4	72	46.0	9.4	97
33-0079	10/04/95	14:27	**i	15.1	7.4	74	47.0	9.7	96
33-0096	11/08/95	11:41	0.4	7.1	6.9	57	36.0	11.7	97
33-0114	12/06/95	10:59	**i	2.8	7.1	53	34.0	13.1	97
33-0121	02/28/96	12:22	0.9	2.6	7.0	57	36.4	13.0	97
33-0133	03/20/96	13:03	0.4	2.4	6.8	63	40.0	12.9	95
33-0146	04/11/96	12:59	**m	**m	**m	**m	**m	**m	**m
33-0167	05/15/96	14:07	0.8	8.7	6.8	45	28.9	11.8	99
33-0180	06/19/96	14:02	0.5	19.9	7.3	95	60.7	9.4	102
DEERFIELD RIVER									
Station: 5-10, Mile Point: 1.2, Unique ID: W0001									
Description: in Greenfield at (Route 5-10) Bridge located on downstream side of bridge over north channel of river.									
33-0050	09/13/95	15:02	1.1	18.1	7.2	102	65.0	9.5	100
33-0081	10/04/95	15:29	0.7	15.2	7.2	116	74.0	9.5	94
33-0099	11/08/95	13:17	0.4	7.1	6.9	66	42.0	11.8	99
33-0100	11/08/95	13:24	0.3	7.1	6.9	66	42.0	11.8	98
33-0116	12/06/95	12:17	**i	2.8	7.0	66	42.0	13.2	98
33-0124	02/28/96	13:26	0.4	3.1	6.8	67	42.8	13.0	98
33-0136	03/20/96	14:14	0.3	2.9	6.8	69	44.4	13.2	99
33-0149	04/11/96	13:50	0.6	6.0	7.2	90	57.8	12.5	102
33-0170	05/15/96	15:04	1.0	9.0	6.9	53	33.8	11.6	99
33-0183	06/19/96	14:57	0.5	20.0	7.1	104	66.3	8.8	96
GREEN RIVER									
Station: GR07, Mile Point: 14.2, Unique ID: W0007									
Description: in Colrain, at USGS gage #01170100 Station north of East Colrain									
33-0038	08/30/95	12:50	0.4	19.6	8.1	126	81.0	9.1	99

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number. ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
GREEN RIVER Station: GR08, Mile Point: 10, Unique ID[2]: W0006 Description: at boat launch about 3/10 of a mile downstream from Browning Brook.									
33-0039	08/30/95	13:21	0.3	20.8	8.2	141	90.0	8.6	95
GREEN RIVER Station: GR, Mile Point: 0.8, Unique ID: W0005 Description: in Greenfield, located at a footbridge over the Green River off Route 5-10, approximately 4/10 of a mile above the Greenfield WWTP, on bridge during high flow and just downstream during low flow.									
33-0006	06/07/95	14:24	0.3	18.3	7.8	160	103	9.2	98
33-0014	07/06/95	14:45	0.3	25.0	8.5	169	108	9.8	117
33-0030	08/16/95	14:07	0.6	23.8	7.9	207	132	8.8	104
33-0040	08/30/95	13:51	0.4	21.9	8.2	202	129	9.6	109
33-0049	09/13/95	14:30	0.4	17.3	7.9	215	138	9.9	103
33-0080	10/04/95	15:00	**i	14.6	7.8	179	114	10.0	98
33-0097	11/08/95	12:46	0.3	6.3	7.1	108	69.0	12.4	101
33-0115	12/06/95	11:36	**i	1.8	7.5	145	93.0	13.4	96
33-0122	02/28/96	12:57	0.3	3.3	6.9	104	66.6	13.4	101
33-0134	03/20/96	13:32	0.3	2.9	6.9	119	76.0	13.4	100
33-0147	04/11/96	13:27	0.4	5.8	7.4	126	80.3	12.4	100
33-0168	05/15/96	14:34	1.2	10.1	7.2	103	65.6	11.6	102
33-0181	06/19/96	14:24	0.4	17.8	7.7	147	94.0	9.4	98
SOUTH RIVER Station: SO-1, Mile Point: 14.9, Unique ID: W0015 Description: 75 feet downstream from first bridge crossing in downtown Ashfield of river exiting Ashfield Pond.									
33-0015	07/20/95	10:13	**i	19.9	6.8	232	148	5.3	58
SOUTH RIVER Station: SO-2, Mile Point: 14.8, Unique ID: W0016 Description: at 2nd bridge crossing in downtown Ashfield off bridge, just below.									
33-0016	07/20/95	10:31	**i	18.6	6.9	240	153	5.0	53
SOUTH RIVER Station: SO-3, Mile Point: 14.2, Unique ID: W0014 Description: in Ashfield, just downstream of bridge crossing at Baptist Corner Road, within 75 feet of bridge, sampled off bank.									
33-0017	07/20/95	10:52	**i	17.2	7.4	211	135	8.0	83
SOUTH RIVER Station: SO-4, Mile Point: 12.8, Unique ID: W0013 Description: in Ashfield, at bridge crossing on Emmets Road just above bridge in stream.									
33-0018	07/20/95	11:10	**i	15.8	7.2	183	117	8.4	84
SOUTH RIVER Station: SO-5, Mile Point: 10.9, Unique ID: W0012 Description: in Ashfield, located off Route 116 about 400 feet downstream from the Bullitt Road bridge, in stream.									
33-0019	07/20/95	11:27	**i	17.2	8.0	188	120	8.8	91
SOUTH RIVER Station: SO-6, Mile Point: 7.3, Unique ID: W0011 Description: in Conway located at 2nd Route 116 bridge crossing of South River after crossing town line from Ashfield near Riley Road, just below bridge, sampled from bank.									
33-0020	07/20/95	13:47	0.2	21.5	8.0	159	102	8.8	100
SOUTH RIVER Station: SO-7, Mile Point: 5.7, Unique ID: W0010 Description: in downtown Conway at bridge on Route 116, waded instream just below bridge.									
33-0021	07/20/95	14:14	0.3	22.0	8.4	164	105	8.9	102

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
SOUTH RIVER									
Station: SO-8, Mile Point: 5.1, Unique ID[2]: W0009									
Description: at bridge crossing of unnamed road between Shelburne Falls Road and Reeds Bridge Road, Conway									
33-0022	07/20/95	14:30	0.2	23.3	8.6	166	106	8.9	104
SOUTH RIVER									
Station: SO, Mile Point: 2.7, Unique ID: W0008									
Description: in Conway (located at USGS Gaging Station) at Reeds Bridge, just off Bardwell Road just above bridge.									
33-0003	06/07/95	12:50	**i	17.2	7.8	145	92.0	9.2	96
33-0011	07/06/95	13:35	0.1i	24.0	8.4	180	115	8.7	102
33-0023	07/20/95	14:52	0.2	23.6	8.3	161	103	8.3	97
33-0027	08/16/95	12:25	0.3	22.3	8.3	193	124	9.3	107
33-0046	09/13/95	13:07	0.3	15.5	7.9	202	130	9.7	96
33-0077	10/04/95	13:48	**i	13.3	7.7	181	116	9.3	89
33-0095	11/08/95	10:54	0.3	6.3	7.1	97	62.0	11.7	95
33-0113	12/06/95	10:23	**i	1.6	7.4	110	70.0	13.4	95
33-0120	02/28/96	11:51	0.2	3.2	7.1	94	60.0	12.9	98
33-0132	03/20/96	12:34	0.1i	2.4	6.8	81	51.8	13.2	98
33-0145	04/11/96	12:31	0.2	7.0	7.5	116	74.1	12.0	101
33-0166	05/15/96	13:37	0.5	10.8	7.2	102	65.0	10.8	96
33-0179	06/19/96	13:33	0.3	16.4	7.6	136	87.2	9.6	98
BEAR RIVER									
Station: BR03, Mile Point: 5.8, Unique ID: W0019									
Description: in Ashfield at Baptist Corner Road bridge just below golf course.									
33-0068	09/27/95	13:16	0.1i	14.4	7.5	201	129	10.4	101
BEAR RIVER									
Station: BR02, Mile Point: 3.5, Unique ID: W0018									
Description: in Ashfield, just downstream of bridge at Pfersick Road, instream.									
33-0069	09/27/95	13:48	0.4	13.1	7.8	152	97.0	10.6	101
BEAR RIVER									
Station: BE, Mile Point: 1.9, Unique ID: W0017									
Description: in Conway, located approximately 250 feet upstream from bridge on Shelburne Falls Road, sampled instream just above unnamed tributary.									
33-0010	07/06/95	13:06	0.1i	19.3	8.2	140	90.0	9.3	100
33-0026	08/16/95	11:52	0.3	19.5	8.1	151	96.0	9.2	100
33-0045	09/13/95	12:14	0.2	13.1	7.8	145	93.0	10.0	95
33-0070	09/27/95	14:11	0.4	12.8	7.9	142	91.0	10.1	95
33-0076	10/04/95	13:23	**i	11.3	7.7	135	86.0	10.1	92
33-0094	11/08/95	10:15	0.2	5.8	7.4	93	60.0	12.0	96
33-0112	12/06/95	09:56	**i	1.7	7.5	95	61.0	13.5	97
33-0119	02/28/96	11:20	**i	2.2	7.2	79	50.4	13.1	97
33-0131	03/20/96	12:13	0.2	1.6	6.9	73	46.9	13.3	96
33-0144	04/11/96	12:12	0.1i	4.9	7.3	89	56.8	12.2	97
33-0165	05/15/96	13:13	0.5	9.8	7.3	85	54.4	11.0	95
33-0178	06/19/96	13:12	0.2	15.4	7.7	110	70.1	9.8	97
NORTH RIVER									
Station: NR04, Mile Point: 3, Unique ID: W0022									
Description: Adamsville Road bridge, Colrain, west bank, under bridge, upstream.									
33-0035	08/30/95	10:46	0.4	17.3	7.2	125	80.0	9.0	93
NORTH RIVER									
Station: NR03, Mile Point: 2.6, Unique ID: W0021									
Description: in Colrain, Route 112 bridge just south of Griswoldville, under bridge, upstream from south bank.									
33-0034	08/30/95	10:24	0.3	20.7	7.5	946	606	9.0	100

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
NORTH RIVER									
Station: NO, Mile Point: 0.8, Unique ID[2]: W0020									
Description: in Colrain, located approximately 3/10 of a mile below USGS Gaging Station at Shattuckville and 500 feet above bridge on Route 112 from the north bank.									
33-0002	06/07/95	11:40	**i	17.3	7.8	152	98.0	9.5	100
33-0009	07/06/95	11:48	0.2	23.0	8.2	186	119	8.9	102
33-0025	08/16/95	11:10	0.4	22.7	8.1	213	136	9.0	103
33-0033	08/30/95	09:59	0.4	17.1	7.8	456	292	9.3	95
33-0044	09/13/95	11:38	0.4	16.2	8.1	520	333	9.6	97
33-0075	10/04/95	12:27	**i	14.3	8.1	399	255	10.6	103
33-0092	11/08/95	12:04	**i	6.1	7.2	75	48.0	12.4	100
33-0109	12/06/95	14:08	0.4	2.1	6.9	105	67.0	13.3	96
33-0118	02/28/96	10:53	0.3	2.6	7.0	75	48.0	13.5	100
33-0130	03/20/96	11:31	**m	**m	**m	**m	**m	**m	**m
33-0143	04/11/96	11:14	0.4	4.7	7.4	93	59.4	12.7	100
33-0164	05/15/96	12:04	0.7	9.0	6.9	69	44.0	11.8	100
33-0177	06/19/96	12:29	0.3	17.1	7.6	139	88.9	9.8	101
EAST BRANCH NORTH RIVER									
Station: EBNR06, Mile Point: 2.4, Unique ID: W0024									
Description: in Colrain, about 700 feet upstream from bridge just north of downtown Colrain on Route 112, sampled from south bank on access road.									
33-0037	08/30/95	11:43	0.4	15.5	7.4	143	92.0	9.7	96
WEST BRANCH NORTH RIVER									
Station: WBNR05, Mile Point: 0.7, Unique ID: W0025									
Description: in Colrain just upstream from bridge across from the Branch Cemetery on Adamsville Road, sampled from north bank in middle of 6 to 8 foot wide stream.									
33-0036	08/30/95	11:06	0.3	17.5	7.7	94	60.0	8.9	93
CLESSON BROOK									
Station: SH01, Mile Point: 5, Unique ID: W0028									
Description: in Ashfield, about 0.5 miles upstream from confluence with Smith Brook near Hawley Road bridge, instream above bridge.									
33-0066	09/27/95	11:46	0.1i	13.1	7.7	76	49.0	10.0	94
CLESSON BROOK									
Station: CL02, Mile Point: 2.4, Unique ID: W0027									
Description: in Buckland, approximately 200 yards downstream from Hog Hollow Road bridge off Route 112.									
33-0064	09/27/95	10:52	0.2	12.4	8.0	152	97.0	10.3	96
CLESSON BROOK									
Station: CL, Mile Point: 0.5, Unique ID: W0026									
Description: in Buckland, located at bridge on Route 112 northeast of Depot Road, off west bank just above bridge.									
33-0063	09/27/95	10:21	0.2	12.5	7.9	154	99.0	10.5	98
33-0074	10/04/95	12:03	**i	12.7	7.8	156	100	10.1	95
33-0090	11/08/95	11:32	**i	6.7	7.2	87	56.0	11.3	93
33-0108	12/06/95	13:42	0.3	1.5	7.0	66	42.0	13.6	96
33-0129	03/20/96	11:11	0.1i	2.1	7.0	79	50.2	13.1	96
33-0141	04/11/96	10:43	0.2	5.4	7.5	106	67.9	12.3	99
33-0157	04/24/96	12:13	**i	9.3	7.0	74	47.2	10.9	96
33-0162	05/15/96	11:29	0.4	9.5	7.0	90	57.9	11.4	98
33-0175	06/19/96	11:58	0.3	16.5	7.7	128	81.6	9.2	93

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
CLARK BROOK									
Station: CK, Mile Point: 0.2, Unique ID[2]: W0029									
Description: in Buckland, located at bridge on Route 112, approximately 200 feet east of Clesson Brook, from north bank just above bridge.									
33-0091	11/08/95	11:44	**i	6.1	7.4	65	42.0	12.0	97
33-0107	12/06/95	13:26	0.4	3.0	6.8	97	62.0	12.7	95
33-0142	04/11/96	10:55	0.2	3.2	7.2	73	46.8	12.8	97
33-0158	04/24/96	12:00	**i	7.4	7.2	59	37.6	11.6	97
33-0163	05/15/96	11:41	0.5	7.5	6.9	61	39.3	11.9	98
33-0176	06/19/96	12:10	0.3	15.3	7.6	82	52.6	9.5	94
SMITH BROOK									
Station: CL03, Mile Point: 0.0, Unique ID: W0030									
Description: at Buckland four corners, just upstream of confluence with Clesson Brook, instream.									
33-0065	09/27/95	11:20	0.2	12.6	7.9	192	123	10.6	100
UPPER BRANCH									
Station: UB01, Mile Point: 0.2, Unique ID: W0031									
Description: in Ashfield above bridge on Apple Valley Road near gravel pit, instream.									
33-0067	09/27/95	12:12	0.1i	12.1	7.8	125	80.0	10.2	94
MILL BROOK									
Station: MB-A, Mile Point: 2.7, Unique ID: W0363									
Description: just upstream of the confluence with Davis Mine Brook, Charlemont.									
33-0187	07/17/96	12:49	0.1i	16.9	7.3	53	34.0	9.2	95
MILL BROOK									
Station: MB-B, Mile Point: 2.69, Unique ID: W0361									
Description: just downstream of the confluence with Davis Mine Brook, Charlemont.									
33-0185	07/17/96	12:21	0.2	16.6	7.2	50	31.7	9.4	95
MILL BROOK									
Station: MIL2, Mile Point: 0.5, Unique ID: W0032									
Description: about 300 feet above covered bridge in Charlemont, instream.									
33-0061	09/27/95	14:10	**i	14.7	7.4	88	57.0	9.8	96
MILL BROOK									
Station: MI, Mile Point: 0.0, Unique ID: W0033									
Description: in Charlemont, located at mouth of brook within 20 feet of confluence of Deerfield River, instream.									
33-0060	09/27/95	13:48	**i	13.9	7.7	90	58.0	9.9	95
33-0089	11/08/95	11:02	**i	5.9	7.1	49	31.0	12.1	97
33-0106	12/06/95	12:59	0.2	2.1	6.5	62	40.0	13.0	94
33-0159	04/24/96	11:32	**i	6.7	6.5	35	22.2	11.6	96
DAVIS MINE BROOK									
Station: DMB-1, Mile Point: 1.71, Unique ID: W0366									
Description: just upstream of the Davis Mine drainage, Rowe.									
33-0190	07/17/96	14:41	**i	19.4	6.4	33	21.3	8.4	91
Pipe/Discharge to DAVIS MINE BROOK									
Station: UKN, Mile Point: 1.7, Unique ID: W0364									
Description: "Davis Mine" drainage, Rowe.									
33-0188	07/17/96	14:25	**i	23.7	3.0	772	494	7.1	84
DAVIS MINE BROOK									
Station: DMB-2, Mile Point: 1.69, Unique ID: W0365									
Description: just downstream of the Davis Mine drainage, Rowe.									
33-0189	07/17/96	14:35	**i	20.2	3.7	176	113	7.9	87

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, ** = censored data, i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
DAVIS MINE BROOK									
Station: DMB-B, Mile Point: 0.01, Unique ID[2]: W0362									
Description: just upstream of the confluence with Mill Brook, Charlemont.									
33-0186	07/17/96	12:33	0.1i	16.4	6.5	46	29.6	9.3	94
HEATH BROOK									
Station: MIL3, Mile Point: 0.2, Unique ID: W0034									
Description: in Heath on Heath Brook approx. 2/10 mile from confluence with Mill Brook off Dell Road, instream.									
33-0062	09/27/95	14:33	**i	11.5	7.7	95	61.0	10.0	92
BOZRAH BROOK									
Station: BO, Mile Point: 0.0, Unique ID: W0035									
Description: in Charlemont, located off South River Road near the entrance to Berkshire East Ski Area, instream, 75 feet upstream from bridge.									
33-0059	09/27/95	13:17	**i	15.2	7.4	97	62.0	9.3	93
33-0088	11/08/95	10:48	**i	6.2	6.9	52	33.0	11.5	94
33-0105	12/06/95	12:05	0.3	2.1	6.4	54	35.0	13.0	94
33-0155	04/24/96	11:14	**i	7.0	6.7	39	25.1	11.3	94
CHICKLEY RIVER									
Station: CH5, Mile Point: 5.5, Unique ID: W0039									
Description: 100 feet downstream of Route 8A bridge in West Hawley above confluence of King Brook, instream.									
33-0056	09/27/95	11:48	**i	10.9	7.3	47	30.0	10.5	94
CHICKLEY RIVER									
Station: CH4, Mile Point: 3.3, Unique ID: W0038									
Description: in Hawley, due west of Forge Hill.									
33-0055	09/27/95	11:09	**i	11.3	7.3	52	33.0	10.5	96
CHICKLEY RIVER									
Station: CH3, Mile Point: 1.7, Unique ID: W0037									
Description: just above confluence with Mill Brook, instream.									
33-0054	09/27/95	10:41	**i	11.6	7.5	56	36.0	10.6	97
CHICKLEY RIVER									
Station: CH7, Mile Point: 0.6, Unique ID: W0036									
Description: in Hawley, across from farm just upstream from 2nd bridge on Route 8A upstream from confluence with the Deerfield.									
33-0058	09/27/95	12:29	**i	13.0	7.9	67	43.0	10.4	99
CHICKLEY RIVER									
Station: CH, Mile Point: 0.0, Unique ID: W0040									
Description: in Charlemont located upstream of bridge on Tower Road between Routes 2 and 8A, approximately 100 feet from Deerfield River, instream except during high flow.									
33-0043	09/13/95	10:56	0.3	13.9	7.9	70	45.0	10.3	99
33-0052	09/27/95	09:56	0.1i	11.9	7.8	66	43.0	10.8	99
33-0073	10/04/95	11:23	**i	12.0	7.5	67	43.0	10.3	95
33-0087	11/08/95	10:30	**i	5.7	7.0	36	23.0	12.3	99
33-0104	12/06/95	11:47	0.3	1.3	6.4	39	25.0	13.7	97
33-0128	03/20/96	10:43	0.1i	1.6	7.0	35	22.4	13.3	97
33-0140	04/11/96	10:08	**m	**m	**m	**m	**m	**m	**m
33-0154	04/24/96	10:52	**i	7.0	6.5	26	16.3	11.5	95
33-0161	05/15/96	10:56	0.4	7.7	6.5	32	20.3	11.9	98
33-0174	06/19/96	11:28	0.2	15.7	7.6	45	28.8	10.1	100
MILL BROOK									
Station: CH2, Mile Point: 0.0, Unique ID: W0041									
Description: Mill Brook just above confluence with the Chickley River, instream.									
33-0053	09/27/95	10:31	**i	11.3	7.6	93	59.0	10.5	96

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Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
KING BROOK									
Station: CH6, Mile Point: 0.0, Unique ID[2]: W0042									
Description: in Hawley in King Brook at confluence with Chickley River.									
33-0057	09/27/95	11:56	**i	10.8	7.0	43	27.0	10.0	90
COLD RIVER									
Station: CO, Mile Point: 0.8, Unique ID: W0043									
Description: in Florida, located at bridge to entrance to Mohawk Trail State Forest Campgrounds off Route 2 (approximately 1.35 miles above the mouth).									
33-0042	09/13/95	10:35	0.1i	14.7	7.4	97	62.0	9.8	95
33-0072	10/04/95	11:04	**i	12.4	7.4	87	56.0	10.2	96
33-0086	11/08/95	10:13	**i	5.1	6.8	39	25.0	12.3	97
33-0103	12/06/95	11:27	0.2	0.70	**	52	33.0	13.6	95
33-0127	03/20/96	10:25	0.1i	0.72	6.9	84	53.7	13.6	96
33-0139	04/11/96	09:54	0.1i	3.1	7.0	96	61.2	13.0	98
33-0152	04/24/96	10:32	**i	5.9	6.3	32	20.2	11.7	95
33-0173	06/19/96	11:07	0.2	17.4	7.2	62	39.5	9.4	97
PELHAM BROOK									
Station: PE, Mile Point: 0.0, Unique ID: W0044									
Description: in Charlemont located at bridge off Zoar Road, just above bridge, south side, instream.									
33-0085	11/08/95	09:54	**i	5.3	6.6	33	21.0	12.3	98
33-0102	12/06/95	11:04	0.3	1.4	6.2	33	21.0	13.5	96
33-0151	04/24/96	10:17	0.1i	7.0	6.0	23	14.7	11.7	97
UNNAMED TRIBUTARY									
Station: VP06ROA, Mile Point: 0.1, Unique ID: W0274									
Description: Guilford, Vermont; Roaring Brook approximately 200 meters northwest (upstream) of Green River Road.									
BC-0010	09/25/96	10:47	** i	10.3	7.7	83.8	53.7	10.0	90
BC-0058	10/08/97	09:36	0.1i	8.7	7.7	92.0	59.0	11.7	98
HINSDALE BROOK									
Station: VP05HIN, Mile Point: 2, Unique ID: W0275									
Description: Shelburne, approximately 700 meters south (downstream) of Wilson Graves Road off the west side of Greenfield Road (Brook Road).									
BC-0009	09/25/96	08:28	**i	11.4	7.9	178	114	10.1	92
SHINGLE BROOK									
Station: VP02SHN, Mile Point: 0.7, Unique ID: W0276									
Description: Deerfield, west of Hawks Road approximately 200 meters south (downstream) of Shelburne/Deerfield border.									
BC-0006	09/24/96	13:31	**i	12.0	7.3	203	130	9.5	88
DRAGON BROOK									
Station: 277, Mile Point: 1.5, Unique ID: W0277									
Description: Shelburne, on the north (upstream) side of the intersection of Allen Road, South Shelburne Road and Bardwell Ferry Road (Orchard Road).									
BC-0004	09/24/96	11:18	**i	10.7	7.7	158	101	9.7	88
DRAGON BROOK									
Station: VP01DRG, Mile Point: 1.49, Unique ID: W0278									
Description: Shelburne, approximately 50 meters south (downstream) of the intersection of Allen Road, South Shelburne Road and Bardwell Ferry Road (Orchard Road).									
BC-0005	09/24/96	11:40	**i	10.9	7.7	162	104	9.8	89
BEAR RIVER									
Station: VP12BEA, Mile Point: 2.8, Unique ID: W0279									
Description: Conway, off the west side of Pine Hill Road approximately 700 meters south/southwest (upstream) of Drakes Brook confluence.									
BC-0002	09/17/96	13:14	**i	13.4	7.8	134	85.8	9.6	91
BC-0055	09/25/97	12:25	**i	8.3	7.9	135	86.0	11.6	96

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Table G3 continued.

OWMID[1]	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (mg/L)	DO (mg/L)	Saturation (%)
BEAR RIVER									
Station: VP11BEA, Mile Point: 2.2, Unique ID[2]: W0280									
Description: Conway, off the northwest side of Shelburne Falls Road just northeast (downstream) of the Pea Brook confluence.									
BC-0003	09/17/96	17:37	**i	13.6	7.8	122	77.9	9.4	90
BC-0056	09/25/97	15:12	**i	9.7	7.9	129	83.0	11.2	96
DRAKES BROOK									
Station: VP13DRK, Mile Point: 0.2, Unique ID: W0281									
Description: Conway, approximately 300 meters above/north of confluence with Bear River.									
BC-0001	09/17/96	09:37	**i	14.3	7.7	104	66.5	9.6	94
BC-0054	09/25/97	10:44	**i	7.5	7.7	105	67.0	11.8	96
FOUNDRY BROOK									
Station: VP07FOU, Mile Point: 0.6, Unique ID: W0282									
Description: Colrain, west of York Road approximately 1000 meters north of confluence with East Branch North River.									
BC-0011	09/17/96	13:35	**i	11.0	7.7	136	86.9	9.5	86
BC-0059	10/08/97	11:42	**i	9.5	7.6	138	89.0	11.0	94
TISSDELL BROOK									
Station: VP08TIS, Mile Point: 0.5, Unique ID: W0283									
Description: Colrain, approximately 700 meters north (upstream) of Adamsville Road.									
BC-0012	09/25/96	15:23	**i	10.4	7.5	80.7	51.7	9.6	86
BC-0060	10/08/97	13:12	**i	10.1	7.6	81.3	52.0	11.0	95
CLESSON BROOK									
Station: VP10CLE, Mile Point: 2.2, Unique ID: W0284									
Description: Buckland, approximately 500 meters north (downstream) of Hog Hollow Road off the east side of Route 112.									
BC-0013	09/26/96	09:52	**i	9.2	7.4	111	71.0	11.1	96
CLARK BROOK									
Station: VP09CLA, Mile Point: 0.3, Unique ID: W0285									
Description: Buckland, approximately 400 meters south (upstream) of Route 112.									
BC-0014	09/26/96	12:43	**i	9.6	7.5	83.9	53.7	11.1	97
BC-0061	10/08/97	15:05	**i	10.5	7.6	93.0	60.0	11.1	97
SMITH BROOK									
Station: VP04SMI, Mile Point: 1, Unique ID: W0286									
Description: Ashfield, approximately 100 meters north (downstream) of the Upper Branch confluence off the west side of Apple Valley Road.									
BC-0008	09/24/96	17:35	**i	11.3	7.5	110	70.4	9.3	85

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i = inaccurate readings from Hydrolab multiprobe likely, m = method not followed

Table G4. 1995/1996 Deerfield River Watershed Water Quality Data. **Units are mg/L unless otherwise expressed.**

DEERFIELD RIVER

Station: UD01, Unique ID[2]: W0004, Description: in Florida, approximately 800 feet below Fife Brook Dam.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
33-0001		06/07/95	10:20	<1.0	5.4	--	10	<2.5	**	**	**	<0.05	20
33-0008		07/06/95	10:43	7.0	7.0	--	6.0	<2.5	<0.10	0.02	0.16	0.02	20
33-0024		08/16/95	10:08	6.0	6.0	50	5.0	<2.5	0.14	<0.02	0.18	0.03	60
33-0041		09/13/95	10:00	8.0	11	--	6.0	<2.5	0.14	<0.02	0.22	<0.01	<20
33-0071		10/04/95	10:28	6.0	3.2	45	5.0	<2.5	0.13	0.02	0.23	0.01	20
33-0084		11/08/95	9:30	4.0	6.1	--	3.0	<2.5	0.16	0.04	0.13	0.02	76
33-0138		04/11/96	9:23	--	--	--	--	--	--	--	--	--	<2
33-0160		05/15/96	10:22	4.0	**	--	3.0	<2.5	0.14	<0.02	0.21	0.02	10
33-0172		06/19/96	10:35	5.0	5.0	--	8.0	<2.5	**	<0.02	0.11	<0.01	<9

DEERFIELD RIVER

Station: UD02, Unique ID: W0003, Description: approximately 1/4 mile above the Florida bridge, this is an alternate station to UD01 used in December February and March.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
33-0101		12/06/95	10:40	5.0	**	--	3.0	<2.5	0.12	<0.02	0.16	0.02	7
33-0117		02/28/96	10:08	5.0	**	--	4.0	<2.5	**	<0.02	0.26	0.02	<2
33-0126		03/20/96	9:59	5.0	8.1	--	9.0	<2.5	**	0.02	0.25	0.01	4

DEERFIELD RIVER

Station: LD, Unique ID: W0002, Description: in Deerfield located approximately 2000 feet below Stillwater Bridge, sampled off south bank.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
33-0004	33-0005	06/07/95	13:40	**	25	--	6.0	<2.5	**	**	**	<0.05	178
33-0005	33-0004	06/07/95	13:40	**	25	--	9.0	<2.5	**	**	**	<0.05	--
33-0012		07/06/95	14:13	--	14	--	--	--	0.10	<0.02	0.14	0.02	140
33-0029		08/16/95	13:11	19	14	92	6.0	<2.5	0.13	<0.02	0.15	0.03	90
33-0048		09/13/95	13:44	13	20	--	6.0	<2.5	0.13	<0.02	0.24	0.01	100
33-0079		10/04/95	14:27	13	5.8	--	7.0	<2.5	0.10	<0.02	0.18	0.01	90
33-0096		11/08/95	11:41	13	8.7	--	3.0	<2.5	0.15	<0.02	0.21	0.02	350
33-0114		12/06/95	11:00	16	**	--	3.0	<2.5	<0.10	<0.02	0.25	0.02	33
33-0121		02/28/96	12:22	10	**	--	5.0	<2.5	<0.10	<0.02	0.27	0.02	19
33-0133		03/20/96	13:03	12	18	--	6.0	20	**	0.04	0.31	0.07	**
33-0146		04/11/96	13:01	13	7.9	--	20	**	<0.10	<0.02	0.23	0.03	19
33-0167		05/15/96	14:02	9.0	**	--	4.0	3.0	<0.10	<0.02	0.25	0.02	20
33-0180		06/19/96	14:02	22	17	--	5.0	<2.5	**	<0.02	0.20	0.01	240

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
DEERFIELD RIVER													
Station: 5-10, Unique ID[2]: W0001, Description: in Greenfield at (Route 5-10) Bridge located on downstream side of bridge over north channel of river.													
33-0050		09/13/95	15:03	20	27	--	10	<2.5	0.40	0.11	0.41	0.10	70
33-0082		10/04/95	**	--	--	--	--	--	--	--	--	--	560
33-0081		10/04/95	15:29	27	10	--	11	4.0	0.59	0.21	0.38	0.16	160
33-0099		11/08/95	13:17	15	10	--	4.0	6.0	0.18	<0.02	0.25	0.03	1,560
33-0116		12/06/95	12:17	12	**	--	6.0	<2.5	0.19	0.03	0.29	0.02	900
33-0124		02/28/96	13:26	13	**	--	5.0	4.0	<0.10	0.02	0.30	0.03	340
33-0136		03/20/96	14:14	15	21	--	7.0	31	**	0.04	0.29	0.09	--
33-0149		04/11/96	13:50	16	9.6	--	8.0	**	0.69	0.03	0.29	0.03	10
33-0170		05/15/96	15:04	11	**	--	4.0	3.0	0.11	<0.02	0.21	0.02	16
33-0183		06/19/96	14:57	24	19	--	8.0	3.0	**	0.08	0.36	0.03	72
GREEN RIVER													
Station: GR, Unique ID: W0005, Description: in Greenfield, located at a footbridge over the Green River off Route 5-10, approximately 4/10 of a mile above the Greenfield WWTP, on bridge during high flow and just downstream during low flow.													
33-0006		06/07/95	14:20	45	61	--	10	<2.5	**	**	**	<0.05	300
33-0014		07/06/95	14:46	65	29	--	12	<2.5	0.10	0.03	0.13	0.02	2,600
33-0030		08/16/95	14:07	50	36	201	22	6.0	0.22	0.02	0.34	0.05	3,000
33-0040		08/30/95	13:50	--	--	--	--	--	--	--	--	--	**
33-0049		09/13/95	14:30	58	67	--	22	<2.5	0.15	<0.02	0.31	0.02	1,300
33-0080		10/04/95	15:00	47	18	--	18	4.0	0.17	0.03	0.29	0.04	560
33-0097		11/08/95	12:48	32	17	--	6.0	10	0.18	<0.02	0.29	0.03	130
33-0115		12/06/95	11:37	35	**	--	16	<2.5	<0.10	<0.02	0.40	0.01	60
33-0122	33-0123	02/28/96	12:57	27	**	--	8.0	15	<0.10	<0.02	0.39	0.05	58
33-0123	33-0122	02/28/96	12:57	26	**	--	8.0	14	<0.10	<0.02	0.38	0.06	--
33-0134	33-0135	03/20/96	13:32	28	42	--	11	55	**	0.07	0.39	0.13	80
33-0135	33-0134	03/20/96	13:32	28	42	--	11	59	**	0.02	0.38	0.14	--
33-0147	33-0148	04/11/96	13:27	29	16	--	11	**	<0.10	0.02	0.28	0.03	44
33-0148	33-0147	04/11/96	13:27	29	15	--	11	**	<0.10	0.02	0.28	0.03	--
33-0168	33-0169	05/15/96	14:33	29	**	--	7.0	7.0	<0.10	<0.02	0.20	0.02	80
33-0169	33-0168	05/15/96	14:33	29	**	--	8.0	8.0	0.16	<0.02	0.20	0.02	--
33-0181	33-0182	06/19/96	14:24	42	29	--	32	<2.5	**	0.02	0.28	<0.01	170
33-0182	33-0181	06/19/96	14:24	41	30	--	11	<2.5	**	<0.02	0.27	<0.01	230

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Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
GREEN RIVER													
Station: GR07, Unique ID[2]: W0007, Description: in Colrain at USGS Gaging Station just north of East Colrain.													
33-0038		08/30/95	12:50	--	--	--	--	--	--	--	--	--	**
GREEN RIVER													
Station: GR08, Unique ID: W0006, Description: at boat launch about 3/10 of a mile downstream from Browning Brook.													
33-0039		08/30/95	13:20	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-1, Unique ID: W0015, Description: 75 feet downstream from first bridge crossing in downtown Ashfield of river exiting Ashfield Pond.													
33-0015		07/20/95	10:13	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-2, Unique ID: W0016, Description: at 2nd bridge crossing in downtown Ashfield off bridge, just below.													
33-0016		07/20/95	10:32	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-3, Unique ID: W0014, Description: in Ashfield, just downstream of bridge crossing at Baptist Corner Road, within 75 feet of bridge, sampled off bank.													
33-0017		07/20/95	10:53	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-4, Unique ID: W0013, Description: in Ashfield, at bridge crossing on Emmets Road just above bridge in stream.													
33-0018		07/20/95	11:10	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-5, Unique ID: W0012, Description: in Ashfield, located off Route 116 about 400 feet downstream from the Bullitt Road bridge, in stream.													
33-0019		07/20/95	11:28	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-7, Unique ID: W0010, Description: in downtown Conway at bridge on Route 116, waded instream just below bridge.													
33-0021		07/20/95	14:14	--	--	--	--	--	--	--	--	--	**
SOUTH RIVER													
Station: SO-8, Unique ID: W0009, Description: in Conway at bridge between Shelburne Falls Road and Reeds Bridge Road just below bridge, sampled instream.													
33-0022		07/20/95	14:31	--	--	--	--	--	--	--	--	--	**

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
SOUTH RIVER													
Station: SO, Unique ID[2]: W0008, Description: in Conway (located at USGS Gaging Station) at Reeds Bridge, just off Bardwell Road just above bridge.													
33-0003		06/07/95	12:30	**	83	--	12	<2.5	**	**	**	<0.05	540
33-0011		07/06/95	13:35	--	29	--	18	<2.5	<0.10	0.03	0.30	0.02	350
33-0023		07/20/95	14:53	--	--	--	--	--	--	--	--	--	**
33-0027	33-0028	08/16/95	12:27	54	34	184	17	<2.5	0.11	<0.02	0.26	0.03	160
33-0028	33-0027	08/16/95	12:37	53	34	192	17	<2.5	<0.10	<0.02	0.26	0.03	120
33-0046	33-0047	09/13/95	13:08	55	66	--	21	<2.5	0.10	<0.02	0.42	0.01	80
33-0047	33-0046	09/13/95	13:08	68	66	--	21	<2.5	0.11	<0.02	0.41	<0.01	<20
33-0077	33-0078	10/04/95	13:48	51	17	--	16	<2.5	<0.10	<0.02	0.29	0.02	85
33-0078	33-0077	10/04/95	13:48	51	17	--	16	<2.5	0.12	<0.02	0.31	0.03	--
33-0095		11/08/95	10:54	28	15	--	6.0	4.0	0.14	<0.02	0.30	0.02	360
33-0113		12/06/95	10:23	29	**	--	9.0	<2.5	<0.10	<0.02	0.51	0.01	330
33-0120		02/28/96	11:51	23	**	--	7.0	<2.5	<0.10	<0.02	0.39	0.02	125
33-0132		03/20/96	12:34	21	28	--	7.0	39	**	0.03	0.33	0.13	184
33-0145		04/11/96	12:31	26	13	--	16	**	0.14	<0.02	0.25	0.05	8
33-0166		05/15/96	13:37	27	**	--	8.0	<2.5	<0.10	<0.02	0.25	0.02	20
33-0179		06/19/96	13:34	38	26	--	17	<2.5	**	<0.02	0.42	<0.01	120
BEAR RIVER													
Station: BR03, Unique ID: W0019, Description: in Ashfield at Baptist Corner Road bridge just below golf course.													
33-0068		09/27/95	13:16	--	--	--	--	--	--	--	--	--	75
BEAR RIVER													
Station: BR02, Unique ID: W0018, Description: in Ashfield, just downstream of bridge at Pfersick Road, instream.													
33-0069		09/27/95	13:48	--	--	--	--	--	--	--	--	--	240

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
BEAR RIVER													
Station: BE, Unique ID[2]: W0017, Description: in Conway, located approximately 250 feet upstream from bridge on Shelburne Falls Road, sampled instream just above unnamed tributary.													
33-0010		07/06/95	13:07	--	32	--	--	--	<0.10	0.02	0.24	0.01	200
33-0026		08/16/95	11:52	55	34	150	4.0	<2.5	<0.10	<0.02	0.27	0.03	90
33-0045		09/13/95	12:15	55	61	--	3.0	<2.5	0.15	<0.02	0.24	0.03	60
33-0070		09/27/95	14:10	--	--	--	--	--	--	--	--	--	55
33-0076		10/04/95	13:23	50	16	--	4.0	<2.5	<0.10	0.02	0.18	0.02	110
33-0094		11/08/95	10:16	30	16	--	1.0	<2.5	<0.10	<0.02	0.17	0.02	80
33-0112		12/06/95	9:56	33	**	--	2.0	<2.5	<0.10	<0.02	0.23	0.01	15
33-0119		02/28/96	11:20	27	**	--	2.0	4.0	<0.10	<0.02	0.26	0.02	34
33-0131		03/20/96	12:13	24	2.4	--	2.0	18	**	0.03	0.28	0.06	44
33-0144		04/11/96	12:12	27	12	--	4.0	**	<0.10	<0.02	0.18	0.02	4
33-0165		05/15/96	13:12	31	**	--	<1.0	<2.5	<0.10	<0.02	0.11	0.01	19
33-0178		06/19/96	13:13	43	26	--	1.0	<2.5	**	<0.02	0.33	<0.01	64
NORTH RIVER													
Station: NR04, Unique ID: W0022, Description: in Colrain, bridge just north of Griswoldville on Adamsville Road, west bank, under bridge, upstream.													
33-0035		08/30/95	10:50	--	--	--	--	--	--	--	--	--	<100
NORTH RIVER													
Station: NR03, Unique ID: W0021, Description: in Colrain, Route 112 bridge just south of Griswoldville, under bridge, upstream from south bank.													
33-0034		08/30/95	10:20	--	--	--	--	--	--	--	--	--	800

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
NORTH RIVER													
Station: NO, Unique ID[2]: W0020, Description: in Colrain, located approximately 3/10 of a mile below USGS Gaging Station at Shattuckville and 500 feet above bridge on Route 112 from the north bank.													
33-0002		06/07/95	11:40	32	38	--	**	<2.5	**	**	**	<0.05	208
33-0009		07/06/95	11:49	--	25	--	10	<2.5	0.25	0.03	0.77	0.07	920
33-0025		08/16/95	11:10	37	23	207	10	<2.5	0.24	<0.02	0.16	0.04	1,726
33-0033		08/30/95	10:00	--	--	--	--	--	--	--	--	--	800
33-0044		09/13/95	11:39	104	55	--	12	<2.5	0.77	<0.02	1.6	0.26	140
33-0075		10/04/95	12:27	42	14	--	10	<2.5	0.49	0.02	1.0	0.24	160
33-0092	33-0093	11/08/95	12:05	16	11	--	2.0	<2.5	0.16	<0.02	0.25	0.03	183
33-0093	33-0092	11/08/95	12:05	18	11	--	2.0	<2.5	0.11	0.02	0.25	0.04	--
33-0109	33-0110	12/06/95	14:08	21	**	--	4.0	<2.5	<0.10	<0.02	0.27	0.02	100
33-0110	33-0109	12/06/95	14:08	21	--	--	5.0	3.0	--	--	--	--	--
33-0118		02/28/96	10:53	17	**	--	5.0	9.0	<0.10	<0.02	0.27	0.03	18
33-0130		03/20/96	11:31	19	23	--	7.0	23	**	0.03	0.29	0.08	61
33-0143		04/11/96	11:14	--	8.5	--	--	--	<0.10	0.02	0.21	0.02	<2
33-0164		05/15/96	12:04	17	**	--	4.0	<2.5	<0.10	<0.02	0.14	0.02	39
33-0177		06/19/96	12:29	32	23	--	7.0	<2.5	**	<0.02	0.32	0.05	124
NORTH RIVER													
Station: NR01, Unique ID: W0023, Description: in Shelburne Falls, 150 feet north of North River Road bridge off Route 112.													
33-0032		08/30/95	9:45	--	--	--	--	--	--	--	--	--	800
EAST BRANCH NORTH RIVER													
Station: EBNR06, Unique ID: W0024, Description: in Colrain, about 700 feet upstream from bridge just north of downtown Colrain on Route 112, sampled from south bank on access road.													
33-0037		08/30/95	11:43	--	--	--	--	--	--	--	--	--	100
WEST BRANCH NORTH RIVER													
Station: WBNR05, Unique ID[2]: W0025, Description: in Colrain just upstream from bridge across from the Branch Cemetery on Adamsville Road, sampled from north bank in middle of 6 to 8 foot wide stream.													
33-0036		08/30/95	11:10	--	--	--	--	--	--	--	--	--	200

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
CLESSON BROOK													
Station: SH01, Unique ID: W0028, Description: in Ashfield, about 0.5 miles upstream from confluence with Smith Brook near Hawley Road bridge, instream above bridge.													
33-0066		09/27/95	11:46	--	--	--	--	--	--	--	--	--	<5
CLESSON BROOK													
Station: CL02, Unique ID: W0027, Description: in Buckland, approximately 200 yards downstream from Hog Hollow Road bridge off Route 112.													
33-0064		09/27/95	10:55	--	--	--	--	--	--	--	--	--	15
CLESSON BROOK													
Station: CL, Unique ID: W0026, Description: in Buckland, located at bridge on Route 112 northeast of Depot Road, off west bank just above bridge.													
33-0063		09/27/95	10:21	--	--	--	--	--	--	--	--	--	15
33-0074		10/04/95	12:03	--	--	--	--	--	--	--	--	--	265
33-0090		11/08/95	11:32	--	--	--	--	--	--	--	--	--	120
33-0108		12/06/95	13:43	--	--	--	--	--	--	--	--	--	21
33-0129		03/20/96	11:11	--	--	--	--	--	--	--	--	--	**
33-0141		04/11/96	10:43	--	--	--	--	--	--	--	--	--	20
33-0157		04/24/96	12:13	20	16	--	6.0	4.0	<0.10	<0.02	0.25	0.02	86
33-0162		05/15/96	11:29	--	--	--	--	--	--	--	--	--	35
33-0175		06/19/96	11:59	--	--	--	--	--	--	--	--	--	45
CLARK BROOK													
Station: CK, Unique ID: W0029, Description: in Buckland, located at bridge on Route 112, approximately 200 feet east of Clesson Brook, from north bank just above bridge.													
33-0091		11/08/95	11:44	--	--	--	--	--	--	--	--	--	60
33-0107		12/06/95	13:28	--	--	--	--	--	--	--	--	--	20
33-0142		04/11/96	10:55	--	--	--	--	--	--	--	--	--	31
33-0158		04/24/96	11:59	16	12	--	3.0	<2.5	<0.10	<0.02	0.07	0.01	110
33-0163		05/15/96	11:41	--	--	--	--	--	--	--	--	--	10
33-0176		06/19/96	12:11	--	--	--	--	--	--	--	--	--	298

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, – = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
SMITH BROOK													
Station: CL03, Unique ID[2]: W0030, Description: at Buckland four corners, just upstream of confluence with Clesson Brook, instream.													
33-0065		09/27/95	11:19	--	--	--	--	--	--	--	--	--	20
UPPER BRANCH													
Station: UB01, Unique ID: W0031, Description: in Ashfield above bridge on Apple Valley Road near gravel pit, instream.													
33-0067		09/27/95	12:12	--	--	--	--	--	--	--	--	--	40
MILL BROOK													
Station: MIL2, Unique ID: W0032, Description: about 300 feet above covered bridge in Charlemont, instream.													
33-0061		09/27/95	14:10	--	--	--	--	--	--	--	--	--	5
MILL BROOK													
Station: MI , Unique ID: W0033, Description: in Charlemont, located at mouth of brook within 20 feet of confluence of Deerfield River, instream.													
33-0060		09/27/95	13:49	--	--	--	--	--	--	--	--	--	135
33-0089		11/08/95	11:02	--	--	--	--	--	--	--	--	--	120
33-0106		12/06/95	13:00	--	--	--	--	--	--	--	--	--	35
33-0159		04/24/96	11:32	5.0	5.8	--	2.0	<2.5	<0.10	<0.02	0.05	0.01	4
HEATH BROOK													
Station: MIL3, Unique ID: W0034, Description: in Heath on Heath Brook approx. 2/10 mile from confluence with Mill Brook off Dell Road, instream.													
33-0062		09/27/95	14:33	--	--	--	--	--	--	--	--	--	20
BOZRAH BROOK													
Station: BO, Unique ID: W0035, Description: in Charlemont, located off South River Road near the entrance to Berkshire East Ski Area, instream, 75 feet upstream from bridge.													
33-0059		09/27/95	13:17	--	--	--	--	--	--	--	--	--	320
33-0088		11/08/95	10:48	--	--	--	--	--	--	--	--	--	40
33-0105		12/06/95	12:03	--	--	--	--	--	--	--	--	--	12
33-0155	33-0156	04/24/96	11:14	12	8.1	--	1.0	<2.5	<0.10	<0.02	0.09	<0.01	24
33-0156	33-0155	04/24/96	11:14	12	8.1	--	<1.0	<2.5	<0.10	<0.02	0.09	<0.01	--
CHICKLEY RIVER													
Station: CH5, Unique ID: W0039, Description: 100 feet downstream of Route 8A bridge in West Hawley above confluence of King Brook, instream.													
33-0056		09/27/95	11:48	--	--	--	--	--	--	--	--	--	43

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, – = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
CHICKLEY RIVER													
Station: CH4, Unique ID[2]: W0038, Description: in Hawley, due west of Forge Hill.													
33-0055		09/27/95	11:10	--	--	--	--	--	--	--	--	--	55
CHICKLEY RIVER													
Station: CH3, Unique ID: W0037, Description: just above confluence with Mill Brook, instream.													
33-0054		09/27/95	10:42	--	--	--	--	--	--	--	--	--	13
CHICKLEY RIVER													
Station: CH7, Unique ID: W0036, Description: in Hawley, across from farm just upstream from 2nd bridge on Route 8A upstream from confluence with the Deerfield.													
33-0058		09/27/95	12:29	--	--	--	--	--	--	--	--	--	**
CHICKLEY RIVER													
Station: CH, Unique ID: W0040, Description: in Charlemont located at bridge on Tower Road between Routes 2 and 8A, approximately 100 feet from Deerfield River, instream except during high flow.													
33-0043		09/13/95	10:57	--	--	--	--	--	--	--	--	--	1,920
33-0052		09/27/95	9:57	--	--	--	--	--	--	--	--	--	108
33-0073		10/04/95	11:23	--	--	--	--	--	--	--	--	--	395
33-0087		11/08/95	10:30	--	--	--	--	--	--	--	--	--	50
33-0104		12/06/95	11:48	--	--	--	--	--	--	--	--	--	10
33-0128		03/20/96	10:43	--	--	--	--	--	--	--	--	--	14
33-0140		04/11/96	10:10	--	--	--	--	--	--	--	--	--	<2
33-0154		04/24/96	10:52	6.0	5.4	--	1.0	5.0	<0.10	<0.02	0.05	0.02	16
33-0161		05/15/96	10:56	--	--	--	--	--	--	--	--	--	10
33-0174		06/19/96	11:31	--	--	--	--	--	--	--	--	--	128
MILL BROOK													
Station: CH2, Unique ID: W0041, Description: Mill Brook just above confluence with the Chickley River, instream.													
33-0053		09/27/95	10:32	--	--	--	--	--	--	--	--	--	60
KING BROOK													
Station: CH6, Unique ID: W0042, Description: in Hawley in King Brook at confluence with Chickley River.													
33-0057		09/27/95	11:57	--	--	--	--	--	--	--	--	--	5

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, – = no data

Table G4 continued.

OWMID[1]	QA/QC	Date	Time (24hr)	Alkalinity	Hardness	Specific Conductance (µS/cm)	Chloride	Suspended Solids	TKN	Ammonia	NO_3-NO_2	Total Phosphorus	Fecal Coliform Bacteria (colonies/100mL)
COLD RIVER													
Station: CO, Unique ID[2]: W0043, Description: in Florida, located at bridge to entrance to Mohawk Trail State Forest Campgrounds off Route 2 (approximately 1.35 miles above the mouth).													
33-0042		09/13/95	10:36	--	--	--	--	--	--	--	--	--	100
33-0072		10/04/95	11:04	--	--	--	--	--	--	--	--	--	30
33-0086		11/08/95	10:13	--	--	--	--	--	--	--	--	--	141
33-0103		12/06/95	11:28	--	--	--	--	--	--	--	--	--	8
33-0127		03/20/96	10:25	--	--	--	--	--	--	--	--	--	10
33-0139		04/11/96	9:53	--	--	--	--	--	--	--	--	--	<2
33-0152		04/24/96	10:32	3.0	4.1	--	4.0	10	<0.10	<0.02	0.08	0.02	4
33-0173		06/19/96	11:07	--	--	--	--	--	--	--	--	--	<9
PELHAM BROOK													
Station: PE, Unique ID: W0044, Description: in Charlemont located at bridge off Zoar Road, just above bridge, south side, instream.													
33-0085		11/08/95	9:53	--	--	--	--	--	--	--	--	--	15
33-0102		12/06/95	11:05	--	--	--	--	--	--	--	--	--	74
33-0151		04/24/96	10:17	3.0	3.6	--	1.0	<2.5	<0.10	0.02	0.04	0.01	<4

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number, * = interference, ** = missing/censored data, -- = no data

Table G5. 1995/1996 DWM Deerfield River Watershed stream discharge measurements. (All measurements made between 0930 and 1400 hours)

	Sampling Equipment	Average Velocity (fps)	Total Discharge (cfs)
GREEN RIVER			
Station: GR			
Description: in Greenfield, at a footbridge over the Green River off Route 5-10, approximately 4/10 of a mile above the Greenfield WWTP			
09/13/95	Swoffer	0.73	6.7
11/08/95	Swoffer	3.16	342
12/06/95	Swoffer	2.26	155
02/28/96	Swoffer	2.85	377
03/20/96	Swoffer	3.05	419
04/11/96	Swoffer	2.57	247
05/16/96	Bridge Board	0.69*	385
06/19/96	Swoffer	1.41	97.6
BEAR RIVER			
Station: BE			
Description: in Conway, approximately 400 yards upstream from bridge on Shelburne Falls Road			
09/13/95	Swoffer	0.53	**
11/08/95	Swoffer	0.6	31.8
12/06/95	Swoffer	0.35	17.0
02/28/96	Swoffer	0.89	51.3
03/20/96	Swoffer	1.02	64.9
04/11/96	Swoffer	0.54	27.5
05/16/96	Swoffer	0.67	35.6
06/19/96	Swoffer	0.24	10.9

***** average depth was 7.12 feet
** censored/missing data

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

MA DEP. 2000. Memorandum to Rick McVoy, Laurie Kennedy, Tom Dallaire, Arthur Johson and Mollie Weinstein from Mark Guilmain dated February 2000. *1994, 95 & 96 QA/QC Assessment Report.* CN 036.0. Division of Watershed Management Department of Environmental Protection. Worcester, MA

Socolow, R.S., L.Y. Comeau, R.G. Casey, and L.R. Ramsbey. 1996. *Water Resources Data for Massachusetts and Rhode Island, Water Year 1995.* U.S. Geological Survey Report MA-RI-95-1. U.S. Geological Survey, Water Resources Division. Marlborough, MA.

APPENDIX H
SUMMARY OF NPDES, WMA, AND FERC LICENSED FACILITIES IN THE DEERFIELD RIVER WATERSHED

Table H1. Deerfield River Watershed Industrial wastewater discharges.

Permitee	NPDES #	Issuance	Flow (MGD)	Type of Discharge	Receiving Water (Segment)
Yankee Atomic Electric Co. (YAEC), Rowe	MA0004367	7/24/2003, Prior issued: 9/1988; Closed: 2/26/1992; to be reissued 2003	0.22	Outfall 001A: auxiliary service (non-contact cooling) water, and test tank water	Sherman Reservoir (MA33018)
USGenNE Electric Co., Rowe/Florida	MA0034878	September 1997	0.07	Outfall 001: station sump water with oil flotation	Deerfield River (MA33-01)
			0.34	Outfall 002: bearing cooling water	
			0.009	Outfall 003: bearing cooling water strainer backwash	
USGenNE Electric Co., Rowe	MA0034886	September 1997	6.58	Outfall 001: equipment cooling water, floor and associated drain water	Deerfield River (MA33-01)
			0.22	Outfall 002: strainer backwash	
USGenNE Electric Co., Monroe	MA0034908	September 1997	0.05	Outfall 001A: max. Discharge of station sump water with oil separation	Deerfield River (MA33-01)
			0.02	Outfall 001B: avg. discharge of station sump water with oil separation	
USGenNE Electric Co., Florida	MA0034894	September 1997	0.072	Outfall 001A: station sump water with oil flotation	Deerfield River (MA33-01)
			0.252	Outfall 001B2: bearing cooling water	
			0.0126	Outfall 003: strainer backwash	
			<10 GPD	Outfall 004: sump water with oil flotation	
USGenNE Electric Co., Buckland	MA0034860	September 1997	0.0015	Outfall 001: floor drain water	Deerfield River (MA33-03)
			0.06	Outfall 002: transformer cooling water	
			0.0216	Outfall 003: bearing cooling water	
USGenNE Electric Co., Buckland	MA0034851	September 1997	0.0015	Outfall 001: internal facility drainage	Deerfield River (MA33-03)
			0.06	Outfall 002: transformer non-contact cooling water	
			0.0216	Outfall 003: bearing contact cooling water	
			0.0432	Outfall 004: cooling water strainer backwash	
USGenNE Electric Co., Florida	MA0034843	September 1997	0.0015	Outfall 001: internal facility drainage	Deerfield River (MA33-03)
			0.06	Outfall 002: transformer non-contact cooling water	
			0.0216	Outfall 003: bearing contact cooling water	
			0.0432	Outfall 004: cooling water strainer backwash	

Table H1 (continued). Deerfield River Watershed Industrial wastewater discharges

Permitee	NPDES #	Issuance	Flow (MGD)	Type of Discharge	Receiving Water (Segment)
Consolidated Edison Energy, Buckland	MA0035670	September 1997	0.00864	Outfall 001: bearing cooling water	Deerfield River, No. 3 canal in Buckland (MA33-03)
			10 GPD	Outfall 002: boiler blowdown	
WTE Recycling, Greenfield	MAR05B674	February 2001	NA	Stormwater discharge	Deerfield River (MA33-04)
BBA Nonwovens Simpsonville, Inc, Ashfield	MA0003697	March 2001	1.35	Industrial and domestic wastewater	North River (MA33-06)
BBA Nonwovens Simpsonville, Inc, Ashfield	MAR05B746	January 2001	NA	Stormwater discharge; permit requires development of a SWPPP (Storm Water Pollution Prevention Plan).	North River (MA33-06)

Table H2. Deerfield River Watershed sanitary wastewater discharges.

Permitee	NPDES #	Issuance	Flow (MGD)	Receiving Water (Segment)
Monroe WWTP, Monroe	MA0100188	October 1998	0.015	Deerfield River (MA33-01)
Charlemont WWTP, Charlemont	MA0103101	September 1997	0.05	Deerfield River (MA33-02)
Shelburne Falls WWTP, Buckland	MA0101044	September 1997	0.25	Deerfield River (MA33-03)
Old Deerfield WWTP, Deerfield	MA0101940	September 1997	0.25	Deerfield River (MA33-03)
Greenfield WPCP, Greenfield	MA0101214	October 2002	3.2	Deerfield River (MA33-04)

Table H3. Deerfield River Watershed FERC Projects.

Project Name	Project Number	Owner Name / Issuance date	Receiving Water (Segment)	Kilowatts
Deerfield No.5	2323D	USGenNE / 4 April 1997	Deerfield River (MA33-01)	17,550
Fife Brook	2669A	USGenNE / 4 April 1997	Deerfield River (MA33-01)	4,800
Bear Swamp	2669B	USGenNE / 4 April 1997	Deerfield River (MA33-01)	610,000
Sherman	2323E	USGenNE / 4 April 1997	Deerfield River (MA33-01)	7,200
Deerfield No.4	2323C	USGenNE / 4 April 1997	Deerfield River (MA33-02)	4,800
Deerfield No. 2	2323A	USGenNE / 4 April 1997	Deerfield River (MA33-03)	4,800
Deerfield No.3	2323B	USGenNE / 4 April 1997	Deerfield River (MA33-03)	4,800
Gardners Falls	2334A	ConEdison Energy / 4 April 1997	Deerfield River (MA33-03)	3,580

Table H4. List of WMA registered and permitted average annual water withdrawals in the Deerfield River Watershed (LeVangie 2003. Water management Act Database. Massachusetts Department of Environmental Protection, Bureau of resource Protection, Database Manager. Boston, MA.).

Permit	Registration	PWSID	System Name	Registered Volume (MGD)	Source	G or S	Well/Source Name	Withdrawal Location (Segment)
	10302901	1029000	Bernardston Fire & Water District	0.17	029-02	G	Gravel Dug Well #2	Bernardston (MA33-30)
					1029000-01	G	Dug Well	Bernardston(MA33-30)
	10306601		BBA Nonwovens	0.89	01	S	North river	Colrain (MA33-06)
	10307401	1074000	Deerfield Fire District	0.1	074-02	G	Keats Spring	Deerfield (MA33-03)
					074-03*	G	Wells Spring	Deerfield (MA34-04)
					074-01	G	GP Well Rt. 5-Wapping Well	Deerfield (MA33-03)
					074-06	G	Stillwater Springs	Deerfield (MA33-03)
					074-04	G	Harris Springs	Deerfield (MA33-03)
					074-05	G	Stillwater Well	Deerfield (MA33-03)
	10307402		Williams Farm, Inc.	0.08	01	S	Williams Farm #1	Franklin (MA33-03)
					02	S	William Farm #2	Deerfield (MA33-03)
					03	S	Williams Farm #3	Deerfield (MA33-03)
					04	S	Williams Farm #4	Deerfield (MA33-03)
	10307403		Savage Farms, Inc.	0.29	01	S	Savage Farm-Deerfield 1	West Deerfield (MA33-03)
					02	S	Savage Farm-Deerfield 2	West Deerfield (MA33-03)
					03	S	Savage Farm-Deerfield 3	West Deerfield (MA33-03)
					04	S	Savage Farm-Deerfield 4	West Deerfield (MA33-03)
	10311401	1114000	Greenfield Water Department	2.12	114-04	G	Millbrook Well #1	Greenfield (MA33-30)
					114-01	S	Glen Brook-Upper Reservoir	Leyden (MA33-29)
					114-06	G	Millbrook Well #3	Greenfield (MA33-30)
					114-05	G	Millbrook Well #2	Greenfield (MA33-30)
					114-03	S	Green River	Greenfield (MA33-28)
9P10326801	10326801	1268000	Shelburne Falls Fire District	0.21	268-01	S	Fox Brook Reservoir	Colrain (MA33-06)
					268-02	G	Well #2	Colrain (MA33-06)
					268-01	G	Well #1(abandoned)	Colrain (MA33-06)
					268-03	G	Well #1 Replacement	Colrain (MA33-06)
	10307404		Trew Corporation	0.14	03	G	Trew Corp Well	Deerfield (MA33-04)

*this source (Wells Spring-03G) is located in the Connecticut River Watershed (segment MA34-04), G – ground water, S – surface water

APPENDIX I
STATE AND FEDERAL WATER QUALITY RELATED GRANT AND LOAN PROJECTS IN THE DEERFIELD WATERSHED

MASSACHSUETTS WATERSHED INITIATIVE

The Massachusetts Watershed Initiative (MWI) was active during the years of 1998-2003. During those years, EOEA Watershed Team Leaders, in conjunction with State and Federal agencies, municipal governments and regional planning agencies, universities, local watershed associations, businesses and other groups, developed work plans that identified the most important goals for each watershed and the specific projects and programs which were needed to meet those goals. Projects funded under the MWI include hydrologic and water quality monitoring and assessment, habitat assessment, non-point source assessment, hydrologic modeling, open space and growth planning, and technical assistance and outreach. MWI funded projects in the Deerfield Watershed related to water quality include:

- MWI Deerfield Workplan Project FY99: ***DRWA Volunteer Monitoring Support*** for the Deerfield River Watershed Association to purchase monitoring equipment and supplies to help expand their volunteer water quality monitoring capacity. Cost: $3,000 (EOEA)
- MWI Volunteer Monitoring Grants FY99: ***Volunteer Wetland Monitoring Project in the Deerfield River Watershed*** conducted by the Green River Watershed Preservation Alliance (GRWPA) during the spring of 1999 to monitor 22 marshes for calling amphibians and marsh birds. Goals of this project (which was continued for 2000 and 2001under different funding) included expanding current monitoring efforts in the Deerfield watershed and to identify biologically significant wetlands that support rare species and/or a high number of species. Cost: $5,000 (EOEA)
- MWI Deerfield Workplan Project FY99: ***Installation of Agricultural BMPs*** to protect water quality on selected farms in the wat ershed. BMPs installed included agrichemical mixing facilities, cattle/tractor access road to protect wetlands, and streamside fencing. Cost: $20,626 (DFA Agriculture Enhancement Program), $1,500 (USFW Partners for Wildlife Program)
- MWI Deerfield Workplan Project FY00: ***Water Quality Monitoring of the Deerfield Watershed*** conducted by Environmental Science Services, Inc. in 2000 as part of comprehensive water quality assessment monitoring being conducted in the watershed during "year two". A QAPP was prepared and water samples were collected for bacteria analysis and meter parameters to augment and compliment the MA DEP/DWM water quality sampling plan in the watershed. Sediments were also collected from behind dams on the mainstem Deerfield River and were analyzed for heavy metals and organics to investigate potential impacts from current and historic landuses along the mainstem. Cost: 49,500 (EOEA)
- MWI Deerfield Workplan Project FY00-FY02: ***ACOE Stream Ecosystem Restoration Feasibility Study*** conducted in 2000 – 2004 by the Army Corps of Engineers to investigate potential stream ecosystem restoration projects on the Green River in Greenfield. Study included hydrologic, sediment, biologic, and historic evaluation of the river that is impounded by four dams within the City of Greenfield. The study concentrated on the feasibility of improving the aquatic habitat including dam removal and installation of fish passage structures. Total Project Cost: $462,000; Cost Share: $180,000 (EOEA); $51,000 (City of Greenfield); $231,000 (ACOE)
- MWI Deerfield Workplan Project FY01-FY02: ***DEP/WERO Wetlands Circuit Rider Position (Greater Connecticut Watershed Regional Project)*** to support the funding of a full time wetlands circuit rider at MA DEP Western Regional Office for two years. The Circuit Rider provided technical assistance and outreach to municipalities in the Western Region, including all towns in the Deerfield Watershed, on local implementation and enforcement of the Wetlands Protection Act. Cost (two years): $85,500 (MA DEP)
- MWI Project 02-07/MWI: ***Deerfield River Watershed Municipal Landfill Assessment*** conducted in 2002 – 2003 by Fuss and O'Neill, Inc. to identify and list all historic and current municipal and industrial landfill sites. Project described each landfill based on its proximity to sensitive receptors, mapped the location of all landfill sites on GIS using GPS technology, and developed GIS maps that included hydrology, critical habitats, local and major roadways, water supplies, public recreation sites, topography, and surficial geology. This information was used to prioritize and rank landfill sites according to potential risk for contamination and identify eight of the most sensitive sites to conduct field reconnaissance and screening level sampling to further evaluate the potential for contamination. Project Cost: $38,000 (MA DEP)

- MWI Deerfield Workplan Project FY03: ***Japanese Knotweed Inventory and Removal*** conducted in 2003 by the DRWA used volunteers to inventory and map stands of the invasive plant, Japanese knotweed along selected tributaries in the Deerfield Watershed. Funding for the entire project was cut when the Watershed Initiative was ended and only inventory portion of the project was performed, so the DRWA plans to look for alternative funding to perform proposed removal activities. Cost: $9,604 (DCR)
- MWI Deerfield Workplan Project FY03: ***Watershed Assessment Report and Watershed Action Plan for the Deerfield Watershed*** began in 2003 and is being conducted by Gomez and Sullivan, Inc. to prepare a detailed assessment of the current environmental conditions in the watershed, evaluate potential causes of impairment to environmental resources, and recommend goals, objectives, and specific action items to mitigate priority problems and protect priority resources. Cost: $25,000 (EOEA)

MASSACHUSETTS ENVIRONMENTAL TRUST

The Massachusetts Environmental Trust (MET) is an office within the Executive Office of Environmental Affairs that protects and preserves the Commonwealth's water resources and their ecosystems through its grant making programs. The Trust's ability to support critical environmental initiatives throughout Massachusetts comes from the sale of special environmental license plates and the proceeds from environmental litigation settlements. The Trust is dedicated to promoting proactive environmental stewardship, environmental awareness, and the protection of our state's water-related resources through annual competitive grants to local, regional and statewide non-profit organizations, educational institutions, and government agencies. MET Grants in the Deerfield Watershed are:

- MET FY 2001 General Grants Program: ***Deerfield River Watershed Association Volunteer Wetland Monitoring Project*** to continue volunteer surveys of selected marshes in the Deerfield Watershed for calling amphibians and selected waterbirds in order to collect baseline data on wetland wildlife communities, increase public awareness, and increase the level of protection for these resources. Grant Amount: $14,875
- MET FY 2002 Environmental Monitoring Grants Program: ***Deerfield River Watershed Association Volunteer Monitoring Program Support*** to establish a water quality laboratory in the watershed to increase the capacity and viability of their volunteer water quality monitoring program. Grant Amount: $4,000

SECTION 319 NONPOINT SOURCE GRANT PROGRAM

This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. Section 319 is administered by the U.S. Environmental Protection Agency (EPA), which oversees the awards to individual states. The MA DEP Bureau of Resource Protection administers this award as part of the Massachusetts Nonpoint Source Program. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; address activities that are identified in the Massachusetts NPS Management Program Plan.

- There were no Section 319 funded projects in the Deerfield Watershed during the period evaluated for this assessment report (1997-2002).

SECTION 604(B) WATER QUALITY PLANNING GRANT PROGRAM

This Grant Program is authorized under Section 604(b) of the Federal Clean Water Act and funds are awarded to individual states through the U.S. EPA. In Massachusetts the 604(b) Program is administered by the MA DEP, Bureau of Resource Protection. The program is designed to assist eligible recipients in providing water quality assessment and planning assistance to local communities. Priority is given to projects that provide diagnostic information to support the MA DEP's watershed management activities and to projects located in one of the priority watersheds targeted for assessment work by the MA DEP. 604(b) projects conducted in the Deerfield Watershed are:

- Section 604(b) Project 97-01/604 – ***Stream Classification and Assessment Project*** conducted by the Franklin Regional Council of Governments in the Connecticut and Deerfield Watersheds to classify and assess stream types using the Rosgen Stream Classification Method. Goals of the project were to use the information to make predictions about stream behavior and anticipate problems in the watershed as a result of certain land uses, identify areas in need of restoration, distinguish between natural stream migration and evidence of stream instability, and improve overall ability to make good watershed planning decisions based on the stability and types of streams in the watershed. Grant Amount: $52,500 (EPA)

104(b)(3) WETLANDS AND WATER QUALITY GRANT PROGRAM

This Grant Program is authorized under Wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. Grant funds under the 104(b)(3) program are made available to Massachusetts agencies under the National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency. These grants, administered by the MA DEP, Bureau of Resource Protection,.provide a results oriented approach that focuses attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are: 1) ensure safe drinking water; 2) reduce, eliminate and/or control point and non-point source pollution; 3) protect wetland quality and function and ensure no-net-loss of wetlands; 4) reduce and reverse acidification of water bodies.

- 99-06/104 *Lake Surveys for TMDL Development*. The objective for this statewide study is to provide a database for lakes listed as impaired on the 303(d) List. Data such as secchi, bathymetry, nutrients, aquatic plant species composition and plant coverage will be compiled to determine optimal plant coverage for fisheries. Additionally, MA DFWELE will provide technical assistance and transfer of fisheries data to government agencies and private organizations involved in watershed management and assist in the development of volunteer and watershed participant action plans. Two ponds in the Deerfield River Watershed, Pelham Lake and Plainfield Pond, were sampled as part of this project in 2000.

RESEARCH AND DEMONSTRATION GRANT PROGRAM

The Research and Demonstration Program (R&D) is authorized by section 38 of Chapter 21 of the Massachusetts General Laws and is funded by proceeds from the sale of Massachusetts bonds. It is administered by the MA DEP, Bureau of Resource Protection. Specifically, the R&D Program was established to enable the Department to conduct a program of study and research and demonstration relating to water pollution control and other scientific and engineering studies "...so as to insure cleaner waters in the coastal waters, rivers, streams, lakes and ponds of the Commonwealth."

- There were no R&D projects in the Deerfield Watershed during the period evaluated for this assessment report (1997-2002).

WELLHEAD PROTECTION GRANT PROGRAM

The Wellhead Protection Grant Program was developed in support of the 1996 Safe Drinking Water Act Amendments and the MA DEP's Source Water Assessment Program. Funding is provided from the Drinking Water State Revolving Fund and is available to public water systems for developing and implementing wellhead protection projects and plans. Wellhead Protection Grant Program projects in the Deerfield River Watershed are:

- 99-07/WHP: ***Ashfield Wellhead Protection Project.*** This project has installed an insulated shelter for the wellhead and a barrier to protect the District's only drinking water source from an adjacent road; installed lightning arresters that protect the water supply from strikes that have interrupted service in the past.
- 99-10/WHP: ***Shelburne Falls Wellhead Protection Project****.* This project is designed to help protect the water supply through public education and proposed wellhead protection bylaws and regulations; work with area governments and schools to raise the awareness of the potential for contamination and for the need to establish Board of Health regulations and town by-laws to protect water sources; and update an out-of-date land use survey and emergency response plan.

- 99-12/WHP: ***Griswoldville Wellhead Protection Project.*** This project will install watertight/flood tight manhole covers in the IWPA; install a chainlink fence and wellhead protection signs; and issue public service announcements for consumers and local town officials on the need to protect the District's well.
- 00-05/WHP: ***Shelburne Falls Wellhead Protection Project – Phase II.*** This project will initiate a K-12 education curriculum; support the adoption of a Board of Health floor drain regulation; develop a Hazardous Materials Storage and Floor Drain Inspection Program; and repair two of the wellhouse's brick walls that leak and allow for stormwater flooding.
- 00-13/WHP: ***Sanderson Academy Wellhead Protection Project.*** This project will install security fencing and a pumphouse to protect the Sanderson Academy's sole source water supply from unauthorized access, improve design of the facility, and develop educational curricula on source protection.
- 01-01/WHP: ***Florida Wellhead Protection Project.*** This project will construct a new containment building outside the Zone I for the Abbott Memorial School in the Town of Florida. This project will eliminate the threat of contamination to the school's water supply and incorporate student participation and education.

SOURCE WATER PROTECTION TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM

The Source Water Protection Technical Assistance/Land Management Grant Program, administered by MA DEP, was developed in support of the 1996 Safe Drinking Water Act Amendments and the MA DEP's Source Water Assessment Program. Funding is provided from the Safe Drinking Water Revolving Fund and is available to public water suppliers and third party technical assistance organizations to assist public water suppliers in protecting local and regional ground and surface drinking water supplies. Source Water Protection Grant Projects in the Deerfield Watershed are:

- 02-06/SWT: ***Greenfield Source Water Protection Project.*** This project, being conducted by Tighe & Bond, Inc., will fund a storm drainage study, a survey of underground storage tanks, and a public education program for the City of Greenfield's Leyden Glen Reservoir.

CLEAN WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts State Revolving Loan Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state water quality requirements. This program assists cities, towns, and wastewater districts in the financing of water pollution abatement projects, including nonpoint source projects. The financial assistance takes the form of subsidized loans at a 2% interest rate to borrowers. The SRF Program is jointly administered by the Division of Municipal Services of the MA DEP and the Massachusetts Water Pollution Abatement Trust. The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed.

- There were no SRF projects in the Deerfield Watershed during the period evaluated for this assessment report (1997-2002).

MASSACHUSETTS DRINKING WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts Drinking Water State Revolving Fund (DWSRF) provides low-cost financing to help community public water suppliers comply with federal and state drinking water requirements. The DWSRF Program's goals are to protect public health and strengthen compliance with drinking water requirements, while addressing the Commonwealth's drinking water needs. The Program incorporates affordability and watershed management priorities. The DWSRF Program is jointly administered by the Division of Municipal Services of the Department of Environmental Protection and the Massachusetts Water Pollution Abatement Trust (Trust). The current subsidy level is equivalent to a 50% grant, which approximates a two percent interest loan. The Program will initially operate with approximately $50 million in financing capacity. For calendar years 1999 through 2003, up to $400 million may be available through the loan program. Drinking Water State Revolving Loan Projects in the Deerfield Watershed are:

- 99-15/SRF: ***Ashfield Water District System Improvement Project.*** This project provides for the construction of a covered storage/pump station/operations facility; replacement of a portion of the distribution system; corrosion control; removal of a surface water source and an upgrade of a ground water source. All of this is being undertaken to achieve compliance with the Safe Drinking Water Act, especially the Surface Water Treatment Rule.

COMMUNITY SEPTIC MANAGEMENT PROGRAM

The enactment of the Open Space Bond Bill in March of 1996 provided new opportunities and stimulated new initiatives to assist homeowners with failing septic systems. The law appropriated $30 million to the MA DEP to assist homeowners. The Department uses the appropriation to fund loans through the Massachusetts Water Pollution Abatement Trust. The fund provides a permanent state/local administered revolving fund to assist income-eligible homeowners in financing necessary Title 5 repairs. Working together, the MA DEP and the Trust have created the Community Septic Management Program to help Massachusetts' communities protect threatened ground and surface waters while making it easier to comply with Title 5. This loan program offers three options from which a local governmental unit can choose.

- Currently two Deerfield Watershed municipalities, Greenfield and Leyden, are involved with the Community Septic Management Program.

DEPARTMENT OF CONSERVATION AND RECREATION (DCR) LAKES AND PONDS GRANT PROGRAM

The Department of Conservation and Recreation, (formerly DEM) Lakes and Ponds Grant Program assists municipalities and local organizations that are striving to meet the challenges of long term lake and pond management by awarding grants for the protection, preservation and enhancement of public lakes and ponds in the Commonwealth. A maximum grant of $25,000 per project is available to eligible applicants on a 50/50 cost-sharing basis. Grant applicants must be municipalities, local commissions, local authorities or lake districts. DCR's Lake and Pond grant program awards grants for the protection, preservation and enhancement of public lakes and ponds in the Commonwealth. A key goal of the program is to promote a holistic approach to lake management, which is based on sound scientific principles and emphasizes the integrated use of watershed management, in-lake management, pollution prevention and education to provide long-term solutions to lake problems.

- 1997 Lakes and Ponds Grant - to the Town of Greenfield for the **Highland Pond Management Project**. Study of Highland Pond that included a watershed analysis, water quality testing, hydrologic assessment, and pond bottom and sediment assessment as well as recommendations for lake management to protect the recreational value of the pond. Grant Amount: $3,250.
- 1999 Lakes and Ponds Grant to the Town of Greenfield for phase II of the **Highland Pond Management Project**. Project involved preparation of a preliminary dredging plan for Highland Pond. Grant Amount: $4,000.

DEPARTMENT OF FISH AND GAME, RIVERWAYS SMALL GRANTS PROGRAM

Initiated in 1987, the Riverways Small Grants Program provides modest amounts of money to promote the restoration and protection of the ecological integrity of Commonwealth's rivers, streams, and adjacent lands. The grants foster action and result in benefits to the community that continue well after the grant period ends, as well as leverage local and foundation funding. In addition to providing seed money, Riverways also offer technical assistance, as appropriate, to both groups receiving grant awards and those that do not. The Riverways Programs, Department of Fish and Game, solicits project proposals for Small Grants from municipal governments and non-profit organizations for projects to be implemented by June 30, each year. Riverways Small Grant Projects in the Deerfield Watershed are:

- Small Grants FY 2000: **Deerfield River Watershed Association Volunteer Wetland Monitoring Project** to hire a project manager to train volunteers who surveyed riparian wetlands and "called" for amphibians and selected waterbirds to establish what species are dependent on these marshes. Grant Amount: $5,000
- Small Grants FY 2002: **Deerfield/Millers Chapter of Trout Unlimited** to hire a coordinator to work with participating schools in the already established Atlantic Salmon Egg Rearing Project. Goals of this project are to help protect salmon in the early years of life in fresh water habitat by increasing local knowledge of salmon restoration efforts, inspiring watershed stewardship among students in the community, and increasing the volunteer base for salmon fry stocking in the spring. Grant Amount: $5,000