APPENDIX A

Technical Memorandum

TM-82-9

CONCORD WATERSHED 2001
DWM WATER QUALITY MONITORING DATA

February 2005

DWM Control Number CN 130.0

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Ellen Roy Herzfelder, Secretary
Massachusetts Department of Environmental Protection
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Division of Watershed Management
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INTRODUCTION AND PROJECT OBJECTIVES

The DWM 2001 water quality monitoring plan for the Concord watershed was developed by DWM in consultation with the former EOEA SuAsCo (Sudbury, Assabet, and Concord) Watershed Team, a coalition of governmental and non-governmental groups. Because of a separate data collection effort for the Assabet River by a consultant (ENSR, Inc.) during the years 1999 and 2000, and a projected similar effort for the Concord River in 2002-2003, the DWM 2001 watershed survey was confined to the Sudbury River. The monitoring strategy was guided primarily by the recommendations in the unpublished 1996 DWM water quality assessment report (MA DEP, 1996) and suggestions by members of the EOEA SuAsCo Watershed Team. Priority monitoring needs addressed by DWM included sampling for water chemistry, bacteria, macroinvertebrate biomonitoring, fish population studies, and fish toxics monitoring. This technical memorandum presents the DWM riverine water quality sampling component of the survey. Results of the other monitoring efforts mentioned above are described in separate DWM memoranda or reports. Additional water quality, bacterial, and biological data, especially for the Assabet River, are available from ENSR, Inc. (ENSR, 2001) and from the Organization for the Assabet River (OAR, 2001).

The 1996 DWM SuAsCo assessment report (MA DEP, 1996) 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 September 2001 for water quality data and three surveys for bacteria data. The three water quality sampling surveys were pre-dawn surveys intended to capture dissolved oxygen minimums. Two of the bacteria surveys were conducted separately from the water quality surveys while the third one (September 11) was conducted as part of a water quality survey.

Samples were analyzed in the field using *Hydrolab® Series 3 Multiprobes* for dissolved oxygen and percent saturation of dissolved oxygen, temperature, pH, conductivity, and total dissolved solids. Samples for alkalinity, nutrients, hardness, turbidity, total suspended solids and bacteria (*E. coli* and fecal coliforms) were collected for analysis at the state's analytical laboratory, the Wall Experiment Station (WES).

QUALITY ASSURANCE AND QUALITY CONTROL

A QAPP (MA DEP 2001d) was written for the 2001 Green Basins water quality sampling surveys in 2001. 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 2001a). While no field audits were performed during the Sudbury River surveys in 2001, basket-drop and wade-in grab samples were assumed to be representative and to have been taken consistent with DWM SOPs (except as noted). For all water quality surveys, quality control samples (field blanks and sample splits) were taken at a minimum of one each per analyte per crew per survey. All water quality and bacteria samples were delivered to the 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 the DWM Data Validation SOP (MA DEP, 2001c). 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 all 2001 DWM data is provided in the DWM 2001 Data Validation Report (MA DEP, 2003).

Appendix A1 of this technical memorandum contains data censoring/qualification decisions for the 2001 Sudbury River data. Definitions for the data qualifiers are included in Appendix A2. This information was excerpted from the DWM 2001 Data Validation Report (MA DEP, 2003).

The samples collected on September 11 were delivered to WES laboratory in the early morning but extraordinary events precluded their expeditious handling and analysis for some of the analytes,

especially the bacteria samples; additionally, some significant field sampling errors occurred requiring eventual censoring or qualification of some of the data. In the case of the bacteria data, due to the emergency closing of WES because of the September 11 World Trade Center attack, all data was censored due to holding time violations. A number of water quality samples had noticeable amounts of solids which, given the less than 7Q10 flow, could only have come from a disturbance of the stream bottom while sampling. See Appendix A3 for a copy of an email detailing the laboratory handling of these samples. The subsequent QA/QC review resulted in censoring of the data for 82-0119 and the qualification (r) of 82-0111. See Sections 5.3 (1) and 5.2.2 in Appendix A1 of this memo for further details.

FIELD AND ANALYTICAL METHODS

DWM personnel performed *in-situ* water quality measurements at 15 stations for dissolved oxygen and dissolved oxygen percent saturation, temperature, pH, conductivity, and TDS with a *Hydrolab® Series 3 Multiprobe.* Water quality samples were collected for alkalinity, turbidity, nutrients, hardness, and total suspended solids for WES laboratory analysis at 14 stations (Table A1 and Figure A1) on July 10, July 31, and September 11, 2001. Fecal coliform and E. coli samples were collected at 22 stations on July 18 and July 30 during bacteria-only surveys, and on September 11 along with the *in-situ* and collected water samples mentioned in the preceding sentence. One station (SU13) sampled on July 10 was dropped for safety reasons and replaced with a nearby station (SU12) for the July 31 and September 10 surveys. Each survey crew also took a minimum of one ambient field blank and one field split sample during each survey 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, 2001a) and *Hydrolab® Series 3 and 4 Multiprobes SOP (2001-02)* (MA DEP 2001b). 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 2001). Samples were transported on ice to WES where they were analyzed according to the WES's Standard Operating Procedures (MA DEP 2001). The specific methods employed for each analyte are presented in Table A2.

Table A1. 2001 DEP-DWM Sudbury River Watershed survey. Location of sites sampled for water quality analysis on July 10, July 18, July 30, July 31, and September 11, 2001.

STREAM	SAMPLE TYPE*	STATION (UNIQUE ID)	DESCRIPTOR (upstream side unless otherwise indicated)
Sudbury River	1, 2, 3	SU01 (W0832)	downstream Fruit Street, Hopkinton/Westborough
Sudbury River	1, 2	SU02 (W0834)	Cedar Street, Hopkinton/Southborough
Sudbury River	1, 2, 3	SU03 (W0835)	Rt. 85 (Cordaville Road) bridge, Hopkinton/Southborough
Sudbury River	1, 2, 3	SU04 (W0840)	downstream Winter Street, Framingham
Sudbury River	1	SU04A (W0838)	Rt 135 near Chestnut St, Ashland
Sudbury River	1, 2, 3	SU07 (W0696)	Danforth Street, Framingham
Sudbury River	1, 2, 3	SU09 (W0850)	Pelham Island Road bridge, Wayland
Sudbury River	1, 2, 3	SU11 (W0848)	Rt. 27 bridge, Wayland
Sudbury River	1, 2, 3	SU12 (W0847)	Sherman Bridge Road bridge, Wayland/Sudbury
Sudbury River	2, 3	SU13 (W0855)	Rt. 117 bridge, Concord/Lincoln (only sampled once)
Sudbury River	1, 2, 3	SU15 (W0844)	downstream Nashawtuc Road bridge, Concord
Whitehall Brook	1, 2, 3	WH01 (W0833)	Fruit Street, Hopkinton
Indian Brook	1	IB01 (W0853)	Cross St, Ashland
Indian Brook	1	IB01A (W0836)	downstream Indian Brook Rd, Ashland
Cold Spring Brook	1	CS01 (W0837)	Chestnut St, Ashland
Eames Brook	1	EP01 (W0839)	downstream of footpath @ end of Sherwin Terrace, Framingham
Unnamed tributary**	1, 2, 3	CB01 (W0841)	Outlet Lake Cochituate off foot bridge, Framingham
Unnamed tributary**	1, 2, 3	CB02 (W0842)	School St/Rt 126, Saxonville

STREAM	SAMPLE TYPE*	STATION (UNIQUE ID)	DESCRIPTOR (upstream side unless otherwise indicated)
Pine Brook	1	PI01 (W0851)	Pine Brook Rd, Wayland
Wash (Hop) Brook	1, 2, 3	WB01 (W0849)	Landham Road, Sudbury
Pantry Brook	1	PB01 (W0846)	Concord Rd, Sudbury
Mill Brook	1	MB01 (W0845)	Lowell Road, Concord
Assabet River	1, 2, 3	AS01 (W0843)	downstream Rt. 2 bridge, Concord

***** 1 – bacteria samples
2 – *In-situ* Hydrolab® monitoring
3 – Physico/Chemical samples

****** Locally known as "Cochituate Brook"

Table A2. WES/DWM Analytical Methods & MDLs for 2001 Water Quality Analytes

	EPA Method*	SM Methods**	Other Methods	MDLs	RDLs
In-Situ Water Quality Analytes					
Hydrolab® Multiprobe Series 3			DWM SOP (CN 4.0)	NA	NA
Water Quality Analytes					
Total Phosphorus		SM 4500-P-E		0.005, 0.01 and 0.010 mg/l	0.010 mg/l
Alkalinity		SM 2320 B		2 and 2.0 mg/l	2 mg/l
Hardness	EPA 200.7	SM 2340 B		0.66 mg/l	0.66 mg/l
TSS		SM 2540 D		1.0 mg/l	1.0 mg/l
NH3-N	EPA 350.1			0.02, 0.020 and 0.10 mg/l	0.02, 0.020 mg/l
NO3-NO2-N	EPA 353.1			0.02, 0.020 and 0.10 mg/l	0.02, 0.020 mg/l
Turbidity	EPA 180.1			0.10 NTU	0.10 NTU
Fecal Coliform		SM 9222D		Not defined; usu. 5 and 10 cfu/100ml	NI
E. coli		SM 9213D		Not defined; usu. 5 and 10 cfu/100ml	NI

***** = "Methods for Chemical Analysis of Water and Wastes", Environmental Protection Agency, Environmental Monitoring Systems Laboratory – Cincinnati (EMSL-CI), EPA-600/4-79-020, Revised March 1983 and 1979 where applicable.
****** = Standard Methods, Examination of Water and Wastewater, 20th edition
NA = Not Applicable
NI = No Information

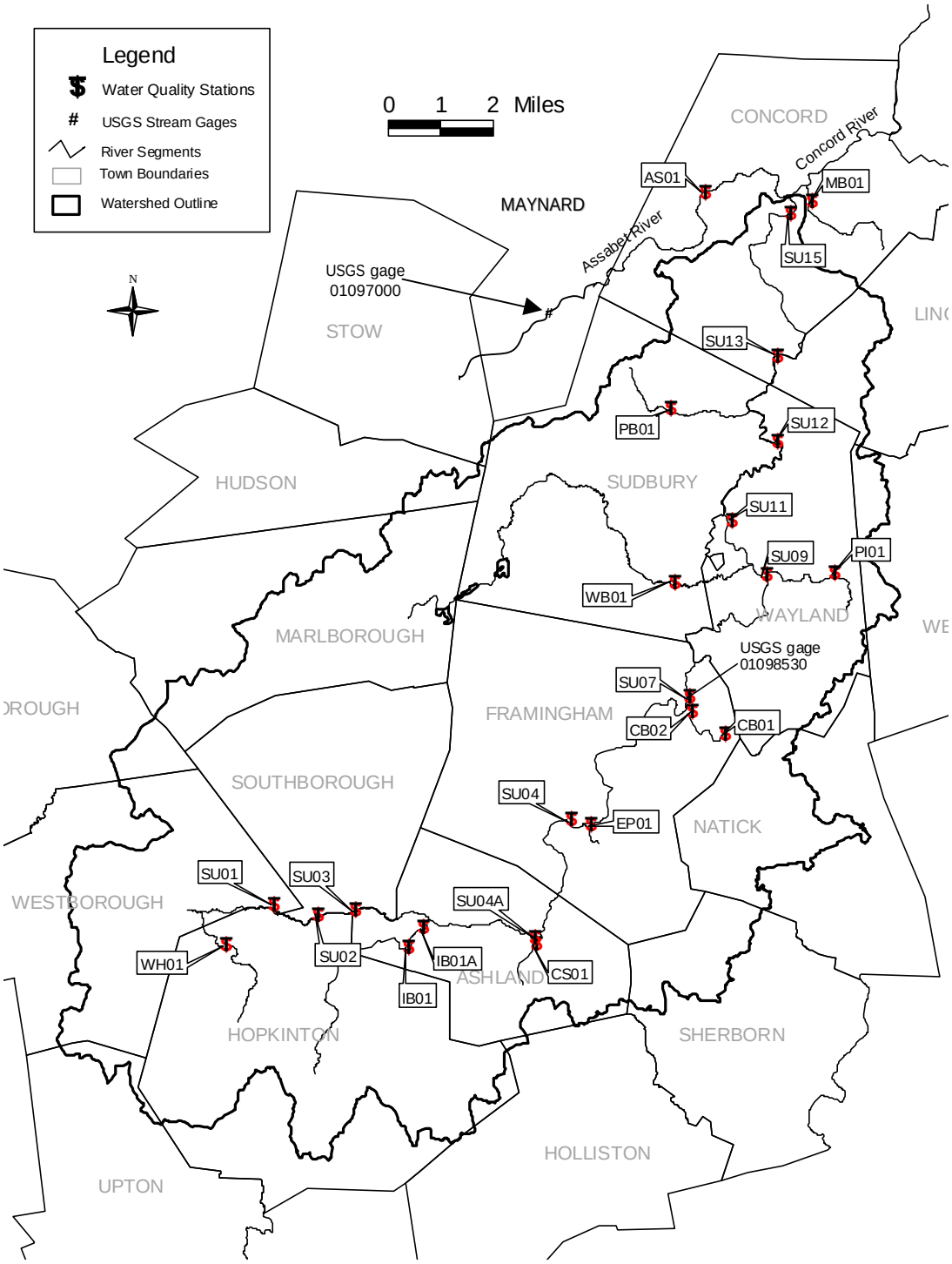


Figure A1. Location of 2001 DEP/DWM water quality sampling stations and USGS gaging stations in the Sudbury River Watershed.

SURVEY CONDITIONS

Conditions prior to each survey were characterized by analyzing precipitation and streamflow data. Rainfall data from four Department of Conservation And Recreation (DCR, formerly DEM), Office of Water Resources precipitation stations in Maynard, Concord, and Marlborough (Marler, 2004) and two NOAA/National Weather Service precipitation stations in Worcester and Natick (NOAA) were reviewed for the five days prior to and on the sampling dates (Table A3). While four of these stations are on the periphery of the Sudbury watershed, their data should be indicative of conditions for the watershed. However, examination of the data does indicate the localized nature of many of the precipitation events recorded.

Streamflow data (Tables A4 – A5) used to estimate hydrological conditions for the water quality sampling events were obtained from two USGS stream gages, one on the Sudbury River (No. 01098530 in Saxonville) and one on the Assabet River (No. 01097000 in Maynard) as reported in the USGS 2001 water year compilations (Socolow *et al*, 2002). Seasonal flow data in graphics form is presented in Figures A2 and A3. Locations of the gages are illustrated in Figure A1. Streamflow statistics for these gages are available from USGS (Socolow *et al.* 2002). Streamflow conditions were also compared in relation to the 7-day, 10-year (7Q10) low flow estimates. The 7Q10 for the Sudbury River (6.2 cfs) was calculated using the USEPA DFLOW3 program (USEPA) and the existing data record from the Saxonville gage (Socolow *et al* 2002). The 7Q10 for the Assabet River at Maynard is generally, but not universally, agreed upon to be 15.1 cfs. Using DFLOW3 and the flow record from the Maynard gage from 1985 to date gives a value of 12.1 cfs. Because of the major impact of the three POTWs upstream of the gage, there is an open discussion on the accepted value but DWM has consistently used the 15.1 cfs as the 7Q10 flow.

Survey conditions are described below for each DWM sampling event:

July 10, 2001: This water quality survey was conducted after all 5 preceding days showed significant precipitation at most of the recording stations. The hydrograph for the Saxonville gaging station clearly shows that the Sudbury was on the receding limb of a storm peak and survey field conditions confirmed that stream depths were high. The 120 cfs flow at the Saxonville gaging station for July 10 was higher than the July 2001 monthly average of 85.7 cfs for this station and for the July period-of-record (POR) average flow of 74.0 cfs. Flow was very much higher than the 7Q10 of 6.2 cfs for the Sudbury at the Saxonville gage. The data for this date's survey should not be considered representative of dry conditions.

Station SU13 (unique id W0855) was sampled only on July 10 whereupon it was deemed too dangerous to sample (as it required climbing onto an unsafe bridge structure) during ensuing surveys. All subsequent surveys substituted station SU12 (unique id W0847).

July 18, 2001: This bacteria-only survey was conducted at a flow (47.0 cfs) below both the 2001 monthly average (85.7 cfs) and the July POR flow (74.0 cfs) for the Saxonville gage. While there was recordable precipitation at a number of the recording stations the Saxonville hydrograph did not show any increase in flow which may have been due to scattered showers rather than regional rainfall. Based on the hydrograph, the data for this date's survey is possibly representative of dry conditions.

July 30, 2001: This bacteria-only survey was conducted at a flow (7.4 cfs) just above the 7Q10 flow of 6.2 cfs at the Saxonville gage. While a number of the precipitation stations recorded rain 3 or more days prior to the sampling date, both the general extended dry period prior to July 30 and a hydrograph minimally responsive to the precipitation indicates that this date's survey is most likely representative of not only dry but also 7Q10 conditions.

July 31, 2001: This water quality survey, as was the July 30 survey above, was conducted during and following essentially dry weather. Flow at the Saxonville gage was 7.0 cfs, just slightly above the 6.2 cfs 7Q10 flow. The sampling date was preceded by 3 days of no recorded rainfall and the rainfall recorded in Maynard was probably local with no effect on the Sudbury River. Data collected during this survey are interpreted as being representative of both dry weather and 7Q10 conditions.

September 11, 2001: Data collected during this survey are being interpreted as representative of dry weather and below 7Q10 conditions. Flow at the Saxonville gage was 4.3 cfs. Unfortunately, some of the data had to be censored or qualified due to field sampling errors and/or to holding time issues. See discussion under “Quality Assurance and Quality Control”.

Table A3: Estimated Sudbury River Basin 2001 Precipitation Data Summary based on DCR (DEM) and NOAA data[1]

(reported in inches of rainfall)

Survey Dates	5 Days Prior					4 Days Prior					3 Days Prior					2 Days Prior					1 Days Prior					Survey Date				
	Wor	Nat	May	Con	Mar	Wor	Nat	May	Con	Mar	Wor	Nat	May	Con	Mar	Wor	Nat	May	Con	Mar	Wor	Nat	May	Con	Mar	Wor	Nat	May	Con	Mar
July 10 WQS[2]	0.29	0.12	0.12	0.43	0.23	0.01	0.32	0.65	0.0	0.0	0.0	0.0	0.00	0.07	0.12	0.21	0.08	0.1	T*	0.03	0.24	0.0	T*	T*	0.0	0.3	0.0	0.00	0.11	0.77
July 18 bacteria[3]	0.0	T	0.01	0.0	0.0	0.0	0.0	0.0	0.02	0.02	0.0	0.01	0.19	0.0	0.0	0.0	0.0	0.0	0.17	0.18	0.26	0.02	0.21	0.29	0.0	0.0	0.24	0.25	0.02	0.0
July 30 bacteria	0.0	0.0	0.0	0.12	0.1	0.23	0.01	0.05	0.56	0.33	0.0	0.26	0.47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
July 31 WQS	0.23	0.01	0.05	0.56	0.33	0.0	0.26	0.47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T*	0.0	0.0	T*	0.0
Sept 11 WQS & bacteria	0.0	n/a	0.0	0.0	0.0	0.0	n/a	0.0	0.0	0.0	0.0	n/a	0.0	0.0	0.0	0.0	n/a	0.0	0.0	0.0	0.03	n/a	0.0	0.0	0.0	0.0	n/a	0.26	0.0	0.0

[1] DEM Office of Water Resources precipitation stations: May = Maynard, Con = Concord, Mar = Marlborough; NOAA precipitation station: Wor (Worcester)
NOAA/NCDC stations: Nat = Natick (n/a = Natick daily data not available September), Wor = Worcester

[2] WQS = Water Quality Survey

[3] bacteria = bacteria survey

T* = trace

Table A4
USGS Flow Data Summary
Sudbury River at Danforth Street, Saxonville, MA
Discharge in Cubic Feet per Second (cfs)
USGS Gage # 01098530

Survey Dates 2001	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Survey Date	Monthly Mean 2001	POR* Mean
10 July	176	173	141	133	127	120	85.7	74.0
18 July bacteria	105	97	92	88	86	47	--	--
30 July bacteria	9.2	13	13	8.7	7.6	7.4	--	--
31 July	13	13	8.7	7.6	7.4	7.0	--	--
11 Sept	4.7	4.6	4.5	4.4	4.5	4.3	8.78	60.4

7Q10 @ USGS, Gage 01098530 = 6.2 cfs (from DFLOW3 (USEPA) and period of record)
*Period of Record: 1980 - 2001 (mean annual discharge = 196 cfs)

Table A5
USGS Flow Data Summary
Assabet River at Maynard, MA
Discharge in Cubic Feet per Second (cfs)
USGS Gage # 01097000

Survey Dates 2001	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Survey Date	Monthly Mean 2001	POR* Mean
10 July	133	155	126	102	92	88	85.1	73.0
18 July bacteria	94	77	66	59	64	69	--	--
30 July bacteria	32	39	41	36	33	28	--	--
31 July	39	41	36	33	28	25	--	--
11 Sept	4.1	5.6	6.0	8.5	9.8	9.8	17.8	62.8

7Q10 @ USGS, Gage 01097000 = 15.1 cfs,
*Period of Record: 1941 - 2001 (mean annual discharge = 190 cfs)

Figure A2

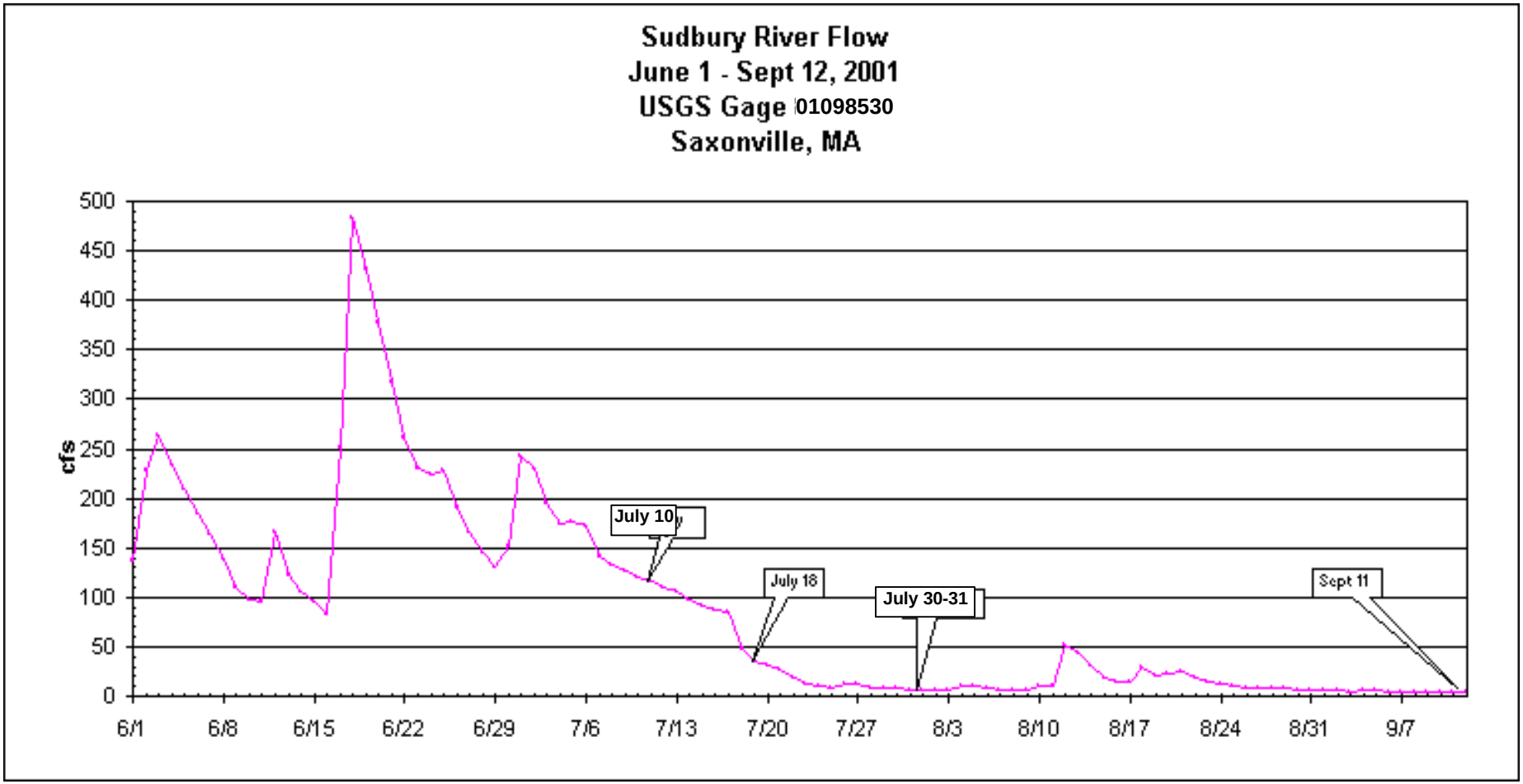
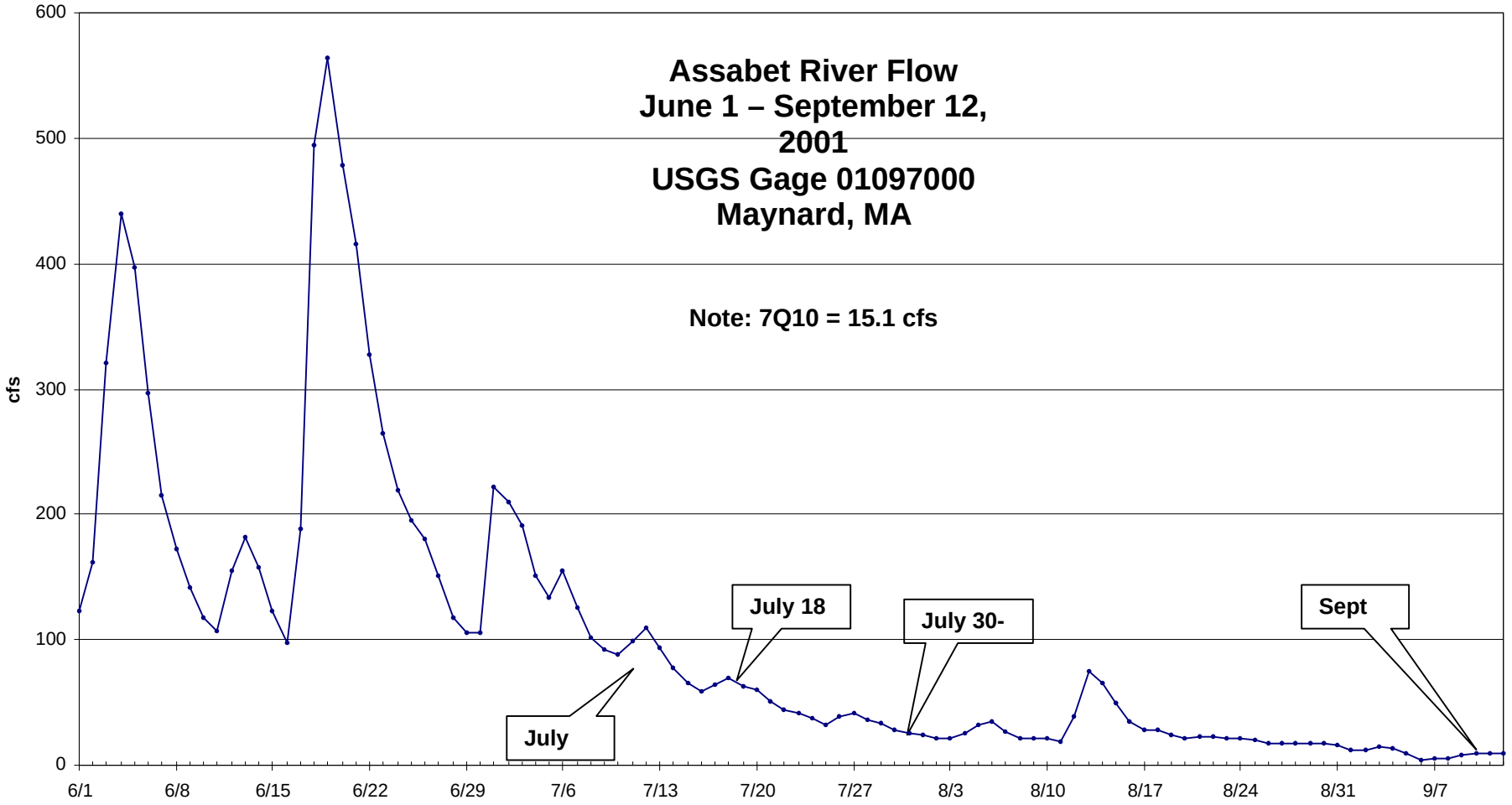

Sudbury River Flow
June 1 - Sept 12, 2001
USGS Gage 01098530
Saxonville, MA
cfs
500
450
400
350
300
250
200
150
100
50
0
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
8/24
8/31
9/7
July 10
July 18
July 30-31
Sept 11

Figure A3


Assabet River Flow
June 1 – September 12, 2001
USGS Gage 01097000
Maynard, MA
Note: 7Q10 = 15.1 cfs
cfs
600
500
400
300
200
100
0
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
8/17
8/24
8/31
9/7
July
July 18
July 30-
Sept

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*. Data exports for publishing are provided by DWM's database manager.

Text highlighted with gray shading are additions by Brian Friedmann to the data export .

Table A6. 2001 MA DEP Sudbury River Watershed *in-situ* Hydrolab® Data.
Temperature, pH, Conductivity, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Dissolved Oxygen Percent Saturation (SAT) (Data qualifiers listed in Appendix A2)

Sudbury (2001) (QC Status: 4) Exported: 5/27/2004 2:33:13 PM

Unnamed Tributary ("Cochituate Brook")
Unique_ID: W0841 Station: CB01, Mile Point: 1.3
Description: unnamed tributary to Sudbury River, outlet Lake Cochituate, Framingham

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(µS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0024	04:45	0.4	24.8	7.6cu	396	253	8.5	101
7/31/2001	82-0104	05:32	0.1i	21.1	7.4cu	400	256	7.3u	80u
9/11/2001	82-0131	05:58	0.1i	22.3u	8.1cu	409	262	8.7u	98u

Unnamed Tributary ("Cochituate Brook")
Unique_ID: W0842 Station: CB02, Mile Point: 0.2
Description: unnamed tributary to Sudbury River, at School Street/Route 126, Framingham

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0025	05:15	0.4	23.9	7.1c	441	282	6.9	81
7/31/2001	82-0105	05:58	0.1i	18.1	7.1cu	820c	525	6.0	62
9/11/2001	82-0132	06:24	0.2	20.7	7.1c	863c	552c	6.1	67

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0843 Station: AS01, Mile Point: 2.4
Description: at Route 2/2A bridge, Concord

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0010	03:14	##i	23.2u	6.9c	385	246	7.0	81
7/31/2001	82-0090	03:31	0.5	20.4u	7.0cu	506	324	6.7	72
9/11/2001	82-0110	03:08	0.4	23.0	7.0cu	628	402	5.2u	60u

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0832 Station: SU01, Mile Point: 31.2
Description: at Fruit Street, Hopkinton/Westborough

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0019	02:46	0.3	22.2	6.2	464	297	2.8u	32u
7/31/2001	82-0099	03:19	0.1i	18.7	6.3	397	254	5.0u	52u
9/11/2001	82-0122	02:54	0.2	21.0u	6.4	500	320	4.0	44

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0834 Station: SU02, Mile Point: 30
Description: at Cedar Street, Hopkinton/Southborough (locality of Southville)

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0021	03:26	0.3	21.2	6.5u	486	311	6.0	67
7/31/2001	82-0101	04:03	0.1i	19.1	6.6	351	225	6.7	71
9/11/2001	82-0124	03:38	0.1i	21.0	6.5	547	350	4.9	54

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0835 Station: SU03, Mile Point: 29.3
Description: at Route 85 (Cordaville Street/River Street) Hopkinton/Southborough (locality of Cordaville)

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0022	03:45	0.2	21.3	6.7u	486	311	7.8u	87u
7/31/2001	82-0102	04:26	0.1i	20.0	6.9u	437	280	8.2	88
9/11/2001	82-0125	03:57	0.2	21.9	6.7	531	340	6.4u	72u

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0840 Station: SU04, Mile Point: 21.9
Description: at Winter Street, Framingham

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0023	04:17	0.4	23.8	7.0cu	383	245	8.3	97
7/31/2001	82-0103	04:58	0.2	22.8u	7.0cu	401	256	7.6	86
9/11/2001	82-0130	05:22	0.1i	22.4	6.8	433	277	5.2u	59u

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0696 Station: SU07, Mile Point: 16.5
Description: just upstream/south of Danforth Street, Framingham

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0018	05:33	0.4	23.3	7.0cu	416	266	7.9	92
7/31/2001	82-0098	06:21	0.1i	19.7	7.0c	547	350	6.8	73
9/11/2001	82-0121	06:55	0.1i	20.9	6.9c	625	400	5.3	58

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0850 Station: SU09, Mile Point: 12.1
Description: at Pelham Island Road, Wayland

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0017	06:30	0.4	23.4u	6.7	416	266	5.8u	67u
7/31/2001	82-0097	05:56	0.5	21.4u	7.2cu	500u	320	7.6	83
9/11/2001	82-0119	05:55	0.6	22.1	7.0cu	489u	313u	6.4	72

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0848 Station: SU11, Mile Point: 10.5
Description: at Route 27, Wayland

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0013	06:00	##i	23.7	6.7	413	265	5.3u	62u
7/31/2001	82-0093	05:04	0.5	21.7	7.0cu	443	283	6.3u	70u
9/11/2001	82-0115	04:55	0.6	23.8	7.2cu	521	334	7.2u	83u

SUDBURY RIVER (Saris: 8247650) ***{not sampled on 7/10; see SU13 for explanation – BFF}***
Unique_ID: W0847 Station: SU12, Mile Point: 7.5
Description: at Shermans Bridge Road/Lincoln Road, Wayland/Sudbury

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/31/2001	82-0092	04:37	0.5	23.4	7.1c	465	298	7.2	82
9/11/2001	82-0114	04:28	0.9	24.2	7.2cu	522	334	7.5u	88u

SUDBURY RIVER (Saris: 8247650) ***{Sampled only once on 7/10; deemed too dangerous; substituted SU12 for ensuing surveys – BFF}***
Unique_ID: W0855 Station: SU13, Mile Point: 5
Description: Route 117, Concord/Lincoln

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0012	05:11	0.2	23.6	6.5	400	256	3.6	42

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0844 Station: SU15, Mile Point: 0.5
Description: at Nashawtuc Road, Concord

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0011	04:15	##I	23.4	6.5	385	246	4.4	51
7/31/2001	82-0091	03:58	0.5	25.2	7.1cu	410	262	7.3	86
9/11/2001	82-0111	03:31	0.9	25.0	7.1cu	444	284	7.2u	85u

WASH BROOK (Saris: 8247800)
Unique_ID: W0849 Station: WB01, Mile Point: 2.4
Description: at Landham Road, Sudbury

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0014	06:40	##I	21.4	6.7	386	247	3.4	38
7/31/2001	82-0094	05:29	0.5	18.3	7.0cu	457	292	4.7	49
9/11/2001	82-0116	05:22	0.4	21.2	7.1cu	507	324	3.2u	35u

WHITEHALL BROOK (Saris: 8248425)
Unique_ID: W0833 Station: WH01, Mile Point: 1
Description: at Fruit Street, Hopkinton

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
7/10/2001	SU-0020	03:06	0.5	19.9	6.1	306	196	2.4u	26u
7/31/2001	82-0100	03:41	0.1i	17.7u	6.2	203	130	3.9	40
9/11/2001	82-0123	03:15	0.1i	20.0	6.3	220	141	2.3u	25u

Table A7. 2001 MA DEP Sudbury River Watershed Instream Physico/Chemical and Bacteria Data.
Alkalinity, Hardness, Total Suspended Solids (TSS), Turbidity, Ammonia Nitrogen, Nitrate-Nitrite Nitrogen, Total Phosphorus, E. coli, Fecal coliform (Data qualifiers listed in Appendix A2)

Sudbury (2001) (QC Status: 4) Exported: 5/27/2004 2:46:09 PM

Unnamed Tributary ("Cochituate Brook")
Unique_ID: W0841 Station: CB01, Mile Point: 1.3
Description: unnamed tributary to Sudbury River, outlet Lake Cochituate, Framingham

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0024	--	04:40	--			0.90	23	50	<0.02	0.16	0.014	1.8
7/18/2001	82-0051	--	06:35	--	22e	27e							
7/30/2001	82-0081	--	06:15	--	30	10							
7/31/2001	82-0104	--	05:25	--			1.6	28	56	<0.02	<0.06	0.015	1.9
9/11/2001	82-0131	--	05:55	--	##h	##h	1.2	31	49	<0.02	<0.06	0.015	1.8

Unnamed Tributary ("Cochituate Brook")
Unique_ID: W0842 Station: CB02, Mile Point: 0.2
Description: unnamed tributary to Sudbury River, at School Street/Route 126, Framingham

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0026	SU-0025	**	--			1.3	27	56	<0.02	0.17	0.023	3.0
7/10/2001	SU-0025	SU-0026	05:10	--			1.3	26	55	<0.02	0.18	0.023	2.9
7/18/2001	82-0053	82-0052	**	--	180d	140							
7/18/2001	82-0052	82-0053	06:40	--	95d	85							
7/30/2001	82-0083	82-0082	**	--	150	55							
7/30/2001	82-0082	82-0083	06:25	--	230	85							
7/31/2001	82-0106	82-0105	**	--			1.4	55	109	<0.02	0.52	0.025	1.0
7/31/2001	82-0105	82-0106	05:50	--			1.4	41	108	<0.02	0.52	0.025	1.3
9/11/2001	82-0132	82-0133	**	--	##h	##dh	1.9	55	104	<0.02	0.46	0.032	1.5
9/11/2001	82-0133	82-0132	**	--	##h	##dh	2.1	54	104	<0.02	0.45	0.032	1.5

MILL BROOK (Saris: 8246750)
Unique_ID: W0845 Station: MB01, Mile Point: 0.4
Description: at Lowell Road, Concord

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0032	--	05:32	--	300	50							
7/30/2001	82-0062	--	05:30	--	70	30							
9/11/2001	82-0112	--	03:48	--	##h	##h							

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0843 Station: AS01, Mile Point: 2.4
Description: at Route 2/2A bridge, Concord

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0010	--	03:30	--			2.9	22	52	<0.02	0.81	0.16	4.2
7/18/2001	82-0030	--	**	--	400	130							
7/30/2001	82-0060	--	05:00	--	250	120							
7/31/2001	82-0090	--	03:31	--			1.3	33	70	<0.02	0.77	0.099	2.3
9/11/2001	82-0110	--	03:08	--	##h	##h	0.08	53	78	<0.02	1.5	0.074	1.5

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0832 Station: SU01, Mile Point: 31.2
Description: at Fruit Street, Hopkinton/Westborough

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0019	--	02:45	--			3.3	20	50	<0.02	0.07	0.076	3.6
7/18/2001	82-0042	--	04:40	--	75	**							
7/30/2001	82-0072	--	04:45	--	380	240							
7/31/2001	82-0099	--	03:15	--			4.0	14	47	<0.02	0.14	0.061	3.2
9/11/2001	82-0122	--	02:50	--	##h	##h	3.5	21	59	<0.02	0.19	0.033	2.2

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0834 Station: SU02, Mile Point: 30
Description: at Cedar Street, Hopkinton/Southborough (locality of Southville)

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0021	--	03:27	--			4.5	19	51	<0.02	0.12	0.082	3.9
7/18/2001	82-0044	--	05:00	--	35	35							
7/30/2001	82-0074	--	05:00	--	390	270							
7/31/2001	82-0101	--	03:55	--			4.4	12	41	<0.02	0.16	0.065	1.7
9/11/2001	82-0124	--	03:35	--	##h	##h	3.9	19	59	<0.02	0.24	0.047	1.5

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0835 Station: SU03, Mile Point: 29.3
Description: at Route 85 (Cordaville Street/River Street) Hopkinton/Southborough (locality of Cordaville)

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0022	--	03:45	--			3.8	20	51	<0.02	0.21	0.068	1.9
7/18/2001	82-0045	--	05:07	--	55	15							
7/30/2001	82-0075	--	05:12	--	150	110							
7/31/2001	82-0102	--	04:15	--			5.0	17	50	<0.02	0.22	0.073	1.9
9/11/2001	82-0125	--	03:50	--	##h	##h	2.0	22	56	<0.02	0.30	0.034	<1.0

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0838 Station: SU04A, Mile Point: 25.1
Description: at the Route 135 crossing upstream of Cold Spring Brook confluence, Ashland

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0048	--	05:45	--	520	130							
7/30/2001	82-0078	--	05:40	--	660	170							
9/11/2001	82-0128	--	**	--	##h	##h							

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0840 Station: SU04, Mile Point: 21.9
Description: at Winter Street, Framingham

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0023	--	04:15	--			1.5	17	46	<0.02	0.17	0.036	<1.0
7/18/2001	82-0050	--	06:10	--	**	20							
7/30/2001	82-0080	--	06:03	--	100	12							
7/31/2001	82-0103	--	04:50	--			1.9	20	48	<0.02	0.06	0.032	2.4
9/11/2001	82-0130	--	**	--	##h	##h	1.9	21	43	<0.02	<0.06	0.029	2.2

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0696 Station: SU07, Mile Point: 16.5
Description: just upstream/south of Danforth Street, Framingham

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0018	--	05:30	--			2.5	19	50	<0.02	0.23	0.042	1.7
7/18/2001	82-0041	--	06:55	--	140	30							
7/30/2001	82-0071	--	06:35	--	40	17							
7/31/2001	82-0098	--	06:15	--			1.2	32	69	<0.02	0.17	0.022	1.6
9/11/2001	82-0121	--	06:40	--	##h	##h	0.75	35	70	<0.02	0.23	0.015	<1.0

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0850 Station: SU09, Mile Point: 12.1
Description: at Pelham Island Road, Wayland

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0017	--	06:30	--			4.6	24	55	<0.02	0.23	0.064	6.7
7/18/2001	82-0039	--	07:10	--	130	60							
7/30/2001	82-0069	--	06:55	--	52	15							
7/31/2001	82-0097	--	05:56	--			5.3	36	82	<0.02	0.20	0.060	9.6
9/11/2001	82-0119	--	05:55	--	##h	##h	##r	##r	##r	##r	##r	##r	##r

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0848 Station: SU11, Mile Point: 10.5
Description: at Route 27, Wayland

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0013	--	05:55	--			##m	##m	##m	<0.02	0.21	0.089	##m
7/18/2001	82-0035	--	06:40	--	95	54							
7/30/2001	82-0065	--	06:20	--	75	5							
7/31/2001	82-0093	--	05:04	--			3.9	36	77	<0.02	0.38	0.080	8.2
9/11/2001	82-0115	--	04:55	--	##h	##h	1.7	52	82	<0.02	0.31	0.034	11

SUDBURY RIVER (Saris: 8247650) ***{not sampled on 7/10; see SU13 for explanation – BFF}***
Unique_ID: W0847 Station: SU12, Mile Point: 7.5
Description: at Shermans Bridge Road/Lincoln Road, Wayland/Sudbury

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0034	--	06:15	--	55	10							
7/30/2001	82-0064	--	06:00	--	85	40							
7/31/2001	82-0092	--	04:37	--			4.6	35	75	<0.02	0.22	0.083	8.6
9/11/2001	82-0114	--	04:33	--	##h	##h	2.0	45	80	<0.02	0.12	0.020	6.1

SUDBURY RIVER (Saris: 8247650) ***{Sampled only once on 7/10; deemed too dangerous; substituted SU12 for ensuing surveys – BFF}***
Unique_ID: W0855 Station: SU13, Mile Point: 5
Description: Route 117, Concord/Lincoln

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0012	--	05:15	--			3.1	27	55	<0.02	0.15	0.091	6.1

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0844 Station: SU15, Mile Point: 0.5
Description: at Nashawtuc Road, Concord

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0011	--	04:00	--			2.6	24	53	0.08	0.13	0.084	6.0
7/18/2001	82-0031	--	05:15	--	60	30							
7/30/2001	82-0061	--	05:15	--	75	30							
7/31/2001	82-0091	--	03:58	--			4.0	33	66	<0.02	<0.06	0.080	9.8
9/11/2001	82-0111	--	03:34	--	##h	##h	2.8r	49r	65r	<0.02r	<0.06r	0.055r	8.0r

PANTRY BROOK (Saris: 8247700)
Unique_ID: W0846 Station: PB01, Mile Point: 1.8
Description: at Concord Road, Sudbury

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0033	--	05:55	--	580	140							
7/30/2001	82-0063	--	05:50	--	1600	710							
9/11/2001	82-0113	--	04:12	--	##h	##h							

WASH BROOK (Saris: 8247800)
Unique_ID: W0849 Station: WB01, Mile Point: 2.4
Description: at Landham Road, Sudbury

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0015	SU-0014	**	--			2.5	44	66	<0.02	0.63	0.16	2.9
7/10/2001	SU-0014	SU-0015	06:45	--			2.5	40	67	<0.02	0.62	0.16	3.6
7/18/2001	82-0037	82-0036	**	--	210	5							
7/18/2001	82-0036	82-0037	06:55	--	140	<5							
7/30/2001	82-0067	82-0066	**	--	230	85							
7/30/2001	82-0066	82-0067	06:35	--	220	70							
7/31/2001	82-0095	82-0094	**	--			1.6	54	77	<0.02	0.54	0.14	2.9
7/31/2001	82-0094	82-0095	05:29	--			1.6	65	78	<0.02	0.56	0.13	2.8
9/11/2001	82-0117	82-0116	**	--	##h	##h	0.80	68	78	<0.02	2.1	0.14	2.0
9/11/2001	82-0116	82-0117	05:20	--	##h	##h	0.80	68	79	<0.02	2.3	0.13	2.0

PINE BROOK (Saris: 8247950)
Unique_ID: W0851 Station: PI01, Mile Point: 1.7
Description: at Pine Brook Road, Wayland

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0055	--	07:23	--	140	25							
7/18/2001	82-0040	--	07:40	--	190	160							
7/30/2001	82-0070	--	07:05	--	5	<5							
9/11/2001	82-0120	--	06:19	--	##h	##h							

EAMES BROOK (Saris: 8248125)
Unique_ID: W0839 Station: EP01, Mile Point: 0.1
Description: downstream/northwest of footpath at end of Sherwin Terrace, Framingham

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0049	--	06:00	--	140	<5							
7/30/2001	82-0079	--	05:53	--	240	15							
9/11/2001	82-0129	--	**	--	##h	##h							

COLD SPRING BROOK (Saris: 8248375)
Unique_ID: W0837 Station: CS01, Mile Point: 0.03
Description: at Chestnut Street, Ashland

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0047	--	05:38	--	130	<5							
7/30/2001	82-0077	--	05:35	--	120	55							
9/11/2001	82-0127	--	04:20	--	##h	##h							

INDIAN BROOK (Saris: 8248400)
Unique_ID: W0853 Station: IB01, Mile Point: 1
Description: at Cross Street, Ashland

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/18/2001	82-0046	--	05:20	--	75	70							

INDIAN BROOK (Saris: 8248400)
Unique_ID: W0836 Station: IB01A, Mile Point: 0.4
Description: Indian Brook Road culvert, Ashland (housing development not shown on 1987 USGS Framingham quad-see street atlas)

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/30/2001	82-0076	--	05:23	--	30	25							
9/11/2001	82-0126	--	04:10	--	##h	##h							

WHITEHALL BROOK (Saris: 8248425)
Unique_ID: W0833 Station: WH01, Mile Point: 1
Description: at Fruit Street, Hopkinton

Date	OWMID	QAQC	Time	Depth	FECAL	ECOLI1	TURB	ALK	HARD	NH3-N	NO3-NO2-N	TP	SSOLIDS
			(24hr)	(m)	CFU/100ml	CFU/100ml	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
7/10/2001	SU-0020	--	03:03	--			5.3	20	38	<0.02	<0.06	0.11	6.7
7/18/2001	82-0043	--	04:50	--	150	120							
7/30/2001	82-0073	--	**	--	130	80							
7/31/2001	82-0100	--	03:35	--			1.9	12	32	<0.02	0.30	0.050	2.7
9/11/2001	82-0123	--	03:10	--	##h	##h	2.0	21	36	<0.02	0.13	0.045	3.1

REFERENCES

ENSR, 2001. SuAsCo Watershed Assabet River TMDL Study Phase One, Final Report. December, 2001. (Available on CD from MA DEP / DWM)

Marler, L., October 2004. Personal Communication. MA Department of Conservation and Recreation. Boston MA.

MA DEP. 1996. Unpublished. SuAsCo Assessment Report. Division of Watershed Management, Massachusetts Department of Environmental Protection, Worcester, MA.

MA DEP. 2001. Laboratory Quality Assurance Plan and Standard Operating Procedures. Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Senator William X. Wall Experiment Station. Lawrence, MA.

MA DEP. 2001a. CN 1.1 Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure. May 25, 2001. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2001b. CN 4.1 - Hydrolab Series 3 and 4 Multiprobes SOP (2001-02) May 15, 2001. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

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

MA DEP. 2001d. CN 62.0 - DWM QAPP for 2001 Monitoring in the West-Farm, Concord, Taunton and So. Coastal Basins. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2003. CN 149.0 2001 Data Validation Report . Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

NOAA, http://www.erh.noaa.gov/, for Worcester and Natick precipitation data.

OAR. 2001. Organization for the Assabet River http://www.assabetriver.org/wq/ - reports

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

USEPA, DFLOW 3, Technical Guidance Manual for Performing Wasteload Allocations, Book VI - Design Conditions, Chapter 1 - Stream Design Flow for Steady-State Modeling, PB92-231178, http://epa.gov/waterscience/dflow/index.htm

APPENDIX A1

Quality Assurance/Quality Control Data Validation for the Sudbury Watershed 2001 Water Quality Survey

Selected Excerpts from:
Data Validation Report for Year 2001 Project Data (CN 149.0)

December, 2004

Department of Environmental Protection
Division of Watershed Management

5.0 2001 Discrete Water Sample Data

5.1 QA/QC Objectives and Criteria for 2001 Discrete Water Sample Data

The collection and analysis of discrete water samples in 2001 followed the DWM Standard Operating Procedure for Grab Sampling (CN# 1.1) and analyte-specific WES SOPs.

The grab sampling protocol outlines the use of new-for-2001 "**basket samplers**" in lieu of buckets (used by DWM in 2000) to collect samples from drop locations.
Also, the taking of field replicates for quality control purposes differed from that performed in 2000. In 2000, large-volume samples were split into two samples to measure precision or repeatability. In 2001, most replicate samples were taken as **separate, co-located (side-by-side), simultaneous field duplicates** to estimate overall precision (including variation due to sampling technique).
Using the following criteria, as well as other considerations and input from data reviewers, individual datum were either:

1) Accepted
2) Accepted with qualification, or
3) Censored

In cases where poor quality control (e.g., blank/cross contamination, lab accuracy) affected batched analyses or entire surveys, censoring/qualification decisions were applied to groups of samples (e.g., 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 minor exceedances (e.g., < than 20% 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 replicates were collected, the data are typically qualified with "f". If blanks were omitted and duplicates taken, typically no data are qualified, as long as there are no documented historical problems for the survey-specific samplers or station locations with regard to field contamination. If blanks were taken but duplicates were not, the data may be qualified with "f". Typically, no censoring of data takes place for insufficient QC sample frequencies only.

- 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 directly or via a sampling device (equipment blank) using the same methods as for its corresponding field sample (e.g., blank samples were preserved in the same way). All blanks were submitted to the WES laboratory "blind". If the field blank results were greater than the MDL (indicating potential sampling error, airborne contaminants, dirty equipment, etc.), the data may be censored or qualified, depending on extent and other factors.

- Field Replicates: In 2001, field duplicate samples for rivers were taken as co-located, simultaneous duplicates. As a result, these duplicate results include any spatial, natural variability present between side-by-side samples (which should be minimal in most cases where site selection has accounted for uniform mixing). Duplicate lake samples were sequential and therefore also include any temporal variability.

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 2001 QAPP document. If the criteria are not met, the sample/duplicate data may be censored or qualified, depending on extent of exceedance and other factors. Arguably, very poor precision of field duplicate samples reflects poor reproducibility for entire surveys and/or analytical batch runs, and should result in censoring or qualification of the entire survey/batch data.

- Results of Field and/or Lab Audits and Miscellaneous Survey Information: If, based on the results of field evaluation of implementation of field sampling SOPs, samples are deemed to have been taken incorrectly or to not represent station conditions at the time of sampling, then individual or survey-based sample results may be qualified or censored. Likewise, the results of QC audits of lab(s) analytical accuracy (and precision) for specific parameters are evaluated. If results indicate poor accuracy or repeatability, batch run data may be qualified or censored. In addition, information from survey personnel regarding sample integrity and representativeness may lead to decisions to qualify or censor data.

- 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 using appropriate qualifiers:

- 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%. For bacteria, duplicate data are evaluated based the range of logged values.

- 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 Field and Lab Audit Results

Field Audits – ***(No water quality field audits were performed during the 2001 Sudbury surveys. – BFF)*** In 2001, nine field audits (total) were performed by DWM's QC Analyst. Six of these were for water sample collection and multi-probe use. Specifically, these six audits were useful in:

- Reminding survey staff of the potential of using two separate multi-probe units when one crew is sampling fresh and salt waters (to ensure proper calibration ranges for conductivity measurements).
- Stressing the importance of survey timing to enable ebb tide sampling in tidal areas
- Noting inattention to required field safety precautions
- Noting inattention to proper care of multi-probe units
- Stressing the importance of filling out fieldsheets completely, and
- Stressing the need to depth-calibrate the multi-probe initially at the first station

Any field audit results affecting sample data are reflected in the tables below. (Copies of completed audit forms are available from DWM's QC Analyst.)

Lab Audits – To provide external evaluation of lab performance with regard to analyses for fecal coliform bacteria and nutrients (TP, TKN, PO4, NO3 and NH3) quality control samples were provided to WES.

The external audit of WES for fecal coliform bacteria analysis planned for 2001 was intended to employ semi-quantitative samples provided by Microcheck, Inc.. DWM placed the order two weeks prior but missed the cutoff for the PT Study. The audit was rescheduled for Spring, 2002. The results of the April, 2002 audit were satisfactory.

The nutrients QC samples (via Accustandard, Inc.) were diluted at DWM and sent double-blind to WES along with some equipment blank samples (see 5.3 below). Due to mis-communication between Accustandard and DWM, the dilution resulted in sample concentrations above the preferred range, making them less useful in assessing low-level accuracy. As a result, DWM instructed WES to run only the NO3-NO2-N and NH3-N QC samples. These results showed good precision between same concentration replicate samples (albeit at high concentrations) and ND for lab blank samples. Quality control audit samples for TP that were provided to WES in 2000 and 2002 showed satisfactory results.

5.4 Miscellaneous Information

The following are particularly noteworthy regarding 2001 DWM/CERO surveys and WES analyses. The validation decisions contained in the tables below reflect these considerations.

1) **9/11/01 Sudbury River survey, Concord Watershed**: Survey coordinator noted that many water samples had excessive sediment buildup upon delivery to the lab that was inexplicable (sediment transport was not evident during survey). Based on these observations, specific instructions on sample processing (decanting) were given to the lab (see 9/18/01 e-mail from B. Friedmann). The cause of the undue sediment in samples is thought to have been sampling error (presumed to be poor sampling technique for both basket use and wade in samples. Despite the cause(s) and efforts to process these samples accordingly, those samples with medium to high sediment may not have been representative of field conditions and therefore have been censored or qualified. Samples with only slight sediment have been presumed to be representative.

3) **MDL/RDL with regard to "ND" Results**: In 2001, WES began to use Reporting Detection Limits or RDLs in addition to MDLs in their data reports. These reports defined (in a standard footnote) results less than the RDL as not detected or "ND". Based on a clarifying email from Oscar Pancorbo dated 8/1/2003, "ND" actually referred to <MDL for most WES results prior to May, 2002. The exception to this is NO3-N, where "ND" results referred to <RDL.

7) **Turbidity Results**: Poor comparison between paired sample data for field vs. laboratory turbidity resulted in the censoring of all Year 2001 field turbidity results measured using the Hydrolab®

multi-probe. Follow-up QC testing is planned to resolve accuracy/precision issues related to turbidity.

5.5 2001 Censored/Qualified Discrete Water Sample Data

All Year 2001 data **(Concord excerpts only – BFF)** for discrete water samples that have been censored or qualified are listed below by watershed, except for missing data. Additional sample information is also provided as needed for accepted data in need of further elaboration/ discussion. For qualifier definitions see Appendix A2.

Concord Watershed

Projname	Analyte	DATE	OWMID	LabSNum	rResVal	DWMQual	Units
Concord (2001)	Fecal Coliforms	7/18/2001	82-0051	2001275-10	22	**e**	CFU/100mL
Concord (2001)	Fecal Coliforms	7/18/2001	82-0052	2001275-11	95	**d**	CFU/100mL
Concord (2001)	Fecal Coliforms	7/18/2001	82-0053	2001275-12	180	**d**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0110	2001454-15	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0111	2001454-16	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0112	2001454-17	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0113	2001454-18	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0114	2001454-19	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0115	2001454-20	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0116	2001454-21	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0117	2001454-22	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0118	2001454-23	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0119	2001454-24	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0120	2001454-25	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0121	2001454-14	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0122	2001454-01	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0123	2001454-02	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0124	2001454-03	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0125	2001454-04	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0126	2001454-05	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0127	2001454-06	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0128	2001454-07	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0129	2001454-	##	**h**	CFU/100mL

Projname	Analyte	DATE	OWMID	LabSNum	rResVal	DWMQual	Units
				08			
Concord (2001)	Fecal Coliforms	9/11/2001	82-0130	2001454-09	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0131	2001454-10	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0132	2001454-11	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0133	2001454-12	##	**h**	CFU/100mL
Concord (2001)	Fecal Coliforms	9/11/2001	82-0134	2001454-13	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	7/18/2001	82-0051	2001275-10	27	**e**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0110	2001454-15	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0111	2001454-16	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0112	2001454-17	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0113	2001454-18	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0114	2001454-19	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0115	2001454-20	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0116	2001454-21	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0117	2001454-22	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0118	2001454-23	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0119	2001454-24	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0120	2001454-25	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0121	2001454-14	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0122	2001454-01	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0123	2001454-02	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0124	2001454-03	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0125	2001454-04	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0126	2001454-05	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0127	2001454-06	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0128	2001454-07	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0129	2001454-08	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0130	2001454-09	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0131	2001454-10	##	**h**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0132	2001454-11	##	**dh**	CFU/100mL
Concord (2001)	E. coli - MTEC	9/11/2001	82-0133	2001454-	##	**dh**	CFU/100mL

Projname	Analyte	DATE	OWMID	LabSNum	rResVal	DWMQual	Units
				12			
Concord (2001)	E. coli - MTEC	9/11/2001	82-0134	2001454-13	##	**h**	CFU/100mL
Concord (2001)	Turbidity	7/10/2001	SU-0013	2001251-22	##	**m**	NTU
Concord (2001)	Turbidity	9/11/2001	82-0111	2001455-46	2.8	**r**	NTU
Concord (2001)	Turbidity	9/11/2001	82-0119	2001455-52	##	**r**	NTU
Concord (2001)	Alkalinity	7/10/2001	SU-0013	2001251-22	##	**m**	mg/l
Concord (2001)	Alkalinity	9/11/2001	82-0111	2001455-46	49	**r**	mg/l
Concord (2001)	Alkalinity	9/11/2001	82-0119	2001455-52	##	**r**	mg/l
Concord (2001)	Hardness	7/10/2001	SU-0013	2001251-22	##	**m**	mg/l
Concord (2001)	Hardness	9/11/2001	82-0111	2001455-46	65	**r**	mg/l
Concord (2001)	Hardness	9/11/2001	82-0119	2001455-52	##	**r**	mg/l
Concord (2001)	Ammonia-N	7/10/2001	SU-0027	2001251-52	0.06	**b**	mg/l
Concord (2001)	Ammonia-N	9/11/2001	82-0111	2001455-28	<0.02	**r**	mg/l
Concord (2001)	Ammonia-N	9/11/2001	82-0119	2001455-34	##	**r**	mg/l
Concord (2001)	Nitrate/Nitrite-N	9/11/2001	82-0111	2001455-28	<0.06	**r**	mg/l
Concord (2001)	Nitrate/Nitrite-N	9/11/2001	82-0119	2001455-34	##	**r**	mg/l
Concord (2001)	Total Phosphorus	9/11/2001	82-0111	2001455-28	0.055	**r**	mg/l
Concord (2001)	Total Phosphorus	9/11/2001	82-0119	2001455-34	##	**r**	mg/l
Concord (2001)	Suspended solids	7/10/2001	SU-0013	2001251-04	##	**m**	mg/l
Concord (2001)	Suspended solids	9/11/2001	82-0111	2001455-10	8.0	**r**	mg/l
Concord (2001)	Suspended solids	9/11/2001	82-0119	2001455-16	##	**r**	mg/l

APPENDIX A2

Selected Excerpts from:
Data Validation Report for Year 2001 Project Data (CN 149.0)

December, 2004

Department of Environmental Protection
Division of Watershed Management

2001 Data Symbols and Qualifiers

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 data (i.e., data that has been discarded for some reason).
NOTE: Prior to 2001 data, "**" denoted either censored or missing data.

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

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

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

Multiprobe-Specific Qualifiers:

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

Qualification Criteria for Depth (i):

General Depth Criteria: Apply to each OWMID#

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

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

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

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

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

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

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

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

Sample-specific Qualifiers:

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

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

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

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

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

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

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

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

matrix complications, lost/unanalyzed samples, missing data or deviations from field sampling SOPs.

“ **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 A3

Email Re: 9/11/2001 Sample Processing

For Internal Review Only
Friedmann, Brian (DEP)
To: Brian Friedmann(E-mail); Richard Chase(E-mail)
Subject: Sudbury Sampling Processing for 9/11/01 Survey

Richard, after speaking with you and Jim Sullivan at WES, I decided to have the lab do the following with regard to the sediment—contaminated samples from the 9/11/01 water quality survey:

1. Nutrients (low tot P, NH3, N03+N02) and general chem (hard, tot alk, turb) were all to be decanted.

2. Total suspended solids (TSS) were shaken.

3. Bacteria samples were analyzed the following day which violates holding time.

Based on the list of the sample bottles that I visually inspected at WES, I can make a qualifying assessment of the reported data. I will also use prior data from the other two surveys to assess the data from the 9/11 survey.

Field conditions for flow and velocity during the survey were such that no scouring or other significant sediment transport should have been occuring except for minor detritus and algae.

Since the nutrient bottles were acidified in the field, the potential is for them to have higher reported values in the bottles that contained sediment. For those bottles that I have confidence in that did not have sediment, I would expect that decanting would give a number close to or no higher than the value if the bottle were shaken. For those with reported sediment, the reported values will most likely be higher than they should; at best, we will have an upper limit value for the nutrients.

For TSS, which will be determined after shaking, high confidence samples should be OK; sediment—contaminated samples will be “upper limit”.

For Tot Alk, Hard, and Turb, which will be decanted, high confidence samples should be close to the “real” value and represent a lower limit. For the sediment—contaminated samples, values will represent an upper limit.

Here is the transcription of the notes I took when we delivered samples to WES:

Station	OWMID	Sediment Visible
SU15	82—0111	medium amount (approx. 1mm)
SU12	82—0114	slight amount (approx <0.5mm)
SU11	82—0115	slight amount
WB01	82—0116	slight amount (0116 and 0117 are the duplicates)
WB01	82—0117	slight amount
SU09	82—0119	high amount (approx. 2mm)
SU02	82—0124	trace amount (probably naturally occurring as was wade—in)
SU03	82—0125	trace amount (probably naturally occurring)
SU04	82—0130	trace amount (probably naturally occurring)

Brian Friedmann
DWM
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APPENDIX B - MA DEP OWM/DWM FISH TOXICS MONITORING IN THE CONCORD RIVER WATERSHED 1995, 1996, 1997, 2000, AND 2001

INTRODUCTION

Fish toxics monitoring is a cooperative effort between three Massachusetts Department of Environmental Protection Offices/Divisions- Watershed Management, Research and Standards (ORS), and Environmental Analysis (Wall Experiment Station- WES), the Massachusetts Department of and Game, Division of Fisheries and Wildlife (MDFW), and the Massachusetts Department of Public Health (MDPH).

Between July 1995 and August 2001 the MA DEP Office of Watershed Management (OWM) /Division of Watershed Management (DWM) collected fish at eight sites in the Concord River Watershed as follows (See Figure 1).

Waterbody	Location	Date(s) Sampled
Lake Cochituate	Natick/Wayland	July 28, 1995
Lake Boon	Stow/Hudson	July 11, 1996
Whitehall Reservoir	Hopkinton	July 26, 1996
Warners Pond	Concord	September 16, 1997
Assabet River (3 stations)	Concord, Maynard, Hudson	September 17,18, 1997
Nutting Lake	Billerica	August 18, 2000
Hocomonco Pond	Westborough	August 21, 2001
Sudbury Reservoir	Marlborough/Southborough	August 14, 2001

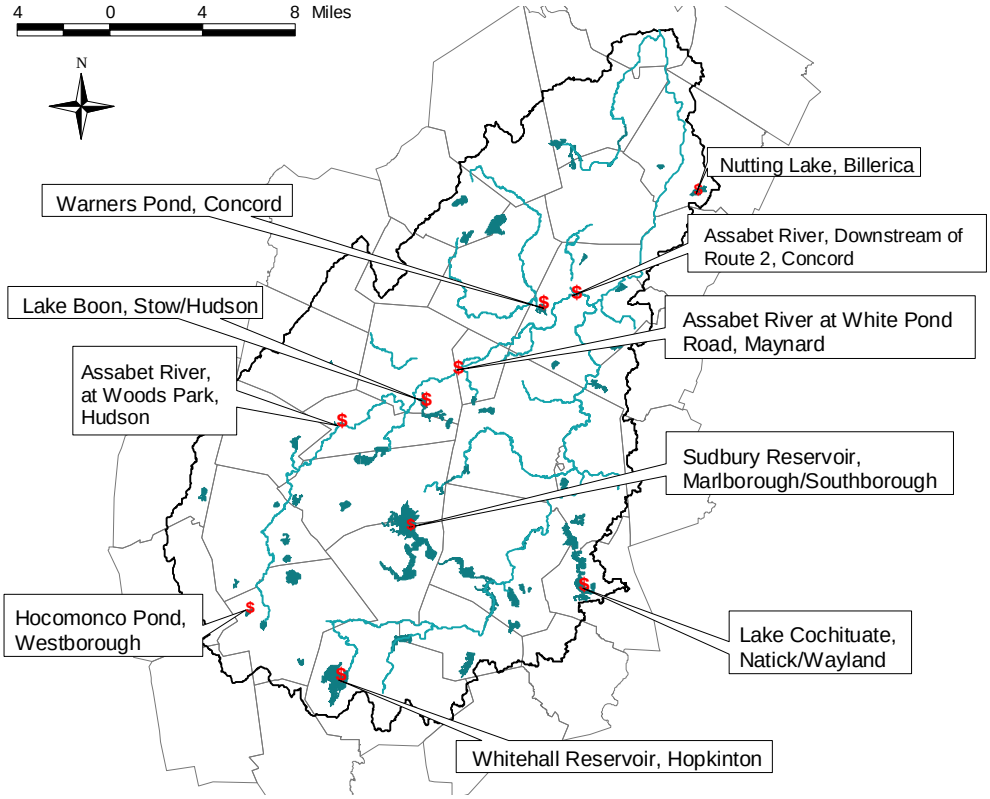

Figure B1. Fish Toxics Monitoring Locations in the Concord River Watershed, 1995-2001

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. Human health concerns have received highest priority and, therefore, fish tissue analysis has been restricted to edible fillets. As such, fish toxics monitoring was designed to screen the edible fillets of several species of fishes representing different feeding groups (i.e., bottom dwelling omnivores, top-level predators, and water column feeders) for the presence of heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides. Beginning in 1999 MA DEP DWM Fish Toxics Monitoring was conducted in accordance with Fish Toxics Quality Assurance Project Plans (QAPPs). Data Quality Objectives are presented in the QAPPs. There were no deviations from the QAPPs.

METHODS

Field Methods

Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody and collecting most fish shocked. Fish collected by electrofishing were stored in a live well filled with site water until the completion of sampling. Trotlines were baited with nightcrawlers or shiners, set overnight, and retrieved the following day. Fish to be retained for analysis were put on ice and returned to the DWM laboratory in Grafton (1995 and 1996) or Worcester (1997, 2000, and 2001). All other fish were returned to the water unharmed when possible. Specific information regarding collection techniques is presented below.

Waterbody	Date(s)	Technique(s)
Lake Cochituate	7/28/95	boat-mounted electrofisher
Lake Boon	7/11/96	boat-mounted electrofisher
Whitehall Reservoir	7/25/96	boat-mounted electrofisher
	8/15/96	trotlines
Warners Pond	9/16/97	boat-mounted electrofisher
Assabet River (3 sites)	9/17/97	boat-mounted electrofisher
	9/18/97	boat-mounted electrofisher
Nutting Lake	8/18/00	boat-mounted electrofisher
	8/19/00	trotlines
Sudbury Reservoir	8/14/01	MDFW's boat mounted electrofisher
Hocomonco Pond	8/21/01	MDFW's boat mounted electrofisher

Lab Methods

Iced fish, which were brought to the MA DEP DWM laboratory in Grafton or Worcester, were processed using protocols designed to assure accuracy and prevent cross-contamination of samples. Specimen lengths and weights were recorded along with any notes on tumors, lesions, or other anomalies noticed during an external visual inspection. Scales, spines, or pectoral fin ray samples were obtained and archived for use in age determination. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR 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 (or 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 and organics analysis included the following.

During 1995, 1996, and 1997 analytical methods included 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. Additional information on analytical techniques used at WES is available from the laboratory.

In 2000 and 2001 mercury was analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead 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.” Additional information on analytical techniques used at WES is available from the laboratory.

RESULTS AND DISCUSSION

According to standard practice, all laboratory analytical results were forwarded to the Massachusetts Department of Public Health. Data for all surveys are presented in Tables 3-1 through 3-4. All raw data files, field sheets, lab reports, chain of custody forms, and other metadata are maintained in open files and databases at the MA DEP DWM in Worcester. Quality Assurance Data are available in *Data Validation Report for Year 2000 Project Data (CN 083.0) DRAFT December 19, 2002*.

1995 Lake Cochituate, Natick/Wayland

Lake Cochituate (sampled by public request) is a large (594 acre) mesotrophic waterbody located in the Sudbury River Watershed. There are three distinct basins separated by two major highways. The watershed is highly developed both commercially and residentially and includes a number of major industrial areas. The lake receives direct stormwater runoff from a number of large storm drains. There is historic evidence (MDFW) of a tar/oil dump on Beaverdam Brook, a tributary to Lake Cochituate's South Basin. MDFW files note numerous problems dating back to the early 1950s. These problems include low dissolved oxygen, algal blooms, and fish kills. The requestor noted seeing dead fish on numerous occasions in the southern basin near the United States Army's Natick Laboratory. The United States Army's Natick Laboratory site was listed on the National Priority List (NPL) in May of 1994 due to groundwater contamination. Contaminants of concern include a number of volatile organic compounds, mercury, and polyaromatic hydrocarbons. Cleanup of the site will be funded by the Department of Defense. The United States Environmental Protection Agency (USEPA) is the lead regulatory agency with the MA DEP BWSC supporting. The requestor also notes a large number of people "subsistence fishing" on the lake. The MDFW stocks the lake with trout (Salmonidae), northern pike (*Esox lucius*), and tiger musky (*Esox lucius* x *masquinongy)* and rates fishing pressure as high (>40 fishing trips/acre/year).

Electrofishing at Lake Cochituate resulted in the collection of three largemouth bass (*Micropterus salmoides*), three black crappie (*Pomoxis nigromaculatus)*, three yellow perch *(Perca flavescens)*, three American eel *(Anguilla rostrata)*, one pumpkinseed *(Lepomis gibbosus)*, two bluegill *(Lepomis macrochirus)*, and one yellow bullhead (*Ameiurus natalis)*. Three-fillet composites of largemouth bass, black crappie, American eel, yellow perch, and sunfish (pumpkinseed and bluegill) were analyzed at the Wall Experiment Station for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB Arochlors and congeners, and pesticides. An individual sample of yellow bullhead was also submitted to WES.

Arsenic, cadmium, and lead were below method detection limits in all samples analyzed. Mercury concentrations ranged from 0.049 mg/kg in a composite of American eel (LCF95-10-12) to 0.411 mg/kg in a composite of largemouth bass (LCF95-1-3). Selenium concentrations ranged from 0.100 mg/kg in the individual yellow bullhead (LCF95-16) to 0.187 mg/kg in the aforementioned composite of largemouth bass. Organic scan analysis resulted in the detection of PCB Arochlor 1254 in four of the six samples analyzed. Concentrations ranged from none detected in composites of black crappie (LCF95-4-6) and yellow perch (LCF95-7-9) to 3.2 mg/kg in a composite of American eel (LCF95-10-12). Composite samples of largemouth bass (LCF95-1-3), and sunfish (LCF95-13-15) as well as the individual yellow bullhead (LCF95-16) also had detectable concentrations of PCB Arochlor 1254. Of the four samples with detectable concentrations of PCBs only the American eel sample exceeded the MDPH's informal trigger level of 1.0 mg/kg total PCBs. It should be noted that this sample had an unusually high lipid content (21% lipids). PCBs are known to be lipophilic compounds. Organochlorine pesticides were below MDLs in all samples analyzed.

Elevated PCB Arochlor 1254 in American eel resulted in the issuance of the following MDPH fish consumption advisory.

”Children younger than 12 years, pregnant women, and nursing mothers should not eat fish from Lake Cochituate”.

“The general public should not consume American eel from Lake Cochituate.”

Although mercury concentrations were below the MDPH trigger level for mercury (0.5 mg/kg), it should be noted that bass in the composite ranged from 0.59 to 0.80 kg (approximately 1.3 to 1.7 pounds) in weight. Larger bass most likely contain mercury concentrations approaching or exceeding the MDPH trigger level. Selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth and do not appear to be a concern.

1996 Lake Boon, Hudson/Stow
Lake Boon is a 175-acre mesotrophic lake located in the towns of Hudson and Stow. The watershed is predominantly forested but the immediate shoreline is heavily developed with year-round residences.

Electrofishing at Lake Boon resulted in the collection of three largemouth bass, two black crappie, three yellow perch, three white perch *Morone americana*, three bluegill, and three American eel. Fillets were composited by species and were analyzed at the Wall Experiment Station for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB arochlors , and pesticides. Additional species observed/collected but not analyzed included golden shiner *Notemigonus crysoleucas*, pumpkinseed *Lepomis macrochirus*, brown bullhead *Ameiurus nebulosus* , and chain pickerel *Esox niger*. One brown bullhead was noted as having a large melanoma.

Arsenic, cadmium, and lead were below method detection limits in all samples analyzed. Mercury concentrations ranged from 0.197 mg/kg in a composite of American eel (LBF96-15-17) to 0.827 mg/kg in a composite of black crappie (LBF96-4+5). Selenium concentrations ranged from 0.072 mg/kg in the composite of black crappie to 0.255 mg/kg in the composite of white perch (LBF96-9-11). PCB and organic scan analysis resulted in the detection of trace amounts of PCB Arochlor 1242 (0.091 mg/kg), DDD (0.064 mg/kg), DDE (0.13 mg/kg), and DDT (0.024 mg/kg) in one (American eel LBF96-15-17) of the six samples analyzed. Concentrations in all other samples were either not detected or below method detection limits (MDLs).

The composites of black crappie and largemouth bass (LBF96-1-3) contained mercury concentrations (0.827 and 0.61 mg/kg respectively) which exceeded the MDPH trigger level of 0.5 mg/kg. Elevated mercury concentrations resulted in the issuance of the following MDPH fish consumption advisories.

”Children younger than 12 years, pregnant women, and nursing mothers should not eat largemouth bass or black crappie from Lake Boon”.

“The general public should limit consumption of largemouth bass and black crappie from Lake Boon to two meals per month.”

It is unclear what may be causing the elevated mercury concentrations in Lake Boon fishes. It is assumed that atmospheric deposition of mercury is the primary source of mercury to this waterbody. Selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth and do not appear to be a concern.

With regard to the trace concentrations of organochlorine pesticides and PCBs in American eel, it should be noted that American eel are considered worst-case for organic contamination due to their bottom feeding/dwelling habits as well as their very high lipid concentrations (22%). Organochlorine pesticide and PCB concentrations were not considered to pose a public health threat.

1996 Whitehall Reservoir, Hopkinton
Whitehall Reservoir is a 575-acre eutrophic lake located in the Town of Hopkinton. Although there is very little shoreline development landuse in the watershed is a mix of forested and medium density residential. The MDFW stocks the Reservoir with trout each spring. In addition, the waterbody occasionally receives stockings of northern

pike and tiger musky. The Reservoir is managed by the Massachusetts Department of Conservation and Recreation and gets heavy fishing pressure year round.

In accordance with the Office of Watershed Management's (OWM's) Concord River Watershed Team's request, Whitehall Reservoir in Hopkinton was sampled for fish on July 25, 1996. Electrofishing resulted in the collection of a fair number of largemouth bass in the 8 to 11 inch range. Three specimens that were slightly shorter than the 12-inch minimum size limit were retained for analysis. In addition to largemouth bass, composites of black crappie, yellow perch, and bluegill were also prepared for analysis. Additional fish sampling was conducted using trotlines on August 15, 1996. Overnight trotline sets resulted in the collection of yellow bullhead and white catfish *Ameiurus catus*. Fillets were composited by species and were analyzed at the Wall Experiment Station for cadmium, lead, mercury, arsenic, selenium, percent lipids, PCB Arochlors , and organochlorine pesticides. Additional species observed/collected but not analyzed included pumpkinseed, chain pickerel and white perch .

Cadmium, and lead were below method detection limits in all samples analyzed. Mercury concentrations ranged from 0.369 mg/kg in a composite of bluegill (WRF96-10-12) to 1.06 mg/kg in a composite of yellow bullhead (WRF96-13-15). Composite samples of largemouth bass (WRF96-1-3), black crappie (WRF96-4-6), yellow bullhead, white catfish (WRF96-16-18), and bluegill contained mercury concentrations which exceeded the MDPH trigger level of 0.5 mg/kg. Selenium concentrations ranged from 0.051 mg/kg in the composite of white catfish to 0.146 mg/kg in the composite of yellow bullhead. Arsenic was detected at concentration just above the method detection limit in both yellow bullhead and white catfish samples. PCB and organic scan analysis resulted in the detection of trace amounts of DDD and DDE (0.013 and 0.023 mg/kg respectively) in white catfish. All other contaminants in all other samples were either not detected or below method detection limits (MDLs).

Elevated mercury concentrations resulted in the issuance of the following MDPH fish consumption advisories.

"Children younger than 12 years, pregnant women, and nursing mothers should not eat fish from Whitehall Reservoir".

"The general public should not consume yellow bullhead from Whitehall Reservoir."

"The general public should limit consumption of all other species from Whitehall Reservoir to two meals per month."

It is unclear what may be causing the elevated mercury concentrations in Whitehall Reservoir fishes. It is assumed that atmospheric deposition of mercury is the primary source of mercury to this waterbody. It should be noted that although largemouth bass and black crappie are regularly found to contained elevated mercury, species such as bluegill and yellow bullhead rarely bioaccumulate mercury to concentrations which exceed the MDPH trigger level. Trace amounts of organochlorine pesticides in the composite of white catfish were not considered a public health threat.

1997 Warners Pond, Concord

This 54-acre pond in the Town of Concord is located within the Assabet River watershed. Residential development is heavy along a small section of the shoreline and watershed, and part of the pond's immediate watershed is in active agricultural use. The pond is very shallow with a very high percent coverage by macrophytes. The pond receives flow from Fort Pond Brook and Nashoba Brook, which drain large portions of Acton, Boxborough, and Westford.

Boat electrofishing in Warners Pond on September 16, 1997 resulted in the collection of three largemouth bass, three black crappie, three yellow perch, three bluegill, and three yellow bullhead.

Cadmium, and lead were below method detection limits in all samples analyzed. Mercury concentrations ranged from 0.180 mg/kg in a composite of bluegill (WPF97-10-12) to 0.52 mg/kg in a composite of largemouth bass (WPF97-1-3). Selenium concentrations ranged from 0.133 mg/kg in the composite of black crappie (WPF97-4-6) to 0.139 mg/kg in the composite of bluegill. Arsenic was detected at 0.048 mg/kg in the

composite of largemouth bass and at 0.062 mg/kg in the composite of yellow perch (WPF97-7-9). PCBs and organochlorine pesticides were below detection in all samples analyzed.

Although mercury concentrations were below levels of concern in most species analyzed mercury was slightly elevated in the composite sample of largemouth bass. While the concentration (0.52 mg/kg) is consistent with data from similar waterbodies it does exceed the MDPH's trigger levelfor mercury. As a result of the elevated mercury concentrations in largemouth bass the MDPH issued a fish consumption advisory for Warners Pond, which advises that:

"Children younger than 12 years, pregnant women and nursing mothers should not eat largemouth bass from Warners Pond," and

"The general public should limit consumption of largemouth bass from Warners Pond to two meals per month."

Mercury concentrations in largemouth bass are similar to those found at other locations across the Commonwealth and the primary source is assumed to be atmospheric deposition. Selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth and do not appear to be a concern. While arsenic was detected three of the five samples, concentrations were low. While there is no United States Food and Drug Administration (USFDA) "Action Level" for arsenic, the USFDA reports legal limits (foreign countries) for arsenic in fisheries products ranging from 0.1 mg/kg (Venezuela) to 10 mg/kg (Hong Kong). Most countries listed had legal limits of 1.0 mg/kg or greater. Potential sources include bedrock geology, herbicides, and insecticides.

One of the yellow bullhead from Warners Pond was observed to have a melanoma (glossy black raised area) approximately one inch in diameter located on its side. The melanoma appeared similar to those noted in bullhead from the Sudbury River a number of years ago. Dr. Harshbarger of the Smithsonian Institute's Registry of Tumors in Lower Animals reported that the melanoma observed in bullhead from the Sudbury River most likely "have a genetic basis rather than being chemically induced" (Harshbarger 1989).

This very shallow eutrophic waterbody appears to be supporting a very diverse and abundant assemblage of warmwater fishes. Due to the already highly eutrophied condition of Warners Pond, efforts to control agricultural and other non-point sources of nutrients within the immediate watershed and the watersheds of Fort Pond and Nashoba Brooks are essential to maintaining a viable recreational fishery in Warner's Pond.

1997 Assabet River, Concord

The Assabet River segment downstream from Route 2 in Concord contains both wide, shallow reaches containing sand and gravel riffles and deeper, slow-moving pool type habitats containing snags in the form of downed trees and large boulders. Land use in the immediate watershed is a mix of forested, residential, and agricultural. There is also a medium-sized, four-lane highway (Route 2) at the upper end of this segment. Boat electroshocking on September 17 1997 resulted in the capture of three white sucker, three yellow perch, three bluegill, and three largemouth bass and one yellow bullhead.

Cadmium and lead were below method detection limits in all samples analyzed. Mercury concentrations were relatively low in most samples, but the composite of largemouth bass (Arf97-7-9) contained 0.47 mg/kg of mercury and an individual yellow bullhead (Arf97-16) was found to contain 0.64 mg/kg of mercury. Selenium concentrations ranged from 0.126 mg/kg in the individual yellow bullhead to 0.266 mg/kg in the composite of bluegill (ARF97-10-12). Trace amounts of arsenic (0.063 mg/kg and 0.073 mg/kg) were detected in the composite of yellow perch (ARF97-4-6) and the composite of bluegill (ARF97-10-12), respectively. The composite of white sucker (ARF97-1-3) and the individual yellow bullhead were found to contain detectable concentrations of PCB Arochlor 1254.Note the relatively high concentrations of lipids (2.5 and 3.8% respectively) in these samples.

Although mercury in the yellow bullhead sample exceeded the MDPH trigger level the MDPH will not issue an advisory as the result of a data point from an individual fish sample. While it is not surprising to see largemouth bass containing mercury approaching the MDPH trigger level of 0.5 mg/kg it is surprising to see bullhead in excess of this trigger level. It should be noted that the downstream end of this segment is located

fairly close to the confluence with the Assabet and Sudbury River (source of the Concord River) and that both the Sudbury and Concord Rivers have documented problems with regard to the bioaccumulation of mercury. It is possible that this particular bullhead migrated into the Assabet from a downstream area of the Concord River or from the Sudbury River.

Selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth and do not appear to be a concern.

While arsenic was detected in two of the six samples concentrations were low just above the level of detection. While there is no USFDA Action Level for arsenic the USFDA reports legal limits (foreign countries) for arsenic in fisheries products ranging from 0.1 mg/kg (Venezuela) to 10 mg/kg (Hong Kong). Most countries listed had legal limits of 1.0 mg/kg or greater. Potential sources include bedrock geology, herbicides, and insecticides.

The PCB concentrations (0.19 and 0.27 mg/kg) were well below the MDPH PCB trigger level of 1.0 mg/kg. Potential sources of PCBs to the Assabet River in Concord include a number of wastewater treatment plants (WWTPs) as well as historic industrial discharges to the river but no specific source had been identified at this time. It should be noted that PCBs had also been detected in fish from the Sudbury and Concord Rivers in 1988. Organochlorine pesticides were below detection in all samples analyzed.

1997 Assabet River, Maynard

An impoundment of the Assabet River located at White Pond Road was sampled as a result of a public request. Although a small portion of the shoreline is developed with year-round residences, a large percentage of the immediate watershed is forested. Submerged aquatic macrophytes were abundant and the waters surface was covered entirely by floating duckweed. The requester notes that the impoundment receives flow from Taylor Brook, which drains a Superfund Site located within the watershed. Boat electroshocking on September 18, 1997 resulted in the capture of three largemouth bass, three brown bullhead, three bluegill, and two black crappie.

Cadmium, and lead were below method detection limits in all samples analyzed. Mercury concentrations ranged from 0.08 mg/kg in the composites of brown bullhead (ARF97-32-34) and bluegill (ARF97-35-37) to 0.41 mg/kg of mercury in the composite of largemouth bass (Arf97-29-31). Selenium concentrations ranged from 0.079 mg/kg in the composite of brown bullhead to 0.125 mg/kg in the composite of largemouth bass. A trace amount of arsenic (0.041 mg/kg) was detected in the largemouth bass composite. PCBs and organochlorine pesticides were below detection in all samples analyzed.

Mercury concentrations were below the MDPH trigger level in all samples analyzed. Selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth and do not appear to be a concern. While arsenic was detected in one sample, the concentration was just above the level of detection. While there is no USFDA Action Level for arsenic the USFDA reports legal limits (foreign countries) for arsenic in fisheries products ranging from 0.1 mg/kg (Venezuela) to 10 mg/kg (Hong Kong). Most countries listed had legal limits of 1.0 mg/kg or greater.

Although the requestor also noted a high incidence of deformities in bullhead from this station fifteen that were examined on the day of sampling appeared normal. There have been other reports of strange looking growths and coloration on certain fishes. One of the descriptions provided closely fit a characteristic known as “spawning or nuptial tubercles,” which are normal in certain cyprinids (minnows). Other descriptions involved color variation that can also be highly variable in some fishes depending on the time of the year and the individual fish. Fisherman and others should continue to monitor the numbers and types of fish found to exhibit abnormalities. Photo documentation would be helpful in trying to determine the identity of any abnormalities.

1997 Assabet River, Hudson

An impoundment of the Assabet River located in downtown Hudson was also sampled as a result of a public request. The watershed is heavily developed with residences and the impoundment’s shoreline contains evidence of historic industrial activities, a service station, and other light industry. Boat electrofishing on

September 18, 1997 resulted in the collection of three largemouth bass, three white sucker, three bluegill, two American eel, and one brown bullhead.

Cadmium and lead were below method detection limits in all samples analyzed. Mercury concentrations ranged from 0.120 mg/kg in the individual brown bullhead (ARF97-28) to 0.47 mg/kg in the composite of largemouth bass (Arf97-17-19). Selenium concentrations ranged from 0.052 mg/kg in the individual brown bullhead to 0.130 mg/kg in the composite of American eel (Arf97-26+27). A trace amount of arsenic (0.054 mg/kg) was detected in the composite of white sucker (Arf97-20-22). PCB Arochlor 1254 was detected in two of the five samples analyzed. The composites of white sucker and American eel contained 0.17 mg/kg and 0.32 mg/kg of PCB Arochlor 1254 respectively. All other PCB Arochlors and organochlorine pesticides were below detection in all samples analyzed.

Although mercury concentrations in Assabet River (Hudson) fishes were below the MDPH trigger level in all samples analyzed the largemouth bass sample contained mercury just below the MDPH trigger level(0.5 mg/kg) and it is likely that larger bass contain mercury concentrations that exceed the "trigger level". While arsenic was detected in one sample the concentration was just above the level of detection. While there is no USFDA Action Level for arsenic the USFDA reports legal limits (foreign countries) for arsenic in fisheries products ranging from 0.1 mg/kg (Venezuela) to 10 mg/kg (Hong Kong). Most countries listed had legal limits of 1.0 mg/kg or greater. Selenium concentrations are consistent with those found in other waterbodies across the Commonwealth and do not appear to be a concern.

Although white sucker and American eel were found to contain detectable concentrations of PCB Arochlor 1254 these samples were well below the MDPH PCB trigger level of 1.0 mg/kg. Potential sources of PCBs to the Assabet River in Hudson include WWTPs as well as historic industrial discharges, but no specific source has been identified at this time.

It was noted that a small number of largemouth bass from this impoundment had what appeared to be small skin lesions. In addition, a largemouth bass is also noted as having a skin pigmentation problem (black blotches). It was unclear what might be causing these anomalies.

2000 Nutting Lake, Billerica

This 78-acre eutrophic lake is located within the Concord River watershed in the Town of Billerica. A causeway divides the pond into an eastern and a western basin. Electrofishing and trotlines set overnight in the western basin resulted in the collection of three chain pickerel, three bluegill, and three yellow bullhead. Additional species observed included largemouth bass, American eel, black crappie, pumpkinseed, golden shiner, and yellow perch.

Cadmium, lead, and arsenic were below MDLs in all samples analyzed. Mercury ranged from 0.30 mg/kg in the composite of bluegill (Nlf00-4-6) to 0.61 mg/kg in the composite of yellow bullhead (Nlf00-7-9). Selenium ranged from 0.08 in the composite of chain pickerel *Esox niger* (Nlf00-1-3) to 0.16 mg/kg in the composite of bluegill. PCBs and organochlorine pesticides were below MDLs in all three samples analyzed from Nutting Lake.

Mercury exceeded the MDPH trigger level (0.5 mg/kg) in both the composite of chain pickerel (0.57 mg/kg) and the composite of yellow bullhead (0.61 mg/kg). As a result of the elevated mercury concentrations the MDPH issued the following fish consumption advisory in February of 2001.

"Children younger than 12 years, pregnant women, and nursing mothers should not eat any fish from Nutting Lake."

"The general public should limit consumption of all fish from Nutting Lake to two meals per month."

It should be noted that while elevated mercury concentrations in predatory fishes is fairly common the presence of elevated mercury (greater than the MDPH "trigger" level) in bottom feeders such as yellow bullhead is relatively rare. It is unclear what may be causing the elevated mercury concentrations in Nutting Lake. It is assumed that atmospheric deposition of mercury is the primary source of mercury to this waterbody

Selenium concentrations are consistent with those found in other waterbodies within the Commonwealth and do not appear to be of concern.

2001 Hocomonco Pond, Westborough
This 27-acre eutrophic pond is located in the Sudbury River Watershed in the Town of Westborough. Although the immediate shoreline is undeveloped land use in the ponds watershed is a mix of industrial, commercial, and forest. There is also a remediated EPA superfund site located on the southeastern shoreline of the pond. Access to the pond was prohibited for many years during site remediation and, although the area is being considered for increased levels of recreation in the near future, the pond remains closed to fishing.

Electrofishing at Hocomonco Pond in Westborough on August 21, 2001 resulted in the collection of three largemouth bass, three yellow bullhead, three pumpkinseed, three chain pickerel, and three bluegill. Additional species observed included: chain pickerel, golden shiner (*Notemigonus crysoleucas*), brown bullhead, white sucker, redfin pickerel (*Esox americanus americanus*), American eel, and yellow perch.

Arsenic, lead, and cadmium were below method detection limits (MDLs) in all samples analyzed. Mercury ranged from 0.076 mg/kg in a composite of bluegill (Hpf01-4-6) to 0.31 mg/kg in a composite of largemouth bass (Hpf01-1-3). Selenium ranged from 0.11 in yellow bullhead (Hpf01-13-15) to 0.18 mg/kg in the composite of pumpkinseed (Hpf01-10-12). PCBs and organochlorine pesticides were below MDLs in all five samples analyzed from Hocomonco Pond.

Mercury was below the MDPH trigger level of 0.5mg/kg in all samples analyzed and selenium concentrations are consistent with those found in other waterbodies within the Commonwealth and do not appear to be of concern. Although one of the historic contaminants of concern at the site was PAHs they were not analyzed for. Historic data from Hocomonco Pond and other studies indicate that semi-volatile organic compounds such as PAHs do not bioaccumulate in fish tissue (Jonasch 1986).

2001 Sudbury Reservoir, Southborough/Marlborough
Sudbury Reservoir is a 1292-acre reservoir located in the Town of Southborough and the City of Marlborough. It was originally constructed as a water supply reservoir for the Boston Metropolitan Area and continues to serve as a back-up emergency water supply for this area. The immediate watershed and shoreline is undeveloped but the watershed as a whole is heavily developed both residentially and commercially. Fish toxics monitoring during 1987 revealed mercury concentrations in largemouth bass ranging from 0.26 to 0.50 mg/kg (n=3).

Electrofishing at Sudbury Reservoir in Marlborough/Southborough on August 14, 2001 resulted in the collection of three largemouth bass, three black crappie, three yellow perch, three white perch, and three yellow bullhead. Additional species observed included pumpkinseed, chain pickerel, bluegill, redbreast sunfish (*Lepomis auritus*), and smallmouth bass (*Micropterus dolomieui*).

Arsenic, lead, and cadmium were below method detection limits (MDLs) in all samples analyzed. Mercury ranged from 0.063 mg/kg in a composite of black crappie (SRF01-0-12) to 0.16 mg/kg in a composite of white perch (SRF01-7-9). Selenium ranged from 0.21 in yellow bullhead (SRF01-13-15) to 0.74 mg/kg in the composite of white perch. PCBs and organochlorine pesticides were below MDLs in all five samples analyzed from Sudbury Reservoir.

Mercury was below the MDPH trigger level in all five samples analyzed in 2001. It should be noted that largemouth bass sampled in 2001 were smaller than those sampled in 1987. Selenium concentrations are consistent with those found in waterbodies throughout the Commonwealth.

SUMMARY

Fish toxics monitoring screening surveys in the Concord River Watershed between 1995 and 2001 resulted in site-specific fish consumption advisories for five of the ten waterbodies sampled.

Fish toxics monitoring screening surveys should be conducted in the future to screen additional Concord River Watershed waterbodies for the presence of mercury, PCBs and other toxic contaminants. Additional fish toxics monitoring in the middle and north basins of Lake Cochituate might help to pinpoint potential sources of PCBs as well as document the magnitude and extent of PCB contamination.

Study of the Sudbury River continues as part of the Nyanza Superfund Site's remediation phase. In the summer of 2003 the United States Fish &Wildlife Service spent two weeks catching largemouth bass, brown bullhead, and yellow perch from within the Sudbury River as part of this remediation. They collected over 700 fish for this study. Results are not yet available.

Due to the highly eutrophic condition of Warners Pond DWM biologists recommended controlling agricultural and other nonpoint sources of nutrients within the immediate watershed of Warners Pond and in the watersheds of Fort Pond and Nashoba Brook in order to maintain a viable recreational fishery. Fisherman and others should continue to monitor numbers and types of fish found to exhibit abnormalities in the Assabet River and, if possible, photo document these to help to determine the identity and ultimately causes of any abnormalities.

REFERENCES

Harshbarger, J. C. 1989 Letter to Robert J. Maietta of MA DEP. National Museum of Natural History, Smithsonian Institution, Washington D.C.

Jonasch, J. J. 1986. Letter to Peter Oatis of the MDFWELE. Massachusetts Department of Environmental Quality Engineering, Technical Services Branch. Westborough, MA

MA DEP. 1995. Open File. *1995 Fish Toxics Monitoring Data in the Concord River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 1996. Open File. *1996 Fish Toxics Monitoring Data in the Concord River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 1997. Open File. *1997 Fish Toxics Monitoring Data in the Concord River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP 1999. CN 13.0 . *Fish Contaminant Monitoring Program, Quality Assurance Project Plan, 1999.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

MA DEP. 2000. Open File. *2000 Fish Toxics Monitoring Data in the Concord River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2001. Open File. *2001 Fish Toxics Monitoring Data in the Concord River Watershed.* Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, MA.

MA DEP. 2003. CN 37.0. *Fish Contaminant Monitoring Program, Quality Assurance Project Plan.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

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

Maietta, R. J. 1995. *1995 Public Request Fish Toxics Monitoring Surveys (TM-S-4).* Massachusetts Department of Environmental Protection, Office of Watershed Management. Worcester, MA

Maietta, R. J. 1997. *1997 Public Request Fish Toxics Monitoring Surveys (TM-S-9).* Massachusetts Department of Environmental Protection, Office of Watershed Management. Worcester, MA

Maietta, R. J. and J. Colonna-Romano. 2000. *2000 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys (TM-S-13).* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Maietta, R. J., Colonna-Romano, J., and R.F. Chase. 2002. *2001 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys (TM-S-16).* 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.

MDPH. 2002. *Freshwater Fish Consumption Advisory List.* Massachusetts Department of Public Health. Boston, MA.

Table B1. Analytical Results for 2001 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Hocomonco Pond, Westborough, Concord Watershed													
HPF01-1	8/21/01	LMB	35.0	680	2001032 (L2001387-6) (L2001388-6)	<0.08	<0.8	0.31	<0.060	0.14	0.06	ND	ND
HPF01-2	8/21/01	LMB	35.1	650									
HPF01-3	8/21/01	LMB	31.0	480									
HPF01-4	8/21/01	B	17.0	100	2001033 (L2001387-7) (L2001388-7)	<0.08	<0.8	0.076	<0.060	0.15	0.07	ND	ND
HPF01-5	8/21/01	B	19.1	120									
HPF01-6	8/21/01	B	17.8	110									
HPF01-7	8/21/01	CP	38.6	410	2001034 (L2001387-8) (L2001388-8)	<0.08	<0.8	0.16	<0.060	0.15	0.06	ND	ND
HPF01-8	8/21/01	CP	33.9	280									
HPF01-9	8/21/01	CP	41.6	490									
HPF01-10	8/21/01	P	17.2	110	2001035 (L2001387-9) (L2001388-9)	<0.08	<0.8	0.078	<0.060	0.18	0.07	ND	ND
HPF01-11	8/21/01	P	16.4	100									
HPF01-12	8/21/01	P	16.0	100									
HPF01-13	8/21/01	YB	23.2	210	2001036 (L2001387-10) (L2001388-10)	<0.08	<0.8	0.10	<0.060	0.11	0.19	ND	ND
HPF01-14	8/21/01	YB	24.9	220									
HPF01-15	8/21/01	YB	21.7	190									

[1] Species (LMB) largemouth bass *Micropterus salmoides*
(P) pumpkinseed *Lepomis gibbosus*
(B) bluegill *Lepomis macrochirus*
(CP) chain pickerel *Esox niger*
(YB) yellow bullhead *Ameiurus natalis*

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

Table B1 (Continued). Analytical Results for 2001 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (µg/g)	Pesticides (µg/g)
Sudbury River, Marlborough, Concord Watershed													
SRF01-1	8/14/01	LMB	30.9	390	2001027 (L2001387-1) (L2001388-1)	<0.08	<0.8	0.10	<0.060	0.37	0.11	ND	ND
SRF01-2	8/14/01	LMB	33.9	700									
SRF01-3	8/14/01	LMB	32.6	520									
SRF01-4	8/14/01	YP	26.5	220	2001028 (L2001387-2) (L2001388-2)	<0.08	<0.8	0.10	<0.060	0.42	0.12	ND	ND
SRF01-5	8/14/01	YP	28.1	280									
SRF01-6	8/14/01	YP	23.8	200									
SRF01-7	8/14/01	WP	23.9	200	2001029 (L2001387-3) (L2001388-3)	<0.08	<0.8	0.16	<0.060	0.74	0.62	ND	ND
SRF01-8	8/14/01	WP	23.0	180									
SRF01-9	8/14/01	WP	25.8	240									
SRF01-10	8/14/01	BC	22.1	180	2001030 (L2001387-4) (L2001388-4)	<0.08	<0.8	0.063	<0.060	0.43	0.07	ND	ND
SRF01-11	8/14/01	BC	19.7	130									
SRF01-12	8/14/01	BC	25.0	250									
SRF01-13	8/14/01	YB	26.0	320	2001031 (L2001387-5) (L2001388-5)	<0.08	<0.8	0.095	<0.060	0.21	0.17	ND	ND
SRF01-14	8/14/01	YB	31.2	440									
SRF01-15	8/14/01	YB	20.3	170									

[1] Species (LMB) largemouth bass *Micropterus salmoides*
(YP) yellow perch *Perca flavescens*
(WP) white perch *Morone americana*
(BC) black crappie *Pomoxis nigromaculatus*
(YB) yellow bullhead *Ameiurus natalis*

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

Table B2. 2000 DEP DWM Concord 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)
Nutting Lake, Billerica, SuAsCo R. Watershed													
Nlf00-1	8/18/00	CP	36.5	290	2000027 (L2000348-1 metals) (L2000355-1 organics)	<0.04	<0.40	0.57	<0.04	0.08	0.084	ND	ND
Nlf00-2	8/18/00	CP	37.1	300									
Nlf00-3	8/18/00	CP	37.2	280									
Nlf00-4	8/18/00	B	17.4	100	2000028 (L2000348-2 metals) (L2000355-2 organics)	<0.04	<0.40	0.30	<0.04	0.16	0.28	ND	ND
Nlf00-5	8/18/00	B	17.9	100									
Nlf00-6	8/18/00	B	16.9	100									
Nlf00-7	8/18/00	YB	26.1	250	2000029 (L2000348-3 metals) (L2000355-3 organics)	<0.04	<0.40	0.61	<0.04	0.09	0.16	ND	ND
Nlf00-8	8/18/00	YB	27.0	300									
Nlf00-9	8/18/00	YB	26.5	260									

[1]**Species** (CP) chain pickerel *Esox niger*
(B) bluegill *Lepomis macrochirus*
(YB) yellow bullhead *Ameiurus natalis*

ND - not detected or the analytical result is at or below the established method detection limit (MDL). See MDLs listed on following page**.**

Table B3. 1997 Concord River Basin Survey. Fish toxics monitoring data (mg/kg wet wt.) for the Assabet River, Concord/Hudson/Maynard and Warners Pond, Concord.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Code[2]	Length (cm)	Weight (gm)	Cd	Pb	Hg	As	Se	% Lipids	PCB[3] (µg/g)	Pesticides[3] (µg/g)
Assabet River														
Station F0041: downstream of Route 2, Concord.														
97028	ARF97-1	9/17/97	WS	C	41.1	940	<0.020	<0.140	0.320	<0.040	0.157	2.5	0.19*	ND
	ARF97-2	9/17/97	WS	C	40.0	800								
	ARF97-3	9/17/97	WS	C	40.5	820								
97029	ARF97-4	9/17/97	YP	C	26.1	280	<0.020	<0.140	0.230	0.063	0.257	0.41	ND	ND
	ARF97-5	9/17/97	YP	C	26.1	270								
	ARF97-6	9/17/97	YP	C	27.7	320								
97030	ARF97-7	9/17/97	LMB	C	33.1	540	<0.020	<0.140	0.470	<0.040	0.133	0.31	ND	ND
	ARF97-8	9/17/97	LMB	C	27.8	320								
	ARF97-9	9/17/97	LMB	C	31.6	430								
97031	ARF97-10	9/17/97	B	C	19.1	170	<0.020	<0.140	0.290	0.073	0.266	0.24	ND	ND
	ARF97-11	9/17/97	B	C	19.0	160								
	ARF97-12	9/17/97	B	C	19.8	180								
97033	ARF97-13	9/17/97	WP	C	21.3	140	<0.020	<0.140	0.210	<0.040	0.219	0.71	ND	ND
	ARF97-14	9/17/97	WP	C	20.1	130								
	ARF97-15	9/17/97	WP	C	20.1	120								
97034	ARF97-16	9/17/97	YB	I	30.1	400	<0.020	<0.140	0.640	<0.040	0.126	3.8	0.27*	ND

[1]Species bluegill (B) *Lepomis macrochirus*
largemouth bass (LMB) *Micropterus salmoides*
white perch (WP) *Morone americana*
white sucker (WS) *Castomus commersoni*
yellow bullhead (YB) *Ameiurus natalis*
yellow perch (YP) *Perca flavescens*

[2]Sample Type (All samples were fillets with skin off.)
Composite (C)
Individual (I)

[3] Analyzed just beyond the EPA recommended holding time although extraction was within holding time.

*Arochlor 1254

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

Table B3 (Continued). 1997 Concord River Basin Survey. Fish toxics monitoring data (mg/kg wet wt.) for the Assabet River, Concord/Hudson/Maynard and Warners Pond, Concord.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Code[2]	Length (cm)	Weight (gm)	Cd	Pb	Hg	As	Se	% Lipids	PCB[3] (µg/g)	Pesticides[3] (µg/g)
Assabet River Station F0042: at Woods Park, Hudson.														
97035	ARF97-17	9/18/97	LMB	C	37.4	800	<0.020	<0.140	0.470	<0.040	0.104	0.22	ND	ND
	ARF97-18	9/18/97	LMB	C	35.2	670								
	ARF97-19	9/18/97	LMB	C	34.2	630								
97036	ARF97-20	9/18/97	WS	C	44.0	1000	<0.020	<0.140	0.280	0.054	0.124	4.4	0.17*	ND
	ARF97-21	9/18/97	WS	C	44.6	1050								
	ARF97-22	9/18/97	WS	C	44.5	1020								
97037	ARF97-23	9/18/97	B	C	19.0	150	<0.020	<0.140	0.230	<0.040	0.106	0.12	ND	ND
	ARF97-24	9/18/97	B	C	19.7	180								
	ARF97-25	9/18/97	B	C	19.3	160								
97038	ARF97-26	9/18/97	AE	C	56.0	400	<0.020	<0.140	0.270	<0.040	0.130	22.0	0.32*	ND
	ARF97-27	9/18/97	AE	C	60.0	460								
97039	ARF97-28	9/18/97	BB	I	27.7	300	<0.020	<0.140	0.120	<0.040	0.052	1.0	ND	ND

[1]Species bluegill (B) *Lepomis macrochirus*
largemouth bass (LMB) *Micropterus salmoides*
American eel (AE) *Anguilla rostrata*
white sucker (WS) *Castomus commersoni*
brown bullhead (BB) *Ameiurus nebulosus*

[2]Sample Type (All samples were fillets with skin off.)
Composite (C)
Individual (I)

[3] Analyzed just beyond the EPA recommended holding time although extraction was within holding time.

*Arochlor 1254

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

Table B3 (Continued.) 1997 Concord River Basin Survey. Fish toxics monitoring data (mg/kg wet wt.) for the Assabet River, Concord/Hudson/Maynard and Warners Pond, Concord.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Code[2]	Length (cm)	Weight (gm)	Cd	Pb	Hg	As	Se	% Lipids	PCB[3] (? g/g)	Pesticides[3] (? g/g)
Assabet River														
Station F0043: White Pond Road, Maynard.														
97040	ARF97-29	9/18/97	LMB	C	40.2	1060	<0.020	<0.140	0.410	0.041	0.125	0.14	ND	ND
	ARF97-30	9/18/97	LMB	C	42.5	1100								
	ARF97-31	9/18/97	LMB	C	37.5	860								
97041	ARF97-32	9/18/97	BB	C	26.8	220	<0.020	<0.140	0.080	<0.040	0.079	0.35	ND	ND
	ARF97-33	9/18/97	BB	C	28.5	290								
	ARF97-34	9/18/97	BB	C	30.5	430								
97042	ARF97-35	9/18/97	B	C	18.3	150	<0.020	<0.140	0.080	<0.040	0.113	0.12	ND	ND
	ARF97-36	9/18/97	B	C	18.3	140								
	ARF97-37	9/18/97	B	C	19.6	160								
97043	ARF97-38	9/18/97	BC	C	22.5	180	<0.020	<0.140	0.260	<0.040	0.115	0.13	ND	ND
	ARF97-39	9/18/97	BC	C	19.6	120								

[1]Species bluegill (B) *Lepomis macrochirus*
largemouth bass (LMB) *Micropterus salmoides*
Brown bullhead (BB) *Ameiurus nebulosus*
black crappie (BC) *Pomoxis nigromaculatus*

[2]Sample Type (All samples were fillets with skin off.)
Composite (C)
Individual (I)

[3] Analyzed just beyond the EPA recommended holding time although extraction was within holding time.

*Arochlor 1254

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

Table B3 (Continued.) 1997 Concord River Basin Survey. Fish toxics monitoring data (mg/kg wet wt.) for the Assabet River, Concord/Hudson/Maynard and Warners Pond, Concord.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Code[2]	Length (cm)	Weight (gm)	Cd	Pb	Hg	As	Se	% Lipids	PCB[3] (? g/g)	Pesticides[3] (? g/g)
Warners Pond														
Station F0040: Concord.														
97023	WPF97-1	9/16/97	LMB	C	32.4	520	<0.020	<0.140	0.520	0.048	0.138	0.14	ND	ND
	WPF97-2	9/16/97	LMB	C	31.2	450								
	WPF97-3	9/16/97	LMB	C	31.7	480								
97024	WPF97-4	9/16/97	BC	C	23.6	200	<0.020	<0.140	0.420	0.056	0.133	0.05	ND	ND
	WPF97-5	9/16/97	BC	C	23.0	200								
	WPF97-6	9/16/97	BC	C	23.7	200								
97025	WPF97-7	9/16/97	YP	C	23.1	180	<0.020	<0.140	0.190	0.062	0.121	0.12	ND	ND
	WPF97-8	9/16/97	YP	C	22.8	180								
	WPF97-9	9/16/97	YP	C	22.7	170								
97026	WPF97-10	9/16/97	B	C	19.7	200	<0.020	<0.140	0.180	<0.040	0.139	0.12	ND	ND
	WPF97-11	9/16/97	B	C	18.8	180								
	WPF97-12	9/16/97	B	C	18.8	170								
97027	WPF97-13	9/16/97	YB	C	24.9	270	<0.020	<0.140	0.270	<0.040	0.134	0.31	ND	ND
	WPF97-14	9/16/97	YB	C	27.5	360								
	WPF97-15	9/16/97	YB	C	24.9	250								

[1]Species bluegill (B) *Lepomis macrochirus*
largemouth bass (LMB) *Micropterus salmoides*
black crappie (BC) *Pomoxis nigromaculatus*
yellow bullhead (YB) *Ameiurus natalis*
yellow perch (YP) *Perca flavescens*

[2]Sample Type (All samples were fillets with skin off.)
Composite (C)
Individual (I)

[3] Analyzed just beyond the EPA recommended holding time although extraction was within holding time.

*Arochlor 1254

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

Table B4. 1996 SuAsCo RIVER BASIN SURVEY. Fish toxics monitoring data (mg/kg wet wt.) for Lake Boon, Hudson/Stow and Whitehall Reservoir, Hopkinton.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Type[2]	Length (cm)	Weight (g)	Cd	Pb	Hg	As	Se	% Lipids	PCB (ug/l)	Pesticides (ug/l)	
Lake Boon															
96019	LBF96-1	07/10/96	LMB	C	32.2	400.0	<0.20	<1.0	0.606	<0.040	0.110	0.08	ND[3]	ND	
	LBF96-2	07/10/96	LMB	C	31.1	360.0									
	LBF96-3	07/10/96	LMB	C	30.0	340.0									
96020	LBF96-4	07/10/96	BC	C	25.7	200.0	<0.20	<1.0	0.827	<0.040	0.072	0.02	ND	ND	
	LBF96-5	07/10/96	BC	C	25.8	220.0									
96021	LBF96-6	07/10/96	YP	C	19.1	100.0	<0.20	<1.0	0.280	<0.040	0.143	0.15	ND	ND	
	LBF96-7	07/10/96	YP	C	24.5	160.0									
	LBF96-8	07/10/96	YP	C	20.1	100.0									
96022	LBF96-9	07/10/96	WP	C	25.6	220.0	<0.20	<1.0	0.384	<0.040	0.255	0.13	ND	ND	
	LBF96-10	07/10/96	WP	C	24.2	190.0									
	LBF96-11	07/10/96	WP	C	23.1	160.0									
96023	LBF96-12	07/10/96	B	C	17.9	120.0	<0.20	<1.0	0.342	<0.040	0.117	0.08	ND	ND	
	LBF96-13	07/10/96	B	C	18.7	120.0									
	LBF96-14	07/10/96	B	C	18.6	130.0									
96024	LBF96-15	07/10/96	AE	C	56.0	400.0	<0.20	<1.0	0.197	<0.040	0.101	22	0.091*	DDD	0.064
	LBF96-16	07/10/96	AE	C	50.9	300.0								DDE	0.13
	LBF96-17	07/10/96	AE	C	50.6	320.0								DDT	0.024

Notes:

[1]Species
American eel (AE) *Anguilla rostrata*
bluegill (B) *Lepomis macrochirus*
black crappie (BC) *Poxomis nigromaculatus*
largemouth bass (LMB) *Micropterus salmoides*
white perch (WP) *Morone americana*
yellow bullhead (YB) *Ameiurus natalis*
yellow perch (YP) *Perca flavescens*

[2]Sample Type (All samples were fillets with skin off.)
Composite (C)
Individual (I)

[3]ND = Not Detected

*Aroclor 1242

Table B4 (Continued). 1996 SuAsCo RIVER BASIN SURVEY. Fish toxics monitoring data (mg/kg wet wt.) for Lake Boon, Hudson/Stow and Whitehall Reservoir, Hopkinton.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Type[2]	Length (cm)	Weight (g)	Cd	Pb	Hg	As	Se	% Lipids	PCB (ug/l)	Pesticides (ug/l)
Whitehall Reservoir														
96028	WRF96-1	07/25/96	LMB	C	28.0	300.0	<0.20	<1.00	0.818	<0.040	0.100	0.17	ND	ND
	WRF96-2	07/25/96	LMB	C	28.6	310.0								
	WRF96-3	07/25/96	LMB	C	26.9	240.0								
96029	WRF96-4	07/25/96	BC	C	26.7	230.0	<0.20	<1.00	0.851	<0.040	0.085	0.16	ND	ND
	WRF96-5	07/25/96	BC	C	25.6	210.0								
	WRF96-6	07/25/96	BC	C	25.9	200.0								
96030	WRF96-7	07/25/96	YP	C	22.0	120.0	<0.20	<1.00	0.369	<0.040	0.082	0.21	ND	ND
	WRF96-8	07/25/96	YP	C	20.8	100.0								
	WRF96-9	07/25/96	YP	C	20.0	100.0								
96031	WRF96-10	07/25/96	B	C	19.0	130.0	<0.20	<1.00	0.507	<0.040	0.114	0.27	ND	ND
	WRF96-11	07/25/96	B	C	19.0	130.0								
	WRF96-12	07/25/96	B	C	20.0	140.0								
96037	WRF96-13	08/15/96	YB	C	27.2	300.0	<0.20	<1.00	1.06	0.040	0.146	0.12	ND	ND
	WRF96-14	08/15/96	YB	C	27.5	240.0								
	WRF96-15	08/15/96	YB	C	27.2	240.0								
96038	WRF96-16	08/15/96	WC	C	41.2	1060.0	<0.20	<1.00	0.854	0.047	0.051	1.1	ND	DDD 0.013
	WRF96-17	08/15/96	WC	C	34.4	460.0								DDE 0.023
	WRF96-18	08/15/96	WC	C	33.2	440.0								

Notes:

[1]Species
bluegill (B) *Lepomis macrochirus*
black crappie (BC) *Poxomis nigromaculatus*
largemouth bass (LMB) *Micropterus salmoides*
white catfish (WC) *Ictalurus catus*
yellow bullhead (YB) *Ameiurus natalis*
yellow perch (YP) *Perca flavescens*

[2]Sample Type (All samples were fillets with skin off.)
Composite (C)
Individual (I)

[3]ND = Not Detected

*Aroclor 1242

TABLE B5. Analytical results for 1995 Concord 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.

Analysis #	Sample ID	Collection Date	Species Code[1]	Sample Type[2]	Length (cm)	Weight (gm)	Cd	Pb	Hg	As	Se	% Lipids	PCB (ug/g)	Pesticides (ug/g)
Lake Cochituate														
	LCF95-1	07/28/95	LMB	C	38.9	800	<0.20	<1.00	0.411	<0.040	0.187	0.28	0.25*	ND
95033	LCF95-2	07/28/95	LMB	C	33.9	630								
	LCF95-3	07/28/95	LMB	C	33.8	590								
	LCF95-4	07/28/95	BC	C	24.3	210	<0.20	<1.00	0.184	<0.040	0.162	0.15	ND[3]	ND
95034	LCF95-5	07/28/95	BC	C	21.6	170								
	LCF95-6	07/28/95	BC	C	21.9	170								
	LCF95-7	07/28/95	YP	C	27.0	200	<0.20	<1.00	0.237	<0.040	0.142	0.08	ND	ND
95035	LCF95-8	07/28/95	YP	C	24.5	170								
	LCF95-9	07/28/95	YP	C	24.6	180								
	LCF95-10	07/28/95	AE	C	58.1	410	<0.20	<1.00	0.049	<0.040	0.162	21	3.2*	ND
95036	LCF95-11	07/28/95	AE	C	61.9	450								
	LCF95-12	07/28/95	AE	C	58.2	380								
	LCF95-13	07/28/95	P	C	17.6	110	<0.20	<1.00	0.088	<0.040	0.150	0.16	0.39*	ND
95037	LCF95-14	07/28/95	B	C	18.7	110								
	LCF95-15	07/28/95	B	C	17.1	100								
95038	LCF95-16	07/28/95	YB	I	23.7	200	<0.20	1.6	0.093	<0.040	0.100	0.28	0.91*	ND

Notes: [1] Species
American eel (AE) *Anguilla rostrata*
bluegill (B) *Lepomis macrochirus*
brown bullhead (BB) *Ameiurus nebulosus*
black crappie (BC) *Pomoxis nigromaculatus*
Yellow bullhead (YB) *Ameiurus natalis*
largemouth bass (LMB) *Micropterus salmoides*
pumkinseed (P) *Lepomis gibbosus*
white perch (WP) *Morone americana*
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 organics analysis only.

** Submitted for metals analysis only.

APPENDIX C
DWM LAKES SURVEY DATA 1996 AND 2001 IN THE SUASCO RIVER WATERSHED

1996

In the SuAsCo River Watershed DWM conducted synoptic surveys at 54 lakes during the 1996 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. 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 guideline). 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 C1. SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Ashland Reservoir	Ashland	82003	U	155.0	Moderate tea stain; slight to moderate algal turbidity (>1.2m SD, est.); slight brown silt and organic matter (undecomposed) over sand, gravel and vegetation near shore, dark brown to black organic muck further out; sparse plant cover at south end and west side; non-native aquatic and wetland species (Mh, Ls)
Assabet River Reservoir	Westborough	82004	H	333.0	Slight stain; very turbid (<1.2 m SD, est.); surface scum (blue-green bloom evident); partly decomposed matter over sandy bottom; very dense plant cover (all types) through most of the west side of the pond, very dense encroaching emergents around entire perimeter with occasional patches of floating plants (<10% affected); non-native aquatic and wetland species (Ms, Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Bartlett Pond	Northborough	82007	E	45.0	Slight stain; moderate turbidity; green algae masses; dark brown silt over sand along shore, dark brown to black muck further out; cove next to boat ramp about 40-50% covered with floating leaf plants, very dense floating leaf and emergent plants around southern perimeter (about 20' out), open at northern end; presence of non-native aquatic and wetland species (Cc, Ms, Pc, Ls)
Batemans Pond	Concord	82008	E	20.0	Heavy stain; slight turbidity (1.3m SD at dock); much organic matter on bottom; southwestern area partly filled in with wetland plants, western and northeastern section heavily encroached by emergent plants, patches of very dense floating leaf plants frequently throughout pond (about 50% of the pond affected); non-native aquatic and wetland species (Mq, Ls)
Boons Pond	Stow/ Hudson	82011	E	175.0	Slight stain; little to moderate greenish brown to gray-brown turbidity; slight brown silt on sand, gravel bottom and vegetation further out; 100% of eastern cove with very dense floating leaf, submergent and emergent plants, main basin with plants sparse on surface; non-native aquatic species (Cc, Mh)
Carding Mill Pond	Sudbury	82015	E	40.0	No water quality observations possible; 100% very dense cover of duckweed and filamentous algae over at least the lower half of the pond
Chauncy Lake	Westborough	82017	U	177.0	Green/brown turbidity; heavy near access (possibly <1.2 m SD, est.) but uncertain in main body of the lake; dark silt covering over sand and gravel bottom near shore, dark muck further out; windrows of green filamentous algae; very dense plant cover in cove area, but the rest of the pond is sparse; non-native aquatic and wetland species (Ms, Ls)
Clamshell Pond	Clinton	82018	U	8.0	No water quality observations possible; about a third of the pond covered with very dense floating leaf plants

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Lake Cochituate (Middle Basin)	Natick/ Wayland	82125	U	131.0	Slight stain; moderate turbidity (likely >1.2 m SD, est.); undecomposed matter and vegetation on bottom over sand and gravel; mostly sparse aquatic plant density on the surface, areas of very dense low-growing submergent plants but not a nuisance, patches of floating leaf and submergents plants to the surface, (< 10% of the surface area affected)
Lake Cochituate (North Basin)	Framingham/ Natick/ Wayland	82020	U	195.0	North end mostly clear water; very slight turbidity; slight organic material over sand, brown silt coating on rocks; southeast shore with moderate green turbidity; undecomposed organic matter and green algae on bottom; low-growing submergent plants very dense in some areas, surface plants sparse over most of the pond
Lake Cochituate (South Basin)	Natick	82127	E	233	Poor water quality; high green turbidity (possibly < 1.2 m SD, est.); heavy green filamentous algae on rocky bottom, also brown silt, gas bubbles given off from rocks, black muck further out; sparse surface plant cover throughout the basin; non-native wetland species (Ls) and potentially a non-native aquatic species (M. sp.)
Dudley Pond	Wayland	82029	E	84.0	Heavy green/brown turbidity heavy (likely < 1.2 m SD, est.); much organic matter on bottom; surface plant cover sparse throughout the pond except occasional patches near the outlet; non-native aquatic species (Ms, Pc)
Elm Street Pond	Chelmsford/ Carlisle	82032	E	42.0	Moderate stain; moderate turbidity; slight surface scum; organic debris on bottom; about 95% of the pond covered with floating leaf plants; non-native wetland species (Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). Concord River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Farm Pond	Framingham	82035	E	149.0	Considerable variability at observation sites; main basin varied from clear with little turbidity along the west shore to brown turbidity at the north end; bottom types were dark silt on plants and rocks to mucky brown with algal mats; the west basin had a heavy green-gray turbidity (<1.2 m SD, est.) with many algal mats; the main basin had sparse plant cover except for patches of floating leaf plants in the north end; west basin had very dense patches of floating leaf plants along the north and west shores (<10% of total area affected); non-native wetland species (Ls) and potentially a non-native aquatic species (M. sp.)
Farrar Pond	Lincoln	82036	U	126.0	Slight stain; much vegetation and organic debris over sandy bottom; cove to the southwest has very dense floating leaf plants, west potion has patches of floating leaf, southeast end has dense to very dense cover past the peninsula (about 50% of pond affected by dense or very dense cover); non-native wetland species (Ls)
Fiske Street Pond	Carlisle/ Chelmsford	82097	E	28	No water quality observed; 75-100% of the entire pond covered with floating leaf and emergent plants; non-native wetland plants (Ls)
Fisk Pond	Natick	82038	U	68.0	Moderate stain; moderate brown turbidity (>1.2 m SD, est.); bottom vegetated with silty brown coating; slight powdery scum on surface; much debris washed up at the outlet structure; gas bubbles rising from bottom; very dense aquatic plant cover in western cove and coves along south side, about a third of the surface area affected; non-native aquatic and wetland species (Mh, Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Fort Meadow Reservoir	Marlborough/ Hudson	82042	U	284.0	No stain to slight stain; very slight to moderate turbidity; slight oily scum and water meal along the southwest shore of the west basin; partly decomposed matter and brown silt over sand and gravel bottom; dense stands of emergent plants located frequently along the south and west shore of the west basin, otherwise the surface plant cover is sparse throughout the pond; non-native wetland species (Ls, Pa)
Fort Pond	Littleton	82043	U	100.0	Moderate tea stain; moderate brown turbidity; brown silt over sandy bottom; a few patches of floating leaf plants scattered, otherwise sparse surface plant cover; non-native wetland species (Ls)
Framingham Reservoir #1 (Sterns Reservoir)	Framingham	82044	U	162.0	Slight to moderate stain; slight turbidity (> 1.2 m SD, est.); bottom uncertain, algae attached to some milfoil; oily/powdery scum on surface in the southwest "arm"; dense to very dense submergent and floating leaf plants in the northern cove, thin band of floating leaf and submergent plants around the remaining perimeter except frequent patches of floating leaf plants (about 50% cover) in the western cove; non-native aquatic and wetland species (Mh, Ms, Ls)
Framingham Reservoir #2	Framingham/ Ashland	82045	U	125.0	Moderate tea stain; moderate turbidity (1.1 m SD measured); bottom uncertain; sparse surface plant cover over entire lake; non-native wetland species (Ls)
*Framingham Reservoir #3**	Framingham	82046	U	237.0	Slight stain; moderate green/gray algal turbidity (2.1 m SD measured); slight brown silt over rocks on bottom; sparse surface aquatic plants over entire lake; non-native aquatic and wetland species (Ms, Ls)
Gates Pond*	Berlin	82047	U	84.0	Clear; no turbidity; light brown silt on rocks and gravel; sparse surface plant cover over entire pond; non-native wetland species (Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Gleasons Pond	Framingham	82048	U	12.0	No water quality observations; very dense floating leaf plants along the north shore and interspersed throughout the pond (about 25% of the pond surface affected)
Great Meadow Pond #3	Concord	82053	E	38.0	Moderate stain, heavy brown turbidity (likely < 1.2 m SD, est.), mucky dark brown silt on the bottom and on vegetation in the east basin; no open water in the west basin; very dense vegetation over the entirety of both basins; non-native aquatic and wetland species (Nl, Tn, Ls)
Gristmill Pond	Marlborough/ Sudbury	82055	H	12.0	No water quality observations possible; 75% covered with algal and duckweed mats; non-native wetland species (Ls)
Hager Pond	Marlborough	82056	H	14.0	Poor water quality; green/brown turbidity (< 1.2 m SD, est.); mucky brown bottom; floating algal and duckweed mats very dense along the northern shore and the far end of the southern arm (about 50% of the main basin affected); non-native wetland species (Ls)
Heard Pond	Wayland	82058	U	71.0	No stain; moderate to heavy (brown/green) turbidity (possibly <4' SD est.); silty brown, muck over sandy bottom near shore and muck, undecomposed matter, and dark-colored algae further out; water level low (about 8' of shore exposed); northwest side of pond with extensive beds of floating leaf plants (about 100' from shore), north side less extensive plant growth, eastern shore is sparsely covered, and the south end is filled in with emergent and floating leaf plants (about 25% of surface affected); non-native aquatic and wetland species (Ms, Tn, Ls)
Heart Pond	Chelmsford	82059	U	91.0	Slight stain; slight turbidity, slight brown silt over sand near shore and vegetation further out; overall surface plant cover is sparse; non-native wetland species (Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*, Tn= *Trapa natans*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Hocomonoco Pond	Westborough	82060	U	27.0	Slight stain, moderate brown turbidity in open water area; much undecomposed and partly decomposed organic matter on bottom; very dense floating leaf and emergent vegetation at the west end, east end has a band of floating leaf plants near the shore (about a third of the total pond surface is affected); non- native wetland species (Ls)
Hopkinton Reservoir	Ashland/ Hopkinton	82061	U	170.0	Moderate tea stain; large chunks of bluegreens; slight turbidity (> 1.2 m SD, est.); slight silt on rocky/gravel bottom; sparse surface plant cover throughout the pond; non-native wetland species (Ls)
Learned Pond	Framingham	82069	U	34.0	No stain; dark brown/black organic matter over sandy bottom; occasional patches of floating leaf plants spaced around perimeter, otherwise sparse surface plant cover throughout the pond; non-native wetland species (Ls)
Little Chauncy Pond	Northborough	82070	E	45.0	Slight stain; moderate turbidity (> 1.2 m SD est.); brown silt over rocks and gravel; about a third to half of the pond covered with very dense floating leaf plants; non-native aquatic species (Mh, Pc)
Long Pond	Littleton	82072	U	88.0	Little stain; slight turbidity; slight light brown silt over sandy bottom; very dense growths of emergent and floating leaf plants around the entire pond, cove on south side and the west end are very densely covered (about 10% of the total surface is affected); many freshwater mussels observed; non-native wetland species (Ls, Pa) and potentially a non-native aquatic species (M. sp.)
Milham Reservoir*	Marlborough	82077	U	69.0	Moderate tea stain; little turbidity; white foam on the shore; slight brown silt on rocks and gravel, some undecomposed matter on bottom; sparse surface aquatic plant cover throughout the pond; non-native wetland species (Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*, Tn= *Trapa natans*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Nagog Pond*	Littleton/ Acton	82082	U	284.0	Clear; very slight turbidity; much undecomposed matter over rock/sand/ gravel bottom, slight brown silt on rocks; moderate patches of floating leaf plants in coves on south end of lake, overall sparse surface plant cover throughout the pond; non-native wetland species (Ls)
Nutting Lake, (East Basin)	Billerica	82088	U	28.0	Moderate tea stain; moderate turbidity; fine dark brown organic silt over sandy bottom; dense to very dense floating leaf plants around about 50% of the perimeter (<10% surface area affected); non-native aquatic and wetland species (Tn, Ls)
Nutting Lake, (West Basin)	Billerica	82124	U	51.0	Clear; little turbidity; slight brown silt over sandy bottom near shore with vegetation on bottom in deeper water; dense to very dense floating leaf plants around most of the perimeter (< 10% of the surface area affected); non-native wetland species (Ls)
Rocky Pond	Boylston	82095	U	60.0	Clear; slight turbidity; much organic matter and vegetation over sand and gravel bottom; encroachment around the peninsula from the west center, very dense cover in the southwestern cove near the outlet and along the south shore to the southeast cove; northern part of the pond mostly open water except the east shore (about 1/4 to 1/3 of the surface affected); non-native aquatic species (Mh)
Russell Millpond	Chelmsford	82096	U	20.0	Slight to dark tea stain; slight to moderate brown turbidity and iron floc in some areas, mucky brown bottom in other areas; green powdery scum on about 50% of the surface; pond very low (about 30-40' of the shore exposed); dense plant cover in the remaining water at the upper end of the lower pond, the rest is open water; upper pond is covered with very dense submergent, floating leaf and emergent plants except for a narrow channel; non-native aquatic and wetland species (Tn, Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Saxonville Pond	Framingham	82097	E	59.0	No apparent stain; slight turbidity; surface scum apparent; much partly decomposed organic matter on bottom; from bridge at the outlet about half of the observed width is very dense with submergent and/or floating leaf plants, for the remainder of the pond upstream the plant cover is very dense in beds that vary along both sides of the pond to the entire width; non-native aquatic and wetland species (Cc, Mq, Ls)
Smith Pond	Northborough	82099	E	18.0	Slight stain; moderate turbidity (>1.2 m SD, est.); much organic matter on bottom; duckweed and algae mats on surface; lower end of the pond with very dense floating leaf, algal mats, and duckweed around perimeter and very dense submergent plants, upper end of the pond has very dense cover of floating leaf plants (about 1/2 to 2/3 of the surface affected); non-native wetland species (Ls)
Solomon Pond	Northborough	82100	U	22.0	Clear; little turbidity; brown mucky bottom with some rocks and undecomposed matter; very dense emergent plant cover encroaching upon east and north shore, large patches of floating leaf plants along the northeast section and on the west shore (< 10% surface affected)
Stearns Mill Pond	Sudbury	82104	E	19.0	Very turbid and covered with duckweed (< 1.2 m SD, est.); about 50% of the lower pond with a very dense cover of duckweed and algae; the upper end is 100% covered; non-native wetlands species (Ls)
Sudbury Reservoir*	Marlborough/ Southborough	82106	U	1292.0	No stain; moderate yellow-green algal turbidity; light brown silt on bottom over rocks, some undecomposed organic debris; red-orange stain on rocks at some sites; yellow/white foam on shore in some areas; most of the reservoir has a sparse cover of surface plants, but there are occasional patches of floating leaf plants; non-native wetland species (Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Warners Pond	Concord	82110	E	54.0	Moderate to heavy tea stain; slight to moderate turbidity; dark brown silt and decomposed debris over sandy bottom; encroaching emergent and floating leaf plants around entire pond, southern coves very dense with floating leaf plants, northwest and north shore covered with floating leaf plants, eastern side and middle between islands with occasional patches (about 50 – 75% of the surface affected); non-native aquatic and wetland species (Tn, Ls) and potentially another non-native aquatic species (M. sp.)
Waushacum Pond	Framingham	82112	U	81.0	Slight stain; slight to moderate turbidity; organic debris over sand and gravel bottom; white foam on windward shore; very dense plant cover in the south cove, most of the pond with sparse surface cover; non-native aquatic and wetland species (Mh, Ls)
Westborough Reservoir*	Westborough	82114	U	54.0	Clear; little turbidity; a few patches of floating leaf plants on west side, but mostly sparse throughout the pond
White Pond	Concord	82118	U	43	Clear; little turbidity; very little silt on sand, gravel and rock bottom; spare surface aquatic plants throughout the pond
White Pond*	Hudson/ Stow	82119	U	62.0	Clear; little turbidity; brown/green periphytic material on bottom vegetation over sand, also undecomposed matter; water level low (about 5-10' of exposed shore); sparse surface plant cover throughout the pond
Whitehall Reservoir	Hopkinton	82120	U	575.0	Clear; little turbidity; much undecomposed to decomposed organic matter on bottom and vegetation; very dense submergent and floating leaf plants near shore to about 200'out in southern basin, about 50% of the cove at the north end with dense to very dense floating leaf plants, most of the main basin open; non-native aquatic and wetlands species (Cc, Mh, Ls)
Williams Lake*	Marlborough	82121	U	70.0	Clear; slight turbidity; slight brown muck over gravelly bottom; sparse surface plant cover throughout the lake

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic State-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

Table C1 (Continued). SuAsCo River Watershed 1996 Summer Lake Status.

Lake	Location	WBID	Trophic Status	Size (acres)	Survey Observations
Willis Pond	Sudbury	82122	U	68.0	Dark tea stain; slight turbidity (+0.6 m SD measured but <1.2 m est.); slight brown silt over sandy bottom; very dense encroaching emergent and floating leaf plants around pond, particularly from the north side wetland area, sparse surface plant cover in the rest of the lake; non-native wetland species (Ls)
Winning Pond	Billerica	82132	U	23.0	Dark tea stain; moderate turbidity (> 1.2 m SD, est.); undecomposed matter over sand, gravel, and rocks; very dense patches of floating leaf and emergent plants around about 75% of the shore (affecting <10% of the total area), northeast cove had a very dense plant cover; non-native aquatic and wetland species (Ec, Ms, Tn, Ls)

INFORMATION CODES: *Italic*= 2002 Integrated List Category 4c; **Bold**= 2002 Integrated List Category 5

Trophic Status-- O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H= Hypereutrophic, U= Undetermined.

Non-native Plants-- Cc= *Cabomba caroliniana*, Ec= *Eichornia crassipes*, Ls= *Lythrum salicaria, Mq= Marsilea quadrifolia*, Mh= *Myriophyllum heterophyllum*, Ms= *Myriophyllum spicatum*, M. sp.= possibly *Myriophyllum heterophyllum* (needs confirmation because insufficient key characteristics were observed to positively identify), Pa= *Phragmites australs,* Pc= *Potamogeton crispus*

* Indicates Class A (water supply) water body; all others are Class B.

2001

In the SuAsCo Watershed baseline lake surveys were conducted in July, August, and September 2001 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Five ponds, Assabet River Reservoir, Whitehall Reservoir, Willis Pond, Farm Pond, and Heard Pond, were sampled three times each (generally at monthly intervals). A technical memorandum by Dr. Mark Mattson and Albelee Haque (2004) entitled *Baseline Lake 2001 Technical Memo* provides details of sample collection methods, results, data, and aquatic plant maps for the lakes surveyed in the Westfield, Taunton, South Coastal, and SuAsCo Watersheds in 2001.

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 various depths creating profiles at deep hole stations. 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 were mapped and recorded. Details on procedures used can be found in the *Baseline Lake Survey Quality Assurance Project Plan* (MA DEP 2001).

Data was excerpted from the *Baseline Lake Survey 2001 Technical Memo* and presented in tables C2 and C3.

Table C2. 2001 DEP DWM SuAsCo Watershed Baseline Lakes *in situ* Hydrolab® data

Date	OWMID	Time (24hr)	Depth (m)	Temp (C)	pH (SU)	Cond@ 25C (uS/cm)	TDS (mg/l)	DO (mg/l)	SAT (%)
Assabet River Reservoir (Palis: 82004)									
Unique_ID: W0938 Station: A Description: Deep hole, center of eastern lobe, Westborough									
6/26/2001	LB-1269	13:57	0.5	27.4u	8.4c	172	110	9.4u	115u
		14:02	1.5	26.1	8.4c	172	110	9.3u	111u
		14:14	2.0	25.1	7.8cu	173	111	8.9u	105u
		14:06	2.5	21.9	6.8u	188	120	5.3u	59u
		14:10	2.7	20.3	6.4u	195	125	3.5u	38u
7/24/2001									
	LB-1362	13:40	0.5	27.1	8.1c	181	116	8.6	107
		13:45	1.5	27.1	8.1c	181	116	8.7u	107u
		13:59	2.4	27.0	8.0c	181	116	8.0u	98u
8/29/2001									
	LB-1455	10:12	0.5	25.3	8.1cu	189	121	8.8	105
		10:19	1.5	25.2	8.1cu	189	121	8.8u	105u
		10:35	2.3	24.3	6.2	193	124	##u	##u
		10:24	2.5	23.9u	6.0	201	128	0.3u	4u
		10:29	2.7	23.0	5.8	239u	153u	<0.2	<2
Farm Pond (Palis: 82035)									
Unique_ID: W0946 Station: A Description: Deep hole, southeast quadrant of pond, Framingham									
6/28/2001	LB-1513	12:07s	##ms	##ms	##ms	##ms	--	##ms	##ms
		12:11s	##ms	##ms	##ms	##ms	--	##ms	##ms
		12:21s	##ms	##ms	##ms	##ms	--	##ms	##ms
		12:30s	##ms	##ms	##ms	##ms	--	##ms	##ms
		12:31s	##ms	##ms	##ms	##ms	--	##ms	##ms
		12:32s	##ms	##ms	##ms	##ms	--	##ms	##ms
8/9/2001									
	LB-1555	09:03	0.5	29.2	8.5c	876c	561c	8.6u	111u
		09:09	1.5	29.2	8.6c	878c	562c	8.6u	110u
		09:18	2.5	27.1	8.1c	876c	561c	8.3u	103u
		09:26	3.5	25.0u	7.1cu	939c	601c	1.7u	20u
		09:33	4.5	21.6u	7.1c	##cu	##cu	<0.2	<2
		09:38	5.4	17.9u	7.6cu	2,326cu	1,490cu	<0.2	<2
9/7/2001									
	LB-1597	11:52s	0.5s	23.2s	8.1cs	939cs	--	9.3s	100s
		11:57s	1.5s	22.6s	8.0cs	945cs	--	9.1s	97s
		12:01s	2.5s	22.3s	7.9cs	944cs	--	8.4su	89su
		12:06s	3.5s	22.2s	7.7cs	944cs	--	8.1s	87s

"##" = Censored data (i.e., data that has been discarded for some reason)
"--" = No data (i.e., data not taken/not required)
"c" = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard.
" 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.
"s" = field sheet recorded data were used to accept data, not electronically recorded using Multi-probe surveyor unit, due to operator error or equipment failure.
" u " = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc

Table C2 (Continued). 2001 DEP DWM SuAsCo Watershed Baseline Lakes *in situ* Hydrolab® data

Date	OWMID	Time (24hr)	Depth (m)	Temp (C)	pH (SU)	Cond@ 25C (uS/cm)	TDS (mg/l)	DO (mg/l)	SAT (%)
Heard Pond (Palis: 82058)									
Unique_ID: W0944 Station: A Description: Deep hole, northeast quadrant of pond, Wayland									
6/27/2001	LB-1487	10:00s	##ms	##ms	##ms	##ms	--	##ms	##ms
		10:03s	##ms	##ms	##ms	##ms	--	##ms	##ms
		10:07s	##ms	##ms	##ms	##ms	--	##ms	##ms
		10:10s	##ms	##ms	##ms	##ms	--	##ms	##ms
		10:15s	##ms	##ms	##ms	##ms	--	##ms	##ms
8/1/2001									
	LB-1529	10:04s	0.5s	25.3su	7.2csu	378s	--	8.6su	104su
		10:08s	1.5s	24.3s	6.8su	378s	--	6.5su	75su
9/4/2001									
	LB-1571	10:37s	0.5s	22.7s	7.4cs	394s	--	8.9s	103s
		10:41s	1.5s	22.5s	7.3cs	394s	--	8.5su	98su
Whitehall Reservoir (Palis: 82120)									
Unique_ID: W0942 Station: A Description: Deep hole, center of southern lobe, Hopkinton									
6/26/2001	LB-1274	10:01	0.5	26.6u	6.4u	101	64.4	8.2	99
		10:05	1.5	25.3	6.4	101	64.3	8.3	98
		10:10	2.5	24.3	6.2u	101	64.9	7.3	84
		10:15	3.5	20.2	5.8	104	66.6	5.5	59
		10:20	4.0	17.4u	5.7	105	66.9	4.3	43
		10:25	5.0	14.8u	5.6	104	66.2	3.3	31
		10:30	5.5	13.0	5.5	103	66.1	3.0	28
		10:35	6.5	10.9	5.4	103u	66.1u	1.5u	13u
		10:40	7.0	10.3	5.4	104	66.6	1.0	8
		10:45	7.5	9.6	5.6u	107u	68.2u	<0.2	<2
7/24/2001									
	LB-1367	09:54	0.5	25.2	6.5	102	65.4	8.3	100
		10:01	1.6	25.2	6.5	102	65.4	8.3	99
		10:08	2.4	25.1	6.5	102	65.4	8.3	99
		10:17	3.6	22.8u	5.8u	103	66.2	4.0u	46u
		10:22	4.5	18.3u	5.5	105	67.0	##i	##i
		10:32	5.4	14.4u	5.4	103u	66.1u	1.1	11
		10:37	6.5	12.1u	5.5	105u	66.9u	<0.2	<2
8/29/2001									
	LB-1460	13:12	0.5	25.5u	6.3u	102u	65.4u	8.0	96
		13:15	2.0	24.8	6.3	102	65.3	8.0	95
		13:21	3.0	24.5	6.3	102	65.3	7.9	92
		13:54	3.5	24.0	6.2u	102	65.5	##u	##u
		13:25	4.0	22.4u	5.6u	105	67.3	0.4iu	5iu
		13:29	4.5	18.7u	5.5	106u	67.5u	0.5i	5i
		13:34	5.0	16.6	5.4	105u	67.2u	0.4iu	4iu
		13:39	5.5	14.5	5.5	103	65.8	5.1iu	49iu
		13:43	6.1	12.9	5.4	102	65.4	##u	##u
		13:47	7.0	10.9u	6.3u	144u	92.2u	<0.2	<2

"##" = Censored data (i.e., data that has been discarded for some reason)
"--" = No data (i.e., data not taken/not required)
"c" = Greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard.
"i" = Inaccurate readings from Multi-probe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low inonic check and for the deionized blank water check, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses.
" 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.
"s" = Field sheet recorded data were used to accept data, not electronically recorded using Multi-probe surveyor unit, due to operator error or equipment failure.
" u " = Unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc

Table C2 (Continued). 2001 DEP DWM SuAsCo Watershed Baseline Lakes *in situ* Hydrolab® data

Date	OWMID	Time (24hr)	Depth (m)	Temp (C)	pH (SU)	Cond@ 25C (uS/cm)	TDS (mg/l)	DO (mg/l)	SAT (%)
Willis Pond (Palis: 82122)									
Unique_ID: W0945	**Station: A** Description: Deep hole, southeast quadrant of pond, Sudbury								
6/27/2001	LB-1491	11:48s	##ms	##ms	##ms	##ms	--	##ms	##ms
		11:51s	##ms	##ms	##ms	##ms	--	##ms	##ms
		11:55s	##ms	##ms	##ms	##ms	--	##ms	##ms
		11:58s	##ms	##ms	##ms	##ms	--	##ms	##ms
		12:01s	##ms	##ms	##ms	##ms	--	##ms	##ms
8/1/2001									
	LB-1533	11:09s	0.5s	26.3s	5.7s	47.4s	--	6.5su	80su
		11:14s	1.5s	23.4s	5.4s	47.4s	--	4.0s	47s
		11:18s	2.5s	22.1s	5.5s	55.9s	--	<0.2s	<2s
9/4/2001									
	LB-1575	11:36s	0.5s	22.9s	5.9s	48.3s	--	6.7s	78s
		11:40s	1.5s	22.5s	5.8s	48.3s	--	6.3s	73s

"##" = Censored data (i.e., data that has been discarded for some reason)
"--" = No data (i.e., data not taken/not required)
"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.
"s" = Field sheet recorded data were used to accept data, not electronically recorded using Multi-probe surveyor unit, due to operator error or equipment failure.
"u" = Unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc

Table C3. 2001 DEP DWM SuAsCo Watershed Baseline Lakes physico-chemical data.

Date	Secchi Depth (m)	Secchi Time (24 hr)	Station Depth (m)	OWMID	QAQC	Time (24 hr)	Sample Depth (m)	Relative Depth	Alkalinity (mg/l)	Total Phosphorus (mg/l)	Apparent Color (PCU)	Chl a (mg/m^3)
Assabet River Reservoir (Palis: 82004)												
Unique_ID: W0938 Station: A Description: Deep hole, center of eastern lobe, Westborough												
6/26/2001	3.0	13:50	3.3	LB-1264	LB-1265	14:20	0.5	Surface	11d	0.019b	37h	
				LB-1265	LB-1264	14:25	0.5	Surface	22d	0.018b	37h	
				LB-1266	--	14:35	**	Bottom	21	0.048b	65h	
				LB-1267	LB-1268	14:46	0 - **	Depth Integrated				##h
				LB-1268	LB-1267	14:46	0 - **	Depth Integrated				##h
7/24/2001	2.6	13:56	3.2									
				LB-1358	LB-1357	**	0.5	Surface	15	0.022	38	
				LB-1357	LB-1358	**	0.5	Surface	15	0.022	34	
				LB-1359	--	**	**	Bottom	28	0.085	280	
				LB-1361	LB-1360	**	0 - **	Depth Integrated				6.8d
				LB-1360	LB-1361	**	0 - **	Depth Integrated				4.3d
8/29/2001	2.6	11:04	3.3									
				LB-1451	LB-1450	10:50	0.5	Surface	16	##d	39	
				LB-1450	LB-1451	10:50	0.5	Surface	17	##d	43	
				LB-1452	--	11:00	2.7	Bottom	28	0.024d	320	
				LB-1453	LB-1454	11:11	0 - 2.7	Depth Integrated				28.8
				LB-1454	LB-1453	11:13	0 - 2.7	Depth Integrated				34.2
Assabet River Reservoir (Palis: 82004)												
Unique_ID: W0939 Station: B Description: Center of lake, approximately 600 feet north of point on southern shore, Westborough												
6/24/2001	**	**	**	LB-1270	--	15:05	--			0.020b		
7/24/2001	**	**	**	LB-1363	--	**	--			0.025b		
8/29/2001	**	**	**	LB-1456	--	11:33	0.5	Surface		0.019b		

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

Table C3. 2001 DEP DWM SuAsCo Watershed Baseline Lakes physico-chemical data.

Date	Secchi Depth (m)	Secchi Time (24 hr)	Station Depth (m)	OWMID	QAQC	Time (24 hr)	Sample Depth (m)	Relative Depth	Alkalinity (mg/l)	Total Phosphorus (mg/l)	Apparent Color (PCU)	Chl a (mg/m^3)
Farm Pond (Palis: 82035)												
Unique_ID: W0946 Station: A Description: Deep hole, southeast quadrant of pond, Framingham												
6/28/2001	2.5	11:58	5.9	LB-1508	LB-1509	**	0.5	Surface	33	0.019b	24	
				LB-1509	LB-1508	**	0.5	Surface	34	0.013b	27	
				LB-1510	--	**	5.4	Bottom	55	0.040b	24	
				LB-1511	LB-1512	**	0 - 5.4	Depth Integrated				10.2
				LB-1512	LB-1511	**	0 - 5.4	Depth Integrated				13.0
8/9/2001	3.4	10:05	6.0	LB-1550	LB-1551	09:30	0.5	Surface	36	0.015	18	
				LB-1551	LB-1550	09:35	0.5	Surface	35	0.015	<15	
				LB-1552	--	09:50	5.5	Bottom	110	0.070	540	
				LB-1553	LB-1554	10:10	0 - 5.5	Depth Integrated				22.0
				LB-1554	LB-1553	10:10	0 - 5.5	Depth Integrated				22.3
9/7/2001	1.8	11:42	4.0	LB-1592	LB-1593	12:15	0.5	Surface	41	0.022b	28	
				LB-1593	LB-1592	12:15	0.5	Surface	41	0.021b	27	
				LB-1594	--	12:20	3.5	Bottom	41	0.024b	23	
				LB-1595	LB-1596	12:25	0 - 3.5	Depth Integrated				6.6
				LB-1596	LB-1595	12:25	0 - 3.5	Depth Integrated				4.6
Heard Pond (Palis: 82058)												
Unique_ID: W0944 Station: A Description: Deep hole, northeast quadrant of pond, Wayland												
6/27/2001	1.2	09:54	2.6	LB-1483	LB-1482	**	0.5	Surface	19	0.022b	37	
				LB-1482	LB-1483	**	0.5	Surface	19	0.026b	37	
				LB-1484	--	**	2.1	Bottom	21	0.058b	55	
				LB-1486	LB-1485	**	0 - 2.1	Depth Integrated				24.6
				LB-1485	LB-1486	**	0 - 2.1	Depth Integrated				22.4
8/1/2001	0.9	10:01	2.0	LB-1524	LB-1525	10:10	0.5	Surface	34d	0.043	43	
				LB-1525	LB-1524	10:10	0.5	Surface	25d	0.038	43	
				LB-1526	--	10:15	1.5	Bottom	25	0.067	49	
				LB-1527	LB-1528	10:15	0 - 1.5	Depth Integrated				17.4
				LB-1528	LB-1527	10:15	0 - 1.5	Depth Integrated				16.8
9/4/2001	0.3	10:34	2.0	LB-1566	LB-1567	10:45	0.5	Surface	24	0.075	70	
				LB-1567	LB-1566	10:46	0.5	Surface	24	0.074	70	
				LB-1569	LB-1570	10:49	0 - 1.5	Depth Integrated				29.8
				LB-1570	LB-1569	10:50	0 - 1.5	Depth Integrated				26.7

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

Table C3. 2001 DEP DWM SuAsCo Watershed Baseline Lakes physico-chemical data.

Date	Secchi Depth (m)	Secchi Time (24 hr)	Station Depth (m)	OWMID	QAQC	Time (24 hr)	Sample Depth (m)	Relative Depth	Alkalinity (mg/l)	Total Phosphorus (mg/l)	Apparent Color (PCU)	Chl a (mg/m^3)
Whitehall Reservoir (Palis: 82120)												
Unique_ID: W0942 Station: A Description: Deep hole, center of southern lobe, Hopkinton												
6/26/2001	3.2	11:15	8.2	LB-1271	--	11:00	0.5	Surface	<2f	0.023bf	41f	
				LB-1272	--	11:15	7.5	Bottom	5f	0.018bf	34f	
				LB-1273	--	11:25	0 - 7.0	Depth Integrated				2.0f
7/24/2001	3.0	10:00	7.3	LB-1364	--	**	0.5	Surface	5	0.016b	39	
				LB-1365	--	**	**	Bottom	7	0.022b	34	
				LB-1366	--	**	0 - **	Depth Integrated				5.9
8/29/2001	4.2	14:20	8.4	LB-1457	--	14:08	0.5	Surface	6	0.009b	31	
				LB-1458	--	14:15	7.0	Bottom	21	0.047b	280	
				LB-1459	--	**	0 - 7.0	Depth Integrated				9.5
Whitehall Reservoir (Palis: 82120)												
Unique_ID: W0943 Station: B Description: Center of lake, approximately 1000 feet east of large island, Hopkinton												
6/26/2001	**	**	**	LB-1275	--	11:40	--			0.016bf		
7/24/2001	**	**	**	LB-1368	--	**	--			0.015b		
8/29/2001	**	**	**	LB-1461	--	14:45	--			0.009b		

" ** " = Missing data (i.e., data that should have been reported)
"--" = No data (i.e., data that should have been reported)
" b " = blank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).
"f" = frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP

Table C3. 2001 DEP DWM SuAsCo Watershed Baseline Lakes physico-chemical data.

Date	Secchi Depth (m)	Secchi Time (24 hr)	Station Depth (m)	OWMID	QAQC	Time (24 hr)	Sample Depth (m)	Relative Depth	Alkalinity (mg/l)	Total Phosphorus (mg/l)	Apparent Color (PCU)	Chl a (mg/m^3)
Willis Pond (Palis: 82122)												
Unique_ID: W0945 Station: A Description: Deep hole, southeast quadrant of pond, Sudbury												
6/27/2001	0.8	11:43	2.9	LB-1488	--	**	0.5	Surface	<2	0.033b	110	
				LB-1489	--	**	2.4	Bottom	4	0.13b	180	
				LB-1490	--	**	0 - 2.4	Depth Integrated				13.2
8/1/2001	1.0	11:05	2.6	LB-1530	--	11:25	0.5	Surface	2	0.054b	160	
				LB-1531	--	11:30	2.1	Bottom	2	0.036b	180	
				LB-1532	--	11:22	0 - 2.1	Depth Integrated				13.0
9/4/2001	1.1	11:33	2.3	LB-1572	--	11:45	0.5	Surface	2.0	0.050b	170	
				LB-1573	--	11:47	1.8	Bottom	2.0	0.047b	170	
				LB-1574	--	**	0 - 1.8	Depth Integrated				10.7
10/4/2001	0.7	12:25	2.4	LB-1868	--	12:30	0.5	Surface		0.058b		

" ** " = Censored or missing data (i.e., data that should have been reported)
" -- " = No data (i.e., data not taken/not required)
" b " = blank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).

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. 2001. CN 65.0 *Quality Assurance Project Plan for TMDL Baseline Lakes Survey 2001.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

Mattson and Haque. 2004. CN 167.0. *Baseline Lake Survey 2001 Technical Memo.TM-S-16* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

APPENDIX D

(Excerpted from Report #TM-82-8)

The Upper Concord Watershed
Results of the 2001 Biomonitoring Survey

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CN: 184.0

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List of Figures and Tables

Introduction

As part of the watershed assessment activities of the Department of Environmental Protection's (DEP) Division of Watershed Management (DWM), benthic macroinvertebrate samples were collected in July 2001 from streams in the Assabet River and Sudbury River basins of the Concord Watershed. These biomonitoring samples were collected from 13 stations and analyzed to detect indications of the status of aquatic community health. The station locations are described in Table 1 and their positions within the watershed are shown in Figure 1.

Table 1. Biomonitoring station descriptions, listed from most upstream to most downstream (tributaries at point of confluence with the Assabet or Sudbury River).

	Unique ID#	Station	Stream	Location description	Date Sampled
Assabet River Basin	B0466	ARW	ASSABET RIVER	downstream/north from Fisher Street, Westborough, MA	18 July 2001
	B0462	HB	HOP BROOK	approximately 110 meters downstream/east from Otis Street, Northborough, MA	3 July 2001
	B0359	ARN	ASSABET RIVER	downstream/north from School Street, Northborough, MA	18 July 2001
	B0461	NB	NORTH BROOK	approximately 750 meters upstream/north from Randall Road, Berlin, MA	2 July 2001
	B0465	ARH	ASSABET RIVER	approximately 50 meters downstream/east from Broad Street, Hudson, MA	19 July 2001
	B0389	ARS	ASSABET RIVER	upstream/north form Route 62, Stow, MA	19 July 2001
	B0198	FMB	FORT MEADOW BROOK	approximately 270 meters upstream/southwest from Shay Street, Hudson, MA	3 July 2001
	B0463	SB	SPENCER BROOK	upstream from Barrett's Mill Road, downstream from Angiers Pond, Concord, MA	3 July 2001
Sudbury River Basin	B0360	SRH	SUDBURY RIVER	upstream/west from Cordaville Road/River Street (Rte. 85) bridge, Hopkinton/Southborough, MA	19 July 2001
	B0202	IB	INDIAN BROOK	approximately 380 meters downstream/northeast from Cross Street, Ashland, MA	5 July 2001
	B0484	SRF	SUDBURY RIVER	approximately 300 meters downstream/southeast from Winter Street, Framingham, MA	19 July 2001
	B0464	LCA & LCB	[Unnamed stream]	unnamed tributary draining Lake Cochituate to Sudbury River, approximately 150 meters downstream from the lake outlet, Framingham, MA	5 July 2001
	B0199	PB	PINE BROOK	approximately 100 meters downstream/southeast from Pine Brook Road, Wayland, MA	5 July 2001

Streams in these basins were sampled by comparable methods in 1986 (Nuzzo 1987), 1987 (Nuzzo 1989), and 1996 (Nuzzo 1996). Sampling locations in common with the 2001 sampling were:

- ARW—Assabet River between Fisher Street and Maynard Street, Westborough, MA (1987)
- ARN—Assabet River at School Street, Northborough, MA (1987)
- FMB—Fort Meadow Brook upstream from Shay Street, Hudson, MA (1996)
- SRH—Sudbury River upstream from Route 85, Southborough/Hopkinton, MA (1986)
- IB—Indian Brook downstream from Cross Street, Ashland, MA (1996)
- SRF—Sudbury River downstream from Winter Street, Framingham, MA (1986)
- PB—Pine Brook downstream from Pine Brook Road, Wayland, MA (1996).

The identifications of specimens from the 1996 data set were only taken to family, which limits the comparisons that can be made with the 2001 data. Taxonomy for the 1986, 1987, and 2001 samples was to genus or species whenever possible.

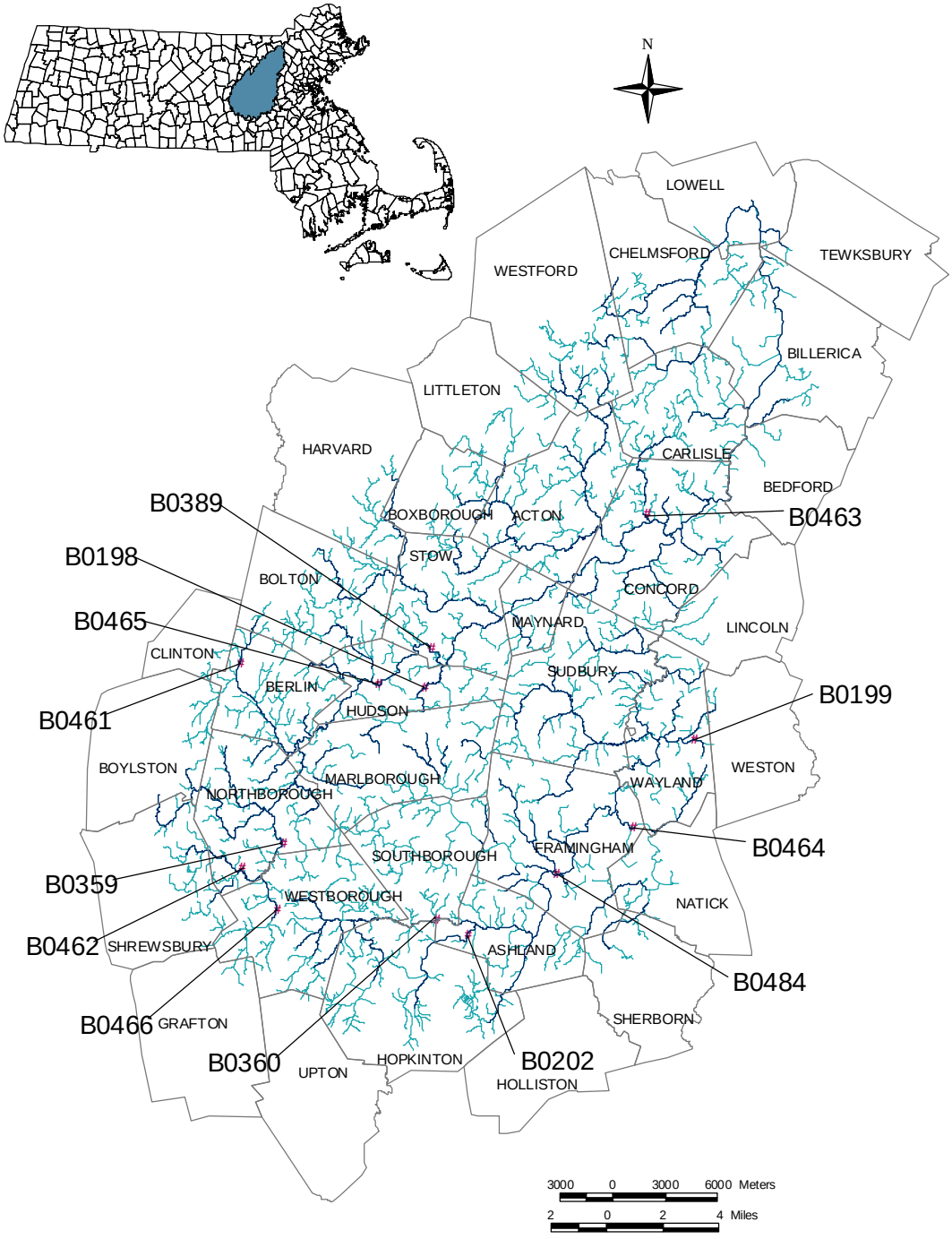


Figure 1. Location of stream sites where aquatic macroinvertebrate samples were collected in 2001 from the upper Concord River Watershed (Sudbury River and Assabet River basins).

Methods

As described in the Quality Assurance Project Plan (QAPP; DWM 2001) and standard operating procedures (Nuzzo 2003), aquatic macroinvertebrates were collected from wadable riffle habitat sites by kicking bottom substrates to dislodge the organisms. A kick-net with a 500 μm mesh bag, pressed firmly against the stream bottom just downstream from the kicked area, was used to capture the organisms released to the current. Samples were composites of 10 kicks taken from approximate 0.46 m by 0.46 m areas (about 2 m^2 total) of riffle habitat within a 100 m reach. Samples were preserved in the field with denatured 95% ethanol, then brought to the DWM lab for processing. Before leaving the sample reach, habitat data were recorded on field sheets and habitat qualities were scored using a modification of the evaluation procedure in Plafkin, et al. (1989). Sampling was conducted at 13 sites in the Assabet River and Sudbury River basins of the watershed from 2 July through 19 July 2001.Processing the benthos samples entailed extracting a count-based subsample from randomized grids within sorting pans. Specimens were sorted from the other materials in the sample until approximately 100 organisms (±10%) were extracted. Only specimens qualifying as members of the following groups were counted toward the subsample:

- all aquatic Annelida;
- all aquatic Mollusca;
- aquatic macro Crustacea except Decapoda;
- aquatic Arachnida; and
- the aquatic life stages of Insecta, including adult Elmidae (Coleoptera) but excluding all other adult Coleoptera and all Hemiptera.

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) metrics and scores (Plafkin, et al. 1989). The modifications were: substitution of "reference site affinity" (RSA) for the Community Loss Index and elimination of the shredder/total ratio (no separate leaf-pack material was collected). The reference site affinity metric is a modification of Percent Model Affinity (Novak and Bode 1992). Instead of using the model's percentages for Oligochaeta, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Chironomidae, and "other," these percentages were taken from the reference site data. The RSA score is then calculated as:

$$100 - S(d \times 0.5)$$

where d is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBP III 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 if =65%. The whole suite of metrics used for the analysis were:

- Richness (the total number of different species present),
- HBI (Hilsenhoff Biotic Index, as modified in Nuzzo 2003; HBI is the sum of the products of the pollution tolerance values and the abundance of each of the taxa present divided by the total count in the subsample)
- EPT (sum of richness among the orders Ephemeroptera, Plecoptera, and Trichoptera),
- EPT/Chironomidae (ratio of total abundance among EPT taxa to total abundance among chironomid taxa),
- SC/FC (ratio of the proportion of sample that is represented by individuals that predominantly feed by scraping to those that feed primarily by filter-feeding),
- % Dominant (most abundant taxon as a percent of the assemblage; >25% is generally considered hyperdominant and indicative of a stressor impact),
- RSA (described above).

As a final step in sample processing, the sample remainder (the portion of the sample that was not encompassed in the subsampling) is scanned for taxa that were not encountered. Sometimes referred to as a "large/rare search," this helps give a fuller picture of the diversity of aquatic macroinvertebrates in the riffle habitats sampled. Though not part of the RBP analysis, this information can be useful in water resource management deliberations. This additional count of taxa (subsample richness plus the number of additional taxa encountered during the "large/rare search") is referred to here as apparent richness to distinguished it from the RBP Richness metric.

Results and Discussion

The Assabet River Basin

Eight locations in the Assabet River basin, including the reference site, were sampled in 2001; four of these were on the mainstem Assabet River. Habitat scores ranged from 136 to 184 out of 200 possible points (see Appendix A). Even the lowest scoring habitat among these sites was considered good enough to support an aquatic community as healthy as that of the reference site (Plafkin, et al. 1989). The list of taxa and their frequency in each of the samples can be found in Appendix B, Table B1. The benthos analysis resulted in all the sites in the Assabet drainage being classified *Slightly Impacted* or *Moderately Impacted* (Appendix B, Table B2).

NB (B0461)—North Brook, Berlin, MA

Habitat

The setting of this stream made it appear to be one of the better choices for a reference site in the upper Concord Watershed. Most of the upstream watershed was forested or agricultural land in Berlin, but a small portion of the drainage originated from a residential and commercial/industrial section of Clinton. The land surrounding the sample location off Alan Road in Berlin, MA was all forested.

No erosion or obvious nonpoint source (NPS) pollution problems were detected in the landscape surrounding the sample reach, though Alan Road and the railroad trestle were recognized as having such potential (mostly at upstream crossing points over tributary brooks). The stream width was about 3 m and the depth was fairly uniform at about 25 cm. The water was clear but had a slight tea color to it. The substratum composition throughout the reach was estimated as 10% bedrock, 40% boulder, 30% cobble, 10% pebble, and 10% gravel. Composition at kick sample points were similar but without bedrock (30% boulder, 40% cobble, 20% pebble, 10% gravel).

The trees in the riparian zone produced a canopy over 100% of the sample reach. The predominant trees present were *Acer rubrum* (red maple), *Fagus* sp. (beech), *Pinus strobus* (white pine), and *Betula* sp. (birch). The understory was essentially all herbaceous, with mosses, several species of ferns, *Symplocarpus foetidus* (skunk cabbage), and *Impatiens* sp. (jewel weed) most prominent. About half the sample reach was covered with instream vegetation; nearly all of it moss but with *Callitriche* sp. (water starwort) and liverworts present, also. No algae were observed.

All habitat parameters in the habitat assessment scored in the "optimal" range except Velocity-Depth Combinations, which scored as suboptimal. Any portion of the sample reach that might have been considered to qualify as "deep" was limited, but was probably mostly adequate for fish passage. The overall habitat score was 180/200.

Benthos

At the time of sample collection, stonefly nymphs were easily detected in the catch and sponges were observed on the underside of rocks. Consistent with the expectations for a "least impacted" reference site, the benthos data from the sample exhibited a number of attributes associated with good water quality. The total richness was high (34) as was the number of EPT taxa (13); and HBI (3.86) and % dominance (16%) were low. These indicate a well-balanced community dominated by pollution sensitive organisms. The assessment score for the reference was set at six points for each metric, giving a total of 42. A search of the portion of sample not included in the subsample yielded an additional four taxa: *Cordulegaster* sp. (Odonata), *Anchytarsus* sp. (Coleoptera), *Antocha* sp. (Diptera), and *Atherix* sp. (Diptera). If included, these taxa would have increased the total richness to 38.

The good quality habitat and the indications of a diverse and healthy aquatic macroinvertebrate community mark North Brook and its environs as an exceptional component of the upper Concord Watershed. As such it merits special consideration for protection.

ARW (B0466)—Assabet River, Westborough, MA

Habitat

When conducting reconnaissance for sampling sites on 27 June 2001, the stretch of the Assabet River extending upstream for about 150 m from Fisher Street toward Mill Street was characterized as having excellent aquatic habitat. The riparian zone was, for the most part, wooded and reasonably well buffered from all but one house and yard at the Mill Street end of the reach. Riffles and cobble substrates predominated instream, making this an ideal location for application of the RBP sampling protocols. Upon returning to sample on 18 July 2001, however, water levels in the river had dropped substantially. Barely a trickle of water escaped the Nichols dam at the A-1 Impoundment, leaving a mostly dry streambed between Mill Street and Fisher Street, with shallow pools barely connected by very shallow, narrow bands of flowing water. These were, in fact, too shallow to sample with a kick-net.

Sampling was conducted, instead, immediately downstream from Fisher Street, where there was just enough riffle habitat with sufficient depth to allow water to flow through the kick-net. Substrates in these riffles were characterized as 60% cobble, 20% pebble, and 20% sand and gravel. While no obvious signs of erosion were detected, there were deposits of sand instream—presumably with origins farther upstream. Some trash, probably tossed from the Fisher Street bridge, littered the reach. The water here lacked any obvious turbidity or color.

The riparian zone of both banks was wooded with mixed hardwoods, producing a canopy that was about 75-80% closed over the stream. There was a well-developed shrub layer that was extensively covered with grape vines (*Vitis* sp.). Moss was the only instream vegetation and covered only about 10% of the sample reach.

The habitat score demonstrated that the biggest habitat problem was related to low water. Cover for fish was virtually unavailable (although some small bullheads were caught in the kick-samples) in the shallow water. Velocity depth patterns were reduced to two (shallow/fast and shallow/slow), resulting in a score in the *Marginal* category. Channel flow status also scored as *Marginal* because only about a quarter of the channel had water in it. The total habitat score was 138 out of 200.

Benthos

With Richness of only 12 (35% of the reference), an EPT index of 7 (little more than half that of the reference station, and lacking Plecoptera—stoneflies), and an increase in the HBI relative to the reference station suggest this site may be under stress from organic enrichment. The total assessment score was 24, which was 62% of the possible total score of 42, placing this site in the category of *Slightly Impacted*. As this site had one of the lowest habitat scores, and clearly has

substantial fluctuations in flow volume, it is likely that the indications of ecosystem stress result from the combined effects of enrichment, habitat, and flow fluctuations. A post-processing search of the remainder sample turned up isopods (scuds) and hydrachnids (water mites), increasing the apparent richness to 14.

HB (B0462)—Hop Brook, Northborough, MA

Habitat

Hop Brook drains portions of eastern Shrewsbury and western Northborough to Smith Pond in Northborough, MA. From the Smith Pond dam at Otis Street, Hop Brook flows through an old stone mill sluice for about 50 m before abruptly forming a pair of reflexed bends (an "S" curve). The remaining 2 km (1.2 mi.) of the brook's course to the Assabet River is through a very low gradient, wetland landscape. Sampling for aquatic macroinvertebrates was conducted in the riffles amid the initial pair of bends in the brook downstream from Smith Pond. There was some slight erosion observed, particularly near the top of the reach along the southern bank. Trash littering the sample (mostly scrap wood) and the presence of geese upstream from Otis Street suggested potential sources of NPS pollution. The water did not appear to be colored but was slightly turbid. The substratum composition for the reach as a whole was estimated as 10% boulder, 20% cobble, 40% pebble, and 30% sand and gravel. The composition in the kick-sample areas was characterized the same except no boulders were encountered and cobble was about 30%.

The riparian zones were wooded, mostly with *Fraxinus* sp. (ash) and *Acer* sp. (maple), forming a canopy over about 85% of the stream. The underlying woody species included *Sambucus* sp. (elderberry), *Rosa* sp. (rose), *Vitis* sp. (grape), and *Rhus radicans* (poison ivy). Included among the herbaceous cover were ferns, *Symplocarpus foetidus* (skunk cabbage), *Lythrum salicaria* (purple loosestrife), *Typha* sp. (cat-tail), and *Sparganium* sp. (bur-reed). Only about 20% of the reach was covered by instream vegetation; about half of that was moss and the remainder was submergent rooted species, including *Myriophyllum* sp. (water milfoil), *Elodea* sp. (waterweed), and *Callitriche* sp. (water starwort). Some *Lemna* sp. (duckweed) was observed on the water's surface.

All the habitat features covered by the habitat assessment scored within the *Optimal* range. The total habitat score was 183/200.

Benthos

During sample collection crayfish and sponges were observed in the reach. Analysis of the sample produced results for Richness, HBI, EPT, and RSA that were deficient in comparison to the reference site. The total RBP score for this site was 30, which fell in the range for *Slightly Impacted*. Given how good the habitat was in this reach it is somewhat surprising that the RBP results weren't more comparable to the reference. This may be a warning signal of possible NPS impacts from the impoundments and/or land uses in Hop Brook's watershed.

The post-processing visual scan of the sample turned up specimens of Zygoptera (damselflies) and Limnephilidae (a family of case-building caddisflies), boosting the apparent richness to 24.

ARN (B0359)—Assabet River, Northborough, MA

Habitat

Between Maynard Street in Westborough and School Street in Northborough the Assabet River flows through an extensive wetland corridor, picking up flow from the Westborough/Shrewsbury wastewater treatment plant (WWTP) as well as from Hop Brook and several small tributaries. Through much of the year the Westborough/Shrewsbury WWTP contributes the major portion of the river's volume in this stretch. From the WWTP to School Street the river is fairly uniformly wide and slow-moving.

Kick-samples for aquatic macroinvertebrates were collected just downstream from the School Street bridge, where the gradient increased enough over a short distance to create riffle habitat. Through this stretch of riffle substratum composition was estimated as 40% boulder, 40% cobble, and 20% gravel and sand. The surrounding land use was characterized as 40% forested, 30% residential, and 30% recreational (golf course). There were no obvious signs of erosion problems and the road and golf course were identified as having NPS pollution potential—although along the sample reach the golf course was separated from the river by a fence and a vegetated buffer zone (a little farther downstream the river flows right through the golf course). The water had a "treated sewage" odor, was slightly turbid, and had a moderately dense greenish-brown color.

Trees and shrubs produced a canopy over about 80% of this constricted section of the river, in spite of accounting for only 10% and 20% of the riparian vegetation, respectively. This was due to being concentrated along the margins of the stream. The 70% that was herbaceous growth was mostly beyond the shrubby cover lining both banks. Mowing of herbaceous cover on both banks to within 6-12 m of the stream resulted in substantially reduced points for riparian vegetative zone width when calculating a habitat score for this site. No instream vascular plants or algae were observed within the sample reach.

Though the epifaunal substratum composition in the riffles was "optimal," sediment deposition and embeddedness scored in the "suboptimal" range. This implies an unfavorable impact on the suitability of the substratum to support a diverse community of benthic invertebrates by virtue of diminishing substrate heterogeneity and reducing the median particle size (Minshall 1984). Channel alteration also scored as suboptimal, though in this case it is likely that the bridge abutment and riprapping were mainly responsible for the presence of riffle habitat here. The total habitat score was 154/200.

Benthos

Richness was lower here than at the reference station, and the EPT index was among the lowest from the survey. At that, 49 of the 51 EPT individuals were the filter-feeding hydropsychid caddisflies—*Hydropsyche betteni* (27% of total) and *Cheumatopsyche* sp. (24% of total). Though the constituents of the EPT orders are typically pollution intolerant organisms, the hydropsychids tend to have moderate pollution tolerances and tend to proliferate when there is a rich supply of suspended organic matter. This is reflected in the increased HBI (5.35), indicating a moderate stress from organic enrichment. Though all of these metrics point to enrichment-related water quality degradation, the assessment score placed this site in the *Slightly Impacted* category. This result is not as bad as might have been expected, considering the proportion of the river's flow that is from wastewater.

No additional taxa were enumerated as a result of the large/rare search.

ARH (B0465)—Assabet River, Hudson, MA

Habitat

In the 50 m immediately below Broad Street in Hudson, MA there was sufficient wadable riffle habitat to allow application of the RBP III sampling protocol. This location (coupled with station ARS on the downstream side) served as an upstream bracket on the Hudson WWTP. The river was about 15 m wide here. The water depth ranged from about 0.5 m to 0.75 m, with the deepest water encountered along the margin.

The land use in the surrounding riparian areas was 90% residential (though a little farther upstream land use is at least 50% commercial/industrial) and the remaining 10% woodlot. Canopy cover was essentially 0%. There was slight erosion observed at this site, as well as obvious indications of NPS pollution (yard waste from some of the adjacent residences, evidence of run-off from the road and bridge abutment areas). Instream there were prominent deposits of

sand and trash. The substratum composition throughout the reach was estimated as 5% boulder, 30% cobble, 5% pebble and gravel, 50% sand, and 10% silt. By contrast, the composition where the actual kick-samples were taken was 10% boulder, 50% cobble, 10% pebble and gravel, 20% sand, and 10% silt.

Riparian zone vegetation was mostly herbaceous, primarily grasses, *Lythrum salicaria* (purple loosestrife), and *Peltandra viginica* (arrow arum). Woody cover was restricted, but included *Salix* sp. (willow), *Pinus strobus* (white pine), *Rhus typhina* (sumac), and *Vitis* sp. (grape). The stream bottom was about 70% covered with aquatic vegetation, most of it rooted submergent forms such as *Potamogeton* sp. (pondweed), *Elodea* sp. (waterweed), *Myriophyllum* sp. (water milfoil), and *Callitriche* sp. (water starwort). Mosses and rooted emergent aquatic plants were also present, as were the free-floating *Lemna* sp. (duckweed) and *Wolffia* sp. (watermeal). Filamentous and thin-film green algal growth covered about half the area of the reach.

The habitat scoring indicated that habitat quality suffered most from channelization, moderate deposition of sand, and having a riparian vegetative zone with limited protective capabilities due to human activities. The overall habitat score was 136/200.

Benthos

As with the preceding upstream station (ARN), total and EPT richness were low in this sample, and the filter-feeding caddisfly *Hydropsyche betteni* was again hyperdominant (35% of the total). In addition, the HBI was high (the highest of any of the stations in the survey) and the ratio of scrapers to filtering collectors was low compared to the reference station, or even the next upstream station. This indicated a more degraded condition than upstream and resulted in a lower overall RBP score and an assessment of *Moderately Impacted*, again with organic enrichment implicated.

No additional taxa were enumerated as a result of the large/rare search.

ARS (B0389)—Assabet River, Stow, MA

Habitat

As the Assabet River flows from Hudson it receives the effluent from the Hudson WWTP. Entering Stow the river flows into an impounded wetland before wrapping around Orchard Hill to spill over the dam and flow past the Gleasondale Mill. In so doing, the river changes its direction of flow from mostly northeasterly (on the west side of Orchard Hill) to just about due south (on the east side of Orchard Hill and Gleasondale Mill). From the dam to Route 62 the river has a steep enough gradient to create a continuous, fast-flowing riffle reach, with the wall of the mill on one side and a wooded bank on the other. When the river passes under Route 62 it bends sharply to the east, the flow velocity slows way down, and the river widens. Sampling was conducted just upstream from Route 62 (about 5.6 km, or 3.5 mi, downstream from ARH). Several residences were located on the east bank just beyond the top of the sample reach. No evidence of erosion was detected within the sample reach but the adjacent mill and nearby road crossings were acknowledged as potential nonpoint sources of pollution. The river was about 12 m wide here, with depths between 0.25 m and 0.5 m. Bottom substrates were a good mix of boulder, cobble, and pebble, with sand and gravel accounting for only about 10% of the total. There was some coating of substrates with fine particulate organic matter (FPOM), but most of the organic substrate material was coarse particulates (CPOM). There was no color to the water and no surface oils, but a sewage odor was detected and the water was slightly turbid.

The trees, mostly silver maple (*Acer saccharinum*), along the east bank produced a canopy over about 50% of the stream channel. Other conspicuous woody vegetation included sumac (*Rhus typhina*), grape (*Vitis* sp.), and poison ivy (*Rhus radicans*). The remainder of the riparian zone vegetation appeared primarily to be moss and loosestrife (*Lythrum salicaria*). Instream vegetation was present in roughly 70% of the sample reach. About 10% of this vegetation was

rooted emergent forms, such as arrow arum (*Peltandra virginica*) and pickerelweed (*Pontederia cordata*); 70% were rooted submergents such as *Potamogeton* sp.*, Myriophyllum* sp.*,* and *Elodea* sp. The free-floating *Lemna* sp. could be seen over about 20% of the sample reach at any given moment. Thin film green algae were found on rocks in less than 5% of the sample reach.

The bottom substrates, current velocity, and the availability of benthic habitat (minimal amounts of exposed bottom substrate) made for excellent habitat for aquatic macroinvertebrates. The only deficiencies reflected in the habitat score had to do with the channelization of the reach and the restriction of riparian vegetation as a result of human activities. The overall habitat score for this sampling site was 150/200.

Benthos

Most of the metrics for these data were comparable to the next upstream site (ARH). Nearly all the metrics (the EPT/Chironomidae abundance ratio being the exception) indicated this site was still degraded compared to the reference station, and indeed the RBP score ranked it as *Moderately Impacted*.

No additional taxa were enumerated as a result of the large/rare search.

FMB (B0198)—Fort Meadow Brook, Hudson, MA

Habitat

Sampling was conducted in a stretch of this stream where it flows between Gospel Hill and Whitney Hill. When this site was sampled in 1996 it was observed that it appeared that house lots were being cleared along the brook. In fact, in 2001 we observed three new homes along or at the head of the sample reach. These residential properties accounted for about 30% of the surrounding land use, the remainder was forest. There were no signs of erosion, though there were deposits of sand on the stream bottom. Obvious sources of NPS pollution were debris related to yard grooming/maintenance. No water odors, color, or turbidity were detected. The stream was about 4 m wide and depths ranged from about 0.25 m to 0.30 m. The substratum composition throughout the reach was estimated as 20% boulder, 10% cobble, 10% pebble, 10% gravel, and 50% sand. Within the actual kick sample areas, however, the composition was 50% boulder, 30% cobble, 10% pebble and gravel, and 10% sand.

Trees provided a canopy over about 95% of the stream channel in the sampling reach. The most conspicuous trees were ash (*Fraxinus* sp.), red maple (*Acer rubrum*), oak (*Quercus* sp.), and white pine (*Pinus strobus*). Elderberry (*Sambucus* sp.) was the only shrub recorded and the herbaceous layer was overwhelmingly ferns, though some skunk cabbage (*Symplocarpus foetidus*) was also noted. Instream vegetation covered only about 5% of the sample reach, and all of it was mosses and liverworts.

Stable instream fish cover was limited to approximately 30% of the reach but epifaunal substrates were generally pretty good. Deposition of sand and the associated embeddedness of substrates compromised the habitat potential of the larger substrates. Disruption of the riparian zone along the north bank where the residential development has taken place is reflected in the low scores for bank vegetative protection, bank stability, and riparian vegetative zone width. The overall habitat score was 140/200.

Benthos

Richness, EPT, % Dominance, and RSA were the metrics that lost points in the RBP evaluation of this site. For the most part the degree of degradation indicated was mild. The RBP score ranked this site as *Slightly Impacted*.

The large/rare search detected an aeshnid dragonfly nymph and a nematode. Only the dragonfly would be counted toward richness so the apparent richness is increased from 22 to 23.

SB (B0463)—Spencer Brook, Concord, MA

Habitat

The section of Spencer Brook between Angiers Pond and Barrett's Mill Road was slated for sampling in 1996 but had to be dropped when, on the July sampling date, it was discovered the streambed was nearly 100% exposed (i.e., water could only be found in a few isolated puddles in this reach). When sampled on 3 July 2001 there was sufficient water present to cover the 4 m wide channel and provide a depth of from 0.5 m to 0.75 m. The land surrounding the sample reach was all forested, with no evidence of erosion or NPS pollution inputs.

The streambed in the reach was dominated by cobble and boulder (together 75-80% of the composition) and large woody snags contributed notably to available fish cover. The water had no detectable odors but there was a tea-stained color to it as well as a slightly turbid appearance.

There was a tree canopy over about 95% of the stream channel. Trees noted in the surrounding landscape included birch (*Betula* sp.), white pine (*Pinus strobus*), red maple (*Acer rubrum*), and elm (*Ulmus* sp.). As components of the understory, elderberry (*Sambucus* sp.), ferns, moss, and skunk cabbage (*Symplocarpus foetidus*) were recorded. About 60% of the reach had aquatic vegetation. Most of the aquatic vegetation was mosses but water milfoil (*Myriophyllum* sp.) and duckweed (*Lemna* sp.) were also present. No algae were seen.

The features of this sample reach led to optimal ratings in all the habitat categories except embeddedness—which was just high enough to make it fall into the suboptimal category. This embeddedness may indicate run-off problems upstream of the sample reach (though no potential problem areas, other than the road crossing at the dam, were noted at the time of sampling). The habitat ranking for this site was one of the two best encountered during the 2001 survey of the upper Concord Watershed. The overall habitat score was 184/200.

Benthos

HBI, EPT, and the EPT/Chironomidae ratio were the most strongly affected metrics for this site. Total richness and the SC/FC ratio, though, were sufficiently lower than at the reference site to result in point reductions. The RBP ranking for this site was *Slightly Impacted*. The relatively high HBI and the relatively low EPT index—and the fact that not a single mayfly (Ephemeroptera) or stonefly (Plecoptera) was among the five EPT taxa—however, appears to be a strong signal for organic enrichment and potential adverse impacts on the aquatic biota.

The Sudbury River Basin

Five locations in the Sudbury River basin were sampled in 2001; two of these were on the mainstem Sudbury River. Habitat scores ranged from 165 to 185 out of 200 possible points (see Appendix A). These scores were comparable to the reference site, indicating that habitat quality should not be regarded as a limiting factor to the development of an aquatic community as healthy as that of the reference site (Plafkin, et al. 1989). The analysis of the benthic macroinvertebrate samples from the Sudbury drainage resulted in a rating of *Moderately Impacted* for two sites and *Slightly Impacted* for the other three (Appendix B, Table B2).

SRH (B0360)—Sudbury River, Hopkinton, MA

Habitat

Approximately four kilometers downstream from where the Sudbury River exits Cedar Swamp and emerges from under Interstate 495, this was the farthest upstream station sampled in the Sudbury River drainage. For much of this distance the river is very low gradient (no more than

about 0.2%) with a wetland floodplain. The sample reach, however, was a segment between the outlet of a small impoundment and Route 85 where the gradient became steeper (1%) where the river was wadable and there was good riffle habitat with large substrates (nearly all cobble and boulder). The surrounding land use was mostly described as forested (60%) but the adjacent roadway encroached considerably on the riparian zone of one bank, representing about 40% of the total riparian zone area along the sample reach. No signs of erosion were detected in the reach but the adjacent roadway and upstream construction activities were identified as having potential as sources of NPS pollution. The water was turbid but no odors were detected. The river was about 3 m wide and water depths were generally between 0.2 m and 0.4 m.

The trees in the riparian zone produced a canopy cover of about 95%. The trees present were predominantly ash (*Fraxinus* sp.), maple (*Acer* sp.), and birch (*Betula* sp.). Shrubs and other woody vegetation included elderberry (*Sambucus* sp.), grape (*Vitis* sp.), and poison ivy (*Rhus radicans*). Herbaceous cover recorded from the riparian zone was ferns and cardinal flower (*Lobelia cardinalis*). The only instream vegetation was moss, but it covered about 85% of the reach. No algae were observed.

The habitat assessment rated all but three parameters as optimal. Scores in the suboptimal range were given for channel alteration (because of past channelization and bank reinforcement), velocity-depth combinations (one of the four categories was restricted or absent), and riparian vegetative zone width (the road encroached to within 18 m along one side of the river). Overall this was very good riffle habitat for both fish and aquatic invertebrates and received a total score of 179/200.

Benthos

Due to an elevated HBI, reduced total and EPT richness, and hyperdominance (by a filter-feeding caddisfly, *Chimarra* sp.), this site ranked no better than *Slightly Impacted*. Next to the reference station, however, this site had the highest EPT index and was the only site in this survey to score any points for the EPT index. Nevertheless, these findings should be regarded as signals of potential long-term threat from organic enrichment.

Crayfish and sponges were observed while sampling at this station. The large rare search on the processed sample resulted in detection of the following additional qualifying taxa: Hydrachnidia (aquatic mite), a very large Corydalidae (hellgrammite), *Promoresia* sp. (an elmid beetle), and a tipulid (cranefly). Adding these to the richness metric would give an apparent richness of 27.

IB (B0202)—Indian Brook, Ashland, MA

Habitat

The sampling site on this brook was within 400 m downstream from Cross Street in a segment of steep gradient with a series of cascading riffles and small plunge pools. It was set in a forested landscape without evidence of damming or channel alteration except for the small wooden bridge (perhaps strong enough to support an automobile) built across it. The stream was about 4 m wide and water depths varied from 0.25 m to 0.5 m. No evidence of erosion or NPS problems was detected, but the upstream road crossings and nearby new home construction were noted as having NPS pollution potential. The water had no detectable odors, was clear, and had no discernable color. Boulders and cobble accounted for about 80% of the bottom substrate materials.

Riparian zone trees included maple (*Acer* sp.), birch (*Betula* sp.), ash (*Fraxinus* sp.), and hemlock (*Tsuga canadensis*). The only woody growth recorded in the understory was poison ivy (*Rhus radicans*). Components of the ground cover were ferns, Japanese knotweed (*Polygonum cuspidatum*), skunk cabbage (*Symplocarpus foetidus*), and moss. Instream moss was the only vegetation, covering roughly 50% of the reach. No algae were seen.

Each category of the habitat assessment scored in the optimal range, giving this site the highest score for any of the sample sites in the 2001upper Concord Watershed survey. The overall score was 185/200.

Benthos

Indian Brook had the lowest HBI (higher values indicate organic enrichment) of any of the sites in this survey, including the reference. The total richness was among the highest of the sample sites but was still only 68% of the reference site richness, and EPT was less than half that of the reference site. The scraper to filter-feeder ratio (SC/FC) was relatively low and the capniid stoneflies were hyperdominant. In spite of the fact the scores for these metrics were reduced enough to result in a RBP ranking of *Slightly Impacted*, the low HBI and the hyperdominance by a sensitive stonefly (Capniidae) known to sometimes occur in high densities indicate that organic enrichment is not likely as a problem here. In fact, field notes indicate that there may have been a problem with sampling efficiency because of the number of large, difficult to move/difficult to sample, boulders.

SRF (B0484)—Sudbury River, Framingham, MA

Habitat

Within about 300 m downstream from Winter Street and the Sudbury Reservoir #1 (Stearns Reservoir) dam was a stretch of the river that was within a wooded landscape with fast-flowing current and coarse substrates (5% boulder, 40% cobble, 30% pebble, and only 25% sand and gravel). About 40% of the organic particulates were fines (FPOM) that coated the substrates. There was no indication of erosion or NPS inputs from the land areas adjoining the sample site. The river was about 6 m wide with depths of from 0.25 m to 0.35 m in the riffles/runs and up to 0.5 m in the pools. No odors were associated with the water here but it was slightly turbid.

Oak (*Quercus* sp.), white pine (*Pinus strobus*), and ash (*Fraxinus* sp.) populated the riparian zone and contributed to the canopy reaching over roughly 70% of the channel. Elderberry (*Sambucus* sp.) and grapes (*Vitis* sp.) were the only woody components of the understory, while the herbaceous cover was mostly jewelweed (*Impatiens* sp.), loosestrife (*Lythrum salicaria*), and moss. The instream vegetation was milfoil (*Myriophyllum* sp.) but that was present in no more than 5% of the sample reach. No algal growths were seen.

The habitat scoring identified three deficiencies. Stable fish cover (marginal) was present in only about 30% of the area, sediment deposition (suboptimal) affected more than 5% of the area, and only two velocity/depth combinations (marginal) were observed. All other habitat characters scored in the optimal range. The total habitat score was 166/200.

Benthos

In the field this site was impressive because of the abundance of large bryozoan colonies, sponges, unionid mussels, pisidiid clams, and hydropsychid caddisflies. Based on analysis of the sample, degradation of water quality at this site was indicated by the high HBI, low richness, low EPT index, and low SC/FC ratio, along with hyperdominance of both *Hydropsyche betteni* (37%) and pisidiid clams (30%). The preponderance of filter feeding organisms (82%) in the sample and the high HBI, in particular, are classic traits of lotic communities downstream from productive impoundments. The RBP scoring ranked this site as *Moderately Impacted.*

No additional taxa were picked up from the large rare search.

LCA and LCB (B0464)—unnamed stream connecting Lake Cochituate outlet to Sudbury River, Framingham, MA

Habitat

Lake Cochituate drains to the Sudbury River via an unnamed stream (about 2.3 km—1.4 mi.—from lake outlet to confluence with the Sudbury) flowing between the north side of Massachusetts Turnpike (I-90) interchange 13 and a residential area in Framingham, MA. The sample reach was about 150 m downstream from the lake outlet, the width was roughly 5 m, and the depths ranged from around 0.3 m to 0.5 m. The reach was essentially a long riffle/run of varying depths, with better riffle habitat near the top of the reach. Bottom substrate composition over the entire reach was estimated to be 65% gravel and sand and only 35% pebble or larger materials. In the swift current where the kick samples were collected, however, the gravel and sand accounted for 40% of the bottom composition and cobble and pebble for 60%. The water had a fish odor and was slightly turbid. No color or surface oils were detected. Slight erosion was noted along both banks, and the highway interchange was acknowledged as having potential as a source of NPS contamination.

The riparian zone was mostly forested and produced a canopy extending above approximately 80% of the stream channel. Trees recorded from the riparian zone were red maple (*Acer rubrum*), oaks (*Quercus* sp.), white pine (*Pinus strobus*), and white birch (*Betula papyrifera*). The shrubs and vines present were elderberry (*Sambucus* sp.) and grapes (*Vitis* sp.). The ground cover consisted of mosses, ferns, grasses, and jewelweed (*Impatiens* sp.). No aquatic vegetation was found anchored in the sample reach but fragments of *Elodea* sp. did float through—presumably dislodged from somewhere in the lake. Thin-film green algae were observed on rocks in about 10% of the reach. All rated habitat parameters ranked in the optimal range except bank stability, which scored as suboptimal because of the observed small areas of erosion. The total habitat score for this site was 175/200.

Benthos

While in the field collecting this sample it was clear that the hydropsychid caddisflies were in very high densities. The sample was so overwhelmed with hydropsychid caddisfly larvae (92%) that two subsamples were picked. The second subsample was picked excluding all hydropsychids to reveal any attributes of the community structure or collective tolerance that might be masked by the extremely dense populations of hydropsychids.

The subsample including the hydropsychids—LCA—had the lowest richness encountered in the survey and the only EPT taxa found were hydropsychid species (*Hydropsyche betteni* and *Cheumatopsyche* sp.); the HBI was the second highest from the survey (the highest HBI being for its companion subsample, LCB); and it had the most extreme hyperdominance of the survey (*Hydropsyche betteni*—73% of the assemblage). Without including the hydropsychids (subsample LCB) the number of taxa counted almost doubled, but there were no other EPT taxa found and the HBI increased. The RSA values for these two subsamples were the lowest for the survey. Even with the hydropsychids excluded, one taxon (*Gammarus* sp.) emerged as hyperdominant (29%) over the other taxa present. The RBP score using just LCA was borderline *Moderately Impacted/Severely Impacted*. With the exclusion of the hydropsychids, LCB scored little better, but fell within the range for *Moderately Impacted*. Like the Sudbury River downstream from Winter Street, the dominance by filter feeders (and in this case, the exceptional hyperdominance by a single species of filter feeding caddisfly—*H. betteni*) and the high HBI values obtained for this site are characteristic of benthic communities in riffle habitats downstream from very enriched impoundments.

PB (B0466)—Pine Brook, Wayland, MA

Habitat

The sample reach was located in a forested landscape almost 200 m downstream from Pine Brook Road. This reach was away from the influences of artificial channel alterations and no evidence of erosion or NPS pollution in the surrounding area was observed. The upper reaches of this brook, however, historically have had NPS inputs (Nuzzo 1996)—most notably from a farm where cows had direct access to the headwater impoundment and were observed standing in the water (this was observed again in 2001).

At the sample reach the brook was about 2 m wide and very shallow, from less than 0.25 m up to 0.30 m deep. Substratum composition in the reach was much finer than the other sites in the survey: 70% was gravel or finer particles; whereas in the riffles areas actually sampled only about 45% of the substrates were gravel or smaller, 40% was pebble, and 15% was cobble. No odors, surface oils, turbidity, or color were detected from the water.

The canopy was completely closed (100% canopy) over the brook. The riparian zone trees were mostly slippery elm (*Ulmus rubra*), maple (*Acer* sp.), ash (*Fraxinus* sp.), and oak (*Quercus* sp.). In the understory were elderberry (*Sambucus* sp.), rose (*Rosa* sp.), and grape (*Vitis* sp.). Included among the non-woody ground cover were ferns, skunk cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens* sp.), and moss. Moss was the only instream vegetation but it covered less than 5% of the reach. Thin-film green algae were found attached to rocks, also in less than 5% of the reach.

Sediment deposition affecting almost 30% of the stream bottom led to a score in the low suboptimal range for that parameter. Velocity/depth combinations scored in the marginal range, due mainly to the fairly uniformly shallow water depth. All other habitat characters scored within the optimal range. The overall habitat score was 165/200.

Benthos

Though the total richness at this site was matched by four other sites for the second highest number of taxa present, it was still only 68% of the reference site's richness. The number of EPT taxa was less than a third of the reference site and there was slight hyperdominance (22% *Tvetenia bavarica gr.*). The RBP score for this site was in the range for *Slightly Impacted*. In a similar fashion to Spencer Brook (SB) in the Assabet drainage, the low EPT index (with an absence of Ephemeroptera and a paucity of Plecoptera) coupled with the relatively high HBI serve as a signal of organic enrichment and the potential for ensuing degradation.

Conclusions

The outcome of the 2001 biological assessment of the streams in the upper Concord Watershed is plotted against a proposed conceptual model that relates the response of aquatic communities to increasing human disturbance (Figure 2). It incorporates both the biological impact categories (non-, slightly, moderately, severely impacted) outlined in the RBP III biological assessment and the Tiered Aquatic Life Use (TALU) conceptual model developed by US EPA and refined by various state environmental agencies (US EPA 2003). The model summarizes the main attributes of an aquatic community that can be expected at each level of the biological condition category, and how these metric-based bioassessments can then be used to make aquatic life use determinations as part of the Clean Water Act, section 305(b) reporting process.

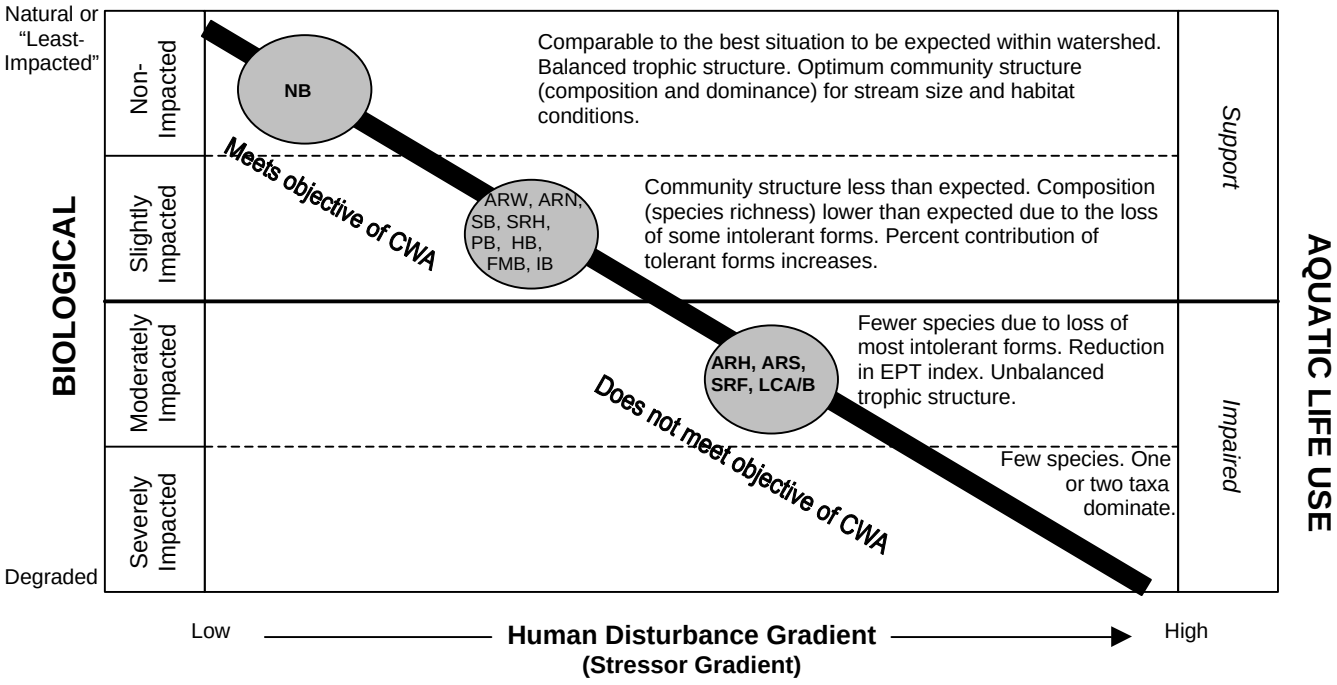


Figure 2. Tiered Aquatic Life Use conceptual model showing the status of the 2001 biomonitoring sites in the upper Concord Watershed.

Four sites—Assabet River in Hudson (**ARH**) and Stow (**ARS**), the Sudbury River in Framingham (**SRF**), and the unnamed Sudbury River tributary from Lake Cochituate (**LCA/B**)—in this survey were found to be *Moderately Impacted*, based on RBP analysis. For all of these, the attributes of the assemblages indicate impairment that is likely the result of organic enrichment. Organic enrichment was implicated at five additional sites—Assabet River in Westborough (**ARW**) and Northborough (**ARN**), Spencer Brook (**SB**), Sudbury River in Hopkinton (**SRH**), and Pine Brook (**PB**)—but these ranked as *Slightly Impacted*. These may be vulnerable to impairment if enrichment cannot be abated. Samples collected from SRH and SRF in 1986 and from ARW and ARN in 1987 are compared to 2001 RBP results in Table 2. The comparisons of the attributes of the assemblages at these sites do not show an appreciable, if any, difference in aquatic life status then versus now.

Three other sites were not as obviously showing signs associated with organic enrichment. Hop Brook in Northborough (**HB**) and Fort Meadow Brook in Hudson (**FMB**) were rated *Slightly Impacted*, which may represent an early indication that these sites are being impacted by NPS pollution problems, such as nutrients and sedimentation. The rating of Indian Brook (**IB**) as *Slightly Impacted* was more likely the result of the preponderance of large, immovable boulders and the difficulties they posed for sampling the stream bottom adequately.

North Brook in Berlin, MA (**NB**) was selected to serve as a reference site based on its appearance as a likely "least impacted" catchment within the upper Concord Watershed. The attributes of the aquatic macroinvertebrate assemblage collected there were, in fact, characteristic of a high quality stream. Coupled with the excellent quality of the instream habitat and surrounding landscape, these data identify North Brook and its catchment as worthy of special protection efforts.

Table 2. Comparison of aquatic macroinvertebrate community attributes from samples collected in 1986 or 1987 with those collected in 2001 at the same† Assabet River and Sudbury River sites.

	1986	2001	1986	2001	1987	2001	1987	2001
Macroinvertebrate Assemblage Attributes	SRH	SRH	SRF	SRF	As02	ARW	ARN	ARN
Richness	24	23	8	10	13	12	15	15
HBI	5.15	5.14	5.40	5.68	5.09	4.97	5.98	5.35
EPT	6	9	2	3	3	7	1	3
E	2	3	0	0	1	3	0	0
P	0	0	0	0	0	0	0	0
T	4	6	2	3	2	4	1	3
EPT/chironomid	15.25	2.15	11.00	12.50	8.86	4.42	0.05	4.25
%Dom	18%	27%	56%	37%	29%	20%	28%	27%
SC/FC	0.51	0.09	0	0.07	1	0.89	0	0.40
%FC	33%	66%	92%	82%	41%	39%	34%	63%

† SRF (Sudbury River, Framingham) was sampled ca. 200 m farther downstream in 2001 than in 1986; As02 (Assabet River, Westborough), sampled in 1987, was ca. 300 m downstream from ARW, sampled in 2001. The sites designated as SRH (Sudbury River, Hopkinton) and ARN (Assabet River, Northborough) were essentially the same sample locations in both 1986/1987 and 2001.

Literature Cited

DWM. 2001. Quality assurance project plan for 2001 benthic macroinvertebrate and habitat assessment. CN:63.0 Massachusetts DEP/Division of Watershed Management. Worcester, MA. 67 p.

Minshall, G.W. 1984. Aquatic insect-substratum relationships. *In:* V.H. Resh and D.M. Rosenberg. The ecology of aquatic insects. Praeger. New York, NY. p. 358-400.

Novak, M.A. and R.W. Bode. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. J. N. Am. Benthol. Soc. 11(1):80-85.

Nuzzo, R.M. 1987. 1986 Sudbury River MRB. Technical Memorandum 86-14. Massachusetts DEQE/Division of Water Pollution Control. Westborough, MA. 9 p.

Nuzzo, R.M. 1989. Assabet River Biomonitoring Survey. Technical Memorandum 87-6. Massachusetts DEQE/Division of Water Pollution Control. Westborough, MA. 7 p.

Nuzzo, R. 1996. SuAsCo watershed benthic macroinvertebrates. Technical Memorandum 82-7. Massachusetts DEP/Office of Watershed Management. Grafton, MA. 26 p.

Nuzzo, R.M. 2003. Standard operating procedures: Water quality monitoring in streams using aquatic macroinvertebrates. Massachusetts DEP/Division of Watershed Management, Worcester, MA. 35 p.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. U.S. Environmental Protection Agency. Washington, D.C. EPA/444/4-89-001. 174 p.

US EPA 2003. Using Biological Assessments to Refine Designated Aquatic Life Uses. Presented at the National Biological Assessment and Criteria Workshop: Advancing State and Tribal Programs. Coeur d' Alene, ID. 31 March-4 April 2003.

APPENDIX A

Habitat Assessment Scores

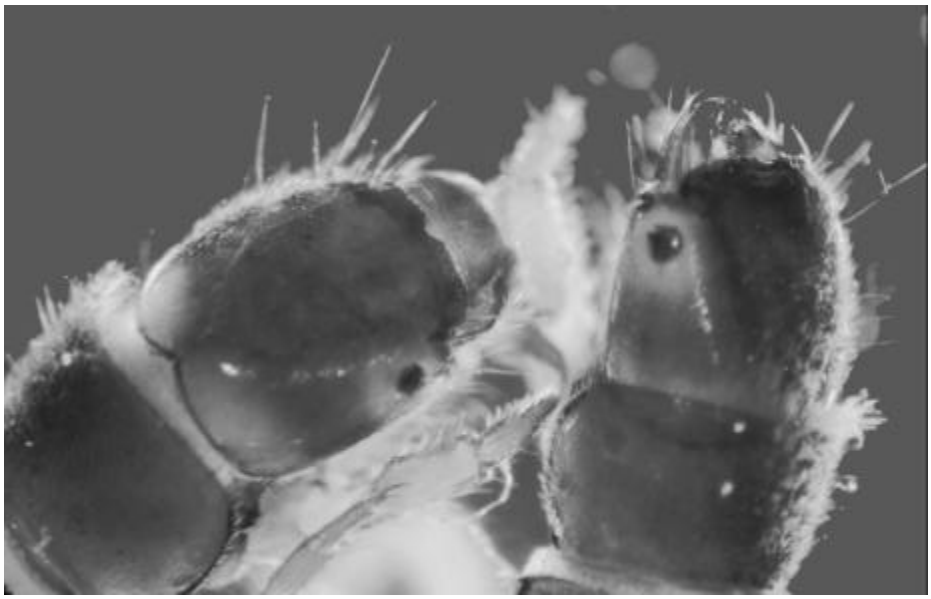
Table A1. Break-down of habitat assessment scores for 2001 upper Concord Watershed survey sites: North Brook, Berlin (NB); Assabet River, Westborough (ARW); Hop Brook, Northborough (HB); Assabet River, Northborough (ARN); Assabet River, Hudson (ARH); Assabet River, Stow (ARS); Fort Meadow Brook, Hudson (FMB); Spencer Brook, Concord (SB); Sudbury River, Hopkinton (SRH); Indian Brook, Ashland (IB); Sudbury River, Framingham (SRF); Lake Cochituate's outlet stream (LCA/B); and Pine Brook, Wayland (PB). All sites were in Massachusetts.

Description	NB†	ARW	HB	ARN	ARH	ARS	FMB	SB	SRH	IB	SRF	LCA/B	PB
Instream Cover (fish)—20 pts.	16	3	18	16	14	17	12	19	19	18	10	16	16
Epifaunal Substrate—20 pts.	18	13	17	16	16	18	16	19	20	18	19	17	16
Embeddedness—20 pts.	16	16	17	12	15	18	13	15	18	18	17	15	16
Channel Alteration—20 pts.	20	16	19	14	9	9	20	20	15	20	20	18	20
Sediment Deposition—20 pts.	18	15	16	14	10	16	10	18	19	17	14	18	12
Frequency of Riffles—20 pts.	13	8	18	16	16	14	10	16	15	17	10	16	10
Channel Flow Status—20 pts.	20	7	19	19	18	18	19	20	18	17	17	20	16
Bank Vegetative Protection-Left Bank—10 pts.	10	10	10	10	9	8	3	10	10	10	10	10	10
Bank Vegetative Protection-Right Bank—10 pts.	10	10	10	10	10	10	10	9	10	10	9	10	10
Bank Stability-Left Bank—10 pts.	10	10	10	10	8	10	6	9	10	10	10	8	10
Bank Stability-Right Bank—10 pts.	10	10	9	10	9	10	9	9	10	10	10	8	9
Riparian Vegetative Zone Width-Left Bank—10 pts.	9	10	10	3	1	1	2	10	9	10	10	9	10
Riparian Vegetative Zone Width-Right Bank—10 pts.	10	10	10	4	1	1	10	10	6	10	10	10	10
Total Habitat Score (200 possible)	180	138	183	154	136	150	140	184	179	185	166	175	165

† North Brook (NB) used as reference site.

APPENDIX B

Benthic Macroinvertebrate Data



Specimens of *Cheumatopsyche* sp., a net-spinning caddisfly (Order: Trichoptera; Family: Hydropsychidae) commonly encountered in the upper Concord Watershed.

Table B1. Benthic macroinvertebrate taxa list, counts, and metric values from the 2001 upper Concord Watershed biomonitoring survey: North Brook, Berlin (NB); Assabet River, Westborough (ARW); Hop Brook, Northborough (HB); Assabet River, Northborough (ARN); Assabet River, Hudson, (ARH); Assabet River, Stow (ARS); Fort Meadow Brook, Hudson (FMB); Spencer Brook, Concord (SB); Sudbury River, Hopkinton (SRH); Indian Brook, Ashland (IB); Sudbury River, Framingham (SRF); sample split "A" from Lake Cochituate outlet stream, Framingham (LCA); sample split "B" from Lake Cochituate outlet stream, Framingham (LCB); Pine Brook, Wayland (PB). All sites were in Massachusetts.

FinalId	FFG	TV	NB†	ARW	HB	ARN	ARH	ARS	FMB	SB	SRH	IB	SRF	LCA	LCB	PB
Hydrobiidae	SC	8			1										2	
Valvata sp.	SC	8								1						
Valvata piscinalis	SC	8					1	3								
Physidae	GC	8			1		1								3	
Helisoma sp.	SC	6								1					1	
Pisidiidae	FC	6	7		2	2	1	32		20	5	5	30	1	11	
Lumbricina	GC	8														2
Enchytraeidae	GC	10							1							
Nais behningi	GC	6	5			1				2	1	3				2
Nais communis	GC	8									1					2
Ophidonais serpentina	GC	6								2						
Slavina appendiculata	GC	6						1								
Tubificidae IWB	GC	10													2	
Lumbriculidae	GC	7	3	3		1		1	1	2						7
Eclipidrilus sp.	GC	5						1								
Hirudinea	GC	7									1					
Erpobdellidae	PR	8					1									
Asellidae	GC	8													1	
Caecidotea communis	GC	8								1						
Crangonyx pseudogracilis	GC	8						1								
Gammarus sp.	GC	6								4			7	4	28	
Hyalella azteca	GC	8			1	1	1			9						
Hydrachnidia	PR	6	2													2
Baetis (subeq. term.) sp.	GC	6						4								
Baetidae (cerci only)	GC	6									1	1				
Baetidae (short term. fil.)	GC	6		3			21	1								
Baetidae (subeq. term.)	GC	6	1	5	2						3					
Stenonema sp.	SC	3	2	9												
Isonychia sp.	GC	2			1						1					
Leptophlebiidae	GC	2	1									1				
Tricorythodes sp.	GC	4					1									
Plecoptera	GC	3														1
Capniidae	SH	1										27				
Leuctra sp.	SH	0	15													
Peltoperlidae	SH	0	1													
Acroneuria sp.	PR	0	1													
Perlodidae	PR	2										1				
Nigronia sp.	PR	0	1							1		3				

Table B1. Benthic macroinvertebrate taxa list . . . 2001 upper Concord Watershed . . . (Continued.)

FinalId	FFG	TV	NB†	ARW	HB	ARN	ARH	ARS	FMB	SB	SRH	IB	SRF	LCA	LCB	PB
Nigronia serricornis	PR	0			1											
Micrasema sp.	SH	2	1													
Glossosoma sp.	SC	0							1							
Cheumatopsyche sp.	FC	5	3	8	8	23	12	6	9	16	4		9	20		
Diplectrona modesta	FC	0														1
Hydropsyche sp.	FC	4						2	6			3				
Hydropsyche betteni	FC	6		11	12	26	37	6		3	8		37	80		12
Hydropsyche morosa gr.	FC	6	4					14			7					
Hydroptilidae	GC	4	1								1					
Hydroptila sp.	GC	6					3									
Mayatrichia sp.	SC	6									5					
Oxyethira sp.	GC	3								1						
Lepidostoma sp.	SH	1	1			2		1								
Leptoceridae	PR	4			2											
Oecetis sp.	PR	5								1						
Pycnopsyche sp.	SH	4		1					1							
Chimarra sp.	FC	4		16	7			17	7	1	26		4			
Dolophilodes sp.	FC	0	5													3
Psychomyia sp.	GC	2					1									
Rhyacophila sp.	PR	1	3													
Rhyacophila fuscula gr.	PR	1										2				
Neophylax sp.	SC	3			1		2									
Microcylloepus sp.	GC	3									3					
Microcylloepus pusillus	GC	3			1											
Optioservus sp.	SC	4	4		13			1	8							
Optioservus ampliatus	SC	4				5										
Oulimnius latiusculus	SC	4		5	9							1	6			4
Promoresia sp.	SC	2							24			2				
Promoresia tardella	SC	2	5													4
Stenelmis sp.	SC	5		18	16		5		18	10	1					
Stenelmis crenata	SC	5				19										
Ectopria nervosa	SC	5	1									5				
Psephenus herricki	SC	4			3											
Culicoides sp.	SC	10	1													
Chironomini	GC	6				1									1	
Glyptotendipes sp.	SH	10												1	2	
Microtendipes pedellus gr.	FC	6				1										
Microtendipes rydalensis gr.	FC	6	3													
Parachironomus sp.	PR	10													1	
Polypedilum aviceps	SH	4							1							1
Polypedilum flavum	SH	6		12	5	4	2			10	1		3	1	8	
Xenochironomus xenolabis	PR	0													1	
Micropsectra sp.	GC	7	8						1		1	3				3
Micropsectra/Tanytarsus sp.	FC	7								1		3				
Rheotanytarsus exiguus gr.	FC	6	1		1	5	9		1	18	1	1				8
Rheotanytarsus pellucidus	FC	5						1	1			1				

FinalId	FFG	TV	NB†	ARW	HB	ARN	ARH	ARS	FMB	SB	SRH	IB	SRF	LCA	LCB	PB
Tanytarsus sp.	FC	6	1						2		10					
Zavrelia sp.	FC	4	1						1			1				
Orthocladiinae	GC	5														1
Chaetocladius sp.	GC	6	1													
Corynoneura sp.	GC	4														1
Cricotopus bicinctus	GC	7						2								
Cricotopus/Orthocladius sp.	GC	7	2										1			
Eukiefferiella claripennis gr.	GC	8														3
Limnophyes sp.	GC	8													2	
Nanocladius sp.	GC	7			1										4	
Orthocladius sp.	GC	6					1									
Parametriocnemus sp.	GC	5	4		2				1	1	11					1
Paraphaenocladius sp.	GC	4														1
Rheocricotopus robacki	GC	5							1							
Thienemanniella xena	GC	6				1						1				1
Tvetenia bavarica gr.	GC	5	3		1				6	4	1	6				20
Tvetenia vitracies gr.	GC	5					4									
Conchapelopia sp.	PR	6							2		1					
Meropelopia sp.	PR	6								1						1
Trissopelopia sp.	PR	4								1		2				
Empididae	PR	6										1				
Chelifera sp.	PR	6	1													
Hemerodromia sp.	PR	6				1								1	12	
Simulium sp.	FC	5	1	1		3			3		4	13	1	1		10
Simulium verecundum cplx.	FC	5										9				
Simulium vittatum cplx.	FC	9					4	1							16	
Antocha sp.	GC	3						1					1			
Dicranota sp.	PR	3	2		2							1				
Tipula sp.	SH	6							1							1
Total			96	92	93	96	107	96	97	111	98	96	99	109	95	92
Station			NB	ARW	HB	ARN	ARH	ARS	FMB	SB	SRH	IB	SRF	LCA	LCB	PB
Richness			34	12	23	15	18	17	22	23	23	23	10	8	15	23
HBI			3.86	4.97	4.82	5.35	5.88	5.56	4.11	5.82	5.14	3.67	5.68	5.84	6.86	5.29
EPT			13	7	7	3	7	7	5	5	9	6	3	2	0	4
EPT/chiro			1.63	4.42	3.30	4.25	4.81	17.00	1.41	0.61	2.15	1.94	12.50	50.00	0.00	0.41
SC			13	32	43	24	8	4	51	12	6	8	6	0	3	8
FC			26	36	30	60	63	79	30	59	65	36	81	102	27	34
SC/FC			0.50	0.89	1.43	0.40	0.13	0.05	1.70	0.20	0.09	0.22	0.07	0.00	0.11	0.24
% Dominant			16%	20%	17%	27%	35%	33%	25%	18%	27%	28%	37%	73%	29%	22%
Ref. Site affinity (RSA)			100%	51%	52%	51%	51%	46%	53%	74%	64%	71%	44%	27%	38%	75%

† North Brook (NB) used as reference site.

Table B2. Summary of RBP metrics and final rankings for the 2001 upper Concord Watershed biomonitoring survey. Results are shown for: North Brook, Berlin (NB); Assabet River, Westborough (ARW); Hop Brook, Northborough (HB); Assabet River, Northborough (ARN); Assabet River, Hudson, (ARH); Assabet River, Stow (ARS); Fort Meadow Brook, Hudson (FMB); Spencer Brook, Concord (SB); Sudbury River, Hopkinton (SRH); Indian Brook, Ashland (IB); Sudbury River, Framingham (SRF); sample split "A" from Lake Cochituate outlet stream, Framingham (LCA); sample split "B" from Lake Cochituate outlet stream, Framingham (LCB); Pine Brook, Wayland (PB). All sites were in Massachusetts.

STATION:	**NB**	**ARW**	**HB**	**ARN**	**ARH**	**ARS**	**FMB**	**SB**	**SRH**	**IB**	**SRF**	**LCA**	**LCB**	**PB**
Habitat Score	180	138	183	154	136	150	140	184	179	185	166	175	175	165
Richness	34	12	23	15	18	17	22	23	23	23	10	8	15	23
HBI	3.86	4.97	4.82	5.35	5.88	5.56	4.11	5.82	5.14	3.67	5.68	5.84	6.86	5.29
EPT	13	7	7	3	7	7	5	5	9	6	3	2	0	4
EPT/Chiro	1.63	4.42	3.30	4.25	4.81	17.00	1.41	0.61	2.15	1.94	12.50	50.00	0.00	0.41
SC/FC	0.50	0.89	1.43	0.40	0.13	0.05	1.70	0.20	0.09	0.22	0.07	0.00	0.11	0.24
% Dom.	0.16	0.20	0.17	0.27	0.35	0.33	0.25	0.18	0.27	0.28	0.37	0.73	0.29	0.22
Sim. (RSA)	100	50.72	51.75	51.04	50.95	45.83	52.88	73.79	64.24	70.83	44.48	27.01	37.73	74.64
STATION:	**NB**	**ARW**	**HB**	**ARN**	**ARH**	**ARS**	**FMB**	**SB**	**SRH**	**IB**	**SRF**	**LCA**	**LCB**	**PB**
Habitat	100%	77%	102%	86%	76%	83%	78%	102%	99%	103%	92%	97%	97%	92%
Richness	100%	35%	68%	44%	53%	50%	65%	68%	68%	68%	29%	24%	44%	68%
HBI	100%	78%	80%	72%	66%	69%	94%	66%	75%	105%	68%	66%	56%	73%
EPT	100%	54%	54%	23%	54%	54%	38%	38%	69%	46%	23%	15%	0%	31%
EPT/Chiro	100%	272%	203%	262%	296%	1046%	87%	38%	133%	120%	769%	3077%	0%	26%
SC/FC	100%	178%	287%	80%	25%	10%	340%	41%	18%	44%	15%	0%	22%	47%
% Dom.	16%	20%	17%	27%	35%	33%	25%	18%	27%	28%	37%	73%	29%	22%
Sim. (RSA)	100%	51%	52%	51%	51%	46%	53%	74%	64%	71%	44%	27%	38%	75%

Table B2. Summary of RBP metrics…2001 upper Concord Watershed… (Continued.)

STATION:	**NB**	**ARW**	**HB**	**ARN**	**ARH**	**ARS**	**FMB**	**SB**	**SRH**	**IB**	**SRF**	**LCA**	**LCB**	**PB**
Habitat Status	Ref.	Supp.	Comp.	Supp.	Supp.	Supp.	Supp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.
Richness	6	0	4	2	2	2	4	4	4	4	0	0	2	4
HBI	6	4	4	4	2	4	6	2	4	6	2	2	2	4
EPT	6	0	0	0	0	0	0	0	2	0	0	0	0	0
EPT/Chiro	6	6	6	6	6	6	6	2	6	6	6	6	0	2
SC/FC	6	6	6	6	2	0	6	4	0	4	0	0	2	4
% Dom.	6	4	6	2	2	2	4	6	2	2	2	0	2	4
Sim. (RSA)	6	4	4	4	4	2	4	6	6	6	2	0	2	6
Total Score	42	24	30	24	18	16	30	24	24	28	12	8	10	24
Impact Cat.†	Ref.	SI	SI	SI	MI	MI	SI	SI	SI	SI	MI	MI/XI	MI	SI

† Ref. = reference station; NI = not impacted; SI = slightly impacted; MI = moderately impacted; XI = severely impacted

APPENDIX E – SUMMARY OF NPDES AND WMA PERMITTING INFORMATION, CONCORD RIVER WATERSHED

Table E1. SuAsCo Watershed Municipal Surface Wastewater Discharges.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
Wayland Waste Water Management District Note: expected to be reissued by EPA by spring 2005	MA0039853	9/4/1998			WWTP taken by eminent domain by the Town of Wayland 26 October 1999. Transferred to Wayland Wastewater Management District Commission	Wetland To Sudbury River (MA82A-04)
Westborough WWTP*	MA0100412	2/12/2000	7.68		#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires highest and best practical treatment (BPT), IPP and CWMP required, 7Q10 upstream of discharge =0.01 cfs	Assabet River (MA82B-02)
Marlborough Westerly WWTP*	MA0100480	12/14/2000	2.89		#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires BPT, IPP and CWMP, 7Q10 upstream of discharge=6.7 cfs	Assabet River (MA82B-04)
Marlborough Easterly WWTP*	MA0100498	9/14/2004	5.5		#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires highest and best practical treatment (BPT), IPP and CWMP required, 7Q10=0.01 cfs	Unnamed Tributary to Hop Brook (MA82A-15)
Lowell Regional Water And Wastewater Utility expected in 2004-2005	MA0100633	9/14/1997			Combined Sewer Overflow (Warren Street Parking Lot) Outfall Number 020-SDS#6 WWTP discharges to Merrimack River, additional CSOs to Merrimack River and Beaver Brook	Concord River (MA82A-09 subwatershed)

Dilution factor = Qe +Qr/Qe where Qe is the design effluent flow and Qr is the estimated 7Q10 of receiving stream
IPP = industrial pretreatment program SWPPP- storm water pollution prevention plan
CWMP = comprehensive wastewater management plan NCCW=non-contact cooling water
*Westborough, Marlborough Westerly, Hudson, and Maynard WWTP were issued interim permits that expired in February 2004. EPA reissued draft permits in the winter of 2004.

Table E1 (Continued). SuAsCo Watershed Municipal Surface Wastewater Discharges.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
Concord WWTF**	MA0100668	3/29/2002 modified	1.2	19:1	#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires highest and best practical treatment (BPT), IPP and CWMP required	Concord River (MA82A-07)
Maynard WWTF*	MA0101001	12/14/2000	1.45		#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires highest and best practical treatment (BPT), IPP and CWMP required, 7Q10 upstream of discharge=14.0 cfs	Assabet River (MA82B-06)
Billerica WWTP**	MA0101711	11/2/2001	5.4	4.1	#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires highest and best practical treatment (BPT), IPP and CWMP required	Concord River (MA82A-08)
Hudson WWTF*	MA0101788	12/14/2000	2.65/ 3.0[1]		#001 treated plant effluent, seasonal limits for ammonia, phosphorus, TSS, BOD. Interim limit for phosphorus, permit requires highest and best practical treatment (BPT), IPP and CWMP required, 7Q10 upstream of discharge=10.0 cfs	Assabet River (MA82B-05)

Dilution factor = Qe +Qr/Qe where Qe is the design effluent flow and Qr is the estimated 7Q10 of receiving stream
IPP = industrial pretreatment program
CWMP = comprehensive wastewater management plan
NCCW=non-contact cooling water
SWPPP- storm water pollution prevention plan
[1]If the average monthly flow exceeds 2.65 MGD for two consecutive months during May 1through October 31 of any year, the seasonal phosphorus limit shall be 0.5 mg/L and the flow limit will be changed to 3.0 MGD. These limits will be come effective 90 days after the second consecutive month of flows above 2.65 MGD and will be expressed as annual average limits, to be reported in a 12 month, rolling basis. Alternatives to increasing this discharge will be evaluated as part of the CWMP. This flow limit is subject to revision based upon findings of the CWMP and the TMDL being developed by MA DEP.
*Westborough, Marlborough Westerly, Hudson, and Maynard WWTP were issued interim permits that expire in February 2004. EPA reissued draft permits in the winter of 2004.
** The permits for Concord and Billerica will be reissued in 2005.

Table E1 (Continued) . SuAsCo Watershed Municipal Surface Wastewater Discharges.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
Middlesex School WWTP NOTE: EPA and DEP issued a new final permit on 3 March 2005. This new permit includes seasonal limits on total phosphorus.	MA0102466	2/4/1988	0.052		Treated effluent; 7Q10 for Spencer Brook = 0.19 MGD	Spencer Brook Via Unnamed Tributary (MA82B-15)
MWRA Cosgrove Intake Facility	MA0040134	10/18/2002	Report	1	#001 intake screen wash water, reservoir foundation leakage, test water, pump seal water, NCCW, hydroelectric turbine bearing lubrication, cooling water, storm water, SWPPP required; treated drinking water goes to Wachusett Reservoir in Nashua Watershed	Wetland tributary to North Brook
MWRA Wachusett Lower Gatehouse and Wachusett Aqueduct	MA0103373	7/15/2002	Report		#001 flows from the Wachsuett Aqueduct Forebay; required to take instream temperature samples during and within three days after WHCP-2 start-up testing at intake valve at Wachusett resevoir Dam, the point of discharge at the Aqueduct Forebay, Northboro Road, Deerfoot Road, intake valve of the Sudbury Reservoir	Wachusett Aqueduct Open Channel and Sudbury Reservoir
US Army (Natick R&D Labs) MA0001724 4/17/1979 NOTE: Currently not discharging; however, US Army wishes to keep permit open/active (Ahsan 2003).						
001			6.4	2.56:1	Main outfall, including climatic chambers	Lake Cochituate (MA82127)
002			0.75	2.74:1	Radiation building	
003			0.75	2.74:1	Engineering building	
004			3.3	2.5:1	Ariem building	

Dilution factor * = Qe +Qr/Qe where Qe is the design effluent flow and Qr is the estimated 7Q10 of receiving stream
IPP = industrial pretreatment program
CWMP = comprehensive wastewater management plan
NCCW=non-contact cooling water
SWPPP- storm water pollution prevention plan

Table E1 (Continued) . SuAsCo Watershed Municipal Surface Wastewater Discharges.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
MWRA- MetroWest Water Supply Tunnel MA0103357 10/31/2002						
#001B			4.32		Excavation and lining of tunnel segment	Sudbury River
#001C			0.014		Excavation to complete near-surfacepiping connections	Sudbury River
#001D			4.68		Hydraulic pressure testing and disinfection of completed tunnel segment	Sudbury River
#002B			5.76		Site dewatering discharges (excavation and lining of tunnel and excavation to complete near-surface piping connections)	Tributary to Stony Brook OR Sudbury Reservoir by pumping over Sudbury dam
#003C			0.036		Site dewatering (near-surface piping connections)	Stony Brook
#013			0.06		Site dewatering (near surface piping connections to Hosmer pump station)	Tributary of the Sudbury Reservoir
#015			0.06		Site dewatering (near-surface piping connections to Edgell Road pimp station in Framingham)	Tributary to the Sudbury River
#016			0.03		Site dewatering (near-surface piping connections to Elm Street pump station in Framingham)	Storm drain located in Sudbury River
#018 Hultman Weir			0.07		Flows from the Wachusett Aqueduct Overflow Strucutre and blowoff from Wachusett Aqueduct Forebay Channel	
#019			0.03		Water treatment plant overflow related to the disinfection and reactivation of the Cosgrove Tunnel	Open Channel

Dilution factor * = Qe +Qr/Qe where Qe is the design effluent flow and Qr is the estimated 7Q10 of receiving stream
IPP = industrial pretreatment program
CWMP = comprehensive wastewater management plan
NCCW=non-contact cooling water
SWPPP- storm water pollution prevention plan

Table E2. SuAsCo Watershed industrial NPDES wastewater discharge facilities.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
Bay State / Sterling Inc. NOTE: This company has gone out of business and no longer discharges.	MA0000108	7/18/1994,	001-0.32, 002-0.28, 004-0.009		Uncontaminated cooling water, 001= point of discharge from building, 002= 36" culvert on Brigham St., 004 = point of discharge to holding pond	Rutters Brook (MA82A-01 subwatershed)
Ashland Sand & Stone Co	MA0000132	11/19/2003	0.65 (max daily)	NA	#001 wastewater from sand and gravel washer	Cold Spring Brook (MA82A-25 subwatershed)
Atlantic-Acton Realty Limited (S/P Acton Realty Trust) NOTE: Now called Powder Mill Plaza, trying to tie in to sewer	MA0028835	6/29/1984	0.045 (Max daily)		Activated sludge wasterwater treatment plant discharge	Assabet River (MA82B-07)
Murphy's Automotive Inc	MA0030660					Sucker Pond (MA82A-26 subwatershed)
Trimount Bituminous Products NOTE: This company has only submitted an application for permit coverage.	MA0033359					Cold Spring Brook (MA82A-25 subwatershed, upstream from MA82003)
Mobil Oil Corp. - Stowe	MA0033669				Terminated by EPA in February 2004	Assabet Brook MA82B-17)
Raytheon - Sudbury Factory NOTE: Facility closed according to NERO	MA0034282 Inactive, changed to MAR00A376 in 1992					Landham Brook (To Sudbury River) (MA82A-06)
Deblois Oil Company NOTE: No longer active (Ahsan 2003).	MA0034576					Drainage To Lake Cochituate (MA82127)
Massachusetts Correctional Institute (MCI) – Concord NOTE: EPA drafted permit in 2002, final has not yet been released for public comment	MA0102245		0.162	78:1		Assabet River (MA82B-07)

Table E2 (Continued). SuAsCo Watershed industrial NPDES wastewater discharge facilities.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
MCI-Billerica -Jail And House Of Corrections NOTE: MCI-Billerica has proposed to tie in to the Billerica sewer system/WWTP but has not yet connected.	MA0102563	9/14/1984	0.15		#001 treatment plant effluent	Concord River, (MA82A-07)
Cabot Corporation	MA0034797				No permit required (11/29/1995)—no longer discharging NCCW; may apply for general permit as needed	
Hudson Light & Power Department	MA0021610	12/101975	3.6		001 and 002-heat exchanger cooling water	Assabet River
L'Energia, Limited Partnership Transferred to UAE Lowell Power LLC	MA0033201 MA0033201	7/25/92 6/10/1999	Monitor		#001- storm water runoff from detention basin, SWPPP required	River Meadow Brook (MA82A-10)
Penn Culvert Company	MA0030147	7/8/1987	Monitor		Storm water runoff, tied into the Billerica WWTP in 1990; the company has ceased production and the permit was closed by EPA on 13 February 2003	Wetland To Middlesex Canal
Sperry Corporation, NOTE: closed, no longer active according to NERO	MA0030155	10/10/1986	0.16 MGD (Max daily)			Cold Brook (MA82A-19 subwatershed)
Stow Partners, LLC (transferred from Belden Wire and Independent Cable)	MA0026999	10/10/2000 original permit date 3/2/1983	001=0.028, 002=0.018		Letter dated 8/19/1999 stated facility ceased operation and closed, boiler blow down discharge	Assabet River

Table E2 (Continued). SuAsCo Watershed industrial NPDES wastewater discharge facilities.

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
W.R. Grace & Company	MA0027421	4/28/1982	0.5		#001Discharge from Acton Water Supply District Assabet Municipal Well No. 1; required to monitor wells surrounding Assabet Well No. 1, Assabet River upstream of discharge, downstream of discharge, 6,000 downstream of discharge at Rt 62 Bridge for VOCs	Assabet River
Coatings Engineering Corp NOTE: Not active (Ahsan 2003)	MA0026743					Landham Brook Via Drainage Ditch (MA82A-06)
Arrow Automotive Industries	MA0036480				No Permit Required, discharge terminated	Assabet River (MA82B-11)
Framingham District Court NOTE: Tier 2 21e site	MA0036145				No Permit Required, discharge terminated	Sudbury River (MA82A-26 subwatershed)
Dennision Manufacturing Company	MA0002844				Ceased discharging non-contact cooling water and the permit was terminated by EPA in August 1999	MA82A-03

The NPDES permit for the William Tonner Co. (MA0002917) was terminated by EPA in May 1986.

Silicon Transistor Corporation (MA0025241) ceased discharging non-contact cooling water and groundwater remediation in February 2001 and EPA determined that a permit is no longer required.

Independent Cable Inc. (MA0026999), also known as Belden Wire & Cable Company ceased operations in October 1999 and no longer discharges.

The permit for Raytheon (MA0001511) was terminated by EPA in April 1997.

Table E3. General NPDES permits in the SuAsCo River Watershed

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
Baker Commodities Inc	MAG250026	6/4/2003	0.1	2.2:1	NCCW, individual permit closed (MA0031585), also mutli-sector general stormwater permit (MAR05C532)	Tributary to Concord River (MA82A-08)
Gotham Ink Of New England Inc	MAG250830	8/7/2001	0.0003	4.0:1	NCCW	Mowry Brook, tributary to Sudbury Reservoir (MA82106)
Haartz Corporation	MAG250006	10/27/2000	0.004		NCCW	Conant Brook to Assabet River (MA82B-14)
Majilite Manufacturing Inc	MAG250011	2/23/2001	0.028	1.06:1	NCCW	River Meadow Brook (MA82A-10)
Kidde-Fenwal Inc.	MAG250946	1/17/2001	0.052	2.41:1	NCCW	Cold Spring Brook (MA82A-25 subwatershed)
Four-In-One Co. Inc., formerly Stickney & Poor Co.	MAG250954	9/8/2000	0.01	1.05:1	NCCW	Unnamed tributary to River Meadow Brook (MA82A-10)
Aerodyne Research Inc.	MAG250970	6/13/2001	0.001		NCCW, Individual permit closed (MA0027804), TRC monitoring required	Wetland To Nutting Lake (MA82124)
Hudson DPW, Gates Pond Water Treatment Plant The Town is reapplying for this expired permit.	MAG640014	9/15/1995	0.084		Individual permit closed (MA0103322)	Hog Brook To Tripps Pond (MA82107)
Ashland WTP	MAG640049	3/26/2002				Hopkinton Reservoir (MA82061)
Billerica WTP	MAG640050	2/21/2001	0.8		Proposed water treatment facility	Unnamed tributary to the Concord River (MA82A-07)
Billerica Sewer Extension Project	MAG070147	3/31/2003			Construction Dewatering	Concord River
East Chelmsford WTP	MAG640059	7/20/2001	NA	NA	Proposed water treatment facility	Unnamed tributary to River Meadow Brook (MA82A-10)
Best Western at Historic Concord	MAG070073	4/13/2000			Construction Dewatering	Assabet River
EarthTech/Town of Ashland	MAG070104	1/9/2001			Construction dewatering for proposed Howe Street Regional Water Treatment Facility	Hopkinton Reservoir (MA82061)
Superior Printing Inks	MAG250016	4/5/2002	0.002		NCCW, individual permit (MA0029513) closed	Unnamed tributary to Sudbury Reservoir (MA82106)

Table E3 (Continued). General NPDES permits in the SuAsCo River Watershed

Permitee	NPDES #	Permit Issuance Date	Flow (MGD)	Dilution Factor	Notes/Comments	Receiving Water
H20 Engineering/Sudbury	MAG640054	4/5/2001	0.012 (avg monthly)	2.7	Proposed Sudbury Water Treatment Facility, dilution factor <10, requires one tox test using *C. dubia* in first quarter of operation	Landham Brook (aka Allowance brook) (MA82A-06 subwatershed)
Sudbury Water Department	MAG640056	8/6/2001	0.018 (avg monthly)	26	Sudbury Water Treatment Facility Well #8 off East Street	Hop Brook (MA82A-05)
Westborough DPW	MAG640007	6/28/2001	0.264		Westborough Water Purification Facility	Hocomonco Pond (MA82060)

Table E4. Multi-sector General Storm Water Permits as of August 2003.

Facility	NPDES PERMIT #	Estimated Location
3M Chelmsford	(MAR05C394)	MA82A-10
Aggregate Industries Northeast	(MAR05C111)	MA82B-04
Allied Systems LTD	(MAR05C201)	MA82112
Avery Dennison	(MAR05B977)	MA82A-02
Baker Commodities	(MAR05C532)	MA82A-08
Ballard Material Products	(MAR05C273)	MA82A-10
Bose Corporation	(MAR05C538)	MA82A-02
Bose Corporation	(MAR05C538)	MA82046
Bullard Abrasives Inc.	(MAR05C060)	MA82A-01
Bunzl Extrusion Inc.	(MAR05C404	MA82B-03
Cabot Corporation	(MAR05B698)	MA82A-07
Cambridge Tool & Manufacturing Company Inc.	(MAR05B999)	MA82A-08
Concord Public Works	(MAR05C449)	MA82A-20
Danafilms Inc.	(MAR05B912)	MA82B-02
Dav-Tech Plating Inc.	(MAR05B869)	MA82106
Department of Public Works	(MAR05C489)	MA82B-02
Diamond Machining Technology	(MAR05B771)	MA82B-03
Evergreen Solar Inc	(MAR05C290)	MA82106
FED EX Freight East Worcester	(MAR05C430	MA82B-02
Federal Express-AYE	(MAR05C088	MA82127
FEDEX Freight East Boston	(MAR05C429)	MA82A-07
FIBA	MAR05C403)	MA82B-02
First Student	(MAR05C214)	MA82A-02
Framingham Auto Terminal	(MAR05C322)	MA82112
Framingham Pump Station	(MAR05B637)	MA82127
Framingham VMF	(MAR05B764)	MA82127
GE Kaye Instruments Inc.	(MAR05C540)	MA82A-08
Genzyme Corporation	(MAR5C100)	MA82A-02
Genzyme Corporation	(MAR5C098)	MA82A-02
Holland Used Auto Parts Inc.	(MAR05B910)	MA82A-07
International Paper	(MAR05B697)	MA82046
Jack's Used Parts	(MAR05C055)	MA82A-09
Japenamelac Corp	(MAR05C006)	MA82A-10
Ken's Foods Inc.	(MAR05C276)	MA82106
Ken's Foods Inc.	(MAR05C255)	MA82106
L3 Communications Essco Inc.	(MAR05B831)	MA82B-07
Maintenance Shop #7	(MAR05C355)	MA82A-02
Majilite Manufacturing	(MAR05B706)	MA82A-10
Massachusetts Container Corp	(MAR05C215)	MA82106
Maxtor Corporation	(MAR05C222)	MA82B-02
MCC-DEC Tech, LLC	(MAR05C448)	MA82127
Middlesex Meterials	(MAR05C039)	MA82A-10
Myrolis Corporation	(MAR05C377)	MA82A-07
Natick Paperboard Corp	(MAR05B680)	MA82127
New Penn Motor Express Inc.	(MAR05C384)	MA82A-07
Perma Inc.	(MAR05B707)	MA82A-07
Post Road Auto Parts	(MAR05B750)	MA82A-15
PRTR Marlborough Transfer	(MAR05C574)	MA82056
Raytheon Company	(MAR05C078)	MA82A-06
Raytheon Company	(MAR05C077)	MA82056
Recycling Center	(MAR05C486)	MA82B-05
Safety-Kleen Systems Inc	(MAR05C295)	MA82106
Tadmuck Auto Parts	(MAR05B756)	MA82A-21
The Haartz Corporation	(MAR05B612)	MA82B-14
United Parcel Service Inc.	(MAR05B940)	MA82A-08
UPS- Ashland	(MAR05B897)	MA82127

Table E5. List of Water Management Act registered and permitted withdrawals in the SuAsCo Watershed.

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)	Segment
Acton Water District	9P421400201	21400203	2002000-06G -05G -19G	1.56 (reg) 0.38 (perm) 1.94	MA82A-07
			2002000-01G -03G -04G -20G -21G -22G -23G -24G -25G		MA82B-13
			2002000-02G -09G 10G -11G -12G -13G -14G -15G -16G -17G -18G		MA82B-14
Ashland Water and Sewer Department	9P231401402	31401401	3014000-04G -05G -07G -08G -09G	1.23 (reg) 0.45 (perm) 1.68	MA82A-12
Assabet Sand and Gravel Company Inc.		21400205	Assabet River w/d	0.17	MA82B-07
Bay State Sterling Inc.		21432803	Well #2 Well #3 Well #4	0.45	MA82A-01
Berberian Farms		21421504	Berberian Stream W/D	0.12 (92 days)	MA82B-02
Bigelow Nurseries Inc.		21421502	Well #2	0.15	Cold Harbor Brook MA82B-18
			Well #1 (reservoir w/d)		Hop Brook MA82B-20
Billerica Water Department	9P31403101	31403101	3031000-01S	4.41 (reg) 0.89 (perm) 5.30	MA82A-07
Carlisle Water Department		31405101	Martin & Fiske St Pond	0.36	MA82A-21 and MA82037
Cavicchio Greenhouse Inc.		31428802	Codger Ln Pond River	0.25	MA82A-05
Chelmsford Water District	9P31405601	31405602	3056000-02G -05G -09G -11G -15G -16G -18G -19G	1.8 (reg) 0.22 (perm) 2.02	MA82A-10

Table E5 (Continued). List of Water Management Act registered and permitted withdrawals in the SuAsCo Watershed.

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)	Segment
Concord Country Club		31406702	01G (Well #1)	0.12	MA82A-04
Concord Water Department	9P31406701	31406704	3067000-01G -03G -06G	2.1 (reg) 0.42 (perm) 2.52	MA82A-04
			3067000-04G		MA82A-19
			3067000-02G -07G		MA82A-20
			3067000-05G		MA82B-09
			3067000-01S Nagog Pond		MA82B-14 and MA82082
Concrete Service Inc.		21402802	Pond 1	0.34	MA82B-04
East Chelmsford Water District	9P421405602	31405601	3056001-01G -02G -03G	0.13 (reg) 0.1 (perm) 0.23	MA82A-10
Framingham Water Department (MWRA)		31410001 RO END date 3/1/1990	3100000-01G -02G -03G	Permitted supply is from MWRA	MA82A-03
Great Oak Farm		21402801	Gr. Oak Farm Pond	0.07	Danforth Brook MA82B-19
Hopkinton Water Department	9P21413901	21413901	2139000-01-05G	0.56 (reg) 0.42 (perm) 0.98	MA82A-11
Hudson Water Department	9P21414102	21414102	2141000-01G	2.0 (reg) 0.95 (perm) 2.95	MA82A-05
			2141000-02G		MA82B-04
			2141000-03G -04G -05G		MA82B-11
			2141000-01S Gates Pond		MA82B-10 and MA82047
Idylwilde Farm Inc.		V21400202	Fort Pond Brook	0.03	MA82B-13
Intel Corp.	9P421414103	21414101	Hudson Well D-1 Hudson Well D-2	0.11 (reg) 0.24 (perm) 0.35	MA82B-04
Juniper Hill Golf Course	9P21421501		01 S (Point A Assabet River) 02S (Point B)	0.15	MA82B-02
Kidde-Fenwal Inc.		31401402	Well #1 Well #2	0.05	MA82A-25
Lincoln Water Department		31415701	3157000-02G	0.28	MA82A-04
Marlborough DPW Water Division	9P21417001	21417001	2170000-01S Milham Reservoir	0.58 (reg) 1.19 (perm) 1.77	MA82077
			2170000-02S Williams Lake		MA82121

Table E5 (Continued). List of Water Management Act registered and permitted withdrawals in the SuAsCo Watershed.

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)	Segment
Mass Civil Defense Agency MCDA		31410002	01G 02G	0.29	MA82A-25
Maynard Department of Public Works	9P421417401	21417401	217400-01G -02G -03G -04G	1.09 (reg)	MA82B-08
			2174000-05G -06G -07G		MA82B-13
Nashawtuck Country Club Inc.		31406708	01G (Sudbury Road Well) 01S (Sudbury RD W/D)	0.1	MA82A-04
Natick Water Department		3149801	3198000-01G -02G -07G -09G -11G -13G	4.1	MA82A-22
Northborough Water & Sewer Department		21421503	2215000-03G	0.74	Cold Harbor Brook MA82B-18
			2215000-01G		MA82B-02
			2215000-02G -04G -05G -06G		MA82B-03
Richard E. Peterson		31406701	01S (Monument St. Pond)	0.1	MA82A-07
Shrewsbury Water & Sewer Department*	9P21427101		2271000-01G	2.64 (reg) 1.01 (perm) 3.65	Hop Brook MA82B-20
Stow Acres		21428602	01G (Well #1) 01S (9th Hole Pond) 04S (13th Hole Pond)	0.14	MA82B-05
Stow Acres Country Club SSC Association		21428602	10th Hole Pond	0.14	MA82B-12
Sudbury Water Department	9P31428801	31428803	3288000-03G, -08G -10G	1.72 (reg) 0.36 (perm) 2.08	MA82A-05
			3288000-02G, -07G 09G 06G 04G		MA82A-06
			3288000-05G		MA82A-19
US Army Soldier Systems Center	9P31419801		Monitoring Well 15B Monitoring Well 90B	0.14	MA82A-03 and MA82127
Verrill Farm		31406707	02S (Wheeler Road (w/d) 04S (Rte 117 #1 w/d)	0.06	MA82A-04
			Rte 117 #2w/d (s)		MA82B-09
			Pantry Road (w/d) (s) Concord Road (w/d) (s)		MA82A-19
W. R. Grace & Co. – CONN		31415501	Well #1 Well #2 Well #3	0.58	MA82B-13

*Shrewsbury has additional registered and permitted sources in the Blackstone Watershed. Shrewsbury no longer withdraws from this source (i.e., all withdrawals are now from the Blackstone Watershed). Their permit to withdraw 0.26 MGD (through 2009) will be rescinded (Kickham 2004).

Table E5 (Continued) . List of Water Management Act registered and permitted withdrawals in the SuAsCo Watershed.

Facility	WMA Permit Number	WMA Registration Number	Source (G = ground, S = surface)	Authorized Withdrawal (MGD)	Segment
Wayland Water Department	9P431431501	31431502	3315000-03G -04G -05G	1.66 (reg)	MA82A-03
			3315000-01G -02G -06G -07G -08G		MA82A-04
Westborough Water Department	9P421432801	21432804	2328000-01S -01G -02G	1.92 (reg) 1.18(per) 3.1	MA82A-01
			2328000-03G -04G -06G		MA82B-01
			2328000-05G -10G		MA82B-02
			2328000-07G -08G		MA82B-03
Westborough Water Dept.	9P42132801	21432804	2328000-01S Westborough Reservoir (Sandra Pond)	1.92 (reg) 1.18 (perm) 3.1	MA82114
Weston Nurseries of Hopkinton		21413902	Rudy's Pond Busconi Pond Meadow Aux. Pond Meadow Pond Garden Center Pond Hill Pond Canal System Kidney Pond Irrigation Pond Stone Pond Tony's Bridge Canal Irrigation Canal/Pond Leaky Pond	0.78	MA82A-25
			Irrigation Pond Field 37N, 37S, 28, Island Pond		MA82A-23

APPENDIX F – DEP GRANT AND LOAN PROGRAMS

Excerpted from the DEP/DWM World Wide Web site,
http://www.mass.gov/dep/brp/mf/othergrt.htm
http://www.mass.gov/dep/brp/wm/projsums.htm

604(B) WATER QUALITY MANAGEMENT PLANNING GRANT PROGRAM

This grant program is authorized under the federal Clean Water Act Section 604(b) for water quality assessment and management planning.

- 00-04 *Lake Cochituate Nonpoint Source Management Plan.* This project will characterize and prioritize nonpoint source pollution problems in the Cochituate watershed. A watershed-wide inventory, mapping, and assessment of the land use activities and NPS sources will be conducted. A detailed NPS assessment and storm water mapping of selected basins will be created and assess local water quality protection measures. It will provide recommendations to communities for improved management of NPS pollution within the watershed and conduct a workshop to provide outreach and technical assistance. A public information brochure will be created on how to prevent NPS pollution in the Cochituate watershed.

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

This grant program is authorized under the Wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. The water quality proposals received by MA DEP under this National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency is a results oriented approach that will focus attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are to: 1) achieve clean air, 2) achieve clean water, 3) protect wetlands, 4) reduce waste generation, and 5) cleanup waste sites.

- *98-01/104 Marlboro Easterly WWTF and Hop Brook Diagnostic/Feasibility Study*. The study will evaluate and make recommendations for the water quality problem plaguing Hop Brook. Existing data will be evaluated and a QAPP will be formed, water quality, aquatic life, and watershed studies will be performed and estimates and recommendations will be made. All existing data, studies, and recommendations will be reviewed to summarize existing reports and identify data gaps. Modeling estimates for annual and seasonal nutrient and water budgets will be provided. Pond contours and sediment depth profiles will be determined along with factors that influence *Hydrodictyon* sp. growth. Algae, fish, zooplankton, and aquatic macrophytes will be surveyed. A watershed survey will be completed to determine nonpoint sources of pollution and an evaluation of various alternatives to reduce nutrient loading and algal growth.
- *98-11/104 Assabet River Modeling Project.* This project will develop and implement a TMDL program for the Assabet River. A literature review will be completed, appropriate models will be identified, and hydrologic and nutrient budgets will be developed. Land use based modeling will be conducted to determine nonpoint source loads, also developing nutrient TMDL and evaluating alternative loading options. A final TMDL report will be written and presented in a public meeting.
- *00-10/104 Nutrient TMDL for the Assabet River*. This project will quantify the loading capacity and TMDL and assess alternatives to achieve goals. A review of the existing Assabet River water quality reports and documents will be conducted and appropriate data sets for modeling will be identified along with nutrient TMDL. A hydrologic and nutrient budget including a low flow model will be developed, calibrated, and verified for the TMDL. Nutrient TMDLs will be developed and alternative loading options will be evaluated.

319 NONPOINT SOURCE GRANT PROGRAM

This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; address activities that are identified in the Massachusetts NPS Management Program Plan.

- *98-04/319 Restoring Concord's Mill Brook: Nonpoint Sources Pollution and Community*. This project will continue the work of the Mill Brook task force to restore and conserve the brook. BMPs (best management practices) will be implemented, resulting in reduction of NPS loading to the brook. An innovative storm water treatment technology will be implemented at a high-risk site. Four catch basins will be retrofitted with new sump units and storm drain pillows or sump skimmers. A QAPP will be developed and monitor to demonstrate the effectiveness of the BMPs installed. A long-term plan will be developed with the Town DPW with recommendations for catch basin technologies and maintenance and implemented to work with the DPW to train street maintenance and snow removal crews in appropriate techniques to mitigate NPS impacts from these operations. A review of snow removal and street maintenance will be performed and new policies developed where needed. Removal of stream bottom sediment and stream bank clean up will be performed where allowed by permit.
- *00-07/319 Town of Acton Nonpoint Source Control Program*. This project will implement a Watershed Trading Program to discharge treated wastewater effluent into the Assabet River, such that for every one pound of phosphorus discharged into the river, three pounds will be prevented from entering via nonpoint sources. This will be achieved in two ways. The first will involve implementing storm water BMPs to demonstrate that adequate phosphorus levels can be achieved to the level required under the trading program. Identification of sites where the town has access and resources to install BMPs will be conducted; storm water run-off will be sampled to understand pre-BMP water quality. Sampling will then be conducted post-BMP initiation to understand and document the project's success. Extrapolation to other Watershed Trading Program goals will be reached. The second will involve the construction of a pond/wetland recirculation system at the town's newly created 9-acre public swimming pond. The swimming pond has relatively high background phosphorus concentrations that will be reduced by the pond/wetland to keep background phosphorus levels from reaching a point that it would support the growth of nuisance levels of algae and macrophytes. A wetland recirculation system will be designed and implemented. A demonstration project manual will also be completed along with public education materials. Funding from 2000 to 2003.
- *00-08/319 Long Point Restoration Project, Littleton, MA.* This project is a Phase II project for the pond. It will restore water quality and the recreational value of Long Pond by implementation of a watershed management program identified in the initial 1990 Diagnostic/Feasibility Study. Removal of nuisance plants via macrophyte hydroraking will be performed along with installation of bottom barriers in selected areas. Long-term recommendations include installation of a detention basin to reduce nutrient and suspended sediment inputs to Long Pond and development of an educational program for the abutters and users of the pond. That program will include information about use/misuse of storm drains, septic system maintenance and upgrades, lawn fertilizer restrictions, protection of shoreline integrity, and disposal of organic material into the pond. Regulations and water resource bylaws will be developed to control development on pre-existing undersized lots within the watershed.
- *01-01/319 Lake Cochituate, Snake Brook NPS Remediation, Phase 1.* This project will install BMPs to reduce the heavy loads of sediment in Snake Brook and Lake Cochituate. It will begin to address the sedimentation and nutrient loading from Snake Brook that has accelerated enrichment of the lake. A detention pond and wetland enhancement will be designed and constructed immediately east of the place where Snake Brook enters the lake. Another detention pond and wetland enhancement will be designed and constructed for the drainage channel in the watershed. Five storm water drainage systems will be designed and constructed within the Snake Brook watershed, and a GIS map of the system will be created. Pre- and post-construction water quality will be monitored and a public education campaign will be started.

- *02-10/319 Implementation of TMDL Recommendations at Lake Boon.* Lake Boon is a 163-acre great pond located in the towns of Stow and Hudson. The Town of Stow will administer this contract on behalf of the towns of Stow and Hudson and the Lake Management Commission. The 1000-acre watershed is a mix of forest and residential development with many lakefront cottages that have been converted into year-round homes. The lake is divided into four basins, the first and the largest of which is largely natural. The remaining three basins are man-made as a result of damming the outlet pond in the mid-1800's. The second, third, and fourth basins are overgrown with invasive plants that have spread considerably in the last decade. Lake Boon is 303(d) listed for nuisance aquatic plants and a TMDL for phosphorus is in the final stages of being drafted. Activities proposed have been recommended in at least one of three studies that have been completed for the lake. The project goal is to improve water quality in the lake through installation of storm water treatment devices and to reduce non-point source pollution at the source by encouraging good practices among watershed residents and stakeholders. As aquatic plant replacement program will also be conducted. Project tasks include development of a QAPP for pre- and post- construction water quality monitoring, monitoring, conducting a lake watershed survey, installing 26 storm water BMPs (leaching catch basins), and developing educational programs and brochures.
- *05-11/319 Dudley Pond Comprehensive Water Quality Improvement Project* Dudley Pond is an 84-acre Great Pond in the Concord River watershed. The Pond is listed in Category 5 for turbidity and exotic species. In addition to turbidity from nonpoint watershed sources, nuisance growth of Eurasian milfoil is a serious problem for the Pond. It significantly impairs the pond's ecological and recreational value. This project is part of a long-term strategy to mitigate water quality impairment in Dudley Pond using both in-lake and watershed BMPs. This project will reduce sediment and nutrient loads to Dudley Pond by implementing low impact development BMPs and restoring a section of eroding riverbank. To help control aquatic vegetation, milfoil weevils will be introduced and diver hand-pulling will be conducted in targeted areas. Targeted pollutants include sediment, nutrients, and Eurasian milfoil. Project tasks include development and implementation of an EPA and MA DEP-approved Quality Assurance Project Plan, construction of a bioretention cell, outlet protection/bank restoration, introduction of milfoil weevils, milfoil hand pulling, and public outreach and education including catch basin stenciling.

MASSACHUSETTS WATERSHED INITIATIVE PROJECTS

The Massachusetts Watershed Initiative was a broad partnership of state and federal agencies, conservation organizations, businesses, municipal officials and individuals that protects and restores natural resources and ecosystems on a watershed basis. The primary goals of the Watershed Initiative were to: improve water quality; restore natural flows to rivers; protect and restore habitats; improve public access and balanced resource use; improve local capacity to protect water resources; and, promote shared responsibility for watershed protection and management. Projects funded under the MWI included hydrologic and water quality monitoring and assessment, habitat assessment, nonpoint source assessment, hydrologic modeling, open space and growth planning, technical assistance and outreach.

- *99-09/MWI Assabet River Total Maximum Daily Load (TMDL) Investigations.* This project will collect information to determine a nutrient TMDL for the Assabet River. A TMDL Advisory Committee will be established and a review of selected water quality models for use as potential tools for allocating nutrient loads. A QAPP will be developed and sampling of nutrients in wet and dry conditions, aquatic plants and algae, and sediment will be performed.
- *00-02/MWI SuAsCo Total Maximum Daily Load (TMDL) Phase 2 Investigations.* This project will continue to collect information to determine a TMDL for nutrients in the Assabet River and begin a sampling program for TMDL analysis of the Sudbury and Concord Rivers. The QAPP for the Assabet River will be updated and a QAPP of the Sudbury and Concord River will be created. Additional water quality and biological sampling will take place in the Assabet while sampling will begin in the Sudbury and Concord Rivers.
- 01-14/MWI *SuAsCo Total Maximum Daily Load (TMDL) Phase 3 Investigations.* This project will collect information for use in determining nutrient TMDLs for the Sudbury and Concord Rivers. A QAPP will be created for those two rivers and water quality and biological sampling will be conducted.

- 02-18/MWI *SuAsCo Total Maximum Daily Load (TMDL) Phase 4 Investigations.* This project will continue to collect water quality data and other information for use in determining nutrient TMDLs for the Sudbury and Concord Rivers. A QAPP will be created for sampling, water quality and biological sampling will take place in selected tributaries of the Sudbury and Concord Rivers.

SOURCE WATER AND TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM

The Source Water Protection Technical Assistance/Land Management Grant Program provides funds to *third party* technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface drinking water supplies. There are no source water and technical assistance/land management grants awarded in the SuAsCo Watershed.

WELLHEAD PROTECTION GRANT PROGRAM

The Wellhead Protection Grant Program provides funds to assist public water suppliers in addressing wellhead protection through local projects and education.

- *99-23/WHP Ashland Wellhead Protection Project.* This project will create an inspection program to locate floor drains, holding tanks, and commercial and industrial hazardous material storage to protect the existing water supply and future sites in the Town of Ashland. A catalog of potential sources of contamination and hazardous materials will be developed and kept up-to-date. A Board of Health floor drain regulation and plan for implementation will be put into effect along with a base map, a database for hazardous materials use/storage for local planning and site inspections.
- *00-04/WHP Acton Wellhead Protection Project.* This project will assess high-risk land-use activities within the Zone II's of the Water Supply District of Acton, including working in surrounding towns that control portions of the District's Zone II areas. Site investigations will be conducted to verify current information, collect new information, and update GIS layers to enhance source water protection efforts. High-risk activities will be assessed using the Department's Source Water Assessment Program criteria within the entire Zone II of each well, including facilities that generate, treat, store, or dispose or hazardous materials/waste, large septic systems (2,000-5,000 gpd), farms, rights-of-way, recreational properties managed with pesticides/fertilizers/manure, underground storage tanks, salt/deicing materials storage, etc. Surveys will be conducted to verify current data and collect new information including GPS coordinates of all high-risk land uses within the Zone II's and map watershed and inventory features in coordination with MassGIS. GIS data layers will be updated or added, as appropriate, to enhance source water protection efforts as well as identify gaps in data in land use information.
- *00-06/WHP Wayland Wellhead Protection Project.* This project will install security fencing around wells in the Town of Wayland and treatment building at the Happy Hollow well site. Wellhead protection signs will be placed along the perimeter of Baldwin Pond and the access road to the Happy Hollow well site between the site and the high school. Three hundred linear feet of six-foot high chain link fence and gates will be installed to protect the pump stations and chemical feed building at the Happy Hollow well site.
- *01-06/WHP Wayland Wellhead Protection Project- Part II.* This project will install a 3,500 gallon tight tank, replacing a septic system located in the Zone I of Wayland's Well 01G. The new system must be in compliance with Title 5 of the State Environmental Code and the existing system must be properly abandoned. Two hundred fifty linear feet of 6-foot high chain-link fencing with barbed wire, one six-foot gate, and one twelve-foot gate with locks will also be placed around Baldwin Pond Well 3.
- *01-12/WHP Chelmsford Wellhead Protection Project.* This project will develop a comprehensive Wellhead Protection Plan as per Department guidance including a public educational outreach program, conduct two rounds of storm water monitoring of four storm drains in accordance with an approved QAPP, and install 25 wellhead protection signs for the Town of Chelmsford throughout the Zone II area.
- *02-10/WHP Hudson Wellhead Protection Project.* This project will purchase and install intrusion alarms to protect drinking water wells 02G through 06G, purchase and install a fire detector to protect drinking water well 02G. Quarterly Progress Reports will be submitted along with a Final Project Report.

CLEAN WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts State Revolving Loan Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state water quality requirements. The SRF Program is jointly administered by the Division of Municipal Services of the MA DEP and the Massachusetts Water Pollution Abatement Trust. Each year the MA DEP solicits projects from the Massachusetts municipalities and wastewater districts to be considered for subsidized loans, which are currently offered at 50% grant equivalency (approximates a two percent interest loan). The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed. Recent SRF projects specific to the SuAsCo Watershed include:

- 99-02/ CW SRF Middle Fort Pond Brook and South Acton Project
- 00-40/ CW SRF Town of Acton Comprehensive Water Resources Management Plan
- 00-42/ CW SRF Middle Fort Pond Brook and South Acton Project
- 00-38/CW SRF Hopkinton Comprehensive Wastewater Management Plan
- 00-21, 00-22, 00-23, 00-24, 00-25, 00-28/ CW SRF Assabet Consortium Comprehensive Wastewater Management Plan
- 01-15 CW/SRF Framingham Stormwater Master Plan
- 02-24/ CW SRF Framingham Comprehensive Wastewater Management Plan
- 03-1746/ CW SRF *Marlborough Comprehensive Wastewater Management Plan* The proposed plan will address the City's Easterly Sevice Area, covering a 20 year planning period and focusing on improvements needed to comply with the NPDES permit limits, particularly with respect to phosphorous discharged to the Hop Brook system.

MASSACHUSETTS DRINKING WATER STATE REVOLVING FUND PROGRAM

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

- 03-725/ DW SRF *Billerica Water Treatment Plant* This project entails the construction of a new 14-MGD conventional Water Treatment Plant (WTP) on a new site to replace the existing WTP, which is 45 years old. The new WTP will draw raw water from the same water supply source, the Concord River. The existing WTP is poorly laid out, is located on a floodplain surrounded by wetlands, and has process and support equipment (pumps, mixers, instrumentation and controls, electrical, HVAC, plumbing) that are reaching the end of their usability. The new WTP will have identical water treatment processes as the existing one but the processes will be enhanced with new and more efficient designs. This is a multi-year carry-over project that was initially approved for SRF financing in Calendar Year 2000.
- 03-677/DW SRF *MWRA Walnut Hill Water Treatment Plant* This project is for the construction of a 405 MGD Water Treatment Plant on Walnut Hill in Marlborough to treat water from the Wachusett Reservoir prior to distribution to more than 40 metropolitan Boston communities. The treatment plant is required pursuant to State and Federal water supply regulations. This project is part of an overall program to meet the requirements of the Source Water Treatment Rule and the Lead and Copper Rule. The treatment plant includes facilities for chlorination, corrosion control and a 50 million gallon finished water storage tank. This is a multi-year carry-over project that was initially approved for SRF financing in calendar year 2000.

TITLE 5

Under the Title 5 Program, the Commonwealth has developed three programs to assist homeowners with wastewater management problems. The Homeowner Septic Loan Program provides low interest loans to homeowners to upgrade systems that will not pass Title 5 inspections. The Comprehensive Community Septic Management Program provides betterment loans to communities to target known or suspected failures or to develop a community-wide management plan. The third option allows homeowners to claim tax credits for septic upgrades. Additional information about the Title 5 Program is available online from the MA DEP website http://www.mass.gov/dep/brp/wwm/t5pubs.htm. In the SuAsCo Watershed the towns of Boylston, Hopkinton, Hudson, Littleton, Maynard, Northborough, Shrewsbury, Southborough, and Westford have participated in the Comprehensive Community Septic Management Program (Casper-Dunne 2004).

APPENDIX G
DWM 1996 CONCORD RIVER WATERSHED WATER QUALITY SURVEY DATA

Table G1. 1996 Concord River Watershed *in situ* Hydrolab® data.

OWMID	Date	Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Conductivity (µS/cm)	TDS (g/L)	DO (mg/L)	Saturation (%)	Turbidity (NTU)
Walden Pond										
Station: WAL1										
Description: Deep hole, center of pond, Concord.										
82-0005	07/11/96	11:44	1.0	24.8	7.3	91	0.06	8.5	102	5
82-0005	07/11/96	11:56	4.5	24.3	7.4	91	0.06	8.9	105	5
82-0005	07/11/96	12:05	6.0	17.4	8.0	88	0.06	13.1	135	5
82-0005	07/11/96	12:10	7.0	13.7	8.7	88	0.06	13.9	132	6
82-0005	07/11/96	12:12	8.0	11.5	8.8	87	0.06	13.9	125	6
82-0005	07/11/96	12:17	9.1	10.2	8.6	86	0.05	13.5	119	6
82-0005	07/11/96	12:18	10.0	8.8	8.5	85	0.05	13.5	115	6
82-0005	07/11/96	12:22	11.0	8.2	8.2	85	0.05	13.3	111	6
82-0005	07/11/96	12:25	12.0	7.5	7.7	85	0.05	12.5	103	6
82-0005	07/11/96	12:28	13.0	6.6	6.7	85	0.05	9.6	78	6
82-0005	07/11/96	12:31	14.0	5.9	6.2	86	0.05	6.6	52	6
82-0005	07/11/96	12:32	15.1	5.7	6.1	86	0.05	6.2	49	6
82-0005	07/11/96	12:35	17.0	5.4	6.0	86	0.05	5.0	39	6
82-0005	07/11/96	12:38	19.1	5.3	5.9	86	0.06	3.8	30	6
82-0005	07/11/96	12:41	21.0	5.1	5.9	86	0.05	2.9	22	6
82-0005	07/11/96	12:44	23.1	5.0	5.8	86	0.06	2.2	17	6
82-0005	07/11/96	12:47	25.1	4.9	5.8	86	0.06	1.7	13	6
82-0005	07/11/96	12:49	27.1	4.9	5.8	88	0.06	<1.0	4	6
82-0005	07/11/96	12:52	29.0	4.9	5.9	92	0.06	<1.0	2	7

Table G2. 1996 Concord River Watershed Bacteria Data.

OWMID	Date	Time (24hr)	Fecal Coliform Bacteria (colonies/100mL)
UNNAMED TRIBUTARY TO ASSABET RIVER			
Station: FPB01, Unique ID: W0324			
Description: Unnamed tributary to the Assabet River downstream from Warners Pond, Commonwealth Avenue bridge, Concord.			
82-0002	06/25/96	10:20	100
FORT POND BROOK			
Station: FPB03, Unique ID: W0328			
Description: Laws Brook Road bridge, Acton.			
82-0003	06/25/96	10:40	3,000
FORT POND BROOK			
Station: FPB04, Unique ID: W0327			
Description: River Street bridge, Acton.			
82-0007	07/18/96	10:00	80
FORT POND BROOK			
Station: FPB05, Unique ID: W0326			
Description: Central Street bridge, Acton.			
82-0009	07/18/96	10:35	20

Table G2 (Continued). 1996 Concord River Watershed Bacteria Data

OWMID	Date	Time (24hr)	Fecal Coliform Bacteria (colonies/100mL)
NASHOBA BROOK			
Station: NB01, Unique ID: W0329			
Description: Wetherbee Street bridge, Acton.			
82-0004	06/25/96	11:05	160
Unnamed tributary to Fort Pond Brook			
Station: CB01, Unique ID: W0323			
Description: Unnamed tributary to Fort Pond Brook, Hosmer Street, Acton. (named Coles Brook on 1987 USGS Quad.)			
82-0008	07/18/96	10:20	140
Unnamed tributary to Fort Pond Brook			
Station: PB01, Unique ID: W0325			
Description: Unnamed tributary to Fort Pond Brook, near mouth at railroad track, Acton. (named Pratts Brook on 1987 USGS Quad.)			
82-0006	07/18/96	09:45	140
TAYLOR BROOK			
Station: TB01, Unique ID: W0330			
Description: Just upstream confluence with Assabet River, Maynard.			
82-0001	06/25/96	10:00	100

APPENDIX H
TECHNICAL MEMORANDUM
SuAsCo Watershed Benthic Macroinvertebrates

To: SuAsCo Watershed Team

From: Robert Nuzzo

Date: 5 December 1996

INTRODUCTION

John Fiorentino and I attempted to conduct biomonitoring at all 15 sites requested by the team. Where possible, we collected benthic macroinvertebrates for our analysis. Where habitat considerations made it inappropriate to apply our standard monitoring protocol we are able only to provide notes from our field observations, at this time, in the event they may help in your evaluation of the status of these sites.

METHODS

A 100 m reach was evaluated for availability of productive habitat for benthic macroinvertebrates. Ten kicks or jabs (for a total of 2 m^2) were apportioned to productive habitats representing at least 10% of such habitat within the reach. For purposes of this sampling, habitats with adequate current velocity passing over rocky substrate, "snags," aquatic vegetation, or exposed root masses were considered "productive." A kick-net with an opening approximately 0.45 m wide and with a mesh size of 590 µm was used.

A subsample of 100 macroinvertebrates was separated from the sample, and specimens were identified to family (Rapid Bioassessment Protocol II or RBP II), to the extent their condition allowed. Community health metrics based on family-level taxonomy were calculated and an impairment category was determined. This type of analysis separates sites into three categories: nonimpaired, moderately impaired, and severely impaired.

RESULTS

The taxonomic list of macroinvertebrates obtained in the subsamples from each site and summary tables of the RBP II metrics are attached as appendices "A" and "B," respectively. Because of the extent of human activity within this watershed it was difficult to find a location that could serve suitably as a reference site for all of the collection sites. We selected two sites to serve as "least impacted" references based on our reconnaissance and the team's guidance. The metrics were calculated independently against each of these references (Gates Pond Brook, Berlin—Table B1, Appendix B; Fort Pond Brook, Acton—Table B2, Appendix B). An attempt was made to discuss the results only in the context of the reference site that was the best match in terms of stream size and habitat characteristics. The best match is not that straight forward, however, so many of the comparisons were performed against both references. You may wish to recalculate the metrics if your familiarity with the watershed suggests that one of the other sites would have made a more suitable reference. Table B3 in Appendix B compares the upstream/downstream pair in Mill Brook, Concord.

SAC01—Mill Brook, Concord, MA (1 July 1996)

HABITAT

It was difficult to find suitable habitat to sample in this brook. The intent was to sample at stations bracketing the downtown area to measure any impacts it may have on instream ecosystems. Sites that had been identified as suitable during reconnaissance in May were unsuitable on this date because lower flow conditions left them with virtually standing water. Mill Brook downstream from Cambridge Turnpike is very low gradient and apparently dominated by sandy soils. Selection of sampling sites, therefore, was based on indications of adequate flow velocities and sufficient productive benthos habitat to provide a total of 2 m^2 sample area.

The upstream site (SAC01A) was located upstream from the Concord Police station (and the adjacent tributary) behind the Concord Ice Company. This reach was very straight, probably channelized at one time. The bottom substrates were primarily sand and silt. The entire sample came from sweeps of instream vegetation. The reach was bordered by a densely vegetated riparian zone on the north bank (a mix of native cover and "false bamboo"); while the south bank had a thin riparian buffer between the brook and a mowed field. Current velocity was fast enough to be perceptible—fast enough as to be adequate, probably—but nowhere in the reach was fast enough to create riffles. The overall habitat score was 95.

The downstream site (SAC01B) was just upstream from Lowell Road, running adjacent to the Star Market parking lot. This reach was obviously channelized at one time, but greater than 20 years ago (determined from looking at a 1970 USGS quadrangle). The habitat was poor in this reach, yet it represented the best benthos habitat downstream from downtown Concord. The majority of the available productive substrate was in the form of snags and instream vegetation and, while not abundant, there were some cobble substrates available. Current velocity was respectable throughout the reach creating occasional riffles and runs. The overall habitat score was 64.

BENTHOS

When compared against its upstream partner, SAC01B scored in the grey area between nonimpaired and slightly impaired. Compared against the two watershed references both SAC01A and SAC01B scored in the moderately impaired category. The habitat scores were 68% and 46%, respectively, of the Gates Pond Brook habitat score, and 63% and 43%, respectively of the Fort Pond Brook habitat score, indicating that habitat quality is the main problem for the benthos in this stream. This confounds detection of any possible point or nonpoint source pollution impacts. To do so on this brook will require a thoughtfully designed study specifically for this situation.

SAC02—Pine Brook, Wayland, MA (3 July 1996)

HABITAT

The reach sampled here is downstream from Pine Brook Road. Nearly the entire reach was riffle, meandering through woodland and wet bottomland over cobble/gravel substrates. This combination of substrates and flow regime provided very good invertebrate habitat. For the most part it appears there is little potential for erosion or nonpoint source pollution (related to overland flow) except upstream from the reach where Pine Brook Road crosses the brook. The major habitat flaw with this reach was the low volume of water: the stream channel was only about one quarter full on the sampling date; the greatest depth was about 0.3 m. The overall habitat score was 159.

The water temperature feels much colder here than at the other sites sampled in this watershed. The SuAsCo team may wish to investigate whether this stream is classified for, or qualifies for, protection under cold water standards.

BENTHOS

This site had a better habitat score than either of the reference sites, yet scored as moderately impaired against both of them. This is probably an indication of nonpoint source nutrient loading problems upstream. One of the two branches at the head of this brook comes out of a very nearly putrid pond on Rice Road in Wayland. The pond is adjacent to a cow pasture with clear access for the livestock; I have even seen cows standing in the water up to their bellies. This branch of the brook also passes through a small pond on a horse farm (though it does not appear that any livestock encroach on this pond) before crossing under the aqueduct and subsequently Old Connecticut Path and joining the other branch. It may be worth investigating potential nonpoint sources of pollution and evaluating their magnitude.

SAC03—Gates Pond Brook, Berlin, MA (2 July 1996)

HABITAT

During our reconnaissance in May we walked this brook from about 100 m upstream from the confluence with the Assabet River to within about 500 m of the outlet of Gates Pond. Downstream from Hudson Road the brook flows between the lawns of two adjacent properties into a marshy area (shallowly flooded at that time) and into a dense thicket of shrubs for the remainder of the distance to the point of confluence with the Assabet River. On the upstream side of the road the brook also runs along side of a couple of houses. Proceeding upstream past the houses the rest of the brook lies in woodlands. The flood plain is covered with wetland vegetation, such as skunk cabbage, but the trees provide a nearly complete canopy overhead. Within this woodland portion of the brook's course we saw only one potential nonpoint source pollution problem. A two-track road, that appears to have been an access road to a sand pit at one time, leads northwesterly from Hudson Road about 200 m. At this point a trail branches off to the west, with no bridge where it crosses the brook (there may have been one at one time). It appears that the only use this trail gets is from dirt bikes, which have caused a great deal of erosion at the point of crossing the brook. Along the trail, where it ascends the gradient from the brook to the sand pit, there is a prominent gully caused by erosion. There may have been some flooding of the sand pit in the past, spilling over and using the trail as a drainage pathway to the brook. We found hay bails, however, staked-out at the two low points at the edge of the pit, evidence of attempts to control runoff from the pit. The slope between the edge of the pit and the brook is generally well vegetated, and so the sand pit likely would not be the cause of on-going erosion. The probable cause of the erosion gully that exists either is current uses of the trail (probably dirt bikes) or a past event (such as runoff from the pit) that started the erosion and caused enough damage that it continues to erode rather than heal over. The benthos samples were collected to bracket this perceived problem area. For lack of a better land mark it was referred to as the "dirt bike crossing" or simply the "crossing." SAC03A was located about 600 m upstream from the crossing and SAC03B was the 100 m reach immediately downstream from the crossing.

At the time of sampling there was very little water in the brook. Current velocity was respectable but the riffles were very shallow (5 cm or less). Habitat at the two locations was fairly comparable; both had rocky riffles, but downstream snags were a greater proportion of the available habitat. The overall habitat score at SAC03A was 139 and at SAC03B it was 132. Since we did not see the outlet of Gates Pond we cannot determine to what extent any outlet structures there may have been responsible for holding back water from the brook.

BENTHOS

The downstream site on Gates Pond Brook (SAC03B) falls into the moderately impaired category when compared to it's upstream counterpart (SAC03A). Because there was no evidence of intervening pollution sources between these two sites except the erosion at the "crossing," the downstream station is probably suffering from the habitat disturbance described above.

SAC04—River Meadow Brook, Carlisle, MA (1 July 1996)

HABITAT

The reach sampled was located approximately 500 to 1000 m upstream from Lowell Street in Carlisle. The brook meanders through woodlands with a wide riparian zone covered with wetland vegetation in the

understory. This was very nice habitat, characterized by periodic riffles and runs, generally very good cover for fish, lots of cobble/boulder/rubble and occasional snags. Overall habitat score was 186—the highest score assigned to a sampling reach in the SuAsCo watershed.

BENTHOS

The benthic invertebrate community results from this location were a real surprise. I expected that the data from this site would serve as a least impacted reference for this watershed. It is remote, though downstream from a cranberry bog, and offered excellent habitat. The assemblage of macroinvertebrates, however, indicates that something is wrong here. The list of taxa was skewed toward those generally regarded as tolerant (an FBI of 6.66) and there was not a single EPT taxon represented in the subsample! Though there are homes built within this subwatershed, they all appear to be out of the flood plain and there were no obvious nonpoint sources of pollution that we came across. This site ranked moderately impaired against both watershed references. The team may wish to investigate nutrient loads and pesticide residues in this brook's watershed.

SAC05—Spencer Brook, Concord, MA (5 July 1996)

HABITAT

We searched for sampling locations on Spencer Brook as far upstream as Middlesex School. From the map and from the points where we viewed it, the brook appeared as a low gradient stream flowing through wetlands until reaching Angiers Pond at the Concord Rod and Gun Club off Strawberry Hill Road. The pond's dam has two spillways nearly side-by-side: a fixed-height easterly outlet and an adjustable (or so it appeared) height, westerly outlet.

During our reconnaissance on 28 May 1996, the smaller, westerly, spillway channel from Angiers Pond flowed only a short distance, filling a small pond with an overflow connection to the easterly channel. We never ventured across this small pond because it seemed clear at the time that the bulk of the discharge from the pond was carried by the easterly channel. There the brook was a fast moving stream meandering through the woodlands below and providing exceptional habitat for both macroinvertebrates and fish. There was an abundance of rocky substrates, there were snags and submerged logs, and a suitable range of water depths. As the brook approached Barrett's Mill Road a dug channel diverged from the main channel, making a dog-leg (perhaps used at one time for irrigation) and returning to the mainstem a short distance from Barrett's Mill Road. From the point of divergence down to Barrett's Mill Road both the side-stream and the main-stream were slow moving and sandy-bottomed. Downstream from Barrret's Mill Road the current was again swift, passing over gravel substrates near the bridge; but the brook quickly flattened out and became deep and sandy-bottomed.

When we returned on 5 July 1996 to sample, the easterly spillway had little if any water flowing over it; and the channel below was virtually dry except for a very few isolated pools that persisted. The water that did occur in the channel between Angiers Pond and Barrett's Mill Road was essentially stagnant. The water was flowing out of Angiers Pond via the westerly outlet to the small pond, with no lateral spill-over into the easterly channel. It was at this time we discovered that the small pond had an outlet and all of the water leaving Angiers's Pond was flowing through the small pond, through a dug channel to the old stone structures remaining from "Barrett's Mill." The mill appears to be a private residence now and the water is conducted underground after passing through stone structures on this property. The water rejoins Spencer Brook at the downstream corner of the Barrret's Mill Road bridge.

If not illegal, this diversion at least strikes me as unconscionable. Nearly 300 m of the brook with superb habitat for aquatic organisms is allowed to dry up while the water is diverted to a private property—and for no apparent use, at that. I would urge the SuAsCo team to try to get the responsible parties to reconstruct the small pond so that there is year-round flow in Spencer Brook itself (the "easterly channel"), and that the "Mill" only receives excess flow.

(Note: Neither the 1969 7.5 minute nor the 1987 15 minute USGS quadrangles represent the stream channel situation accurately.)

BENTHOS

No benthos were collected. We did extensive reconnaissance on the day we arrived to sample to try to find an alternative sampling reach on Spencer Brook. Our search turned up only marginal habitats for benthic invertebrate sampling between Barrett's Mill Road and the confluence with the Assabet River.

SAC06—Fort Pond Brook, Acton, MA (2 July 1996)

HABITAT

We sampled a fourth order reach adjacent to Parker Street, across from Parker House Apartments. The habitat here was generally very good. Riffles with gravel/cobble/boulder substrates predominated. The main habitat problem in this reach is the proximity of the road to the brook's right (east) bank and the steep drop-off to the stream channel. This slope narrowly separates the stream bed from the road and it is sparsely covered with vegetation. The shoulder of the road is covered with low herbaceous cover but the embankment is covered mostly by trees and some shrubs, with little herbaceous understory. This bank has many areas where there is evidence of erosion or there is high erosion potential. Someone (probably the apartments) is disposing of leaf litter along this bank. While this may provide some short-term protection against erosion, during heavy run-off/high flow periods this material probably increases organic loading (hence, BOD) to the brook. The overall habitat score here was 150.

BENTHOS

This site was chosen as a watershed reference because it appears to offer some of the best habitat in the watershed for large-drainage-area streams. It is not ideal, however, from the standpoint of upstream development and the potential influences of nonpoint source pollution. Nevertheless, taken empirically, the data indicate that the benthic community is relatively healthy. The richness was 16, the FBI was 4.54, and the EPT richness was eight. As such, this is probably the best we had for a reference for streams of this size in the SuAsCo watershed.

SAC07—Nashoba Brook, Acton, MA (2 July 1996)

HABITAT

The reach sampled was downstream from the access road to Acton Indoor Sports (off route 2A between Wetherbee St. and Keefe Rd.—near the Concord line). With the exception of a short stretch at the outlet of Ice House Pond our reconnaissance led us to conclude that this reach was the most promising along the Nashoba Brook for applying the rapid bioassessment protocols. The bottom substrates were predominantly sand, with limited patches of gravel and a few bricks providing more stable substrate. Most of the sample was collected from beds of aquatic vegetation (probably *Calitriche* sp.). Flow velocity appeared to be adequate and the channel appeared to follow a natural pattern of meanders, with little indication of any channelization. Both banks were well vegetated. The overall habitat score was 135.

BENTHOS

Calculated against either reference, this site was determined to be in the moderately impaired category. Inasmuch as the habitat scores were comparable to those of the reference sites it is likely that the results reflect nonpoint source influences.

SAC08—Elizabeth Brook, Stow, MA (5 July 1996)

HABITAT

Elizabeth Brook flows through a relatively low-population-density area of the watershed dominated by wetlands. The best kick-sampling site we encountered was immediately upstream from route 117 in Stow. Sampling was restricted to the lower one quarter of the reach where the riffles and cobble/gravel substrates were predominant. The remainder of the reach was above the remnants of an old stone dam, and had sluggish flow. The overall habitat score was 170.

BENTHOS

Calculated against either reference, this site was determined to be in the moderately impaired category. This site had one of the highest habitat scores among the sites sampled so it is not likely that there were habitat limitations. With the extensive wetlands and impoundments upstream of this site and the proximity of housing in some stretches of the brook there may well be impacts from nonpoint source nutrient loadings (i.e., septic systems?).

SAC09—Fort Meadow Brook, Hudson, MA (2 July 1996)

HABITAT

This brook was sampled in a reach running roughly parallel with Shay Street through a nicely wooded area. This was generally very good habitat. There was a good frequency of riffles and the bottom substrate included lots of cobble and gravel but with an extensive amount of sand. The high proportion of sand among the bottom substrates appears to be a characteristic of the prevailing soils in the vicinity of this reach, and not the result of erosion, at this time. This area would be particularly vulnerable, however, to habitat destruction in the brook due to careless construction activities. The overall habitat score was 149.

Immediately upstream from the reach sampled trees are being cleared to within feet of the stream bank, presumably for house lots. No attempt has been made to ameliorate the effects of increased runoff that may result from this activity (e.g., silt screens, hay bails). The team may wish to check with the Hudson Conservation Commission, because there was no “file number” posted. Another situation that calls for action from the Conservation Commission occurs at a point well downstream from the sampled reach. There is already severe erosion taking place that is affecting wetland habitat as well as habitat in the brook itself. The cause is construction of new homes on Hosmer Street. Some silt screen has been installed, but not properly. As a result gully erosion is visible across the front yards of these new homes and an extensive amount of soil is deposited along the sides of the street and in the wetlands. This quite possibly may be a violation of the wetlands protection act.

BENTHOS

The RBP II scores calculated for this site indicate that it has a relatively healthy benthic community. This site will be a good one to track through the years, however, because it is clear that it will be receiving pressure from new home construction. It might be useful to engage this community in some sort of education program to alert landowners to land use practices that can minimize impacts and maximize watershed protection.

SAC10—North Brook, Berlin, MA (17 May 1996)

Though I did not conduct a thorough reconnaissance of this brook, the portion of it I did look at did not lend itself to rapid bioassessment protocols. If there is a specific interest in the status of this brook it may require a specially designed study. At the time of our visit there was a lot of activity related to the sand a gravel operation and construction at Solomon Pond Mall, both of which are neighbors of this brook. It was our intention to return to this brook to do further reconnaissance and evaluate habitat quality as well as any potential nonpoint source problems related to the mall or sand and gravel operation. Unfortunately, since we were running into time conflicts with other commitments and this brook was not rated as one of the higher priority concerns in the watershed we did not get back to it.

SAC11—Pantry Brook, Sudbury, MA (5 July 1996)

HABITAT

Much of Pantry Brook's drainage is through wetlands. We did not find a suitable sampling location on the mainstem but did sample a small tributary to the brook. The stream comes from the outlet of a small pond in a very new residential development accessed by Julian's Way, off Haynes Road. The stream flowed through woods that generally provided a wide buffer from the back yards of the nearest houses, those along Greystone Lane. It appeared that any potential for nonpoint source problems would be concentrated in the vicinity of the pond, where stormwater from Julian's Way contributes to the headwaters. We sampled in a first order reach approximately 250 m downstream from the pond, a position along the stream between the cul-de-sac at the end of Hadley Lane to the east and the cul-de-sac at the end of Greystone Lane to the west (at least 100 m from either of these). The stream was very shallow but the channel had good sinuosity, riffles were present, and there was a lot of cobble and gravel—though about 60% of the stream bottom was sand (apparently consistent with the flood plain soils). About half of the available habitat in this reach was snags, and thus half the sampling effort included snags. The overall habitat score was 143.

BENTHOS

Compared against Gates Pond Brook (SAC03A) as the reference this site ranked as moderately impaired, so there may be nonpoint source influences here. Two factors that may have overstated the relative impairment of this brook were the ratio of scrapers to filtering collectors and the EPT index. Given the dense woodland setting of this brook the relative paucity of scrapers may be understandable. The EPT index for this site calculated out to 88% of the reference—qualifying for only three of six points toward the total—but the real difference was seven vs. eight. I suspect that if there are any significant nonpoint source impacts they are associated with the headwater ponds or road run-off from Julian's Way.

SAC12—Hop Brook, Sudbury, MA (21 May 1996)

HABITAT

This brook was examined between route 20 and Codjer lane. It did not appear that the rapid bioassessment protocol could be applied here suitably. If benthic data are desired it will probably require a specifically designed study.

At route 20 the water was deep and fast, the bottom was sandy, and the margins were deep, soft muck. Routed aquatic vegetation—notably *Potamogeton crispus*—was well established even this early in the season. Filamentous algae were prominent along the margins. Clearly, this stream is carrying a heavy nutrient load.

At Union Avenue/Codjer Lane the water was also deep and fast with similar bottom characteristics. There is a water withdrawal at the upstream side of Union Avenue by Cavicchio Greenhouses. This is a big operation. The team may wish to check into whether this withdrawal is, or should be, registered under the Water Management Act.

The only potential for nonpoint sources of pollution I noted on this reconnaissance was the presence of several auto repair and auto body shops and a stone cutting operation, all located near the brook (along Station Road and Union Avenue) in the reach between route 20 and Codjer Lane.

SAC13—Eames Brook, Framingham, MA (3 July 1996)

HABITAT

It was intended that this brook would be sampled upstream and downstream of the Framingham Reduction Plant. The upstream site was designated SAC13A. Running parallel to Dudley Road, a short distance (approximately 10 m) upstream was a small reinforced concrete bridge (with no road). Between

the two bridges the brook had good current velocity. Amid the riffles bottom substrates were composed of cobble, gravel, and sand; snags provided additional substrate for colonization by benthic macroinvertebrates. Upstream from the small bridge the water appeared to stand stagnant over fine sediments in a straight, wide channel. Though the benthos sampling took place entirely within the riffles between the two bridges the habitat scoring considered the entire 100 m reach upstream from Dudley Road. Lots of bluegills, mats of algae, and filaments of algae were visible looking upstream from the small bridge. The habitat score total was 142.

Downstream from Dudley Road the brook meanders a bit before passing through a control structure (presumably no longer in use). In this stretch sediments are mucky to sandy and oils are released when the sediments are disturbed—especially where the brook borders the reduction plant. A slow current was perceptible through this stretch, and bluegills/pumpkinseeds could be seen swimming about. Even in May (when reconnaissance was conducted) the water was a turbid brown with well established populations of filamentous algae and macrophytes (*Potamogeton crispus*). Trash is strewn at various points all along from Dudley Road to the confluence with the Sudbury River.

During the reconnaissance in May the current velocity immediately downstream from the control structure was slow and the bottom substrates were mucky, in places deep muck. Closer to the confluence with the Sudbury the brook current was almost fast enough to appear as a riffle and the substrates appeared to be predominantly sand and heavy accumulations of leaf litter. It was expected at that time that this most downstream reach could be paired with the Dudley Road site, relying on the snags in the brook to provide sufficient productive substrate. On the sampling date, however, with water levels lower, there was no stretch of this brook downstream from Dudley Road that appeared to present sufficient macroinvertebrate habitat for a useful assessment. If the team wishes to have macroinvertebrate data that bracket the Reduction Plant I recommend that a study be designed specifically for this application (it will probably require a sampling protocol relying on introduced substrates). Because of the release of the sediment oils that was observed, the team might get more useful information from sampling sediments in the vicinity of the Reduction Plant and having them analyzed for PAHs and other petroleum by-products.

BENTHOS

SAC13A was determined to be moderately impaired when compared against SAC06. There are several possibilities that likely contribute to this, all associated with the fact that the reservoir upstream of this site (Farm Pond) is apparently nutrient rich, and about half of the lake's shoreline is bordered by urban development in downtown Framingham.

SAC14—Indian Brook, Ashland, MA (3 July 1996)

HABITAT

Indian Brook was selected as a potential reference site because its drainage is about as sparsely populated as any in this watershed. The brook originates in central Hopkinton, winding its way through an extensive wetland area and feeding Hopkinton Reservoirs in Hopkinton State Park. From the outlet of the lower reservoir (swimming area) Indian Brook leaves the park as a sluggish, if not stagnant, stream as seen from the vicinity of Howe Street. Current velocity is sufficient through the 250 m or so approaching Cross Street but this stretch was so straight that it would seem to have been the result of past channelization. As a consequence, the habitat was somewhat monotonous (in terms of substrates, velocity, and water depth) and considered to be unsuitable for reference purposes.

Approximately 200 m or so downstream from Cross Street, however, natural channel sinuosity was evident and steeper gradient created excellent riffles as the brook flowed through a forested setting. The sample reach was located along this part of the brook, with the lower end marked by a small wooden bridge associated with a Boy Scout campground. The bottom substrates were a mix of cobble, gravel, and sand, with frequent boulders and rubble. The overall habitat score was 173.

BENTHOS

In spite of it's relatively high habitat score Indian Brook ranked as moderately impaired when compared against Fort Pond Brook (SAC06). This could indicate the influence of the possibly eutrophic waters that flow out of the Hopkinton Reservoirs to make up Indian Brook, or perhaps nonpoint source pollution downstream from Hopkinton State Park.

SAC15—Whitehall Brook, Hopkinton, MA (11 July 1996)

HABITAT

Whitehall Brook traverses an extensive network of wetlands, flowing from Whitehall Reservoir in Hopkinton to Cedar Swamp in Westborough and the head of the Sudbury River. Most of this brook is slow moving, with sand, or finer, bottom substrates. The only reach we could find with a suitable combination of current velocity and productive substrates for macroinvertebrate sampling was at the downstream side of Fruit Street; and it is undoubtedly the road crossing that causes enough of a gradient to create the riffle habitat necessary for applying our kick-sampling methodology. Below this reach the gradient again flattens out, the flow becomes imperceptible, and cover/substrate for both fish and invertebrates is scarce. The overall habitat score for the sample reach was 144.

BENTHOS

The RBP II results indicate that SAC15 was unimpaired compared against either Fort Pond Brook or Gates Pond Brook.

SUMMARY

Ten of 14 sites investigated in this watershed had RBP II scores indicating moderate impairment. This suggests that the team will want to take a closer look at these locations and perhaps gather more information on these sites or target them with specific data collections. Four of the sites surface as most in need of follow-up. These are River Meadow Brook in Carlisle (SAC04), Spencer Brook in Concord (SAC05), Fort Meadow Brook in Hudson (SAC09), and Eames Brook in Framingham (SAC13).

River Meadow Brook (SAC04) by all appearances should have provided the best assemblage of macroinvertebrates, but it scored as moderately impaired. Possibilities to explore are nonpoint sources of pollution or pesticide residues related to the cranberry bogs.

Spencer Brook (SAC05) was a severe case of habitat loss, and it is quite needless. I urge the team to look into requiring that a minimum flow be maintained in Spencer Brook between Angiers Pond and Barrett's Mill Road year-round.

Fort Meadow Brook (SAC09), though apparently healthy now, appears to be threatened by construction activities in its watershed. Indeed there is already evidence of serious erosion—with sediment loading to the brook—taking place. Proactive attempts at educating the Hudson Conservation Commission, property owners, and contractors on best management practices to minimize impacts and maximize wetland/watershed protection will undoubtedly pay huge dividends over the next several years.

Eames Brook (SAC13) presented problems for conducting benthic macroinvertebrate assessments. As a consequence I was unable to bracket the Framingham Reduction Plant with sampling sites. From my reconnaissance of the reach between the plant and the confluence with the Sudbury River, however, I observed sediment and surface oils, odors, and rusted-out metal drums suggesting that this area has a history of contamination with potentially toxic materials. It would be prudent to follow up with some sediment testing for PAHs, etc. in this reach to determine if it should have status as a hazardous waste site.

cc: A.S. Johnson
E. Chesebrough

APPENDIX A

Aquatic Macroinvertebrate Taxa List

Table A1. List of macroinvertebrate taxa collected from stream sites in the Sudbury/Assabet/Concord (SuAsCo) watershed between 1 and 11 July 1996. The sampling sites were in: Mill Brook (01A and 01B), Concord; Pine Brook (02), Wayland; Gates Pond Brook (03A and 03B), Berlin; River Meadow Brook (04), Carlisle; Fort Pond Brook (06), Acton; Nashoba Brook (07), Acton; Elizabeth Brook (08), Stow; Fort Meadow Brook (09), Hudson; Pantry Brook (11), Sudbury; Eames Brook (13A), Framingham; Indian Brook (14), Ashland; Whitehall Brook, Hopkinton—all in Massachusetts.

TAXON	FFG	T.V.	01A	01B	02	03A	03B	04	06	07	08	09	11	13A	14	15
Hydrobiidae	SC	8	1											2		
Physidae	GC	8	6					13	1	3				5		
Planorbidae	SC	6	2					1			2			4		
Unionidae	FC	5														1
Pisidiidae	FC	6	1					11	1	1	17	1	1	1	11	1
Enchytraeidae	GC	10		4		1		1					1			
Tubificidae	GC	10	2	1				1						2		
Naididae	GC	9				1		1							2	
Lumbriculidae	GC	7		3	3	2		1	3	2	2	11	1		1	4
Erpobdellidae	PR	8						12								
Asellidae	GC	8	2	1				4						5		2
Gammaridae	GC	6	64	28					2	79			8	2		
Hyalellidae	GC	8												2		6
Hydracarina	PR	6									1	1	1			1
Ephemeroptera	GC	5											2			
Baetidae	GC	4				2	1		3						2	18
Oligoneuriidae	GC	4							9							
Heptageniidae	SC	4					1		4		10	1	1		3	1
Ephemerellidae	GC	1				1	2		1							
Gomphidae	PR	5										1			1	
Aeschnidae	PR	3		1								2	1			
Coenagrionidae	PR	9														1
Plecoptera	SH	3											1			
Peltoperlidae	SH	0				4	5									
Nemouridae	SH	2													1	
Capniidae/Leuctridae	SH	1			2	7	2						22		3	
Perlidae	PR	1					1		2		4					1
Perlodidae	PR	2				4	1									

e A1. (Continued.)

TAXON	FFG	T.V.	01A	01B	02	03A	03B	04	06	07	08	09	11	13A	14	15
Sialidae	PR	8				1										
Corydalidae	PR	5		1							5		3		3	1
Philopotamidae	FC	3			13		2		11		12	14			7	3
Psychomyiidae	GC	2											2			
Hydropsychidae	FC	4	2	4	7	17	7		11	1	31	25	15	19	24	8
Rhyacophilidae	PR	0				1	1									
Glossosomatidae	SC	0			1											
Hydroptilidae	GC	4								1						1
Brachycentridae	FC	1							1							
Odontoceridae	SH	0				2							1			
Leptoceridae	PR	4													1	4
Pyralidae	SH	5									1					
Hydrophilidae	PR	5					1			1			1			
Psephenidae	SC	4				1										
Elmidae	SC	4		1	1	7	1		16	2	9	19				11
Ptilodactylidae	SH	4				3										
Tipulidae	SH	5		1	7	4	2					1	4			
Psychodidae	GC	10		1												
Simuliidae	FC	6		1	57			24	1	1			4	21	4	5
Chironomidae	GC	6	26	55	23	46	80	37	25	4	9	27	40	39	42	28
Tabanidae	PR	6					1									
Empididae	PR	6				1	2		1				1	3		1
TOTAL			106	102	114	105	110	106	92	95	103	103	110	105	105	98
HBI			6.21	6.14	5.34	4.56	5.15	6.66	4.54	5.99	4.45	4.75	4.48	5.98	5.08	5.19

APPENDIX B

RBP II calculations for stream sites sampled in the Sudbury/Assabet/Concord (SuAsCo) watershed between 1 and 11 July 1996.

Table B1. Summary of RBP II calculations for stream sites sampled in the Sudbury/Assabet/Concord (SuAsCo) watershed between 1 and 11 July 1996. All comparisons use SAC03A as reference.

Station	SAC03A (Ref.)	Points	Ratio to Ref.	SAC01A % of Ref.	Points	Ratio to Ref.	SAC01B % of Ref.	Points	Ratio to Ref.	SAC02 % of Ref.	Points
Taxa Richness	18	6	9/18	50	3	13/18	72	3	9/18	50	3
FBI	4.56	6	4.56/6.21	73	3	4.56/6.14	74	3	4.56/5.34	85	3
Scrapers/ Filt. Coll.	0.47	6	1/0.47	213	6	0.20/0.47	43	3	0.03/0.47	6	0
EPT/ Chironomidae	0.83	6	0.08/0.83	10	0	0.07/0.83	8	0	1/0.83	120	6
% Contribution (dom. fam.)	44%	3		60	0		54	0		50	3
EPT Index	8	6	1/8	13	0	1/8	13	0	4/8	50	0
% Similarity	(Ref.)	6		27	0		53	3		35	3
Score		39			12			12			18
% of Reference		(Ref.)	12/39	31		12/39	31		18/39	46	
Ranking		(Ref.)		moderately impaired			moderately impaired			moderately impaired	
Habitat Score		139			95			64			159
% of ref. Habitat			95/139	68		64/139	46		159/139	114	
Habitat Comparability				partially supporting			non-supporting			comparable	

Table B1. (Continued.)

Station	SAC03A (Ref.)	Points	Ratio to Ref.	SAC03B % of Ref.	Points	Ratio to Ref.	SAC04 % of Ref.	Points	Ratio to Ref.	SAC07 % of Ref.	Points
Taxa Richness	18	6	16/18	89	6	11/18	61	3	10/18	56	3
FBI	4.56	6	4.56/5.15	89	6	4.56/6.66	68	3	4.56/5.99	76	3
Scrapers/Filt. Coll.	0.47	6	0.22/0.47	47	3	0.03/0.47	6	0	0.67/0.47	143	6
EPT/Chironomidae	0.83	6	0.29/0.83	35	3	0		0	0.50/0.83	60	3
% Contribution (dom. fam.)	44%	3		73	0		35	3		83	0
EPT Index	8	6	10/8	125	6	0		0	2/8	25	0
% Similarity	(Ref.)	6		64	3		38	3		9	0
Score		39			27			12			15
% of Reference		(Ref.)	27/39	69		12/39	31		15/39	38	
Ranking		(Ref.)		moderately impaired			moderately impaired			moderately impaired	
Habitat Score		139			132			186			135
% of ref. Habitat		(Ref.)	132/139	95		186/139	134		135/139	97	
Habitat Comparability		(Ref.)		comparable			comparable			comparable	

Table B1. (Continued.)

Station	SAC03A (Ref.)	Points	Ratio to Ref.	SAC08 % of Ref.	Points	Ratio to Ref.	SAC09 % of Ref.	Points	Ratio to Ref.	SAC11 % of Ref.	Points
Taxa Richness	18	6	12/18	67	3	11/18	61	3	19/18	106	6
FBI	4.56	6	4.56/4.45	102	6	4.56/4.75	96	6	4.56/4.48	102	6
Scrapers/Filt. Coll.	0.47	6	0.35/0.47	74	6	0.50/0.47	106	6	0.05/0.47	11	0
EPT/Chironomidae	0.83	6	6.3/0.83	759	6	1.48/0.83	178	6	1.1/0.83	133	6
% Contribution (dom. fam.)	44	3		30	3		26	6		36	3
EPT Index	8	6	4/8	50	0	3/8	38	0	7/8	88	3
% Similarity	(Ref.)	6		34	3		52	3		65	3
Score		39			27			30			27
% of Reference		(Ref.)	27/39	69		30/39	77		27/39	69	
Ranking		(Ref.)		moderately impaired			non-mod. impaired			moderately impaired	
Habitat Score		139			170			149			143
% of ref. Habitat		(Ref.)	170/139	122		149/139	107		143/139	103	
Habitat Comparability		(Ref.)		comparable			comparable			comparable	

Table B1. (Continued.)

Station	SAC03A (Ref.)	Points	Ratio to Ref.	SAC15 % of Ref.	Points	Ratio to Ref.	% of Ref.	Points	Ratio to Ref.	% of Ref.	Points
Taxa Richness	18	6	19/18	106	6						
FBI	4.56	6	4.56/5.19	88	6						
Scrapers/Filt. Coll.	0.47	6	0.67/0.47	143	6						
EPT/Chironomidae	0.83	6	1.29/0.83	155	6						
% Contribution (dom. fam.)	44	3		29	6						
EPT Index	8	6	7/8	88	3						
% Similarity	(Ref.)	6		49	3						
Score		39			36						
% of Reference		(Ref.)	36/39	92							
Ranking		(Ref.)		nonimpaired							
Habitat Score		139			144						
% of ref. Habitat		(Ref.)	144/139	104							
Habitat Comparability		(Ref.)		comparable							

Table B2. Summary of RBP II calculations for stream sites sampled in the Sudbury/Assabet/Concord (SuAsCo) watershed between 1 and 11 July 1996. All comparisons use SAC06 as reference.

Station	SAC06 (Ref.)	Points	Ratio to Ref.	SAC01A % of Ref.	Points	Ratio to Ref.	SAC01B % of Ref.	Points	Ratio to Ref.	SAC02 % of Ref.	Points
Taxa Richness	16	6	9/16	56	3	13/16	81	6	9/16	56	3
FBI	4.54	6	4.54/6.21	73	3	4.54/6.14	74	3	4.54/5.34	85	6
Scrapers/Filt. Coll.	0.80	6	1/0.80	125	6	0.20/0.80	25	3	0.03/0.80	4	0
EPT/Chironomidae	1.6	6	0.08/1.6	5	0	0.07/1.6	4	0	1/1.6	63	3
% Contribution (dom. fam.)	27	6		60	0		54	0		50	3
EPT Index	8	6	1/8	13	0	1/8	13	0	4	50	0
% Similarity	(Ref.)	6		31	3		38	3		42	3
Score		42			15			15			18
% of Reference		(Ref.)	15/42	36		15/42	36		18/42	43	
Ranking		(Ref.)		moderately impaired			moderately impaired			moderately impaired	
Habitat Score		150			95			64			159
% of ref. Habitat		(Ref.)	95/150	63		64/150	43		159/150	106	
Habitat Comparability		(Ref.)		partially supporting			nonsupporting			comparable	

Table B2. (Continued.)

Station	SAC06 (Ref.)	Points	Ratio to Ref.	SAC04 % of Ref.	Points	Ratio to Ref.	SAC07 % of Ref.	Points	Ratio to Ref.	SAC08 % of Ref.	Points
Taxa Richness	16	6	11/16	69	3	10/16	63	3	12/16	75	3
FBI	4.54	6	4.54/6.66	68	3	4.54/5.99	76	3	4.54/4.45	102	6
Scrapers/Filt. Coll.	0.80	6	0.03/0.80	4	0	0.67/0.80	84	6	0.35/0.80	44	3
EPT/Chironomidae	1.6	6	0	0	0	0.50/1.6	31	3	6.3/1.6	394	6
% Contribution (dom. fam.)	27	6		35	3		83	0		30	3
EPT Index	8	6	0	0	0	2/8	25	0	4/8	50	0
% Similarity	(Ref.)	6		31	3		14	0		51	3
Score		42			12			15			24
% of Reference		(Ref.)	12/42	29		15/42	36		24/42	57	
Ranking		(Ref.)		moderately impaired			moderately impaired			moderately impaired	
Habitat Score		150			186			135			170
% of ref. Habitat		(Ref.)	186/150	124		135/150	90		170/150	113	
Habitat Comparability		(Ref.)		comparable			comparable			comparable	

Table B2. (Continued.)

Station	SAC06 (Ref.)	Points	Ratio to Ref.	SAC09 % of Ref.	Points	Ratio to Ref.	SAC13A % of Ref.	Points	Ratio to Ref.	SAC14 % of Ref.	Points
Taxa Richness	16	6	11/16	69	3	12/16	75	3	14/16	88	6
FBI	4.54	6	4.54/4.75	96	6	4.54/5.98	76	3	4.54/5.08	89	6
Scrapers/Filt. Coll.	0.80	6	0.50/0.80	63	6	0.15/0.80	19	0	0.07/0.80	9	0
EPT/Chironomidae	1.6	6	1.48/1.6	93	6	0.49/1.6	31	3	0.98/1.6	61	3
% Contribution (dom. fam.)	27	6		26	6		37	3		40	3
EPT Index	8	6	3/8	38	0	1/8	13	0	7/8	88	3
% Similarity	(Ref.)	6		72	6		45	3		54	3
Score		42			33			15			24
% of Reference		(Ref.)	33/42	79		15/42	36		24/42	57	
Ranking		(Ref.)		nonimpaired			moderately impaired			moderately impaired	
Habitat Score		150			149			142			173
% of ref. Habitat		(Ref.)	149/150	99		142/150	95		173/150	115	
Habitat Comparability		(Ref.)		comparable			comparable			comparable	

Table B2. (Continued.)

Station	SAC06 (Ref.)	Points	Ratio to Ref.	SAC15 % of Ref.	Points	Ratio to Ref.	% of Ref.	Points	Ratio to Ref.	% of Ref.	Points
Taxa Richness	16	6	19/16	119	6						
FBI	4.54	6	4.54/5.19	87	6						
Scrapers/Filt. Coll.	0.80	6	0.67/0.80	84	6						
EPT/Chironomidae	1.6	6	1.29/1.6	81	6						
% Contribution (dom. fam.)	27	6		29	6						
EPT Index	8	6	7/8	88	3						
% Similarity	(Ref.)	6		60	3						
Score		42			36						
% of Reference		(Ref.)	36/42	86							
Ranking		(Ref.)		nonimpaired							
Habitat Score		150			144						
% of ref. Habitat		(Ref.)	144/150	96							
Habitat Comparability		(Ref.)		comparable							

Table B3. Summary of RBP II calculations for comparison of the downstream (SAC01B) Mill Brook (Concord, MA) site to the upstream (SAC01A) site. Sites sampled on 1 July 1996.

Station	SAC01A (Ref.)	Points	Ratio to Ref.	SAC01B % of Ref.	Points
Taxa Richness	9	6	13/9	144	6
FBI	6.21	6	6.21/6.14	101	6
Scrapers/Filt. Coll.	1	6	0.20/1	20	0
EPT/Chironomidae	0.08	6	0.07/0.08	88	6
% Contribution (dom. fam.)	60	0		54	0
EPT Index	1	6	1/1	100	6
% Similarity	(Ref.)	6		56	3
Score		36			27
% of Reference		(Ref.)	27/36	75	
Ranking		(Ref.)		non/moderately impaired	
Habitat Score		95			64
% of ref. Habitat		(Ref.)	64/95	67	
Habitat Comparability		(Ref.)		partially supporting	

APPENDIX I

SMART MONITORING PROGRAM: SuAsCo WATERSHED DATA 2000 - 2001

Massachusetts Department of ENVIRONMENTAL PROTECTION

Please refer to DEP DWM CN 83.0 *Data Validation Report For Year 2000 Project Data* (March 2003) and CN 149.0 *Data Validation Report For Year 2001 Project Data* (December 2004) for details on the review and validation of environmental data collected by the SMART program. Additional information on objectives, methods, survey conditions, etc. is available in a technical memorandum by Therese Beaudoin, DEP CERO (in preparation).

Concord River downstream of Rogers Street Bridge, Lowell

SUASCO WATERSHED SMART SAMPLING SUMMARY – 2000 THROUGH 2001		
Location and Segment Numbers	**Station Name**	**Dates Sampled[1]**
Assabet River @ School Street, Northborough MA82B-02	AS04	2000: 3/8/00, 5/3/00, 7/12/00, 8/28/00, 11/15/00 2001: 2/21/01, 4/18/01, 6/20/01, 8/15/01, 10/24/01, 12/12/01 [1]The SMART Monitoring began in the SuAsCo basin in March 2000.
Assabet River @ USGS flow gaging station, State Roads 27/62, Maynard MA82B-05	AS18	
Nashoba Brook @ USGS flow gaging station, Wheeler Road, Acton MA82B-14	NA01	
Sudbury River @ USGS flow gaging station, Danforth Road, Framingham MA82A-03	SU07	
Concord River @ USGS flow gaging station north of Rogers Street, Lowell MA82A-09	CO7	

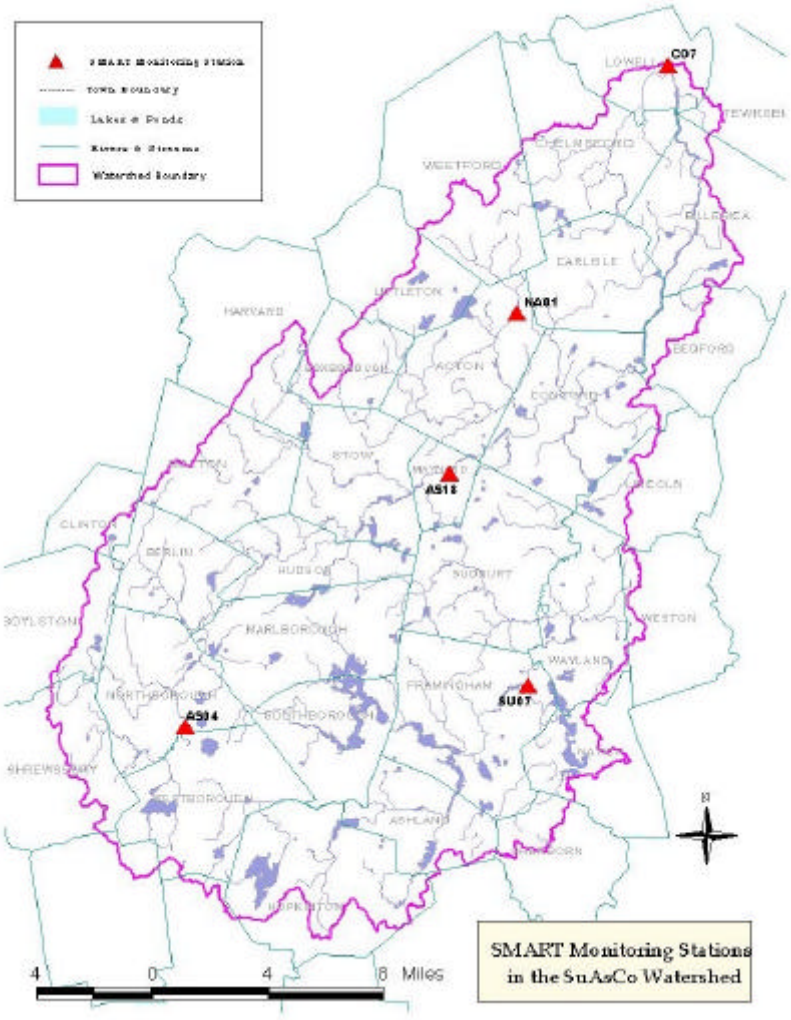


Figure 1: SuAsCo River Basin SMART Sampling Stations – 2000 to Present

Table I1. 2000 SMART *in situ* Hydrolab® data- SuAsCo Watershed.

CONCORD RIVER (Saris: 8246500)
Unique_ID: 679 Station: CO7, Mile Point: 0.8
Description: approximately 100 meters downstream/north from Rogers Street, Lowell

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/8/2000	SM-0006	12:53	0.6	6.0	6.7	308	197	12.7	100
5/3/2000	SM-0046	13:13	0.8	13.3	6.7	270	173	10.9	101
7/12/2000	SM-0100	12:44	0.7	24.1	7.4c	374	239	9.1	107
8/28/2000	SM-0147	13:26	1.0	23.8	6.8	412	264	8.5	98
11/15/2000	SM-0187	12:20	0.9	9.0	6.9	317	203	10.8	93

ASSABET RIVER (Saris: 8246775)
Unique_ID: 695 Station: AS04, Mile Point: 28
Description: approximately 20 meters upstream/south of School Street, Northborough

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/8/2000	SM-0001	09:18	0.1i	5.5	6.6	438	280	11.2	88
5/3/2000	SM-0041	09:32	0.2	10.7	6.4	381	244	9.4	82
7/12/2000	SM-0095	09:09	0.3	19.4	6.7	879c	562c	5.2	56
8/28/2000	SM-0142	09:30	0.6	20.0	6.4	872c	558c	4.4	48
11/15/2000	SM-0182	09:04	0.4	8.1	6.4	373	238	8.6	73

ASSABET RIVER (Saris: 8246775)
Unique_ID: 697 Station: AS18, Mile Point: 7.6
Description: approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard.

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/8/2000	SM-0004	11:09	0.1i	6.0	6.7u	324	207	12.9	102
5/3/2000	SM-0043	11:30	0.3	13.2	6.7	289	185	10.7	99
7/12/2000	SM-0097	10:54	0.6	23.5	7.4c	419	268	8.2	94
8/28/2000	SM-0144	11:41	0.7	23.0	7.2c	462	295	9.1	103
11/15/2000	SM-0184	10:40	0.5	8.6	6.7	319	204	10.8	92

NASHOBA BROOK (Saris: 8246875)
Unique_ID: 698 Station: NA01, Mile Point: 4.3
Description: upstream/north of footbridge in Nashoba Brook Conservation Area southeast of Wheeler Lane, Acton

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/8/2000	SM-0005	11:56	0.1i	5.6	6.4	297	190	11.5	90
5/3/2000	SM-0045	12:15	0.4	11.9	6.4	281	180	10.0	90
7/12/2000	SM-0099	11:42	0.5	19.6	6.6	341	219	6.0	64
8/28/2000	SM-0146	12:27	0.7	19.8	6.3	337	215	5.1	55
11/15/2000	SM-0186	11:26	0.7	7.9	6.3	249	159	8.8	74

SUDBURY RIVER (Saris: 8247650)
Unique_ID: 696 Station: SU07, Mile Point: 16.5
Description: just upstream/south of Danforth Street, Framingham

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
3/8/2000	SM-0003	10:16	0.2	5.6	6.8u	353	226	12.8	101
5/3/2000	SM-0042	10:46	0.3	11.8	6.9	313	200	11.2	101
7/12/2000	SM-0096	10:05	0.5	21.9	7.1c	410	262	8.0	90
8/28/2000	SM-0143	10:51	0.7	22.1	7.0u	422	270	9.5	107
11/15/2000	SM-0183	09:59	0.4	8.9	6.9	353	226	11.3	97

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

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

Table I2. 2001 SMART *in situ* Hydrolab® data- SuAsCo Watershed.

CONCORD RIVER (Saris: 8246500)
Unique_ID: W0679 Station: CO7, Mile Point: 0.8
Description: approximately 100 meters downstream/north from Rogers Street, Lowell

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
2/21/2001	SM-0225	13:07	1.0	0.51	6.2	456	292	15.1u	103u
4/18/2001	SM-0265	13:49	0.8	11.2	6.8	337	216	11.3	102
6/20/2001	SM-0305	12:29	1.0	24.7	6.7	267	171	7.7u	91u
8/15/2001	SM-0345	13:09	0.9	25.0	7.1c	433	277	7.6	90
10/24/2001	SM-0385	12:46	##i	14.1	7.4cu	560	359	10.6	102
12/12/2001	SM-0425	13:07	0.4	5.1	8.9c	537	344	16.4	124

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0695 Station: AS04, Mile Point: 28
Description: approximately 20 meters upstream/south of School Street, Northborough

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
2/21/2001	SM-0220	09:26	0.5	2.7	6.3	625	400	11.3	82
4/18/2001	SM-0260	09:33	0.4	8.9	6.5	541	346	9.5	82
6/20/2001	SM-0300	09:09	0.8	21.6	6.4	381	244	5.5	61
8/15/2001	SM-0340	09:17	0.5	19.7	6.6	1,012c	648c	5.2	56
10/24/2001	SM-0380	09:16	0.1i	15.7	6.6u	885c	566c	4.9	49
12/12/2001	SM-0420	09:10	0.6	7.0	6.8	855c	547	8.2	65

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0697 Station: AS18, Mile Point: 7.6
Description: approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard.

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
2/21/2001	SM-0222	11:32	0.7	1.1	6.4	525	336	14.5	101
4/18/2001	SM-0262	11:34	0.2	10.1	6.7	365	234	11.4	101
6/20/2001	SM-0302	11:04	0.9	23.1	6.4	260	166	7.0	80
8/15/2001	SM-0342	11:18	0.7	23.6	7.0c	582	372	7.6	88
10/24/2001	SM-0382	11:08	##i	13.1	7.3c	707	453	10.5	99
12/12/2001	SM-0422	11:18	0.5	4.3	7.4c	611	391	14.0	104

NASHOBA BROOK (Saris: 8246875)
Unique_ID: W0698 Station: NA01, Mile Point: 4.3
Description: upstream/north of footbridge in Nashoba Brook Conservation Area southeast of Wheeler Lane, Acton

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
2/21/2001	SM-0224	12:10	0.7	0.19	6.0	416	266	10.9	74
4/18/2001	SM-0264	12:09	0.6	8.1	6.4	313u	200u	9.7	82
6/20/2001	SM-0304	11:39	0.8	22.1	6.2	247	158	5.3u	59u
8/15/2001	SM-0344	12:06	0.7	20.6u	6.5	383	245	4.5	49
10/24/2001	SM-0384	11:47	##i	13.1u	6.7	322	206	7.5	70
12/12/2001	SM-0424	12:09	0.5	3.2	6.5	402	257	10.9	78

= Censored data (i.e., data that has been discarded for some reason).
i = inaccurate readings from Multi-probe likely
u = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc.
c = greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard.

Table I2 (Continued). 2001 SMART *insitu* Hydrolab® data- SuAsCo Watershed.

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0696 Station: SU07, Mile Point: 16.5
Description: just upstream/south of Danforth Street, Framingham

Date	OWMID	Time	Depth	Temp	pH	Conductivity @ 25C	TDS	DO	% Saturation
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(mg/l)	(%)
2/21/2001	SM-0221	10:44	1.1	2.5	6.5u	520	333	13.9	101
4/18/2001	SM-0261	10:48	0.4	9.6	6.9c	393	251	11.3	99
6/20/2001	SM-0301	10:19	0.9	23.8	6.8	393	251	7.4u	86u
8/15/2001	SM-0341	10:25	0.6	22.3	7.1c	405	259	8.6	97
10/24/2001	SM-0381	10:20	##i	13.4	6.8	566	362	9.4u	89u
12/12/2001	SM-0421	10:21	0.7	4.2	6.8u	533	341	12.4	92

= Censored data (i.e., data that has been discarded for some reason).
i = inaccurate readings from Multi-probe likely
u = unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc.

Table I3. 2000 SMART Physico-chemical data- SuAsCo Watershed.

CONCORD RIVER (Saris: 8246500)
Unique_ID: W0679 Station: CO7, Mile Point: 0.8
Description: approximately 100 meters downstream/north from Rogers Street, Lowell

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0006		12:53	2.1	69	13	41	0.02	0.52	0.37	0.082	4.1
5/3/2000	SM-0046		13:13	2.3	60	14	35	<0.02	0.28	0.50	0.067	4.9
7/12/2000	SM-0100		12:44	5.1	75	30	56	0.06	0.51	0.96	0.15	11
8/28/2000	SM-0147		13:26	0.20	85	28	60	<0.02	0.77	0.52	0.11	3.7
11/15/2000	SM-0187		12:20	4.4	63	21	47	0.06	0.99	0.61	0.18	7.1

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0695 Station: AS04, Mile Point: 28
Description: approximately 20 meters upstream/south of School Street, Northborough

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0001	SM-0002	09:18	1.0	100	21	69	0.06	1.5	0.39	0.37	1.1
3/8/2000	SM-0002	SM-0001	09:23	1.0	100	22	69	0.06	1.5	0.41	0.37	<1.0
5/3/2000	SM-0041		**	2.0	87	17	62	<0.02	1.3	0.65	0.15	2.9
7/12/2000	SM-0095		09:09	1.2	210	33	135	0.03	3.6	0.95	0.56	1.1
8/28/2000	SM-0142		09:30	1.3	190	33	131	0.04	4.7	0.92	0.69	1.0
11/15/2000	SM-0182		09:00	3.2	82	18	64	0.02	1.2	0.60	0.38	3.1

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0697 Station: AS18, Mile Point: 7.6
Description: approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard.

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0004		11:09	1.3	73	10	45	<0.02	0.80	0.30	0.12	4.0
5/3/2000	SM-0043	SM-0044	11:30	2.2	65	13	40	<0.02	0.44	0.43	0.10	7.3
5/3/2000	SM-0044	SM-0043	11:35	2.2	64	13	40	<0.02	0.44	0.44	0.10	6.6
7/12/2000	SM-0097	SM-0098	10:54	1.2	100	24	61	<0.02	0.75	0.56	0.15	2.1
7/12/2000	SM-0098	SM-0097	10:59	1.2	100	24	61	<0.02	0.77	0.58	0.14	1.7
8/28/2000	SM-0144	SM-0145	11:41	0.80	99	26	64	<0.02	0.86	0.38	0.09	1.3
8/28/2000	SM-0145	SM-0144	11:46	0.90	100	26	64	<0.02	0.86	0.47	0.09	1.2
11/15/2000	SM-0184	SM-0185	10:40	2.5	66	16	47	<0.02d	1.0	0.58	0.20	2.4
11/15/2000	SM-0185	SM-0184	10:45	2.5	66	16	47	0.05d	1.0	0.50	0.20	2.7

NASHOBA BROOK (Saris: 8246875)
Unique_ID: W0698 Station: NA01, Mile Point: 4.3
Description: upstream/north of footbridge in Nashoba Brook Conservation Area southeast of Wheeler Lane, Acton

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0005		11:56	0.80	68	10	43	0.20	0.70	0.44	0.026	<1.0
5/3/2000	SM-0045		12:15	1.0	64	13	39	0.04	0.38	0.50	0.023	1.2
7/12/2000	SM-0099		11:42	2.5	75	26	55	<0.02	0.55	0.64	0.069	1.1
8/28/2000	SM-0146		12:27	0.85	70	30	54	<0.02	0.56	0.58	0.06	<1.0
11/15/2000	SM-0186		11:26	1.9	54	19	37	0.14	0.39	0.75	0.073	1.4

** = Missing data (i.e., data that should have been reported)
d = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

Table I3 (Continued). 2000 SMART Physico-chemical data- SuAsCo Watershed.

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0696 Station: SU07, Mile Point: 16.5
Description: just upstream/south of Danforth Street, Framingham

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0003		10:16	1.3	84	16	44	<0.02	0.30	0.26	0.017	1.6
5/3/2000	SM-0042		10:46	1.9	72	15	39	<0.02	0.31	0.39	0.021	2.2
7/12/2000	SM-0096		10:05	2.1	100	25	56	<0.02	0.30	0.42	0.040	2.0
8/28/2000	SM-0143		10:51	0.60	96	26	58	<0.02	0.24	0.24	0.02	<1.0
11/15/2000	SM-0183		09:59	2.0	82	19	45	<0.02	0.15	0.32	0.022	1.3

Table I4. 2001 SMART Physico-chemical data- SuAsCo Watershed.

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0695 Station: AS04, Mile Point: 28
Description: approximately 20 meters upstream/south of School Street, Northborough

Date	OWMID	QAQC	Time	Depth	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	(m)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0220	--	09:15	--	2.4m	160m	24m	84m	0.15m	1.9m	0.95m	0.47m	2.3m
4/18/2001	SM-0260	--	09:33	--	1.4	130	16	83	0.04	1.6	0.64	0.16	1.9
6/20/2001	SM-0300	--	09:09	--	2.6m	90m	19m	59m	<0.02m	1.2m	0.83m	0.20m	3.3m
8/15/2001	SM-0340	--	09:10	--	1.5m	260m	25m	160m	<0.02m	3.1m	0.87m	0.30m	2.9m
10/24/2001	SM-0380	--	09:10	--	1.1m	200m	37m	130m	<0.02m	6.6m	0.88m	0.76m	<1.0m
12/12/2001	SM-0420	--	09:10	--	1.5m	190m	55m	113m	<0.02m	5.1m	1.2m	2.3m	1.3m

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0697 Station: AS18, Mile Point: 7.6
Description: approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard.

Date	OWMID	QAQC	Time	Depth	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	(m)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0222	SM-0223	11:32	--	1.9	130	16	59	0.08	1.2	0.70	0.18	1.3
2/21/2001	SM-0223	SM-0222	11:37	--	1.9	130	15	60	0.08	1.2	0.71	0.18	1.5
4/18/2001	SM-0262	SM-0263	11:34	--	2.0	88	12	46	0.06	0.51	0.55	0.12	2.8
4/18/2001	SM-0263	SM-0262	11:39	--	1.8	89	12	46	0.05	0.48	0.44	0.13	2.9
6/20/2001	SM-0302	SM-0303	11:04	--	2.7	58	##d	22d	<0.02	0.31	0.62	0.23	14d
6/20/2001	SM-0303	SM-0302	11:09	--	3.0	60	##d	36d	<0.02	0.31	0.65	0.22	9.9d
8/15/2001	SM-0343	SM-0342	**	--	0.85	120	33	76	<0.02	1.0	0.67	0.11d	1.1
8/15/2001	SM-0342	SM-0343	11:25	--	1.1	130	33	76	<0.02	1.0	0.69	0.15d	1.6
10/24/2001	SM-0383	SM-0382	**	--	1.9	150	35	94	<0.02	2.4	1.1	0.11	4.2
10/24/2001	SM-0382	SM-0383	11:05	--	1.9	160	35	94	<0.02	2.4	1.1	0.11	4.2
12/12/2001	SM-0423	SM-0422	**	--	2.6	130	33	70	0.11	2.9	0.92	0.70	5.0d
12/12/2001	SM-0422	SM-0423	11:10	--	2.6	130	34	69	0.10	2.8	0.99	0.69	3.8d

NASHOBA BROOK (Saris: 8246875)
Unique_ID: W0698 Station: NA01, Mile Point: 4.3
Description: upstream/north of footbridge in Nashoba Brook Conservation Area southeast of Wheeler Lane, Acton

Date	OWMID	QAQC	Time	Depth	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	(m)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0224	--	12:10	--	1.3	100	18	52	0.85	0.73	1.3	0.037	<1.0
4/18/2001	SM-0264	--	12:09	--	0.95	73	13	43	0.30	0.47	0.65	0.024	2.3
6/20/2001	SM-0304	--	11:39	--	2.2	55	15	35	0.23	0.29	1.1	0.13	2.0
8/15/2001	SM-0344	--	11:55	--	1.9	93	26	54	0.25	0.44	1.1	0.14	1.9
10/24/2001	SM-0384	--	11:35	--	2.1	64	34	58	<0.02	0.76	0.66	0.060	3.7
12/12/2001	SM-0424	--	12:10	--	2.7	88	28	59	0.38	1.2	0.70	0.070	1.0

SUDBURY RIVER (Saris: 8247650)
Unique_ID: W0696 Station: SU07, Mile Point: 16.5
Description: just upstream/south of Danforth Street, Framingham

Date	OWMID	QAQC	Time	Depth	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	(m)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0221	--	10:44	--	2.3	140	15	52	<0.02	0.40	0.55	0.017	1.0
4/18/2001	SM-0261	--	10:48	--	1.6	99	12	43	<0.02	0.45	0.33	0.017	1.4
6/20/2001	SM-0301	--	10:19	--	2.7	95	17	43	<0.02	0.20	0.49	0.046	2.0
8/15/2001	SM-0341	--	10:15	--	1.1	100	22	49	<0.02	0.20	0.38	0.036	<1.0
10/24/2001	SM-0381	--	10:10	--	1.5	140	29	71	<0.02	0.14	0.40	0.020	<1.0
12/12/2001	SM-0421	--	10:15	--	2.2	140	27	60	<0.02	0.13	0.54	0.020	1.3

= Censored data (i.e., data that has been discarded for some reason).
-- = No data (i.e., data not taken/not required
** = Missing data (i.e., data that should have been reported).
m = method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g., sediment in sample, floc formation), lab error (e.g., cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.
d = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

Table I5. 2000 SMART Quality Assurance/Quality Control data- SuAsCo Watershed.

ASSABET RIVER (Saris: 8246775)
Unique_ID: 695 Station: AS04, Mile Point: 28
Description: approximately 20 meters upstream/south of School Street, Northborough

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0001	SM-0002	09:18	1.0	100	21	69	0.06	1.5	0.39	0.37	1.1
3/8/2000	SM-0002	SM-0001	09:23	1.0	100	22	69	0.06	1.5	0.41	0.37	<1.0
Relative Percent Difference				*0.0%*	*0.0%*	*4.7%*	*0.0%*	*0.0%*	*0.0%*	*5.0%*	*0.0%*	*9.5%*

ASSABET RIVER (Saris: 8246775)
Unique_ID: 697 Station: AS18, Mile Point: 7.6
Description: approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard.

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
5/3/2000	SM-0043	SM-0044	11:30	2.2	65	13	40	<0.02	0.44	0.43	0.10	7.3
5/3/2000	SM-0044	SM-0043	11:35	2.2	64	13	40	<0.02	0.44	0.44	0.10	6.6
Relative Percent Difference				*0.0%*	*1.6%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*2.3%*	*0.0%*	*10.1%*
7/12/2000	SM-0097	SM-0098	10:54	1.2	100	24	61	<0.02	0.75	0.56	0.15	2.1
7/12/2000	SM-0098	SM-0097	10:59	1.2	100	24	61	<0.02	0.77	0.58	0.14	1.7
Relative Percent Difference				*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*2.6%*	*3.5%*	*6.9%*	*21.1%*
8/28/2000	SM-0144	SM-0145	11:41	0.80	99	26	64	<0.02	0.86	0.38	0.09	1.3
8/28/2000	SM-0145	SM-0144	11:46	0.90	100	26	64	<0.02	0.86	0.47	0.09	1.2
Relative Percent Difference				*11.8%*	*1.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*21.2%*	*0.0%*	*8.0%*
11/15/2000	SM-0184	SM-0185	10:40	2.5	66	16	47	<0.02d	1.0	0.58	0.20	2.4
11/15/2000	SM-0185	SM-0184	10:45	2.5	66	16	47	0.05d	1.0	0.50	0.20	2.7
Relative Percent Difference				*0.0%*	*0.0%*	*0.0%*	*0.0%*	*85.7%*	*0.0%*	*14.8%*	*0.0%*	*11.8%*

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

Field Blank Sample/Field Blank Sample (Palis: 00000)
Unique_ID: W00-8 Station: BLANK
Description: QAQC: Field Blank Sample

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			24hr	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
3/8/2000	SM-0007	BLANK	13:00	<0.1	<1.0	<2	<0.66	<0.02	<0.02	<0.10	<0.005	<1.0
5/3/2000	SM-0047	BLANK	13:20	<0.1	<1.0	<2	<0.66	<0.02	<0.02	<0.10	<0.010	<1.0
7/12/2000	SM-0101	BLANK	12:49	<0.1	<2.0	<2	<0.66	<0.02	<0.02	<0.10	<0.010	<1.0
8/28/2000	SM-0148	BLANK	13:31	<0.1	<2.0	<2	<0.66	<0.02	<0.02	<0.10	<0.01	<1.0
11/15/2000	SM-0188	BLANK	12:25	<0.1	<1.0	<2	<0.66	<0.02	<0.02	<0.10	<0.010	<1.0

Table I6. 2001 SMART Quality Assurance/Quality Control data- SuAsCo Watershed.

Field Blank Data

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0226	Blank	13:12	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.010	<1.0
4/18/2001	SM-0266	Blank	13:54	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.010	<1.0
6/20/2001	SM-0306	Blank	12:34	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.010	<1.0
8/15/2001	SM-0346	Blank	**	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.005	<1.0
10/24/2001	SM-0386	Blank	**	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.005	<1.0
12/12/2001	SM-0426	Blank	**	<0.10	1b	<2.0	<0.66	<0.02	<0.06	<0.10	<0.005	<1.0

CONCORD RIVER (Saris: 8246500)
Unique_ID: W0679 Station: CO7, Mile Point: 0.8
Description: approximately 100 meters downstream/north from Rogers Street, Lowell

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0225	--	13:07	2.0	120	18	54	0.18	1.0	0.67	0.094	2.5
2/21/2001	SM-0226	Blank	13:12	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.010	<1.0
4/18/2001	SM-0265	--	13:49	2.2	80	13	42	<0.02	0.31	0.53	0.067	5.4
4/18/2001	SM-0266	Blank	13:54	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.010	<1.0
6/20/2001	SM-0305	--	12:29	4.5	58	17	36	<0.02	0.54	0.77	0.17	7.0
6/20/2001	SM-0306	Blank	12:34	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.010	<1.0
8/15/2001	SM-0346	Blank	**	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.005	<1.0
8/15/2001	SM-0345	--	12:55	5.7	93	33	62	<0.02	0.56	0.78	0.17	8.0
10/24/2001	SM-0386	Blank	**	<0.10	<1	<2	<0.66	<0.02	<0.06	<0.10	<0.005	<1.0
10/24/2001	SM-0385	--	12:30	3.0	110	44	81	<0.02	1.3	0.74	0.16	6.6
12/12/2001	SM-0426	Blank	**	<0.10	1b	<2.0	<0.66	<0.02	<0.06	<0.10	<0.005	<1.0
12/12/2001	SM-0425	--	13:05	6.6	110	38	72	<0.02	1.9	1.1	0.26	13

ASSABET RIVER (Saris: 8246775)
Unique_ID: W0697 Station: AS18, Mile Point: 7.6
Description: approximately 50 meters upstream/southwest of the Route 27/62 bridge, Maynard.

Date	OWMID	QAQC	Time	Turbidity	Chloride	Alkalinity	Hardness	NH3-N	NO3-NO2-N	TKN	TP	TSS
			(24hr)	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
2/21/2001	SM-0222	SM-0223	11:32	1.9	130	16	59	0.08	1.2	0.70	0.18	1.3
2/21/2001	SM-0223	SM-0222	11:37	1.9	130	15	60	0.08	1.2	0.71	0.18	1.5
Relative Percent Difference				*0.0%*	*0.0%*	*6.5%*	*1.7%*	*0.0%*	*0.0%*	*1.4%*	*0.0%*	*14.3%*
4/18/2001	SM-0262	SM-0263	11:34	2.0	88	12	46	0.06	0.51	0.55	0.12	2.8
4/18/2001	SM-0263	SM-0262	11:39	1.8	89	12	46	0.05	0.48	0.44	0.13	2.9
Relative Percent Difference				*10.5%*	*1.1%*	*0.0%*	*0.0%*	*18.2%*	*6.1%*	*22.2%*	*8.0%*	*3.5%*
6/20/2001	SM-0302	SM-0303	11:04	2.7	58	##d	22d	<0.02	0.31	0.62	0.23	14d
6/20/2001	SM-0303	SM-0302	11:09	3.0	60	##d	36d	<0.02	0.31	0.65	0.22	9.9d
Relative Percent Difference				*10.5%*	*3.4%*		*48.3%*	*0.0%*	*0.0%*	*4.7%*	*4.4%*	*34.3%*
8/15/2001	SM-0343	SM-0342	**	0.85	120	33	76	<0.02	1.0	0.67	0.11d	1.1
8/15/2001	SM-0342	SM-0343	11:25	1.1	130	33	76	<0.02	1.0	0.69	0.15d	1.6
Relative Percent Difference				*25.6%*	*8.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*2.9%*	*30.8%*	*37.0%*
10/24/2001	SM-0383	SM-0382	**	1.9	150	35	94	<0.02	2.4	1.1	0.11	4.2
10/24/2001	SM-0382	SM-0383	11:05	1.9	160	35	94	<0.02	2.4	1.1	0.11	4.2
Relative Percent Difference				*0.0%*	*6.5%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
12/12/2001	SM-0423	SM-0422	**	2.6	130	33	70	0.11	2.9	0.92	0.70	5.0d
12/12/2001	SM-0422	SM-0423	11:10	2.6	130	34	69	0.10	2.8	0.99	0.69	3.8d
Relative Percent Difference				*0.0%*	*0.0%*	*3.0%*	*1.4%*	*9.5%*	*3.5%*	*7.3%*	*1.4%*	*27.3%*

** = 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. Batched samples may also be affected.

APPENDIX J- 21E TIER CLASSIFIED SITES IN THE SUASCO WATERSHED

Table J1. MA DEP Bureau of Waste Site Cleanup 21E Tier Classified Oil and HAZMAT Sites in the SuAsCo Watershed as of 8 March 2004.

Rtn	Name	Address	Town	Status
2-0000010	WR Grace	50 Independence Rd	Acton	Tier 1A
3-0000216	Nyanza Chemical	Megunko Rd	Ashland	Tier 1A
2-0000572	Exxon Station	139 Central St	Berlin	Tier 1A
3-0001205	Silicon Transistor Corporation	27 Katrina Rd	Chelmsford	Tier 1A
3-0000713	Costa S Dump Fmr	89-103 Billerica St	Lowell	Tier 1A
3-0000352	Silresim Chemical Corp	86 Tanner St	Lowell	Tier 1A
3-0002473	Army Research Center	Kansas St	Natick	Tier 1A
3-0003672	Clean Corp	229 North Main St	Natick	Tier 1A
3-0000435	Sperry Research Center Fmr	100 North Rd	Sudbury	Tier 1A
2-0000153	Hocomonco Pond	Fisher St	Westborough	Tier 1A
3-0001461	Rj Kelly Co	9-11 Executive Park	Billerica	Tier 1B
3-0020242	Paramount Cleaners	20 Boston Rd	Chelmsford	Tier 1B
3-0004275	Mobil Gasoline Station No 01 789	22 Concord Tpke	Concord	Tier 1B
3-0000589	Commonwealth Gas Co	350 Irving St	Framingham	Tier 1B
3-0000166	Auto Brite Car Wash	105 Hollis St	Framingham	Tier 1B
2-0000763	Marlco Facility 98 Mrl Former	279 Maple St	Marlborough	Tier 1B
2-0013156	Commercial Property	222 East Main St	Marlborough	Tier 1B
3-0002423	Mobil Station	432 Boston Post Rd	Sudbury	Tier 1B
3-0013302	Raytheon Company	430 Boston Post Rd	Wayland	Tier 1B
2-0000401	Mobil Station 6aw #Goh	Massachusetts Tpke	Westborough	Tier 1B
2-0012713	Pitt Construction	816 Main St	Acton	Tier 1C
3-0014545	Martell Motor Express	11 Brick Kiln Rd	Billerica	Tier 1C
3-0000565	Bill & Andys	30 Chelmsford St	Chelmsford	Tier 1C
3-0014625	Commercial Property	54 Chelmsford St	Chelmsford	Tier 1C
3-0000290	Electrometals Inc Fmr	275 Billerica Rd	Chelmsford	Tier 1C
3-0012928	17 Progress Ave	17 Progress Ave	Chelmsford	Tier 1C
3-0001582	Chelmsford Gulf Fmr Citgo	7 Acton Rd	Chelmsford	Tier 1C
3-0002739	Care Cleaners	28 Central Sq	Chelmsford	Tier 1C
3-0004757	Ampet Gasoline Station	100 Chelmsford St	Chelmsford	Tier 1C
3-0000709	Amoco 1166 Fmr	95 Chelmsford St	Chelmsford	Tier 1C
3-0020002	3m Electrical Products Division	279 Billerica Rd	Chelmsford	Tier 1C
3-0018998	Emerson Hospital	133 Old Rd To 9 Acre Cor	Concord	Tier 1C
3-0021297	Parcel 2322 Debris Area Off Knox Trail	Off Knox Trl	Concord	Tier 1C
3-0019550	Industrial Property	770 Water St	Framingham	Tier 1C
3-0021777	Ellingwood Realty Trust	145 Meadow St	Framingham	Tier 1C
2-0013803	Pyne Sand & Stone Co	66 Fruit St	Hopkinton	Tier 1C
3-0000035	Fmr Raytheon Facility	350 Woburn St	Lowell	Tier 1C
2-0010629	Shell Service Sta	342 Boston Post Rd	Marlborough	Tier 1C
2-0013286	Parcel 27 Commercial Property	West Main St	Marlborough	Tier 1C
2-0011001	Shell Service Sta	342 Boston Post Rd	Marlborough	Tier 1C
3-0015672	Intersection With Rte 27	891 Worcester Rd	Natick	Tier 1C
2-0013150	Hop Brook Flood Control Facility	Southwest Cutoff	Northborough	Tier 1C

Rtn	Name	Address	Town	Status
2-0001050	Marane Bulk Terminal Fmr	866 Hartford Tpke	Shrewsbury	Tier 1C
2-0012504	Service Station	626 Great Rd	Stow	Tier 1C
3-0004202	Cumberland Farms/Gulf	470 Boston Post Rd	Sudbury	Tier 1C
3-0010592	Union St	428 Boston Post Rd	Sudbury	Tier 1C
3-0015951	Rte 20	475 Boston Post Rd	Sudbury	Tier 1C
3-0000074	Coatings Engineering	33 Union Rd	Sudbury	Tier 1C
3-0003325	Shepards Mobil Station	268 Boston Post Rd	Wayland	Tier 1C
3-0017974	Cooks Automotive Of Wayland Inc	356 Boston Post Rd	Wayland	Tier 1C
2-0000865	Deblois Oil	240 Turnpike Rd	Westborough	Tier 1C
2-0013978	Fiba Technologies	97 Turnpike Rd	Westborough	Tier 1D
2-0000493	Powdermill Manufacturing	2 Powdermill Rd	Acton	Tier 1D
2-0012283	Meineke Muffler	263 Main St	Acton	Tier 1D
2-0013519	Intersection Of Rt 111 And Rt 27	Massachusetts Ave	Acton	Tier 1D
2-0014429	Concord Oil Co Facility	68 Central St	Acton	Tier 1D
3-0002459	Gasoline Station Fmr	Pond St Kings Plz	Ashland	Tier 1D
3-0000215	Property	11 Mulhall Dr	Ashland	Tier 1D
3-0003617	Commercial Property	230 Eliot St	Ashland	Tier 1D
3-0010908	No Location Aid	32 Nickerson Rd	Ashland	Tier 1D
3-0012610	Fmr Three C Electric Co	280-330 Pleasant St	Ashland	Tier 1D
3-0015667	Nyanza Npl	Megunko Rd	Ashland	Tier 1D
2-0011719	Tolman Greenhouses	63 Walnut St	Berlin	Tier 1D
2-0013494	Residence	158 Lyman St	Berlin	Tier 1D
3-0000644	Faulkner Mills	71 Faulkner St	Billerica	Tier 1D
3-0003679	Commercial Property	Town Farm La	Billerica	Tier 1D
3-0004080	Rte 4 Sewer Project	Nashua Rd Overlook Rd	Billerica	Tier 1D
3-0013453	1/2 Mile South Of Rte 129	Rte 3 N	Billerica	Tier 1D
3-0017475	North Of Concord Rd Exit	Rte 3n	Billerica	Tier 1D
3-0020073	In Front Of 371 Acton Rd	Acton Rd Rte 27	Chelmsford	Tier 1D
3-0022222	No Location Aid	27 Katrina Rd	Chelmsford	Tier 1D
3-0000891	Auto Body Shop Fmr	59 Beaver St	Framingham	Tier 1D
3-0010017	No Location Aid	Rte 30 Speen St	Framingham	Tier 1D
3-0000568	Delitizer Restaurant	147-149 Cochituate Rd	Framingham	Tier 1D
3-0004755	Manhole	Concord St Lincoln St	Framingham	Tier 1D
3-0006011	Property	36 Berkshire Rd	Framingham	Tier 1D
3-0002622	Municipal Property	Arthur St	Framingham	Tier 1D
3-0001405	Property	448 Water St	Framingham	Tier 1D
3-0003940	Gmc Settling Lagoon	63 Western Ave	Framingham	Tier 1D
3-0004356	General Motors Beaver Brook	63 Western Ave	Framingham	Tier 1D
3-0000317	Gmc Gm Assmbly Division Fmr	63 Western Ave	Framingham	Tier 1D
3-0003374	Property	19 Ruth Dr	Framingham	Tier 1D
3-0018948	No Location Aid	44 Morton St	Framingham	Tier 1D
3-0001666	Commercial Property	127 Cochituate Rd	Framingham	Tier 1D
3-0002587	Commercial Property	192 Irving St	Framingham	Tier 1D
3-0018613	No Location Aid	69 Brookfield Cir	Framingham	Tier 1D
2-0011806	No Location Aid	85 Hayden Rowe	Hopkinton	Tier 1D
2-0010964	St Johns Cemetery	Mt Auburn St	Hopkinton	Tier 1D

Rtn	Name	Address	Town	Status
2-0013794	In Front Of 85 Hayden Rowe St	Hayden Rowe St	Hopkinton	Tier 1D
3-0000349	Commonwealth Chemical Corp	1052 Gorham St	Lowell	Tier 1D
3-0000092	Daley School	Flemming St	Lowell	Tier 1D
3-0000754	Undeveloped Property	135-137 Billerica St	Lowell	Tier 1D
3-0017146	No Location Aid	Industrial Ave	Lowell	Tier 1D
3-0004511	Scannell Boilerworks	26-50 Tanner St	Lowell	Tier 1D
3-0000353	Spray Tec Inc Fmr	34 Newhall St	Lowell	Tier 1D
2-0000832	Boroughs Tire Co	167 Northboro Rd	Marlborough	Tier 1D
2-0000086	Acme Glass	134 West Main St	Marlborough	Tier 1D
2-0011998	Frye Tanner	84 Chestnut St	Marlborough	Tier 1D
2-0013965	Millham Brook	Glen St And Ripley St	Marlborough	Tier 1D
2-0013808	Rte 495 S North Of Rte 290 Onramp	Rte 495	Marlborough	Tier 1D
3-0000575	R D Smith	Commonwealth Rd	Natick	Tier 1D
3-0002906	Municipal Wells	Off Massachusetts Tpke	Natick	Tier 1D
3-0006028	Property	17 Greenleaf Rd	Natick	Tier 1D
3-0003858	Parcel	307 West Central St	Natick	Tier 1D
3-0014932	Framingham Ext Relief Svs	327 West Central St	Natick	Tier 1D
3-0019723	Roadway Utilities Rte 30 Framingham Line	Rte 30 @ Speen St	Natick	Tier 1D
2-0010518	E Of Church St	Rte 290 E	Northborough	Tier 1D
2-0012536	Former Volvo Dealer	78 Turnpike Rd	Southborough	Tier 1D
3-0004220	Commercial Property	96 Main St	Wayland	Tier 1D
2-0000982	Burnside Property	22 South St	Westborough	Tier 1D
2-0013004	Assessors Map 30 Parcels 10a & B	160 Flanders Rd	Westborough	Tier 1D
2-0012850	Concord Oil Co	68 Central St	Acton	Tier II
2-0013400	Tosco Corp	289 Main St	Acton	Tier II
2-0014428	Concord Oil Co Facility	68 Central St	Acton	Tier II
3-0001812	Pels Sunoco	126 Pond St	Ashland	Tier II
3-0001365	Perini Corp Property	11 Cordaville Rd	Ashland	Tier II
3-0004669	Middlesex Equipment	2 Megunko Rd	Ashland	Tier II
3-0018035	No Location Aid	205 Main St	Ashland	Tier II
3-0020621	No Location Aid	196 Pond St	Ashland	Tier II
3-0021077	No Location Aid	79 Concord St	Ashland	Tier II
3-0012670	Circle K Store 02515	192 Boston Rd	Billerica	Tier II
3-0012013	Billerica House Of Correction	269 Treble Cove Rd	Billerica	Tier II
3-0017905	No Location Aid	313 Boston Rd	Billerica	Tier II
3-0003747	Mobil Station 01 331	184 Boston Rd	Billerica	Tier II
3-0022226	No Location Aid	301 Boston Rd	Billerica	Tier II
3-0002578	Gasoline Station	18 Lowell St	Carlisle	Tier II
3-0003606	Triangle Service Station	177 Boston Rd	Chelmsford	Tier II
3-0014784	No Location Aid	7-9 Church St	Concord	Tier II
3-0003116	Texaco Service Station Fmr	686 Elm St	Concord	Tier II
3-0001189	Concord Oil	147 Lowell Rd	Concord	Tier II
3-0003844	Pump N Pantry	1089 Concord Tpke	Concord	Tier II
3-0022242	No Location Aid	120 Thoreau St	Concord	Tier II
3-0010090	Albies Oil	3 School St	Framingham	Tier II

Rtn	Name	Address	Town	Status
3-0013144	300 Ft West Of Natick Town Line	22-24 Waverly St	Framingham	Tier II
3-0012985	Corner Of Lindburgh Rd	472 Concord St	Framingham	Tier II
3-0004045	At&T	825 Waverly St	Framingham	Tier II
3-0016656	No Location Aid	47 Blandin Ave	Framingham	Tier II
3-0004084	Framingham District Court	600 Concord St	Framingham	Tier II
3-0003041	Bishop Terrace Condominiums	Bishop Dr	Framingham	Tier II
3-0004674	Sunoco Gasoline Station	506 Concord St	Framingham	Tier II
3-0016580	Beco Station 240	Leland St	Framingham	Tier II
3-0012932	Ellis St	1181-1183 Worcester Rd	Framingham	Tier II
3-0017657	Henry St Garage/Dpw Garage	Henry St	Framingham	Tier II
3-0001047	Ludlow Corp Fmr	387-699 Waverly St	Framingham	Tier II
3-0013141	No Location Aid	697-705 Waverly St	Framingham	Tier II
3-0002361	Aamco Transmission	740 Worcester Rd	Framingham	Tier II
3-0003939	Gmc Fmr Landfill	63 Western Ave	Framingham	Tier II
3-0000691	Property	25 Loring Dr	Framingham	Tier II
3-0017678	No Location Aid	21 Beaver Court Ext	Framingham	Tier II
3-0012507	Gulf Gasoline Station	655 Waverly St	Framingham	Tier II
3-0019689	Old Colony Rail Spur	Irving St	Framingham	Tier II
3-0003215	Gasoline Station 7w	Ma Tpke Mm 1140	Framingham	Tier II
3-0002159	Shell Gasoline Station	480 Franklin St	Framingham	Tier II
3-0002100	Shell Service Station	846 Concord St	Framingham	Tier II
3-0006016	Property	200 State St	Framingham	Tier II
3-0019933	Cross St Union Ave	73 Mt Wayte Ave	Framingham	Tier II
3-0020118	Cross St Union Ave	73 Mt Wayte Ave	Framingham	Tier II
3-0021425	No Location Aid	58 Pearl St	Framingham	Tier II
3-0021920	Assessors Map 240 Block 75	Lockland Ave	Framingham	Tier II
2-0000807	Mobil Station 01 323	92 West Main St	Hopkinton	Tier II
2-0013397	Tosco Corp	60 Main St	Hopkinton	Tier II
2-0010526	Hudson Lagoons	12 Wheeler Rd	Hudson	Tier II
2-0000069	Creative Home Furnishings	32 Washington St	Hudson	Tier II
3-0001796	Lincoln Automotive	170 South Great Rd	Lincoln	Tier II
3-0014478	On Centennial Island	852 3 And 852 5 Lawrence St	Lowell	Tier II
3-0015650	Northeast Side Of Building	45 Bolt St	Lowell	Tier II
3-0017748	Gorham And Maple Streets	Gorham And Maple	Lowell	Tier II
3-0000527	Texaco Service Station Fmr	7 Lincoln Sq	Lowell	Tier II
3-0003828	Gulf Station	365 Chelmsford St	Lowell	Tier II
3-0000601	Jetline/Geochem	263 Howard St	Lowell	Tier II
3-0018305	No Location Aid	Gorham And Maple Sts	Lowell	Tier II
3-0019154	No Location Aid	51 Nottingham St	Lowell	Tier II
3-0020194	Near Court St	125 Manchester St	Lowell	Tier II
3-0021342	No Location Aid	1403 Gorham St	Lowell	Tier II
3-0022069	Lowell Used Auto Parts Inc	108 Tanner St	Lowell	Tier II
3-0021798	Washer Concord River At Rr Tracks	Bolt St	Lowell	Tier II
3-0021267	Mobil Facility 01 795	980 Chelmsford St	Lowell	Tier II
2-0000774	Fossile Construction	329-331 Lincoln St	Marlborough	Tier II

Rtn	Name	Address	Town	Status
2-0000727	Houde Farm Fmr	399 Berlin Rd	Marlborough	Tier II
2-0000093	Old Colony Gas Station	247 Maple St	Marlborough	Tier II
2-0010699	Bakerly Citgo/King Brakes	146 Maple St	Marlborough	Tier II
2-0013126	Wayside Ford	428 Maple St	Marlborough	Tier II
2-0013738	Marlborough DPW	135 Neil St	Marlborough	Tier II
2-0011486	Shell Service Station	413 Lakeside Ave	Marlborough	Tier II
2-0014267	Mobil Corp Parcel 27 Commercial Property	West Main St	Marlborough	Tier II
2-0014434	Mobil Station	260 West Main St	Marlborough	Tier II
2-0014341	Fmr B And M Turnaround	56 Jefferson St	Marlborough	Tier II
2-0014246	Rk Pine Tree Shopping Ctr	771 Boston Post Rd	Marlborough	Tier II
2-0014270	Mobil Facility #01-794	529 Boston Post Rd	Marlborough	Tier II
2-0000709	Heled Inc Property	151 Main St	Maynard	Tier II
2-0012751	Maynard Dpw	38 Winter St	Maynard	Tier II
3-0004310	Derosa Florist Inc	54 Highland St	Natick	Tier II
3-0021037	Pegan Cove Property	Washington St	Natick	Tier II
2-0000674	Texaco Service Station	23 Belmont St	Northborough	Tier II
2-0013507	No Location Aid	45 West Main St	Northborough	Tier II
2-0011682	Logan Equipment	800 Hartford Tpke	Shrewsbury	Tier II
2-0010254	Near Sudbury Reservoir	90 Turnpike Rd	Southborough	Tier II
2-0010279	J Melone & Sons Inc	77 White Pond Rd	Stow	Tier II
2-0013854	Nextel Communications	45 White Pond Rd	Stow	Tier II
3-0019132	Rte 117	142 North Rd	Sudbury	Tier II
3-0001594	Public School	41 Cochituate Rd	Wayland	Tier II
3-0004394	Wayland Automotive	322 Commonwealth Rd	Wayland	Tier II
3-0003171	Mobil Station 01 515	315 Commonwealth Rd	Wayland	Tier II
2-0011308	Corrugated Paper Co	111 Milk St	Westborough	Tier II
2-0000220	Carlstrom Pressed Metal	65 Fisher St	Westborough	Tier II
2-0000426	Stedt Hydraulic Crane Corp	27 Washington St	Westborough	Tier II
2-0013490	Westborough State Hosp	Lyman St	Westborough	Tier II
2-0014298	Nardone Sand & Gravel	37 Power Rd	Westford	Tier II

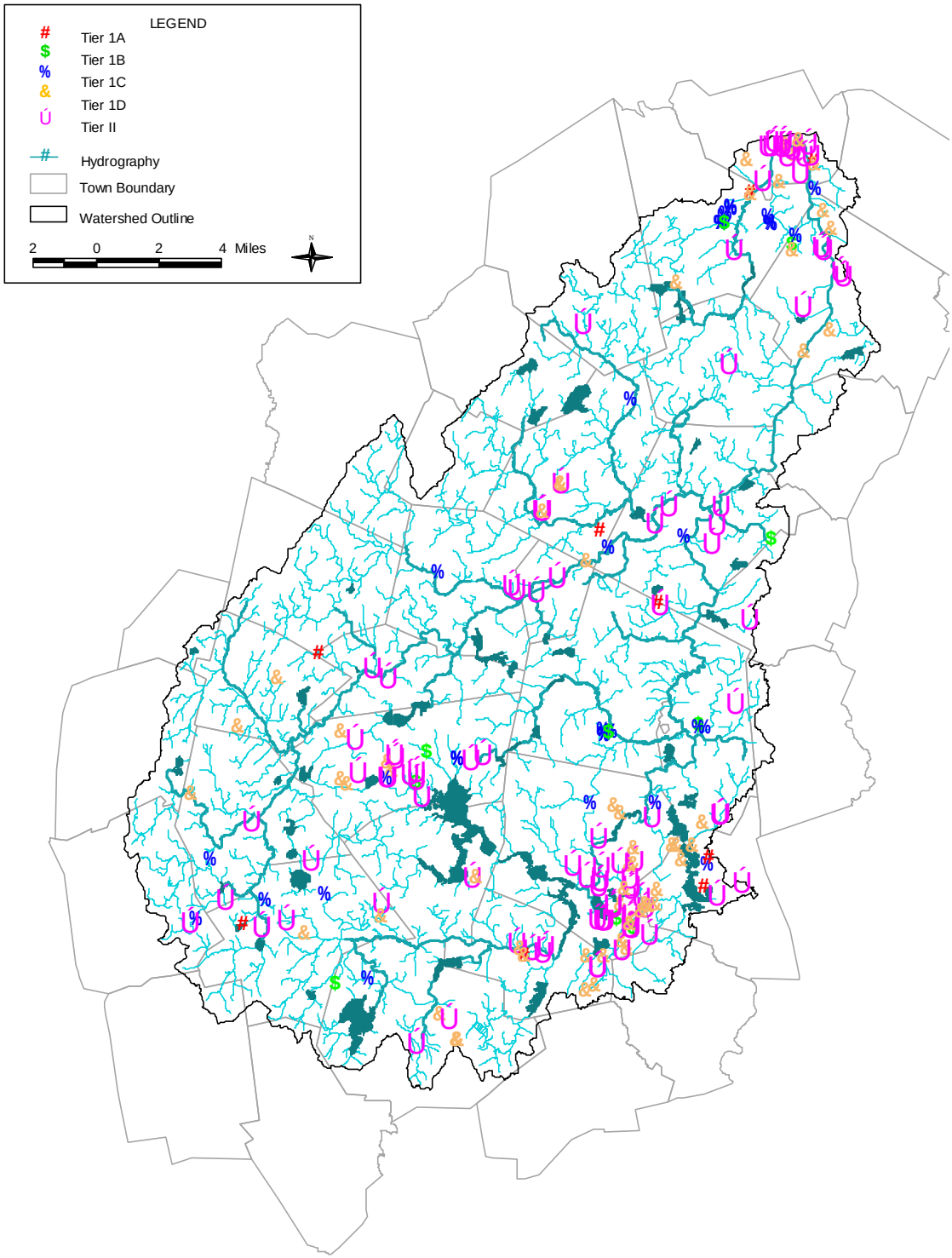


Figure J1. MA DEP Bureau of Waste Site Cleanup 21E Tier Classified Oil and HAZMAT Sites in the SuAsCo Watershed.

APPENDIX K- SOLID WASTE FACILITIES IN THE SUASCO WATERSHED

Table K1. MA DEP Bureau of Waste Prevention Solid Waste Landfill Facilities in the SuAsCo Watershed

Site Name	Address	Town	CAPPED	LINER	Owner/Operator	STATUS	TONS/DAY	SUBWATERSHED
Acton Landfill	14 Forest Rd/Rte 2	Acton	Capped	Not Lined	Town Of Acton	Closed	0	MA82B-13 or MA82B-14
Ashland Landfill	Howe St	Ashland	Capped	Not Lined	Town Of Ashland	Closed	0	MA82A-12
Bedford Landfill	Carlisle Rd	Bedford	Not Capped	Not Lined	Town Of Bedford	Inactive	0	MA82A-07
Bedford Compost Site	Carlisle Rd	Bedford			Town Of Bedford	Active	0	MA82A-07
Berlin Landfill	48 Jones Rd	Berlin		Not Lined	Town Of Berlin	Inactive		
Berlin Transfer Station	48 Jones Rd	Berlin		Unknown	Town Of Berlin	Active	2	
Boxborough Transfer Station	Codman Hill Rd	Boxborough		Unknown	Town Of Boxborough	Active	25	MA82B-12
Boylston Landfill	Mile Hill Rd	Boylston	Capped	Not Lined	Town Of Boylston/ E.J. Flynn Engineers		0	MA82A-08
Carlisle Landfill	26 Lowell St	Carlisle	Not Capped	Not Lined	Town Of Carlisle	Inactive	0	MA82A-21
Carlisle Transfer Station	26 Lowell St	Carlisle			Town Of Carlisle	Active	0	MA82A-21
Concord Landfill	Walden St (Rte 126)	Concord	Capped	Lined	Town Of Concord	Closed	0	MA82A-20
Concord Compost Site	Walden St (Rte 126)	Concord		Unknown	Town Of Concord	Active	0	MA82A-20
Corenco Industrial Landfill	525 Woburn St/Billerica Ave	Billerica	Not Capped	Not Lined	Baker Commodities Inc.	Inactive	0	MA82A-21
E L Harvey Landfill	Wood St (Rte 135)	Hopkinton	Capped	Not Lined	El Harvey & Sons	Closed	0	MA82A-11 or MA82A-01
El Harvey Transfer/ Recycling Facility	68 Hopkinton Rd (Rte 135)	Westborough		Unknown	El Harvey & Sons Inc	Active	500	MA82A-11 or MA82A-01
Fletcher Landfill	South Acton Rd	Stow		Not Lined	Wallace M. Fletcher	Inactive	0	MA82B-13
Framingham Ash Landfill	Rte 9/Old Gates Rd	Framingham	Capped	Not Lined	Town Of Framingham	Closed	0	Reservoir #3 (MA82046)
Framingham Incinerator	Mt Wayte St	Framingham		Unknown	Town Of Framingham	Inactive	0	MA82A-13
Framingham Landfill	Millwood St	Framingham		Not Lined		Inactive	0	MA82A-02
Framingham Landfill Compost Site	Dudley Rd	Framingham		Not Lined	Town Of Framingham	Inactive	0	MA82A-13
Grafton State Hospital Dump	Green St	Shrewsbury	Not Capped	Not Lined	Ma Div Of Capital Asset Mgmt	Inactive	0	MA82B-01
Hudson Landfill	Gates Pond Rd	Berlin	Capped	Not Lined	Town Of Hudson	Closed	0	MA82B-04
Hudson Landfill Compost Site	Old Stow/Cemetaty Rds	Hudson		Unknown	Resource Control Inc./United Waste Systems		0	MA82B-05
Marlborough Landfill	Hudson/Bolton Sts (Rte 85)	Marlborough	Capped	Not Lined	Town Of Marlborough	Closed	0	MA82B-11
Marlborough Sludge Landfill	785 Boston Post Road-East	Marlborough		Not Lined	Town Of Marlborough	Active		MA82A-15

Table K1 (Continued). MA DEP Bureau of Waste Prevention Solid Waste Landfill Facilities in the SuAsCo Watershed

Site_Name	Address	Town	CAPPED	LINER	Owner/Operator	STATUS	TONS/DAY	SUBWATERSHED
Maynard Landfill	Waltham St/Powder Hill	Maynard	Capped	Not Lined	Town Of Maynard	Closed	0	MA82B-09
Northborough Landfill	Southwest Cutoff (Rte 20)	Northborough	Capped	Not Lined	Town Of Northborough	Closed	0	
Northborough Landfill	Boundary/Church Streets	Northborough		Not Lined	Town Of Northborough	Inactive		MA82B-03
Old Wayland Dump	195 Main St	Wayland		Not Lined	Town Of Wayland	Inactive	0	Dudley Pond MA82029
Old Wayland Landfill	Rte 20	Wayland		Not Lined	Town Of Wayland	Inactive	0	MA82A-04 or MA82A-06
Parkerville Landfill	Parkerville Rd	Southborough	Not Capped	Not Lined	Town Of Southborough	Inactive	0	Sudbury Reservoir (MA82106)
Prtr Inc Transfer Station	791 Boston Post Rd (Rte 20)	Marlborough		Unknown	Prtr Inc (WMI)	Active	500	
Shrewsbury Ash Landfill	640 Hartford Tnpk (Rte 20)	Shrewsbury	Partially Capped	Lined	Town Of Shrewsbury/ Wheelabrator Millbury		770	MA82B-01 or MA82B-02
Southborough Dump	Mount Vickery Rd	Southborough	Not Capped	Not Lined	Private	Inactive	0	Sudbury Reservoir (MA82106)
Sudbury Landfill	Powder Mill Rd/Rte 117	Sudbury	Not Capped	Not Lined	Town Of Sudbury	Inactive	0	MA82B-09
Sudbury Landfill	Dakin Rd	Sudbury		Not Lined	Town Of Sudbury/ L. Roy Hawes	Inactive	0	MA82A-19
Sudbury Transfer Station	20 Boston Post Rd (Rte 20)	Sudbury		Unknown	Town Of Sudbury	Active	0	MA82A-04 or MA82A-06
Wayland Sand Hill Landfill	484 Boston Post Rd (Rte 20)	Wayland	Partially Capped	Lined	Town Of Wayland	Active	99	MA82A-04 or MA82A-06
Westborough Landfill	68 Hopkinton Rd (Rte 135)	Westborough	Not Capped	Not Lined	El Harvey & Sons	Inactive	1	MA82A-11 or MA82A-01