APPENDIX A

South Coastal Watersheds

DWM YEAR 2001 WATER QUALITY MONITORING DATA

Technical Memorandum TM-94-1

September 2005

DWM Control Number CN 093.1

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Stephen R. Pritchard, Secretary
Massachusetts Department of Environmental Protection
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Glenn Haas, Director

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INTRODUCTION AND PROJECT OBJECTIVES

The DWM 2001 water quality monitoring plan for the South Coastal Watersheds was developed by DWM in consultation with the former EOEA South Coastal Watersheds Team, a coalition of government and non-government groups. The monitoring strategy was guided primarily by suggestions of members of the EOEA South Coastal Watersheds Team and DWM's review of previous surveys. 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.

The 1996 DWM South Coastal 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 included in order to evaluate impacts from known or suspected sources of pollution to specific areas of the watershed. To address some of these water quality sampling needs, DWM conducted eight water quality sampling surveys from June through October 2001. Three of the eight total water quality sampling surveys were pre-dawn surveys intended to capture dissolved oxygen minimums.

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 or salinity. Samples for alkalinity, nutrients, hardness, chlorides, turbidity, total suspended solids and bacteria (*E. coli*, Enterococci and fecal coliforms) were collected for analysis at the Wall Experiment Station (WES), the Department's analytical laboratory in Lawrence.

QUALITY ASSURANCE AND QUALITY CONTROL

A QAPP (MA DEP 2001c) was written for the DWM water quality sampling surveys in 2001. Procedures used were consistent with the prevailing DWM sampling protocols that are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring, Standard Operating Procedure* (MA DEP 2001a; CN 1.1). 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 multi-probe data. The data were validated and finalized per data validation procedures outlined in DWM SOP CN 56.2 (MA DEP, 2004a). 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 *Data Validation Report for Year 2001 Project Data* (MA DEP, 2004b).

Appendix 1 of this technical memorandum contains data censoring/qualification decisions for the 2001 South Coastal Watersheds data. Definitions for the data qualifiers are also included in Appendix 1. This information was excerpted from the DWM *Data Validation Report for Year 2001 Project Data* (MA DEP, 2004b).

SURVEY METHODS

DWM personnel performed *in-situ* water quality measurements at 24 stations in total for each survey. Sixteen stations that were considered strictly fresh water were sampled by two different crews on the first day of each survey and 8 stations that were considered saltwater or tidally influenced were sampled by a single crew on survey day two. Two-day surveys were conducted on the following dates: June 27 & 28, July 25 & 26, August 29 & 30, September 26 & 27, and October 24 & 25, 2001. In addition, pre-dawn multiprobe readings were made at all stations prior to the daytime sample collection and readings performed during the July and September surveys. Dissolved oxygen and dissolved oxygen percent saturation, temperature, pH, conductivity, and TDS were measured at all freshwater stations with a

Hydrolab® Series 3 Multiprobe. At saltwater stations, TDS measurements were replaced with salinity readings using the same equipment.

Water quality samples were collected from the 16 freshwater stations (Table A1 and Figure A1) during all daytime surveys noted above except the June survey. These samples were analyzed at WES for alkalinity, turbidity, chlorides, nutrients (nitrogen as NH3 and NO3-NO2, and total phosphorus), hardness, and total suspended solids. Due to complications in NO3-NO2-N analysis for saline samples at WES and limited WES lab resources, the analysis for nutrients was limited to 13 stations (freshwater sites not tidally-influenced). Water quality samples for the saltwater stations included the same suite of analytes excepting nutrient analyses due to laboratory method constraints. Fecal coliform bacteria, Enterococci and E. coli samples were collected at all 24 stations during the July, August, September and October surveys. Each survey crew also took a minimum of one ambient field blank and one field duplicate sample during each survey for quality control purposes.

Procedures used for water sampling and sample handling are described in the *Sample Collection Techniques for DWM Surface Water Quality Monitoring, Standard Operating Procedure* (MA DEP, 2001a) and *Hydrolab Series 3/Series 4 Multiprobe Standard Operating Procedure* (MA DEP 2001b). The Wall Experiment Station (WES) 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 in ice to WES where they were analyzed by methods according to the laboratory standard operating procedures (MA DEP 2001). A summary of the analytical methods employed in 2001 can be found in Table A2.

Table A1. 2001 DEP-DWM South Coastal Watersheds survey. Location of sampling stations and parameters for water quality analysis.

Water Body Name	Station ID#	Detailed Site Description	Parameters
Aaron River	AR101	Upstream of flow control structure at Beechwood Street, Cohasset (wade in)	Total Phosphorus (low level); NH_3-N; (NO_3+NO_2)-N; Hardness; Alkalinity; Chloride; multi-probe (DO; %DO; Temperature; pH; Depth; Conductivity; Salinity; Turbidity); Fecal coliform; *E. coli*, Enterococcus.
First Herring Brook	FH101	Route 3A, at outlet of Tack factory Pond, Scituate; upstream side (grab)	Same as above
Second Herring Brook	SH101	Route 123 (Main Street) bridge, Norwell; upstream side of concrete culvert (wade in)	Same as above
Third Herring Brook	TH101	Tiffany Road/East Street crossing, Norwell/Hanover; upstream side (wade in)	Same as above
Iron Mine Brook	IM101	Elm Street crossing, Hanover; upstream side (wade in)	Same as above
Indian Head River	IH102	Cross St. bridge, Hanover/Hanson; upstream (wade in or basket)	Same as above
Drinkwater River	DW101	Circuit Street bridge, Hanover; upstream side (wade in)	Same as above
French Stream	FS101	Approximately 300 feet downstream from Rockland WWTP discharge canal confluence, Rockland (wade in)	Same as above
French Stream	FS102	Summer St. crossing, Rockland; upstream side (wade in)	Same as above
French Stream	FS103	North Avenue crossing, Rockland; upstream side (wade in)	Same as above
South River	SR102	Route 3A (Main Street) bridge, Marshfield; upstream side of stone dam at Veterans Park (grab)	Same as above

Water Body Name	Station ID#	Detailed Site Description	Parameters
Green Harbor River (Tidally-influenced)	GH101	Route 139 bridge, Marshfield; upstream side (wade in)	Same as above
Jones River	JR102	Upstream in impoundment at Elm Street bridge, Kingston; (grab sample from metal walkway)	Same as above
South River	SR103	Temple Street (Myrtle Street) crossing, Duxbury; upstream side; (grab sample at culvert)	Same as above
Jones River	JR103	Route 106 (Wapping Road) crossing, Kingston; upstream side (basket sample)	Same as above
Jones River	JR104	Impounded side (locally known as Forge Pond) of outlet structure, Lake Street, Kingston; (grab at outlet)	Same as above
North River (Tidally-influenced)	NR101	Upstream from Route 3A (Main Street) bridge, Marshfield; from dock on southern shore (grab)	Hardness; Alkalinity; Chloride; multi-probe(DO; %DO; Temperature; pH; Depth; Salinity; Turbidity); Fecal coliform; *E. coli*, Enterococcus.
North River (Tidally-influenced)	NR102	Bridge Street/Union Street bridge, Norwell/Marshield; downstream side (wade in from boat ramp)	Same as above
North River (Tidally-influenced)	NR103	Route 53/139 bridge, Hanover/Pembroke; upstream side at rocks under bridge (wade in)	Same as above
Indian Head River (Tidally-influenced)	IH101	Canoe ramp off eastern end of Riverside Drive (Indian Head Drive), Hanover; (wade in)	Same as above
South River (Tidally-influenced)	SR101	Julian Street/Bayberry Road bridge, Scituate/Marshfield; upstream side (basket sample)	Same as above
Bluefish River (Tidally-influenced)	BR101	Washington Street bridge, Duxbury; upstream side (grab at culvert)	Same as above
Unnamed tributary (locally known as Bluefish River) (Tidally-influenced)	BR102	Harrison Street bridge, Duxbury; upstream side (wade in)	Same as above
Jones River (Tidally-influenced)	JR101	Route 3A (Main Street) crossing, Kingston; upstream side (basket)	Same as above

Table A2. Summary of Analytical Methods.

	EPA Method*	SM Methods**	Other Methods	MDLs	RDLs
***In-Situ* Water Quality Analytes**					
Hydrolab® Multiprobe Series 3			DWM SOP (CN 4.0)	Not applicable	Not applicable
Grab 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	No information
Enterococcus	EPA 1600			Not defined; usu. 5 and 10 cfu/100ml	No information
E. coli		SM 9213D		Not defined; usu. 5 and 10 cfu/100ml	No information
E. coli	***EPA 1103.1			Not defined; usu. 5 and 10 cfu/100ml	No information

***** = "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
*** = Method used for samples analyzed on 10/24/01

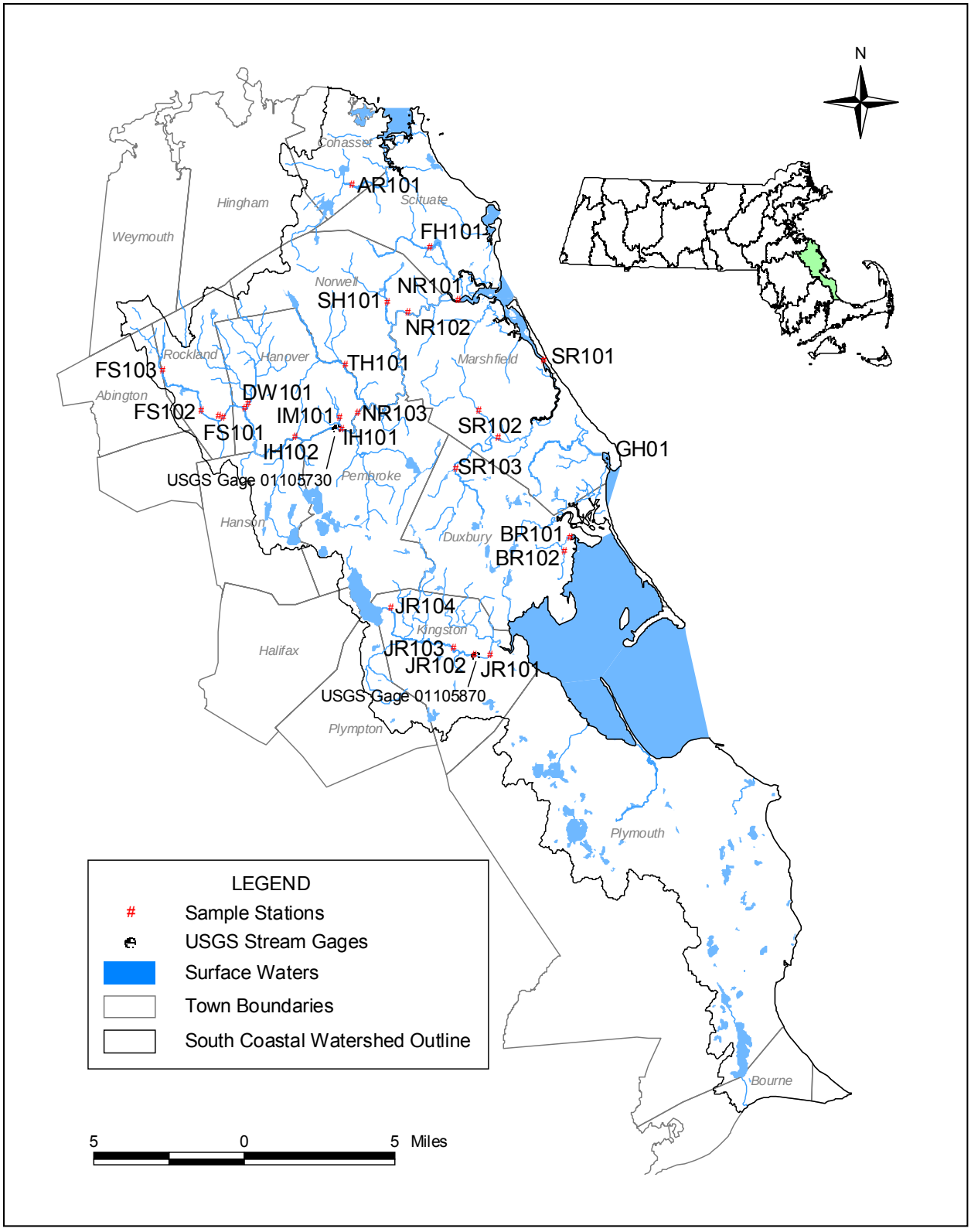


Figure A1: Location of 2001 DEP/DWM Water Quality Sampling Stations and USGS Gaging Stations in the South Coastal Watersheds.

SURVEY CONDITIONS

Conditions prior to each survey were characterized by analyzing precipitation and streamflow data. Rainfall data from the NOAA/National Weather Service precipitation station in Plymouth was reviewed for the five days prior to and on the sampling dates (Table A3). These data should be relatively indicative of conditions for the watershed.

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 Indian Head River (No. 01105730 in Hanover) and one on the Jones River (No. 01105870 in Kingston) as reported in the USGS 2001 and 2002 water year compilations (Socolow *et al*, 2002; Socolow *et al*, 2003). 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; Socolow *et al*, 2003). Streamflow conditions were also compared with the 7-day, 10-year (7Q10) low-flow estimates.

Survey conditions are described below for each DWM sampling event:

June 27 & 28, 2001: This two-day water quality survey was conducted following essentially dry weather. On June 23, 0.32 inches of rain was recorded at the Plymouth Airport, four and five days before the survey dates. This rain resulted in a slight increase in stream flow as measured at the Jones River gage in Kingston. Flow gradually diminished from 26 cfs on June 24 to 19 cfs on June 28. Flow during both survey dates (22 cfs on June 27 and 19 cfs on June 28) was below the June 2001 monthly mean of 34.6 cfs as well as the Period of Record (POR) mean value of 26.8 cfs. However, flow during the survey should be considered well above the 7-day, 10-year low-flow (7Q10) value of 4.02 cfs. Flow at the Indian Head River gage in Hanover gage showed a spike in flow from 34 cfs on June 22 to 50 cfs on June 23 in response to the rain. Flow at this station also gradually diminished to 27 cfs and 23 cfs on the survey dates. Once again this should be considered below the June 2001 monthly mean value of 42.4 cfs and the POR mean of 63 cfs, but still well above the 7Q10 of 1.66 cfs.

July 25 & 26, 2001: Dry weather conditions prevailed on the first day of this survey (July 25), as sampling was performed after a long antecedent dry period. No significant rain had fallen for the five days prior to the survey and only 0.12 inches of rain had been recorded during the 12 days preceding the survey at the Plymouth Airport. This survey was conducted at a flow (11.0 cfs) below both the July 2001 monthly average (17.3 cfs) and the July POR flow (17.6 cfs) for the Jones River gage. The flow at the Indian Head River gage was 9.3 cfs, once again well below the 2001 monthly average of 27.0 cfs and the July POR flow of 22.4 cfs. Survey flow conditions were, however, still well above the 7Q10 values of 1.66 cfs at the Indian Head River gage and 4.02 cfs at the Jones River gage. Samples collected for this portion of the run should be considered representative of dry weather conditions.

Significant rain fell over the area on the second day of the survey. Plymouth Airport recorded 1.38 inches on July 26. It is apparent from the field sheets that the rain occurred during a brief period early in the morning when multiprobe measurements were being taken. While visiting the first two stations in Duxbury at 0210 hours and 0225 hours, respectively, the field crew reported “no rain yet” but by 0245 hours, when sampling in Kingston, heavy rain was falling. As the crew worked north, sampling three more stations in Pembroke (0315), Hanover (0330) and Norwell (0350) precipitation was recorded as light rain, light rain and drizzle, respectively. As the crew continued north and east to sample the last two stations in Marshfield (0410) and Scituate (0430) the field crew reported that the rain had ended. The day-time run on this survey date, which included the collection of water quality samples, commenced at 0730. At this point the field crew reported overcast conditions with no rain falling. This was the case for the remainder of the survey except while sampling the Jones River in Kingston at 0800 when light rain was reported. The rain event only resulted in a flow increase from 9.3 to 9.8 cfs at the Indian Head River gage. The gage on the Jones River recorded a significantly sharper change in flow from 11 to 14 cfs. This discrepancy between gages could be the result of varying watershed areas contributing to flow or local differences in rainfall rather than a more widespread regional rainfall. This survey was conducted at a flow (14.0 cfs) below both the 2001 monthly average (17.3 cfs) and the July POR flow (17.6 cfs) for the Jones River gage. The flow during the survey at the Indian Head River gage was 9.8 cfs, once again, well below the 2001 monthly average of 27.0 cfs and the July POR flow of 22.4 cfs. Survey flow conditions were, however, still well above the 7Q10 values of 1.66 cfs at The Indian Head gage and 4.02

cfs at the Jones River gage. Although the data collected during this survey is probably not representative of "first flush" conditions, increases in bacteria or nutrient levels could be the result of land run-off due to the recent rain event.

August 29 & 30, 2001: Very little rainfall was reported at the Plymouth Airport prior to this survey. A trace amount was reported for August 28, 0.11 inches for August 27, and 0.01 inches or less for the next six preceding days. This weather pattern is obviously demonstrated by the hydrograph at the Jones River gage. Flow diminished from 18 cfs on August 24 to 7.9 cfs on August 30. Interestingly, this was not the case for the gage on the Indian Head River. A similar flow decrease was shown from August 24 (16 cfs) to August 27 (14 cfs); however, a flow of 46 cfs was recorded for August 28 followed by diminishing flows again through the next couple of days to 25 cfs on August 30. With the Jones River gage being closer to the rain recording station at the Plymouth Airport than the gage in Hanover at the Indian Head River, it is plausible and most likely that the area between the gages was in the fringe area of a weather front. The rain was obviously heavier in the northern portion of the watershed and the spike noted in the hydrograph for the Hanover gage resulted from this precipitation. These wet-weather conditions are also demonstrated when flow on the dates of survey are compared to mean flow statistics. The flow at the Hanover gage during the two-day survey was 42 cfs on August 29, and 25 cfs on August 30. When compared to the mean monthly (24.8 cfs) and POR (22.3 cfs) values the flow on August 29 was well above, and the flow on August 30 relatively consistent with, these mean values. However, similar comparisons with data from the Kingston gage do not reveal wet-weather influences. Mean monthly (24.8 cfs) and POR (22.3 cfs) values are both well above the recorded flows of 12 cfs and 7.9 cfs on the survey dates of August 29 and 30, respectively.

September 26 & 27, 2001: Significant precipitation was recorded prior to this survey. As recorded at the Plymouth Airport, 1.54 inches fell on September 21, 0.55 inches on September 22, and 0.26 inches on September 25. This rain resulted in a fluctuating hydrograph at the Indian Head River gage. Flow was only 6.6 cfs on September 21 but rapidly increased to 68 cfs by September 22. Flow diminished over the next few days (i.e., 64 cfs on the 23rd, 32 cfs on the 24th, and 28 cfs on the 25th). On day one of the survey, September 26, flow increased once again to 52 cfs then diminished on the second day to 38 cfs. These flows are well above the Mean Monthly (17.9 cfs) and POR (21.9) flows. At the Jones River gage, flow rose from 8.4 cfs on September 21 to 16 cfs on the September 22, then gradually decreased to 13 cfs on September 24 and 11 cfs for the following three days. Here again these flows are higher than the Mean Montly (8.78 cfs) and POR (16.9) flow values.

October 24 & 25, 2001: No significant rain was reported for the two days of this survey. However, on October 23, the day prior to the survey, 1.18 inches of rain was reported at Plymouth Airport. The hydrographs for the two gages seem to vary in response to this rainfall. The flow at the Hanover gage began at 22 cfs on October 19th, then gradually diminished over the next five days to 14 cfs on the 25th. At the Kingston gage, flow was fairly steady for the period before the rain on October 23rd. Flows were recorded as 7.0 cfs on October 19th, 6.4 on the 20th, 7.5 cfs on the 21st, 9.0 cfs on the 22nd and to 8.9 on the 23rd. Flow did increase in response to the rain on the 24th to 15.0 cf and increased slightly again to 16 cfs on the 25th.

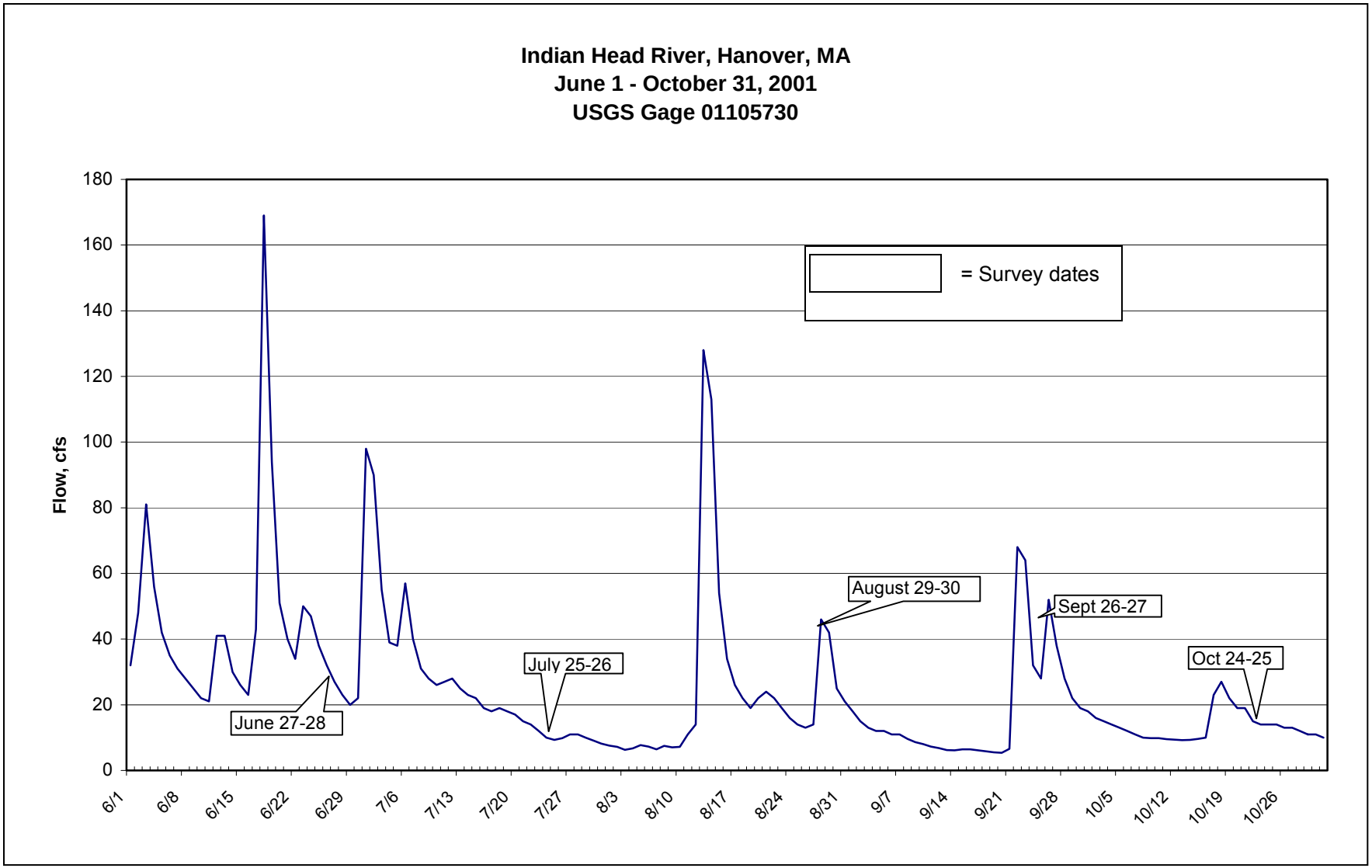
Table A3. Estimated South Coastal Watersheds 2001 Precipitation Data Summary Based on NOAA data for Plymouth, MA. (reported in inches of rainfall)

Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Survey Date	Monthly Total
June 27 June 28	T 0.32	0.32 0.01	0.01 0	0 0.01	0.01 0	0 0	5.23
July 25 July 26	0 0.01	0.01 0	0 0	0 0	0 0	0 1.38	2.65
August 29 August 30	0.01 0.01	0.01 0.01	0.01 0.11	0.11 T	T 0	0 0	4.51
Sept 26 Sept 27	1.54 0.55	0.55 0.01	0.01 0	0 0.26	0.26 0.01	0.01 T	3.12
Oct 24 Oct 25	0 0	0 0.01	0.01 T	T 1.18	1.18 0.01	0.01 0	1.66

Table A4. USGS Flow Data Summary USGS Gage # 01105870 Jones River, Kingston, MA. Discharge in Cubic Feet per Second (cfs)								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Survey Date	Monthly Mean 2001	POR* Monthly Mean
June 27 June 28	27 25	25 26	26 25	25 25	25 22	22 19	34.6	26.8
July 25 July 26	15 15	15 14	14 15	15 12	12 11	11 14	17.3	17.6
August 29 August 30	18 16	16 14	14 13	13 12	12 12	12 7.9	15.9	16.3
Sept 26 Sept 27	8.4 16	16 16	16 13	13 11	11 11	11 11	8.78	16.9
Oct 24 Oct 25	7.0 6.4	6.4 7.5	7.5 9.0	9.0 8.9	8.9 15	15 16	8.52	18.9
7Q10 @ USGS, Gage01105870 = 4.02 cfs *Period of Record: 1966 - 2001 (mean annual discharge = 32.8 cfs)								

Table A5. USGS Flow Data Summary USGS Gage # 01105730 Indian Head River – Hanover, MA Discharge in Cubic Feet per Second (cfs)								
Survey Dates	5 Days Prior	4 Days Prior	3 Days Prior	2 Days Prior	1 Day Prior	Survey Date	Monthly Mean 2001	POR* Monthly Mean
June 27 June 28	34 50	50 47	47 38	38 32	32 27	27 23	42.4	63.0
July 25 July 26	17 15	15 14	14 12	12 10	10 9.3	9.3 9.8	27.0	22.4
August 29 August 30	16 14	14 13	13 14	14 46	46 42	42 25	24.8	22.3
Sept 26 Sept 27	6.6 68	68 64	64 32	32 28	28 52	52 38	17.9	21.9
Oct 24 Oct 25	22 19	19 19	19 15	15 14	14 14	14 14	13.6	34.9
7Q10 @ USGS, Gage 01105730 = 1.66 cfs, *Period of Record: 1966 - 2001 (mean annual discharge = 63.0 cfs)								

Figure A2


Indian Head River, Hanover, MA
June 1 - October 31, 2001
USGS Gage 01105730
Flow, cfs
180
160
140
120
100
80
60
40
20
0
= Survey dates
June 27-28
July 25-26
August 29-30
Sept 26-27
Oct 24-25
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3
8/10
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9/7
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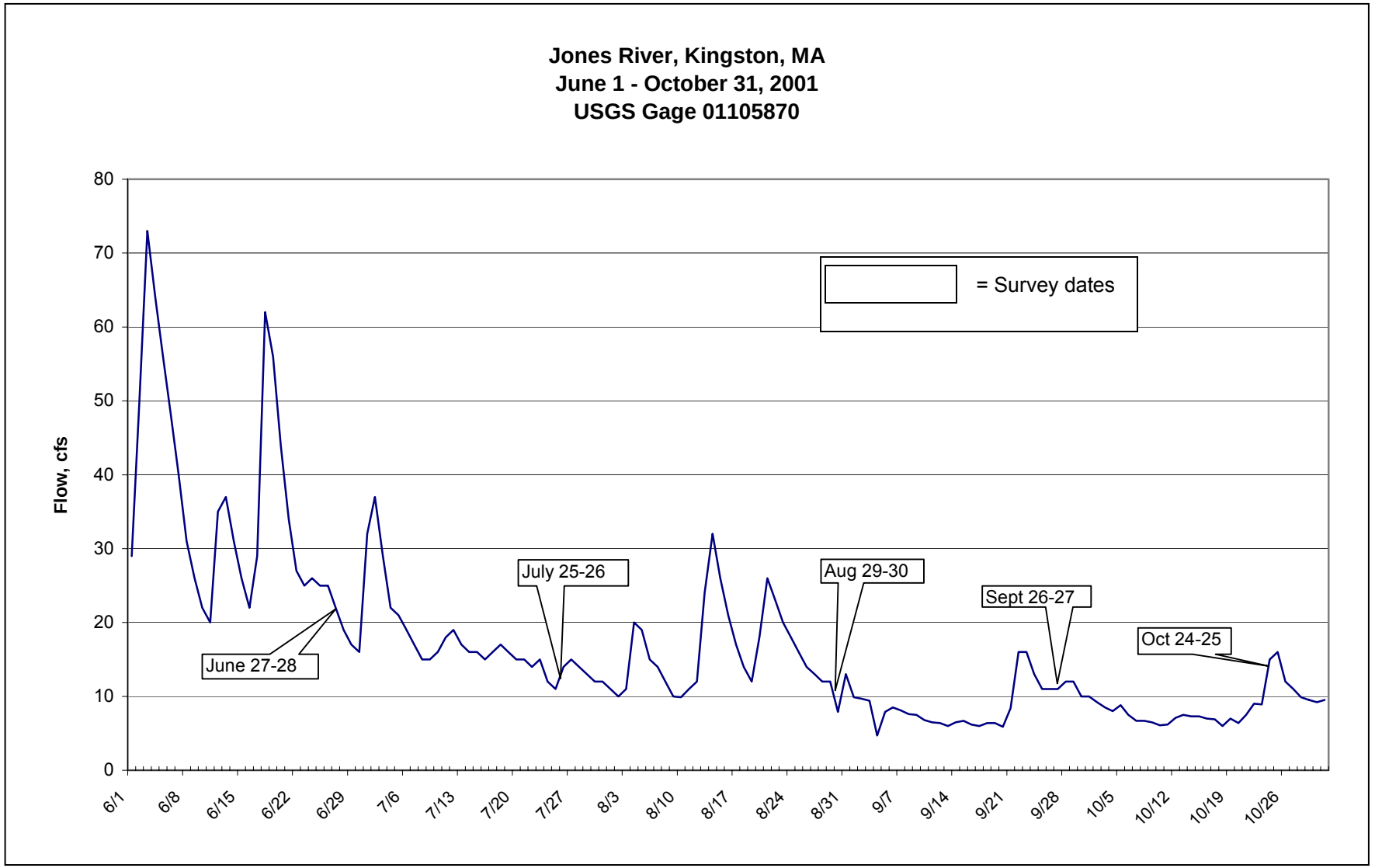
9/21
9/28
10/5
10/12
10/19
10/26

Figure A3


Jones River, Kingston, MA
June 1 - October 31, 2001
USGS Gage 01105870
Flow, cfs
80
70
60
50
40
30
20
10
0
= Survey dates
June 27-28
July 25-26
Aug 29-30
Sept 26-27
Oct 24-25
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
9/14
9/21
9/28
10/5
10/12
10/19
10/26

WATER QUALITY DATA

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

Table A6. 2001 MA DEP South Coastal Watersheds *in-situ* Hydrolab® Data.

Temperature, pH, Conductivity, Total Dissolved Solids (TDS), Salinity, Dissolved Oxygen (DO), Dissolved Oxygen Percent Saturation (Data qualifiers listed in Appendix 1)

UNNAMED TRIBUTARY (locally considered part of Bluefish River)
Unique_ID: W0894 Station: BR102, Mile Point: 0.3
Description: Harrison Street bridge, Duxbury

Date	OWMID	Time	Depth	Temp	pH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0115	08:56	0.5	22.4u	6.6u	7,445u	--	4.2	7.1u	82u
07/26/01	94-0155	02:28	0.8	24.7	6.6u	8,953	--	5.0	6.5u	80u
07/26/01	94-0163	07:41	0.9	23.6	6.7	19,843u	--	11.8u	5.7u	71u
08/30/01	94-0194	09:07	0.3	18.8	6.6c	3,807u	--	2.1cu	6.5	69
09/27/01	94-0224	09:04	0.1i	14.3	7.0u	8,175u	--	4.6u	6.4	64
10/25/01	94-0253	09:38	0.1i	17.1	6.5i	5,953	--	3.3	6.1	64

AARON RIVER
Unique_ID: W0876 Station: AR101, Mile Point: 2
Description: upstream of flow control structure at Beechwood Street, Cohasset

Date	OWMID	Time	Depth	Temp	pH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0110	14:33	0.5	28.0u	5.6	120	76.6	--	3.0u	38u
07/25/01	94-0143	04:42	0.6	25.0u	5.6u	119	76.2	--	##u	##u
07/25/01	94-0151	07:14	0.4	24.9	5.5	119	76.1	--	2.0	24
08/29/01	94-0174	08:55	0.2	22.4	5.9u	121	77.4	--	2.8	32
09/26/01	94-0271	05:32	0.1i	20.5u	5.8i	127u	81.6u	--	2.2u	24u
09/26/01	94-0214	11:04	0.2	20.6	6.1i	126	80.3	--	3.3u	37u
10/24/01	94-0251	09:57	0.5	13.9	5.9	130	83.3	--	5.9	56

NORTH RIVER
Unique_ID: W0917 Station: NR103, Mile Point: 11.5
Description: Route 53/139 bridge, Hanover/Pembroke

Date	OWMID	Time	Depth	Temp	pH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0121	12:35	0.8	26.3u	6.5u	316c	--	0.2c	4.8	59
07/26/01	94-0159	03:18	1.1	26.8	6.6u	796cu	--	0.4cu	5.6u	70u
07/26/01	94-0167	08:28	1.2	26.1	6.6u	5,448	--	3.0	7.5	93
08/30/01	94-0196	10:01	0.7	21.8	6.7c	365c	--	0.2	5.1	57
09/27/01	94-0226	09:56	0.3	18.1	6.7c	397c	--	0.2c	6.7u	70u
10/25/01	94-0255	10:29	0.3	15.9	6.6i	1,018	--	0.5	7.4u	75u

NORTH RIVER
Unique_ID: W0916 Station: NR102, Mile Point: 4.3
Description: Bridge Street/Union Street bridge, Norwell/Marshfield

Date	OWMID	Time	Depth	Temp	pH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0119	11:41	1.0	24.9u	6.7	12,265u	--	7.0u	5.0	61
07/26/01	94-0158	03:55	0.8	18.2	7.5cu	44,243u	--	28.6u	8.5u	106u
07/26/01	94-0166	09:04	0.7	19.3u	7.3c	##u	--	##u	7.5u	87u
08/30/01	94-0198	10:50	1.0	20.4	7.3	36,732	--	23.2	5.8	72
09/27/01	94-0228	10:38	2.3	16.6	7.3	33,448	--	20.9	6.2	71
10/25/01	94-0257	11:08	0.1i	14.3	7.2i	31,173u	--	19.4u	7.8u	85u

NORTH RIVER
Unique_ID: W0915 Station: NR101, Mile Point: 1.8
Description: from dock on southern shore upstream/west of Route 3A (Main Street) bridge, Marshfield

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0118	10:40	2.1	19.1u	7.6c	44,526u	--	28.8u	7.6u	95u
07/26/01	94-0157	04:11	1.1	16.3	7.9c	49,449	--	32.4	10.7u	132u
07/26/01	94-0165	09:24	1.3	16.9	7.8c	47,589u	--	31.1u	9.2u	114u
08/30/01	94-0199	11:10	1.5	17.5	7.9	48,642	--	31.8	8.5	106
09/27/01	94-0229	10:55	2.2	13.2	7.7u	47,734	--	31.2	7.9u	90u
10/25/01	94-0258	11:26	1.9	13.6	7.5i	45,354	--	29.4	7.5u	86u

FIRST HERRING BROOK/Tack Factory Pond
Unique_ID: W0896 Station: FH101, Mile Point: 1
Description: in Tack Factory Pond (an impoundment of First Herring Brook) west/upstream at Cushing Highway (Route 3A), Scituate

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0109	14:13	0.2	28.0u	5.6	183	117	--	4.7u	58u
07/25/01	94-0142	04:24	0.8	26.1u	6.1	197	126	--	6.1	74
07/25/01	94-0150	07:33	0.8	25.8	6.0	198	126	--	5.4u	66u
08/29/01	94-0175	09:14	0.4	22.3u	5.8	191	123	--	5.1u	58u
09/26/01	94-0272	05:11	0.3	20.4u	5.9i	203	130	--	4.3u	47u
09/26/01	94-0215	10:47	0.3	20.4	6.0i	202	129	--	6.6	72
10/24/01	94-0250	09:38	0.4	15.1	6.2	218	140	--	8.4	82

SECOND HERRING BROOK
Unique_ID: W0918 Station: SH101, Mile Point: 1
Description: Route 123 (Main Street) crossing, Norwell

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0108	13:53	##i	25.6	6.3	201	129	--	7.0u	84u
07/25/01	94-0141	04:11	0.3	22.7	6.5	244	156	--	7.2u	82u
07/25/01	94-0149	07:52	0.3	22.5	6.4	245	157	--	7.3	83
08/29/01	94-0176	09:32	0.1i	21.5	6.3u	197	126	--	7.9	88
09/26/01	94-0273	04:57	0.1i	19.7	6.3i	207	132	--	8.4u	91u
09/26/01	94-0216	10:30	0.2	19.0	6.4i	203	130	--	8.6u	91u
10/24/01	94-0249	09:22	0.2	14.0	6.3	229	146	--	8.5u	81u

THIRD HERRING BROOK
Unique_ID: W0922 Station: TH101, Mile Point: 1.9
Description: Tiffany Road/East Street crossing, Norwell/Hanover

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0102	11:12	##i	20.5u	6.0	338	216	--	4.6u	50u
07/25/01	94-0284	02:53	0.7	22.5	6.3iu	369	236	--	4.3u	49u
07/25/01	94-0128	07:22	0.7	21.9	6.3	365	233	--	4.1	46
08/29/01	94-0184	09:22	0.3	19.3	5.8	332	213	--	5.5u	59u
09/26/01	94-0281	03:46	0.4	18.6	5.7	293	187	--	5.9	62
09/26/01	94-0205	08:42	0.4	18.1	5.9	308	197	--	6.1	64
10/24/01	94-0234	09:30	0.1i	13.1	6.0	328	210	--	6.0u	56u

INDIAN HEAD RIVER
Unique_ID: W0909 Station: IH102, Mile Point: 2.4
Description: upstream/west in impoundment at Cross Street bridge, Hanover/Hanson

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0103	11:48	##i	24.4u	6.5	315	201	--	6.8	79
07/25/01	94-0123	03:45	0.6	25.4m	6.7m	392m	251m	--	##mu	##mu
07/25/01	94-0130	07:58	0.8	25.0	6.6	396	254	--	4.9	59
08/29/01	94-0186	10:01	0.4	22.5	6.7u	358	229	--	7.0u	80u
09/26/01	94-0279	04:16	0.4	20.8	6.6	301	193	--	7.1	79
09/26/01	94-0207	09:19	0.6	20.3	6.6u	307	196	--	7.4u	81u
10/24/01	94-0236	10:06	0.2	14.2	6.5u	379	243	--	7.1u	68u

INDIAN HEAD RIVER
Unique_ID: W0908 Station: IH101, Mile Point: 0.6
Description: canoe ramp off eastern end of Riverside Drive (Indian Head Drive), Hanover

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0120	12:16	0.7	26.4u	6.9cu	328c	--	0.2c	7.7u	94u
07/26/01	94-0160	03:34	0.8	27.2	7.2c	391c	--	0.2c	7.8u	97u
07/26/01	94-0168	08:43	1.2	26.5	7.2c	400c	--	0.2c	6.8u	83u
08/30/01	94-0197	10:20	0.5	22.6	7.1	373c	--	0.2c	7.7	87
09/27/01	94-0227	10:13	0.1i	18.8	7.0	334c	--	0.2c	9.1u	96u
10/25/01	94-0256	10:46	0.3	15.8	6.9iu	402ci	--	0.2ci	9.2	92

IRON MINE BROOK
Unique_ID: W0910 Station: IM101, Mile Point: 0.5
Description: Elm Street crossing, Hanover

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0099	10:48	##i	18.1u	6.9c	563	360	--	8.7u	90u
07/25/01	94-0122	03:27	0.7	20.4	6.9cu	763c	488c	--	8.2	90
07/25/01	94-0129	07:42	0.7	19.9	7.0cu	758c	485c	--	8.3u	91u
08/29/01	94-0185	09:43	0.4	17.5	6.8u	515	329	--	8.7u	90u
09/26/01	94-0280	04:02	0.3	18.0	6.8u	458	293	--	8.1	84
09/26/01	94-0206	09:02	0.4	16.6	6.8u	465	297	--	8.5u	86u
10/24/01	94-0235	09:48	0.1i	13.7	6.7u	556	356	--	7.3u	69u

DRINKWATER RIVER
Unique_ID: W0895 Station: DW101, Mile Point: 1.3
Description: Circuit Street bridge, Hanover

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0104	12:07	0.4	20.4	6.2	365	234	--	6.8	73
07/25/01	94-0124	04:05	1.3	18.7u	6.0	451	289	--	##mu	##mu
07/25/01	94-0131	08:15	1.2	20.0u	6.1u	414u	265u	--	##u	##u
08/29/01	94-0187	10:19	1.0	19.1	6.2	320	205	--	7.2u	77u
09/26/01	94-0278	04:34	1.2	18.7	5.9	299u	191u	--	7.0	74
09/26/01	94-0208	09:38	1.0	17.8	6.0	304	195	--	7.2u	75u
10/24/01	94-0237	10:27	0.4	13.6	6.3	370	237	--	6.1	58

FRENCH STREAM
Unique_ID: W0899 Station: FS103, Mile Point: 4.4
Description: North Avenue crossing, Rockland

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0107	13:20	##i	17.4u	6.7u	199	127	--	8.9u	90u
07/25/01	94-0126	04:40	0.8	18.0u	6.8u	216	138	--	8.7u	90u
07/25/01	94-0133	09:25	0.9	17.6	6.9	216	138	--	8.8	91
08/29/01	94-0190	11:28	0.5	17.1	6.7u	213	136	--	8.8u	89u
09/26/01	94-0270	05:01	0.5	17.8	6.5	183u	117u	--	8.2	85
09/26/01	94-0211	10:48	0.5	16.6	6.5	199	127	--	8.5	87
10/24/01	94-0240	11:37	0.2	14.3	6.6u	246	157	--	7.9u	75u

FRENCH STREAM
Unique_ID: W0898 Station: FS102, Mile Point: 1.9
Description: Summer Street crossing, Rockland

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0106	12:56	##i	27.0u	6.6	270	173	--	7.2	87
07/25/01	94-0125	04:22	0.7	24.9	6.5u	280	179	--	6.1	72
07/25/01	94-0132	09:05	0.8	24.5	6.6	282	180	--	6.3u	74u
08/29/01	94-0188	11:10	0.4	22.9	6.8u	228	146	--	7.8	89
09/26/01	94-0269	04:47	0.4	20.8	6.8u	215	138	--	8.2u	91u
09/26/01	94-0210	10:31	0.4	19.9	6.8u	216	138	--	8.4u	91u
10/24/01	94-0239	11:20	0.2	15.4	6.6u	275	176	--	8.2u	81u

FRENCH STREAM
Unique_ID: W0897 Station: FS101, Mile Point: 1.1
Description: approximately 300 feet downstream from confluence with unnamed tributary (Rockland WWTP discharge canal), Rockland.

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0105	12:34	0.1i	24.4u	6.8u	513u	328u	--	7.4u	86u
07/25/01	94-0173	08:37	0.8	23.5	6.9u	553	354	--	5.4	62
08/29/01	94-0189	10:45	0.6	22.5	6.8u	473u	303u	--	6.9	78
09/26/01	94-0209	10:00	0.7	19.7	6.5u	356u	228u	--	6.2u	67u
10/24/01	94-0238	10:55	0.3	17.2u	6.6u	578	370	--	6.5	66

SOUTH RIVER
Unique_ID: W0921 Station: SR103, Mile Point: 10.9
Description: Temple Street (Myrtle Street) crossing, Duxbury

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0112	15:31	0.5	25.6	5.9	199	128	--	1.9u	23u
07/25/01	94-0140	03:40	0.7	24.8	6.2	204	131	--	4.5	53
07/25/01	94-0148	08:26	0.7	24.2	6.1	204	131	--	3.8	45
08/29/01	94-0177	10:16	0.5	21.7u	5.9	189	121	--	3.6	40
09/26/01	94-0274	03:20	0.5	20.1	5.9i	208	133	--	3.7u	40u
09/26/01	94-0217	08:18	0.5	19.3	5.9i	208	133	--	3.7u	39u
10/24/01	94-0248	10:33	0.5	14.3	6.0	206	132	--	6.0u	57u

SOUTH RIVER
Unique_ID: W0920 Station: SR102, Mile Point: 8.2
Description: upstream Route 3A (Main Street) bridge, Marshfield

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0111	15:09	##i	26.4	6.4	202u	129	--	5.8u	70u
07/25/01	94-0283	02:15	0.8	25.6	6.4i	212	136	--	5.7u	69u
07/25/01	94-0127	06:52	0.8	25.0	6.4	213	136	--	5.9u	70u
08/29/01	94-0183	08:47	0.4	21.4	6.4	203	130	--	6.7	74
09/26/01	94-0282	03:19	0.4	20.2	6.4	212	136	--	7.3	80
09/26/01	94-0204	08:14	0.4	19.5	6.4	212	136	--	7.5u	80u
10/24/01	94-0263	09:01	0.3	13.9u	6.3	207	132	--	7.0u	66u

SOUTH RIVER
Unique_ID: W0919 Station: SR101, Mile Point: 2.8
Description: Julian Street/Bayberry Road bridge, Scituate/Marshfield

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0117	10:16	0.8	21.9u	7.3c	42,040u	--	27.0	6.7	88
07/26/01	94-0161	04:36	0.9	16.4u	7.9c	49,040u	--	32.1u	10.3u	127u
07/26/01	94-0169	09:42	0.9	19.6	7.3c	45,240u	--	29.3u	6.1u	78u
08/30/01	94-0200	11:36	0.3	19.0	7.7u	46,620	--	30.3	7.6	96
09/27/01	94-0232	11:16	0.2	15.4u	7.5	43,479u	--	28.1u	7.3u	86u
10/25/01	94-0261	11:53	0.2	15.8	7.4i	43,195u	--	27.9u	7.9u	93u

GREEN HARBOR RIVER
Unique_ID: W0337 Station: GH101, Mile Point: 0.7
Description: Upstream side of Route 139 bridge, Marshfield

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0113	16:07	##i	34.4u	9.3cu	1,663cu	1,060u	--	##u	##u
07/25/01	94-0136	02:08	1.1	14.6	7.4cu	##c	##c	--	5.6u	83u
07/25/01	94-0144	10:08	1.0	##u	7.4cu	##c	##c	--	6.8	87
08/30/01	94-0201	12:07	1.3	17.4	7.6	47,764	--	31.2	7.0u	87u
09/27/01	94-0233	11:43	0.8	15.1u	6.9u	33,539	--	21.0	5.0u	56u
10/25/01	94-0262	12:24	0.5	14.4u	6.9i	42,823u	--	27.6u	5.0u	58u

BLUEFISH RIVER
Unique_ID: W0893 Station: BR101, Mile Point: 0.8
Description: Washington Street bridge, Duxbury

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0114	08:43	0.5	20.4u	7.6c	47,213u	--	30.8	6.6u	87u
07/26/01	94-0154	02:15	0.8	21.5	7.7c	46,788u	--	30.5u	6.2u	83u
07/26/01	94-0162	07:29	0.9	21.4	7.6c	47,435u	--	30.9u	5.4u	73u
08/30/01	94-0193	08:54	0.4	20.8	7.8	47,638u	--	31.1u	6.8	89
09/27/01	94-0223	08:54	0.5	17.0	7.7	45,919u	--	29.8u	6.7	82
10/25/01	94-0252	09:27	0.2	16.7	7.6i	41,585	--	26.7	7.1u	85u

JONES RIVER/Jones River Pond
Unique_ID: W0914 Station: JR104, Mile Point: 7.6
Description: in impounded side (locally known as Forge Pond) of outlet structure, upstream/west of Lake Street, Kingston

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0098	10:02	##i	24.0	5.8	137	87.5	--	2.3	27
07/25/01	94-0139	03:10	0.3	24.2	6.1	197	126	--	0.9	11
07/25/01	94-0147	09:33	0.3	23.8	6.0	201	129	--	0.6	6
08/29/01	94-0180	10:45	0.1i	20.6	5.9	140	89.9	--	0.3u	4u
09/26/01	94-0277	03:53	##i	20.1	6.0i	140u	89.5u	--	0.4u	4u
09/26/01	94-0220	08:51	##i	18.6	6.1i	143	91.5	--	0.5u	5u
10/24/01	94-0243	11:01	##i	15.9u	6.2	197	126	--	2.9u	28u

JONES RIVER
Unique_ID: W0913 Station: JR103, Mile Point: 3.8
Description: Route 106 (Wapping Road) crossing, Kingston

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0097	09:38	0.8	21.8u	6.0	129	82.6	--	3.7u	41u
07/25/01	94-0138	02:52	1.6	23.8	6.4	139	88.7	--	3.4u	40u
07/25/01	94-0146	09:11	1.5	23.0	6.1	140	89.4	--	2.2	25
08/29/01	94-0179	11:06	1.7	20.7	6.1u	135	86.4	--	3.8	41
09/26/01	94-0276	04:11	1.6	19.5	5.9i	141	89.9	--	3.6u	39u
09/26/01	94-0219	09:20	1.0	18.8	6.0i	140	89.7	--	3.7u	40u
10/24/01	94-0246	11:21	1.1	13.8	6.0	136	87.3	--	5.6	53

JONES RIVER
Unique_ID: W0912 Station: JR102, Mile Point: 2.8
Description: impoundment upstream of Elm Street bridge, Kingston

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/27/01	94-0096	09:11	0.4	22.1	6.1	135	86.2	--	4.4u	49u
07/25/01	94-0137	02:40	1.3	23.9	6.6	153	98.0	--	6.1u	72u
07/25/01	94-0145	08:54	0.9	23.4	6.3	153	98.0	--	2.8u	33u
08/29/01	94-0178	11:25	0.3	21.3u	6.3u	148	95.0	--	5.3	59
09/26/01	94-0275	04:24	0.8	19.6	6.1i	151	97.0	--	4.5u	49u
09/26/01	94-0218	09:42	1.0	19.1	6.1i	150	96.0	--	4.0u	43u
10/24/01	94-0247	11:36	0.7	13.7	6.2	149	96.0	--	5.7	54

JONES RIVER
Unique_ID: W0911 Station: JR101, Mile Point: 2.2
Description: Route 3A (Main Street) crossing, Kingston

Date	OWMID	Time	Depth	Temp	PH	Conductivity	TDS	Salinity	DO	Saturation
		(24hr)	(m)	(ºC)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/01	94-0116	09:23	0.4	22.7	6.8	156c	--	0.1c	9.4	106
07/26/01	94-0156	02:48	1.2	24.6	6.8	176c	--	0.1	8.5u	101u
07/26/01	94-0164	08:01	0.9	23.3	7.0c	193c	--	0.1c	7.8u	91u
08/30/01	94-0195	09:30	0.6	18.6	6.8	214cu	--	0.1	8.7	91
09/27/01	94-0225	09:26	##i	16.1	6.8c	172c	--	0.1c	9.3	93
10/25/01	94-0254	10:01	0.1i	16.3	6.6ci	173ci	--	0.1ci	9.1u	92u

Table A7. 2001 MA DEP South Coastal Watersheds Instream Bacteria and Physico/Chemical Data.
Fecal coliform, E. coli, Enterococcus sp., Chloride, Alkalinity, Hardness, Ammonia Nitrogen (NH3-N), Nitrate-Nitrite Nitrogen (NO3-NO2-N), and Total Phosphorus (TP) (Data qualifiers listed in Appendix 1)

Unnamed Tributary (locally considered part of Bluefish River), Unique_ID: W0894, Station: BR102, Mile Point: 0.3
Description: Harrison Street bridge, Duxbury

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0163	--	07:40	1000ej	5000e	9000	9200	50	2000	--	--	--
08/30/01	94-0194	--	09:00	200	<5	450	1200	28	370	--	--	--
09/27/01	94-0224	--	09:04	330	180	1800	2400	37	780	--	--	--
10/25/01	94-0253	--	09:35	120	<5	--	1700	27	590	--	--	--

AARON RIVER, Unique_ID: W0876, Station: AR101, Mile Point: 2
Description: upstream of flow control structure at Beechwood Street, Cohasset

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0110	--	14:30	--	--	--	--	--	--	0.07b	<0.06	0.035
07/25/01	94-0151	--	07:05	55	15	40	29	4	14	<0.02	<0.06	0.037
08/29/01	94-0174	--	08:50	170	120	140	28	5	16	<0.02	<0.06	0.059
09/26/01	94-0214	--	11:00	67	33	76	27	5	17	<0.02	<0.06	0.033
10/24/01	94-0251	--	09:50	14	5b	--	28	7	18	<0.02	0.08	0.031

NORTH RIVER, Unique_ID: W0917, Station: NR103, Mile Point: 11.5
Description: Route 53/139 bridge, Hanover/Pembroke

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0167	--	08:25	790	450	550	2000	25	480	--	--	--
08/30/01	94-0196	--	10:00	240	70	1000	85	19	46	--	--	--
09/27/01	94-0226	--	09:54	160	100	170	85	13	46	--	--	--
10/25/01	94-0255	--	10:30	62e	90e	--	260	21	100	--	--	--

NORTH RIVER, Unique_ID: W0916, Station: NR102, Mile Point: 4.3
Description: Bridge Street/Union Street bridge, Norwell/Marshfield

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0166	--	09:00	80	30	210	14500	88	4400	--	--	--
08/30/01	94-0198	--	10:45	30	5	15	13000	84	3700	--	--	--
09/27/01	94-0228	--	10:38	100	19	90	11000	67	3100	--	--	--
10/25/01	94-0257	--	11:05	14	<5	--	10000	70	3400	--	--	--

NORTH RIVER, Unique_ID: W0915, Station: NR101, Mile Point: 1.8
Description: from dock on southern shore upstream/west of Route 3A (Main Street) bridge, Marshfield

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0171	94-0165	**	30	15	30	17000	100	5300	--	--	--
07/26/01	94-0165	94-0171	09:22	55	10	55	16800	100	5300	--	--	--
08/30/01	94-0202	94-0199	**	25	<5	<5	18000	100	4900	--	--	--
08/30/01	94-0199	94-0202	11:10	20	5	<5	18000	100	4900	--	--	--
09/27/01	94-0230	94-0229	**	24	10	##d	18000	97	4800	--	--	--
09/27/01	94-0229	94-0230	10:53	24	<5	##d	17000	97	4800	--	--	--
10/25/01	94-0260	94-0258	**	5d	5	--	16000	95	4700	--	--	--
10/25/01	94-0258	94-0260	11:20	43d	<5	--	16000	95	4700	--	--	--

FIRST HERRING BROOK/Tack Factory Pond, Unique_ID: W0896, Station: FH101, Mile Point: 1
Description: in Tack Factory Pond (an impoundment of First Herring Brook) west/upstream at Cushing Highway (Route 3A), Scituate

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0109	--	14:10	--	--	--	--	--	--	0.10b	<0.06	0.065
07/25/01	94-0150	--	07:28	25	15	20	50	5	24	<0.02	<0.06	0.069
08/29/01	94-0175	--	09:10	410	230	280	48	5	27	<0.02	<0.06	0.062
09/26/01	94-0215	--	10:45	110	52	43	42	5	29	<0.02	0.08	0.046
10/24/01	94-0250	--	09:30	7e	24be		49	7	32	<0.02	0.07b	0.046

SECOND HERRING BROOK, Unique_ID: W0918, Station: SH101, Mile Point: 1
Description: Route 123 (Main Street) crossing, Norwell

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0108	--	13:50	--	--	--	--	--	--	0.09b	0.19	0.069
07/25/01	94-0149	--	07:45	37e	45e	140	60	7	27	<0.02	0.40	0.072
08/29/01	94-0176	--	09:40	70	20	420	48	7	25	<0.02	0.06	0.051
09/26/01	94-0216	--	10:25	57	33	62	46	7	25	<0.02	<0.06	0.033
10/24/01	94-0249	--	09:00	52	48b	--	54	9	29	<0.02	<0.06	0.028

THIRD HERRING BROOK, Unique_ID: W0922, Station: TH101, Mile Point: 1.9
Description: Tiffany Road/East Street crossing, Norwell/Hanover

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0102	--	11:05	--	--	--	--	--	--	0.32b	0.15	0.058
07/25/01	94-0128	--	07:20	410	200	90	84	20	52	0.13	0.27	0.040
08/29/01	94-0184	--	09:20	730	430	190	90	8	34	<0.02	<0.06	0.061
09/26/01	94-0205	--	08:39	560	19	240	73	9	35	<0.02	0.08	0.062
10/24/01	94-0234	--	09:20	55e	69be	--	80	15	44	<0.02	0.12	0.040

INDIAN HEAD RIVER, Unique_ID: W0909, Station: IH102, Mile Point: 2.4
Description: upstream/west in impoundment at Cross Street bridge, Hanover/Hanson

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0103	--	11:40	--	--	--	--	--	--	0.15b	1.2	0.082
07/25/01	94-0130	--	07:55	65e	80e	200	88	33	53	<0.02	1.7	0.038
08/29/01	94-0186	--	10:00	390	200	480	83	20	53	<0.02	1.6	0.059
09/26/01	94-0207	--	09:16	310	160	560	68	13	44	<0.02	0.86	0.046
10/24/01	94-0236	--	10:00	150	130b	--	82	21	57	<0.02	1.8	0.032

INDIAN HEAD RIVER, Unique_ID: W0908, Station: IH101, Mile Point: 0.6
Description: canoe ramp off eastern end of Riverside Drive (Indian Head Drive), Hanover

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0168	--	08:40	55	12	460	110	22	53	--	--	--
08/30/01	94-0197	--	10:20	45	10	55	88	20	50	--	--	--
09/27/01	94-0227	--	10:11	110	14	1000	78	14	45	--	--	--
10/25/01	94-0256	--	10:45	29	<5	--	82	21	56	--	--	--

IRON MINE BROOK, Unique_ID: W0910, Station: IM101, Mile Point: 0.5
Description: Elm Street crossing, Hanover

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0100	94-0099	**	--	--	--	--	--	--	0.16b	0.81	0.060d
06/27/01	94-0099	94-0100	10:40	--	--	--	--	--	--	0.20b	0.80	0.045d
07/25/01	94-0129	--	07:40	280	250	1000	190	38	96	<0.02	1.3	0.064
08/29/01	94-0185	--	09:40	390	270	550	120	30	70	<0.02	0.58	0.16
09/26/01	94-0206	--	08:59	540	200	860	110	27	65	<0.02	0.37	0.036
10/24/01	94-0235	--	09:40	660	610b	--	130	37	73	<0.02	0.24	0.024

DRINKWATER RIVER, Unique_ID: W0895, Station: DW101, Mile Point: 1.3
Description: Circuit Street bridge, Hanover

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0104	--	12:00	--	--	--	--	--	--	0.18b	0.60	0.10
07/25/01	94-0131	--	08:10	720	340	1000	98	16	47	<0.02	0.82	0.078
08/29/01	94-0187	--	10:15	590	420	1000	78	11	37	<0.02	0.26	0.083
09/26/01	94-0208	--	09:35	870	480	2700	73	8	37	<0.02	0.26	0.061
10/24/01	94-0237	--	10:15	81	62b	--	88	17	49	<0.02	0.31	0.046

FRENCH STREAM, Unique_ID: W0899, Station: FS103, Mile Point: 4.4
Description: North Avenue crossing, Rockland

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0107	--	13:15	--	--	--	--	--	--	0.10b	0.41	0.10
07/25/01	94-0133	94-0135	**	230	140	760	48	19	39	<0.02	0.46	0.044
07/25/01	94-0135	94-0133	**	180	130	670	45	19	40	<0.02	0.46	0.042
08/29/01	94-0191	94-0190	**	730	380	390	48	17	38	<0.02	0.48	0.043d
08/29/01	94-0190	94-0191	11:25	770	350	450	43	18	38	<0.02	0.47	0.057d
09/26/01	94-0212	94-0211	**	2000	540d	1800	42	13	34	<0.02	0.34	0.056
09/26/01	94-0211	94-0212	10:45	2000	180d	1700	41	13	34	<0.02	0.35	0.050
10/23/01	94-0265	94-0264	**	--	--	--	--	--	--	<0.02	0.32	0.026
10/23/01	94-0264	94-0265	14:50	--	--	--	--	--	--	<0.02	0.30	0.026
10/24/01	94-0242	94-0240	**	95	95b	--	50d	21	46	<0.02	0.25	0.027
10/24/01	94-0240	94-0242	11:30	71e	81be	--	70d	22	45	<0.02	0.25	0.027

FRENCH STREAM, Unique_ID: W0898, Station: FS102, Mile Point: 1.9
Description: Summer Street crossing, Rockland

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0106	--	12:55	--	--	--	--	--	--	0.13b	0.34	0.030
07/25/01	94-0132	--	09:00	320	160	9000	61	18	37	<0.02	0.18	0.031
08/29/01	94-0188	--	11:09	920	560	460	45	15	33	<0.02	0.17	0.046
09/26/01	94-0210	--	10:28	810	210	1300	47	15	31	<0.02	0.21	0.032
10/24/01	94-0239	--	11:15	200	180b	--	60	18	39	<0.02	0.28	0.024

Unnamed Tributary to French Stream, Unique_ID: W0907, Station: FS105, Mile Point: 0.1
Description: approximately 100 feet downstream of Rockland WWTP outfall pipe, Rockland.

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
10/23/01	94-0268	--	13:20	--	--	--	--	--	--	0.07	12	0.26

FRENCH STREAM, Unique_ID: W0897, Station: FS101, Mile Point: 1.1
Description: approximately 300 feet downstream from confluence with unnamed tributary (Rockland WWTP discharge canal), Rockland.

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0105	--	12:30	--	--	--	--	--	--	0.18b	6.0	0.10
07/25/01	94-0173	--	08:35	300	230	5000	110	40	92	0.06	5.6	0.14
08/29/01	94-0189	--	10:43	430e	440e	14000	100	41	79	0.08	4.0	1.3
09/26/01	94-0209	--	09:58	850	320	1800	73	22	60	<0.02	3.2	0.13h
10/24/01	94-0238	--	10:45	110	90b		110	30	97	<0.02	9.1	0.12

FRENCH STREAM, Unique_ID: W0906, Station: FS104, Mile Point: 0.001
Description: approximately 30 feet upstream of confluence with Drinkwater River, Hanover

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
10/23/01	94-0267	--	14:00	--	--	--	--	--	--	0.08	4.3	0.076

SOUTH RIVER, Unique_ID: W0921, Station: SR103, Mile Point: 10.9
Description: Temple Street (Myrtle Street) crossing, Duxbury

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/25/01	94-0148	--	08:25	30e	35e	20	48	11	22	--	--	--
08/29/01	94-0177	--	10:10	50	30	15	53	10	21	<0.02	<0.06	0.073
09/26/01	94-0217	--	08:15	120	71	33	49	9	23	<0.02	0.22	0.080
10/24/01	94-0248	--	10:30	29e	67be	--	48	10	24	<0.02	<0.06	0.058

SOUTH RIVER, Unique_ID: W0920, Station: SR102, Mile Point: 8.2
Description: upstream Route 3A (Main Street) bridge, Marshfield

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0111	--	15:05	--	--	--	--	--	--	0.19b	0.16	0.13
07/25/01	94-0127	--	07:00	140	55	460	52	10	22	<0.02	0.12	0.061
08/29/01	94-0183	--	08:33	75	45	150	48	7	22	<0.02	0.12	0.070
09/26/01	94-0204	--	08:10	130	71	230	51	8	24	<0.02	0.09	0.050
10/24/01	94-0263	--	08:48	29e	38be	--	72	11	25	<0.02	0.14	0.032

SOUTH RIVER, Unique_ID: W0919, Station: SR101, Mile Point: 2.8
Description: Julian Street/Bayberry Road bridge, Scituate/Marshfield

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0169	--	09:40	170	20	360	16200	97	5000	--	--	--
08/30/01	94-0200	--	11:30	15	<5	25	18000	100	5000	--	--	--
09/27/01	94-0232	--	11:15	29	14	90	16000	97	4500	--	--	--
10/25/01	94-0261	--	11:50	29	5	--	15000	96	##	--	--	--

GREEN HARBOR RIVER, Unique_ID: W0337, Station: GH101, Mile Point: 0.7
Description: Upstream side of Route 139 bridge, Marshfield.

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0113	--	16:00	--	--	--	--	--	--	0.11ab	<0.06a	0.13a
07/25/01	94-0153	94-0144	**	20	20	5	2400	44	770	<0.02a	<0.06a	0.17a
07/25/01	94-0144	94-0153	10:00	10	10	10	2500	45	770	<0.02a	<0.06a	0.16a
08/30/01	94-0201	--	12:00	200	120	55	1400	45	440	--	--	--
09/27/01	94-0233	--	11:45	120	71	33	1100	25	340	--	--	--
10/25/01	94-0262	--	12:20	130	17	--	2100	52	700	--	--	--

BLUEFISH RIVER, Unique_ID: W0893, Station: BR101, Mile Point: 0.8
Description: Washington Street bridge, Duxbury

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0162	--	07:30	45	30	140	17500	100	5200	--	--	--
08/30/01	94-0193	--	08:40	15	<5	10	18000	98	5100	--	--	--
09/27/01	94-0223	--	08:49	33	5	19	18000	97	5100	--	--	--
10/25/01	94-0252	--	09:15	29	10	--	14000	92	4700	--	--	--

JONES RIVER/Jones River Pond, Unique_ID: W0914, Station: JR104, Mile Point: 7.6
Description: in impoundment (locally known as Forge Pond) just upstream Old Lake Street, Kingston

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/25/01	94-0147	--	09:30	30	<5	160	74	13	25	--	--	--
08/29/01	94-0181	94-0180	**	<5	<5	10	33	18	21	<0.02	<0.06	0.086d
08/29/01	94-0180	94-0181	10:40	<5	<5	15	30	16	21	<0.02	<0.06	0.069d
09/26/01	94-0221	94-0220	**	24d	5	52	29	24	23	<0.02	##d	0.16
09/26/01	94-0220	94-0221	08:50	<5de	10e	29	31	25	23	<0.02	##d	0.18
10/24/01	94-0245	94-0243	**	<5	<5b	--	42	22	26	<0.02	<0.06	0.056
10/24/01	94-0243	94-0245	11:00	<5	<5b	--	40	21	25	<0.02	<0.06	0.053

JONES RIVER, Unique_ID: W0913, Station: JR103, Mile Point: 3.8
Description: Route 106 (Wapping Road) crossing, Kingston

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/25/01	94-0146	--	09:10	75	50	90	27	11	21	--	--	--
08/29/01	94-0179	--	11:00	130	100	75	30	10	21	<0.02	0.26	0.049
09/26/01	94-0219	--	09:18	290	180	260	24	6	22	<0.02	<0.06	0.039
10/24/01	94-0246	--	11:20	410e	480be	--	24	10	24	<0.02	0.28	0.043

JONES RIVER, Unique_ID: W0912, Station: JR102, Mile Point: 2.8
Description: impoundment upstream of Elm Street bridge, Kingston

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0096	--	09:00	--	--	--	--	--	--	<0.02b	0.16	0.085
07/25/01	94-0145	--	08:50	90	85	15	32	13	24	<0.02	0.15	0.050
08/29/01	94-0178	--	11:20	27	17	60	30	11	23	<0.02	0.27	0.058
09/26/01	94-0218	--	09:45	180	57	81	29	8	25	<0.02	0.20	0.036
10/24/01	94-0247	--	11:40	52	29b	--	29	11	25	<0.02	0.26	0.029

JONES RIVER, Unique_ID: W0911, Station: JR101, Mile Point: 2.2
Description: Route 3A (Main Street) crossing, Kingston

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/26/01	94-0164	--	08:00	240	100	1000	250	14	29	--	--	--
08/30/01	94-0195	--	09:30	80	27	980	43	16	26	--	--	--
09/27/01	94-0225	--	09:26	250	67	330	31	7	24	--	--	--
10/25/01	94-0254	--	10:00	140	43	--	30	10	25	--	--	--

Table A8. 2001 MA DEP South Coastal Watersheds Quality Control Data - Duplicates

(Data qualifiers listed in Appendix 1)

NORTH RIVER, Unique_ID: W0915, Station: NR101, Mile Point: 1.8

Description: from dock on southern shore upstream/west of Route 3A (Main Street) bridge, Marshfield

Date	OWMID	QAQC	Time	Log10 (Fecal Coliform)	Log10 (E. coli)	Log10 (Enterococcus)	Chloride	Alkalinity	Hardness
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l
07/26/01	94-0171	94-0165	**	1.477	1.176	1.477	17000	100	5300
07/26/01	94-0165	94-0171	09:22	1.740	1.000	1.740	16800	100	5300
Relative Percent Difference				*16.4%*	*16.2%*	*16.4%*	*1.2%*	*0.0%*	*0.0%*
08/30/01	94-0202	94-0199	**	1.398	0.699	0.699	18000	100	4900
08/30/01	94-0199	94-0202	11:10	1.301	0.699	0.699	18000	100	4900
Relative Percent Difference				*7.2%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
09/27/01	94-0230	94-0229	**	1.380	1.000	--	18000	97	4800
09/27/01	94-0229	94-0230	10:53	1.380	0.699	--	17000	97	4800
Relative Percent Difference				*0.0%*	*35.4%*	--	*5.7%*	*0.0%*	*0.0%*
10/25/01	94-0260	94-0258	**	0.699	0.699	--	16000	95	4700
10/25/01	94-0258	94-0260	11:20	1.633	0.699	--	16000	95	4700
Relative Percent Difference				*80.1%*	*0.0%*	--	*0.0%*	*0.0%*	*0.0%*

IRON MINE BROOK, Unique_ID: W0910, Station: IM101, Mile Point: 0.5

Description: Elm Street crossing, Hanover

Date	OWMID	QAQC	Time	NH3-N	NO3-NO2-N	TP
			(24hr)	mg/l	mg/l	mg/l
06/27/01	94-0100	94-0099	**	0.16b	0.81	0.060d
06/27/01	94-0099	94-0100	10:40	0.20b	0.80	0.045d
Relative Percent Difference				*22.2%*	*1.2%*	*28.6%*

FRENCH STREAM, Unique_ID: W0899, Station: FS103, Mile Point: 4.4

Description: North Avenue crossing, Rockland

Date	OWMID	QAQC	Time	Log10 (Fecal Coliform)	Log10 (E. coli)	Log10 (Entero-coccus)	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/25/01	94-0133	94-0135	**	2.362	2.146	2.881	48	19	39	<0.02	0.46	0.044
07/25/01	94-0135	94-0133	**	2.255	2.114	2.826	45	19	40	<0.02	0.46	0.042
Relative Percent Difference				*4.6%*	*1.5%*	*1.9%*	*6.5%*	*0.0%*	*2.5%*	*0.0%*	*0.0%*	*4.7%*
08/29/01	94-0191	94-0190	**	2.863	2.580	2.591	48	17	38	<0.02	0.48	0.043d
08/29/01	94-0190	94-0191	11:25	2.886	2.544	2.653	43	18	38	<0.02	0.47	0.057d
Relative Percent Difference				*0.8%*	*1.4%*	*2.4%*	*11.0%*	*5.7%*	*0.0%*	*0.0%*	*2.1%*	*28.0%*
09/26/01	94-0212	94-0211	**	3.301	2.732	3.255	42	13	34	<0.02	0.34	0.056
09/26/01	94-0211	94-0212	10:45	3.301	2.255	3.230	41	13	34	<0.02	0.35	0.050
Relative Percent Difference				*0.0%*	*19.1%*	*0.8%*	*2.4%*	*0.0%*	*0.0%*	*0.0%*	*2.9%*	*11.3%*
10/23/01	94-0265	94-0264	**	--	--	--	--	--	--	<0.02	0.32	0.026
10/23/01	94-0264	94-0265	14:50	--	--	--	--	--	--	<0.02	0.30	0.026
Relative Percent Difference				--	--	--	--	--	--	*0.0%*	*6.5%*	*0.0%*
10/24/01	94-0242	94-0240	**	1.978	--	--	50d	21	46	<0.02	0.25	0.027
10/24/01	94-0240	94-0242	11:30	1.851	--	--	70d	22	45	<0.02	0.25	0.027
Relative Percent Difference				*6.6%*	--	--	*33.3%*	*4.7%*	*2.2%*	*0.0%*	*0.0%*	*0.0%*

GREEN HARBOR RIVER, Unique_ID: W0337, Station: GH101, Mile Point: 0.7

Description: Upstream side of Route 139 bridge, Marshfield.

Date	OWMID	QAQC	Time	Log10(Fecal Coliform)	Log10 (E. coli)	Log10 (Entero-coccus)	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/25/01	94-0153	94-0144	**	1.301	1.301	0.699	2400	44	770	<0.02	<0.06	0.17
07/25/01	94-0144	94-0153	10:00	1.000	1.000	1.000	2500	45	770	<0.02	<0.06	0.16
Relative Percent Difference				*26.2%*	*26.2%*	*35.4%*	*4.1%*	*2.2%*	*0.0%*	*0.0%*	*0.0%*	*6.1%*

JONES RIVER/Jones River Pond, Unique_ID: W0914, Station: JR104, Mile Point: 7.6
Description: in impoundment (locally known as Forge Pond) just upstream Old Lake Street, Kingston

Date	OWMID	QAQC	Time	Log10 (Fecal Coliform)	Log10 (E. coli)	Log10 (Entero-coccus)	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
08/29/01	94-0181	94-0180	**	0.699	0.699	1.000	33	18	21	<0.02	<0.06	0.086d
08/29/01	94-0180	94-0181	10:40	0.699	0.699	1.176	30	16	21	<0.02	<0.06	0.069d
Relative Percent Difference				*0.0%*	*0.0%*	*16.2%*	*9.5%*	*11.8%*	*0.0%*	*0.0%*	*0.0%*	*21.9%*
09/26/01	94-0221	94-0220	**	1.380	0.699	1.716	29	24	23	<0.02	##d	0.16
09/26/01	94-0220	94-0221	08:50	0.699	1.000	1.462	31	25	23	<0.02	##d	0.18
Relative Percent Difference				*65.5%*	*35.4%*	*16.0%*	*6.7%*	*4.1%*	*0.0%*	*0.0%*		*11.8%*
10/24/01	94-0245	94-0243	**	0.699	0.699	--	42	22	26	<0.02	<0.06	0.056
10/24/01	94-0243	94-0245	11:00	0.699	0.699	--	40	21	25	<0.02	<0.06	0.053
Relative Percent Difference				*0.0%*	*0.0%*	--	*4.9%*	*4.7%*	*3.9%*	*0.0%*	*0.0%*	*5.5%*

Table A9. 2001 MA DEP South Coastal Watersheds Quality Control Data – Blanks (Data qualifiers listed in Appendix 1)

Date	OWMID	QAQC	Time	Fecal	E. Coli	Entero-coccus	Chloride	ALK	HARD	NH3-N	NO3-NO2-N	TP
			(24hr)	CFU/100ml	CFU/100ml	CFU/100ml	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
06/27/01	94-0101	Blank	**	--	--	--	--	--	--	0.10b	<0.06	<0.005
07/25/01	94-0134	Blank	**	<5	<5	<5	<1	<2	<0.66	<0.02	<0.06	<0.005
07/25/01	94-0152	Blank	**	<5	<5	<5	<1	<2	<0.66	<0.02	<0.06	<0.005
07/26/01	94-0170	Blank	**	<5	<5	<5	<1	<2	<0.66	--	--	--
08/29/01	94-0182	Blank	**	<5	<5	<5	<1	<2	<0.66	<0.02	<0.06	<0.005
08/29/01	94-0192	Blank	**	<5	<5	<5	<1	<2	<0.66	<0.02	<0.06	<0.005
08/30/01	94-0203	Blank	**	<5	<5	<5	<1	<2	9b	--	--	--
09/26/01	94-0213	Blank	**	<5	<5	<5	<1	<2	<0.66	<0.02	0.07	<0.005
09/26/01	94-0222	Blank	**	<5	<5	<5	<1	<2	<0.66	<0.02	<0.06	<0.005
09/27/01	94-0231	Blank	**	<5	<5	<5	<1	<2	<0.66	--	--	--
10/23/01	94-0266	Blank	**	--	--	--	--	--	--	<0.02	<0.06	<0.005
10/24/01	94-0241	Blank	**	<5	<5b	--	<1	<2	<0.66	<0.02	<0.06	<0.005
10/24/01	94-0244	Blank	**	<5	<5b	--	<1	<2	<0.66	<0.02	<0.06	<0.005
10/25/01	94-0259	Blank	**	<5	<5	--	<1	<2	<0.66	--	--	--

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Appendix 1

Quality Assurance/Quality Control Data Validation For The South Coastal Watersheds 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:
Accepted
Accepted with qualification, or
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 $\leq$ 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 – A field audit was performed by DWM's QC Analyst on September 26, 2001 (see Appendix 2). The following five aspects of the survey were rated to assess the overall performance of the crew;1. survey organization, planning and preparation, 2. safety, 3. sampling technique, 4. Hydrolab use, and 5. field sheets, note-taking and chain-of-custody. The crew's performance was rated as 1. good, 2. good, 3. excellent, 4. fair, and 5. excellent, respectively. No data were qualified or censored due to inadequacies detected during the audit.

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. 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) **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.
2) **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.
3) **Flow Surveys**: Streamflow measurement survey work was performed in French Stream in Hanover and at the Rockland WWTP discharge channel in the fall of 2001. These data were not evaluated due to insufficient information.

5.5 2001 Censored/Qualified Discrete Water Sample Data

All Year 2001 data **(South Coastal Watersheds only)** for discrete water samples that have been censored or qualified are listed below, except for missing data. Additional sample information is also provided as needed for accepted data in need of further elaboration/ discussion. Data symbols and qualifiers are presented below the table.

Projname	Analyte	DATE	OWMID	LabSNum	rResVal	DWMQual	Units
South Coastal (2001)	Fecal Coliforms	7/25/2001	94-0130	2001299-04	65	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	7/25/2001	94-0148	2001299-15	30	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	7/25/2001	94-0149	2001299-16	37	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	7/26/2001	94-0163	2001305-02	1000	**ej**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	8/29/2001	94-0189	2001407-16	430	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	9/26/2001	94-0220	2001485-07	<5	**de**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	9/26/2001	94-0221	2001485-08	24	**d**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/24/2001	94-0234	2001532-02	55	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/24/2001	94-0240	2001532-08	71	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/24/2001	94-0246	2001532-14	410	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/24/2001	94-0248	2001532-16	29	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/24/2001	94-0250	2001532-18	7	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/24/2001	94-0263	2001532-01	29	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/25/2001	94-0255	2001535-04	62	**e**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/25/2001	94-0258	2001535-07	43	**d**	CFU/100mL
South Coastal (2001)	Fecal Coliforms	10/25/2001	94-0260	2001535-09	5	**d**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	7/25/2001	94-0130	2001299-04	80	**e**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	7/25/2001	94-0148	2001299-15	35	**e**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	7/25/2001	94-0149	2001299-16	45	**e**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	7/26/2001	94-0163	2001305-02	5000	**e**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	8/29/2001	94-0189	2001407-16	440	**e**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	9/26/2001	94-0211	2001485-17	180	**d**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	9/26/2001	94-0212	2001485-18	540	**d**	CFU/100mL

Projname	Analyte	DATE	OWMID	LabSNum	rResVal	DWMQual	Units
South Coastal (2001)	E. coli - MTEC	9/26/2001	94-0220	2001485-07	10	**e**	CFU/100mL
South Coastal (2001)	E. coli - MTEC	10/25/2001	94-0255	2001535-04	90	**e**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0234	2001532-02	69	**be**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0235	2001532-03	610	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0236	2001532-04	130	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0237	2001532-05	62	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0238	2001532-06	90	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0239	2001532-07	180	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0240	2001532-08	81	**be**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0241	2001532-09	<5	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0242	2001532-10	95	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0243	2001532-11	<5	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0244	2001532-12	<5	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0245	2001532-13	<5	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0246	2001532-14	480	**be**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0247	2001532-15	29	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0248	2001532-16	67	**be**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0249	2001532-17	48	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0250	2001532-18	24	**be**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0251	2001532-19	5	**b**	CFU/100mL
South Coastal (2001)	E. coli	10/24/2001	94-0263	2001532-01	38	**be**	CFU/100mL
South Coastal (2001)	Enterococci	9/27/2001	94-0229	2001493-07	##	**d**	CFU/100mL
South Coastal (2001)	Enterococci	9/27/2001	94-0230	2001493-08	##	**d**	CFU/100mL
South Coastal (2001)	Chloride	10/24/2001	94-0240	2001533-27	70	**d**	mg/l
South Coastal (2001)	Chloride	10/24/2001	94-0242	2001533-29	50	**d**	mg/l
South Coastal (2001)	Hardness	8/30/2001	94-0203	2001416-11	9	**b**	mg/l
South Coastal (2001)	Hardness	8/30/2001	94-0261		##	**m**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0096	2001234-01	<0.02	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0099	2001234-02	0.20	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0100	2001234-03	0.16	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0101	2001234-04	0.10	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0102	2001234-05	0.32	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0103	2001234-06	0.15	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0104	2001234-07	0.18	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0105	2001234-08	0.18	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0106	2001234-09	0.13	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0107	2001234-10	0.10	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0108	2001234-11	0.09	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0109	2001234-12	0.10	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0110	2001234-13	0.07	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0111	2001234-14	0.19	**b**	mg/l
South Coastal (2001)	Ammonia-N	6/27/2001	94-0113	2001234-15	0.11	**ab**	mg/l
South Coastal (2001)	Ammonia-N	7/25/01	94-0144		<0.02	**a**	mg/l
South Coastal (2001)	Ammonia-N	7/25/01	94-0153		<0.02	**a**	mg/l
South Coastal (2001)	Nitrate/Nitrite-N	9/26/2001	94-0220	2001486-26	##	**d**	mg/l
South Coastal (2001)	Nitrate/Nitrite-N	9/26/2001	94-0221	2001486-27	##	**d**	mg/l
South Coastal (2001)	Nitrate/Nitrite-N	10/24/2001	94-0250	2001533-18	0.07	**b**	mg/l
South Coastal (2001)	Nitrate/Nitrite-N	6/27/2001	94-0113		<0.06	**a**	mg/l
South Coastal (2001)	Nitrate/Nitrite-N	7/25/01	94-0144		<0.06	**a**	mg/l
South Coastal (2001)	Nitrate/Nitrite-N	7/25/01	94-0153		<0.06	**a**	mg/l
South Coastal (2001)	Total Phosphorus	6/27/2001	94-0099	2001234-02	0.045	**d**	mg/l
South Coastal (2001)	Total Phosphorus	6/27/2001	94-0100	2001234-03	0.060	**d**	mg/l
South Coastal (2001)	Total Phosphorus	8/29/2001	94-0180	2001408-26	0.069	**d**	mg/l

Projname	Analyte	DATE	OWMID	LabSNum	rResVal	DWMQual	Units
South Coastal (2001)	Total Phosphorus	8/29/2001	94-0181	2001408-27	0.086	**d**	mg/l
South Coastal (2001)	Total Phosphorus	8/29/2001	94-0190	2001408-36	0.057	**d**	mg/l
South Coastal (2001)	Total Phosphorus	8/29/2001	94-0191	2001408-37	0.043	**d**	mg/l
South Coastal (2001)	Total Phosphorus	9/26/2001	94-0209	2001486-33	0.13	**h**	mg/l
South Coastal (2001)	Total Phosphorus	6/27/2001	94-0113		0.13	**a**	mg/l
South Coastal (2001)	Total Phosphorus	7/25/01	94-0144		0.16	**a**	mg/l
South Coastal (2001)	Total Phosphorus	7/25/01	94-0153		0.17	**a**	mg/l

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:

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.)

" 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.
" **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 2

Field Audit Results

Basin: South Coastal

Audit Date: September 26, 2001

Survey Coordinator (and assistants): Greg Decesare (Molly Weinstein, Stella Kiras)

Survey Type: Bacteria, "nutrient", "chemistry" and Hydrolab (daytime)

Auditor: Richard Chase, DWM QA/QC

# of stations audited: 4

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1. **Survey organization, planning and preparation**:

ف Excellent
ف Good ◄
ف Fair
ف Poor

Specific observations: Good trip preparation and efficient use of time at each site. Survey was performed following a pre-dawn Hydrolab survey. Crew re-grouped at central location to prepare for the daytime survey, which began at 8 am.

The selection of the Forge Pond outlet location (immediately "upstream" of the dam structure) as being representative of ambient stream conditions under a range of flow conditions was questionable. Mid-late summer samples at this location when there was little or no flow over the dam were essentially pond samples. All other stations and specific sampling locations visited were representative of ambient water quality conditions.

2. **Safety**

ف Excellent
ف Good ◄
ف Fair
ف Poor

Specific observations: Safety items (field kit, first aid kit) were included in survey equipment brought; crew members were careful crossing streets, entering stations and in/out of water; no risks taken. Given the number of stations where the vehicle was parked on the sidewalk or in the street (blocking lane with flashers on), all survey crew members should have been wearing orange/red safety vests.

3. **Sampling technique**

ڤ Excellent◄
ڤ Good
ڤ Fair
ڤ Poor

Specific observations: Sampling technique followed current DWM SOP. All samples were taken in representative locations. Duplicate samples were taken as co-located, simultaneous duplicates using two samplers side-by-side. Basket sampler was used once, and used correctly.

4. **Hydrolab use**

ڤ Excellent
ڤ Good
ڤ Fair◄
ڤ Poor

Specific observations: Hydrolab operation was consistent with DWM SOPs. Care for the unit, however, may have been compromised by removing the surveyor and sonde from the protective case at each station and carrying it to a specific location for use. Although care was taken, transport of the unit for any distance without the carrying case is inconsistent with DWM SOPs.

Due to relatively low velocities, Hydrolab anchor rope was not used at any of the bridge drop locations (OK). Initial depth calibration was checked at the first station (OK).

5. **Field Sheets, note-taking and chain-of-custody**

ڤ Excellent◄
ڤ Good
ڤ Fair
ڤ Poor

Specific observations: Field sheets were filled out as accurately as possible and with attention to detail; appropriate time was taken to note field conditions in order to complete field sheet correctly. COC sheets for samples were filled out accurately and completely.

Recommendation(s) for Improvement:

ڤ None (excellent performance)

ڤ None (good performance), but send memorandum to DWM staff to clarify issue(s) brought up during audit◄

Issue(s) needing clarification within DWM:

1. Provide and wear safety vests at all times where surveys involve temporary lane blockages and sidewalk parking (for all crew members).

2. Use Hydrolab carrying case at all times. In order to protect these sensitive and expensive instruments, do not remove surveyor/sonde and manually carry to monitoring locations. Any damage to these units affects not only the present survey, but also those planning to use that unit in the future.

3. In selecting site locations, carefully consider the range of flow conditions likely to be observed at each proposed station. If, for example, the intention is to collect data that is representative of tributary stream conditions, choose an in-stream location that will likely continue to have flow in late summer (impoundments usually exhibit artificial drawdown or natural lowering of water level, causing dam overflows to cease).

ڤ Meet with survey coordinator/crew after the survey has been completed to discuss specific issues and/or problems with the survey (fair performance)

Issue(s) that need to be addressed by survey crew: NA

ڤ Schedule re-training for survey crew (poor performance)

Topic(s) of re-training: NA

APPENDIX B

MA DEP DWM 1996 WATER QUALITY MONITORING DATA
SOUTH SHORE COASTAL WATERSHEDS

Water quality sampling in the South Shore Coastal Watersheds was conducted by MA DEP DWM in July and August 1996. The sampling plan was designed by the South Coastal Watershed team to address three areas described below:

1) The Eel River system - anticipated augmentation in flow and possibly nutrient enrichment expected resulting from the siting of the new Plymouth Wastewater Treatment Plant groundwater discharge adjacent to the upper portion of the river. Six stations were established ranging from the headwater area to the lower reach in order to establish "background" conditions and assess existing conditions prior to the new groundwater discharge. Dissolved oxygen, temperature, conductivity and salinity were measured and bacteria samples were collected.

2) The Green Harbor River and marsh area upstream of the flow control structure at the Route 139 dike in Marshfield suffers from restricted incoming tidal flows, excessive macrophyte and algal growth and fish kills. A single sampling station (GH01) directly upstream from the dike was established and monitored for dissolved oxygen, temperature, conductivity and salinity. Bacteria samples were also collected.

3) At the request of MA DEP's, Division of Water Supply, four stations on Furnace Brook were sampled for nitrates. These data were to be used to support the Zone II, Nitrogen Loading Computer Model application of Marshfield's Furnace Brook well.

In-situ measurements of dissolved oxygen, temperature, conductivity and salinity were taken nine times: 6 July 1996 (pre-dawn, mid-day and dusk), 23 July 1996 (pre-dawn and mid-day), 6 August 1996 (pre-dawn and mid-day), and 29 August 1996 (pre-dawn and mid-day). Bacteria samples were collected during each pre-dawn run only. Nitrate samples were collected from Furnace Brook on 29 August 1996.

MATERIALS AND METHODS

Procedures used for sampling technique and sample handling are outlined in the MA DEP document, *Basins Program Standard Operating Procedures River and Stream Monitoring* (MA DEP 1990). The Wall Experiment Station (WES), the Department's analytical laboratory, supplied bottles and field preservatives for all sampling, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures* (MA DEP 1995). Samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to the WES standard operating procedures. Quality control samples included field blanks and field replicates. Water temperature, salinity, and conductivity measurements were made *in situ* at each station using a precalibrated YSI Model 33 S-C-T meter. Oxygen readings were made *in situ* using a precalibrated YSI Model 54A oxygen meter.

QUALITY ASSURANCE AND QUALITY CONTROL

In general, monitoring surveys in the South Shore Coastal Watersheds in 1996 were performed with attention to maintaining quality assurance and control of field samples and field-generated data. Field monitoring activities followed accepted DWM standard operating procedures (MA DEP 1990). Where strict procedures were not in place or necessary, it is assumed that DWM field staff exercised best professional judgment.

The water quality sample data were validated by reviewing QC sample results, analytical holding time compliance, QC sample frequency and related ancillary data/documentation (at a minimum). Data not meeting general data quality objectives of DWM were censored (no data were qualified). Data validation for the 1996 DWM water quality survey is available in a MA DEP Memorandum - *1994, 95 & 96 QA/QC Assessment Report* (MA DEP 2000). Specific decisions pertaining to the South Shore Coastal Watersheds data were excerpted from this memorandum and appear in Table B1. All YSI® probe data were validated to the extent possible using multi-staff review. Data symbols (e.g., "i" = potentially inaccurate) were applied to YSI® data as necessary (see Table B2).

Table B1. 1996 DWM Data Decisions for South Coastal Watershed Discrete Sample Data.

OWMID	Qualifier
94-0075/76 *94-0053/54*	Replicate results are at or below the ideal counting range of 20 CFU for Fecal Coliform analysis.

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

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

RESULTS
In-situ YSI® data (YSI-33/51B/54A) from the 1996 South Shore Coastal Watersheds monitoring surveys are presented in Table B2. Nitrate and fecal coliform bacteria data are presented in Table B3.

The nitrate levels in the Furnace Brook samples were consistent with the predicted values established by the Nitrogen Loading Computer Model. The model had made certain assumptions relative to the levels expected in the system and these data were important in determining the level of confidence expected from the model.

Table B2. In-situ YSI® data (YSI-33/51B/54A).

GREEN HARBOR RIVER (Saris: 9457275), Unique_ID[2]: W0337, Station: GH01
Description: Upstream side of Route 139 bridge, Marshfield.

Date	OWMID[1]	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/09/1996	94-0001	03:00	23.0is	6.0is	** is	7,700is
07/09/1996	94-0011	12:00	23.0is	7.0is	5is	7,900is
07/09/1996	94-0021	19:00	25.0is	8.5is	10is	9,500is
07/23/1996	94-0027	03:15	20.0is	10.5is	2is	4,500is
07/23/1996	94-0040	12:00	19.5is	10.2is	3is	4,800is
08/06/1996	94-0047	03:00	22.0is	10.8is	1is	2,700is
08/06/1996	94-0060	12:00	23.0is	10.5is	1is	3,050is
08/29/1996	94-0070	03:45	19.5is	6.8is	3is	4,950is
08/29/1996	94-0090	12:00	21.0is	7.2is	3is	4,500is

Unnamed Tributary to Eel River, Unique_ID: W0332, Station: ER04
Description:. Sandwich Road bridge between Forge Pond and Howland Pond, Plymouth.

Date	OWMID	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/09/1996	94-0007	04:30	19.0is	7.0is	0is	72is
07/09/1996	94-0015	13:10	20.5is	8.0is	0is	75is
07/09/1996	94-0025	20:00	21.0is	7.3is	0is	77is
07/23/1996	94-0031	04:35	16.7is	8.1is	0is	68is
07/23/1996	94-0044	12:58	17.0is	8.7is	0is	68is
08/06/1996	94-0051	04:15	18.0is	8.8is	0is	70is
08/06/1996	94-0064	12:50	19.0is	9.2is	0is	82is
08/29/1996	94-0073	04:20	18.5is	7.8is	0is	70is
08/29/1996	94-0093	12:35	21.0is	8.5is	0is	70is

Unnamed Tributary to Eel River, Unique_ID: W0333, Station: ER04A
Description: outlet Howland Pond, Clifford Road, Plymouth.

Date	OWMID	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/23/1996	94-0032	04:45	17.9is	6.8is	0is	70is
07/23/1996	94-0045	13:07	17.0is	7.5is	0is	69is
08/06/1996	94-0052	04:25	19.0is	7.5is	0is	75is
08/06/1996	94-0065	12:59	21.5is	6.8is	0is	85is
08/29/1996	94-0074	05:00	19.0is	5.9is	0is	70is
08/29/1996	94-0094	12:45	22.5is	7.8is	0is	70is

EEL RIVER (Saris: 9458000), Unique_ID: W0338, Station: ER01
Description: Plymouth. Upstream Russell Millpond, at outlet cranberry bog east of Long Pond Road, Plymouth

Date	OWMID	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/09/1996	94-0002	03:40	14.0is	6.5is	0is	70is
07/09/1996	94-0012	12:25	15.0is	12.9is	0is	71is
07/09/1996	94-0022	19:25	17.0is	11.9is	0is	75is
07/23/1996	94-0028	03:55	9.0is	7.1is	0is	58is
07/23/1996	94-0041	12:39	13.0is	11.4is	0is	32is
08/06/1996	94-0048	03:40	13.0is	6.8is	0is	65is
08/06/1996	94-0061	12:25	15.0is	12.8is	0is	65is
08/29/1996	94-0071	04:00	14.5is	5.0is	0is	60is
08/29/1996	94-0091	12:20	17.0is	12.5is	0is	60is

[1] OWMID = sample tracking number, [2] Unique ID = unique station identification number.
i = potentially inaccurate data due to lack of calibration records
s = field sheet recorded data were used to accept data.

Table B2 continued. In-situ YSI® data (YSI-33/51B/54A).

EEL RIVER (Saris: 9458000), Unique_ID[2]: W0339, Station: ER02
Description: Russell Mills Road, Plymouth.

Date	OWMID[1]	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/09/1996	94-0003	04:00	20.0is	8.5is	0is	70is
07/09/1996	94-0013	12:45	20.5is	8.5is	0is	75is
07/09/1996	94-0023	19:40	21.5is	8.2is	0is	75is
07/23/1996	94-0029	04:15	18.0is	9.0is	0is	65is
07/23/1996	94-0042	12:45	18.5is	9.4is	0is	68is
08/06/1996	94-0049	03:50	19.5is	8.5is	0is	70is
08/06/1996	94-0062	12:35	21.0is	9.7is	0is	70is

EEL RIVER (Saris: 9458000), Unique_ID: W0340, Station: ER03
Description: Sandwich Road bridge, Plymouth.

Date	OWMID	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/09/1996	94-0006	04:15	20.0is	7.9is	0is	75is
07/09/1996	94-0014	12:55	20.0is	8.4is	0is	80is
07/09/1996	94-0024	19:50	22.0is	8.3is	0is	85is
07/23/1996	94-0030	04:25	17.0is	8.9is	0is	75is
07/23/1996	94-0043	12:54	17.0is	8.8is	0is	72is
08/06/1996	94-0050	04:00	19.0is	8.9is	0is	75is
08/06/1996	94-0063	12:45	21.0is	9.0is	0is	80is
08/29/1996	94-0072	04:15	18.0is	8.2is	0is	75is
08/29/1996	94-0092	12:25	22.0is	9.2is	0is	75is

EEL RIVER (Saris: 9458000), Unique_ID: W0341, Station: ER05
Description: River Street bridge, Plymouth.

Date	OWMID	Time (24hr)	Temp (C)	DO (mg/l)	Salinity (ppt)	Conductivity (un-compensated) (µmhos/cm)
07/09/1996	94-0008	04:40	20.5is	7.0is	0is	90is
07/09/1996	94-0016	13:20	21.0is	7.3is	0is	85is
07/09/1996	94-0026	20:20	23.0is	8.8is	0is	90is
07/23/1996	94-0033	05:00	19.0is	7.8is	0is	83is
07/23/1996	94-0046	13:15	17.5is	7.4is	0is	80is
08/06/1996	94-0053	04:30	20.0is	7.6is	0is	85is
08/06/1996	94-0066	13:10	21.0is	7.0is	0is	85is
08/29/1996	94-0075	05:10	19.5is	7.3is	0is	80is
08/29/1996	94-0095	13:00	23.0is	7.6is	0is	80is

[1] OWMID = sample tracking number,
[2] Unique ID = unique station identification number.
i = potentially inaccurate data due to lack of calibration records
s = field sheet recorded data were used to accept data.

Table B3. 1996 South Coastal Watershed Bacteria and Water Chemistry Data.

OWMID[1]	QA/QC	Date	Time	Fecal Coliform Bacteria (colonies/100mL)	NO3-NO2-N (mg/L)
FURNACE POND, Unique ID[2]: W0331, Station: FB04, Description: Stream in center of dry pond bed, Marshfield.					
94-0081	94-0083	08/29/96	6:40	--	0.96
94-0083	94-0081	08/29/96	6:40	--	1.0
FURNACE BROOK, Unique ID: W0334, Station: FB01, Description: School Street, Marshfield.					
94-0078		08/29/96	6:00	--	0.17
FURNACE BROOK, Unique ID: W0335, Station: FB02, Description: Pumping station access road, Marshfield. (Access road 1/3 mile south of School Street/Main Street intersection.)					
94-0079		08/29/96	6:10	--	0.61
FURNACE BROOK, Unique ID: W0336, Station: FB03, Description: Furnace Street, Marshfield.					
94-0080		08/29/96	6:20	--	1.0
GREEN HARBOR RIVER, Unique ID: W0337, Station: GH01, Description: Upstream side of Route 139 bridge, Marshfield.					
94-0001		07/09/96	3:00	100	--
94-0027		07/23/96	3:15	40	--
94-0047		08/06/96	3:00	<20	--
94-0070		08/29/96	3:45	180	--
Unnamed Tributary to Eel River, Unique ID: W0332, Station: ER04, Description: Sandwich Road bridge between Forge Pond and Howland Pond, Plymouth.					
94-0007		07/09/96	4:30	140	--
94-0031		07/23/96	4:35	<10	--
94-0051		08/06/96	4:15	20	--
94-0073		08/29/96	4:20	40	--
EEL RIVER, Unique ID: W0338, Station: ER01, Description: Upstream Russell Millpond, at outlet cranberry bog east of Long Pond Road, Plymouth					
94-0002		07/09/96	3:40	80	--
94-0028		07/23/96	3:55	70	--
94-0048		08/06/96	3:40	50	--
94-0071		08/29/96	4:00	10	--
EEL RIVER, Unique ID: W0339, Station: ER02, Description: Russell Mills Road, Plymouth.					
94-0003	94-0004	07/09/96	4:00	<20	--
94-0004	94-0003	07/09/96	4:00	<20	--
94-0029		07/23/96	4:15	<10	--
94-0049		08/06/96	3:50	20	--
EEL RIVER, Unique ID: W0340, Station: ER03, Description: Sandwich Road bridge, Plymouth.					
94-0006		07/09/96	4:15	100	--
94-0030		07/23/96	4:25	40	--
94-0050		08/06/96	4:00	<20	--
94-0072		08/29/96	4:15	20	--
EEL RIVER, Unique ID: W0341, Station: ER05, Description: River Street bridge, Plymouth.					
94-0008		07/09/96	4:40	40	--
94-0033	94-0034	07/23/96	5:00	50	--
94-0034	94-0033	07/23/96	5:00	100	--
94-0053	94-0054	08/06/96	4:30	40	--
94-0054	94-0053	08/06/96	4:30	20	--
94-0075	94-0076	08/29/96	5:10	20	--
94-0076	94-0075	08/29/96	5:10	40	--

[1] OWMID = sample tracking number,
[2] Unique ID = unique station identification number.
-- = no data

REFERENCES

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APPENDIX C
DWM 1996 AND 2001 LAKE SURVEY DATA FOR THE SOUTH SHORE COASTAL WATERSHED

1996

Synoptic surveys were conducted by DWM at 76 (plus Musquashcut Pond) lakes, ponds, or reservoirs in the South Coastal Watershed during the summer of 1996 to assess general lake conditions, aquatic vegetation cover, access, trophic status and presence of non-native vegetation (Table C1). 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 surface 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 surface 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 back at the DWM 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 meters (the MDPH bathing beach guidance). 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. 1996 South Coastal Watershed Summer lake observations and trophic status estimates.

Lake Name, Location Waterbody Identification Code	Trophic Status Estimate	Survey Observations
Arnold School Pond, Pembroke MA94004	U	Slight yellow stain; sandy bottom covered with decaying organic matter; moderate plant cover
Bartlett Pond, Plymouth (Manomet) MA94005	U	Slightly brown turbidity; emergent plant encroachment frequent (about 20 ft. from shore), moderate plant cover
Beaver Dam Pond, Plymouth MA94006	U	Slight green stain; sandy bottom; sparse plant cover; non-native aquatic species (**Cc**)
Billington Sea, Plymouth MA94007	E	Moderate green/yellow turbidity; (< 1.2 m Secchi disk estimate); sand/gravel bottom; sparse plant cover
Black Jimmy Pond (Hyle's Pond), Plymouth MA94008	U	Slight turbidity; algal blooms at swimming area; sandy bottom with debris; moderate plant cover
Black Mt. Pond, Marshfield MA94009	E	Tea stained; very dense cover of floating leaf and submergent plants over entire surface; non-native aquatic species (**Mh**)
Bloody Pond, Plymouth MA94015	U	Clear; very slight yellow/gray turbidity; some decaying debris in patches on sandy bottom; sparse plant cover
Boot Pond, Plymouth MA94016	U	Clear; slight turbidity; areas of algae blooms (green and blue- green); sandy bottom; sparse plant cover
Bound Brook Pond, Norwell MA94017	E	Dark tea stain; (< 1.2 m SD, est.); sand/ gravel bottom; white foam at outlet; strong H_2S smell at outlet; very dense cover over 90% of the pond
Briggs Reservoir, Plymouth MA94019	E	Moderate brownish green turbidity (> 1.2 m Secchi disk estimate.); plant cover over 75-100% of the surface; non-native aquatic species (**Cc**)
Briggs Reservoir, Plymouth MA94020	E	Slight yellow stain; sandy bottom with decaying matter abundant; dense aquatic plants; non-native aquatic species (**Cc**)
Cooks Pond, Plymouth MA94027	E	Clear; much decaying organic matter on bottom; fairly clear water; dense aquatic plant cover; non-native aquatic species (**Cc**)
Crossman Pond, Kingston MA94032	E	Bubbly green algal mats on top; moderate brown turbidity; very dense cover over entire pond

Table C1 continued. 1996 South Coastal Watershed Summer lake observations and trophic status estimates.

Lake Name, Location Waterbody Identification Code	Trophic Status Estimate	Survey Observations
Elbow Pond, Plymouth MA94035	U	Clear; sand/gravel bottom; sparse plant cover (< 10% of surface affected)
Factory Pond, Hanover/Hanson MA94175	U	Moderate tea stain; slight turbidity; sand/gravel bottom, organic sediments black indicating anoxic conditions; sparse plant cover; non-native wetland species (**Ls**)
Forge Pond, Plymouth MA94036	U	Slight yellow/brown turbidity; sandy bottom; pond level slightly low; moderate plant cover.
Forge Pond, Hanover MA94037	E	Tea stained; brown turbidity (<1.2 m Secchi disk estimate); moderate algae blooms and filamentous green algae; sand, gravel, rock bottom; dense plant cover over 50-75% of the pond; non-native aquatic and wetland species (**Cc, Ls, Pc**)
Foundry Pond, Kingston MA94038	U	Heavy brown turbidity (< 1.2 m Secchi disk estimate); sparse aquatic plant cover; non-native wetland species (**Pa**)
Fresh Pond, Plymouth MA94040	U	Slight turbidity; some algal blooms; rock/sand bottom; sparse aquatic plant cover
Furnace Pond, Pembroke MA94043	U	Moderate green/brown turbidity; sand/gravel/cobble bottom; sparse aquatic plant cover; non-native wetland species (**Ls**)
Governor Winslow House Pond (Long Tom's Pond), Marshfield MA94047	E	Tea stained; no turbidity; dense emergent and floating leaf plant cover affecting about two thirds of the pond
Great Herring Pond, Plymouth/Bourne MA94050	U	Clear; some very small algal mats; sandy bottom; sparse aquatic plant cover (<10% of surface affected)
Great Sandy Bottom Pond, Pembroke MA94053	U	Moderate brown turbidity; much decaying debris on bottom; water level low (~4 ft.); sparse aquatic plants cover (~25); non-native wetland species (**Pa**)
Great South Pond, Plymouth MA94054	U	Very clear; sandy bottom; very sparse aquatic plant cover
Gunners Exchange Pond, Plymouth MA94055	U	Slight yellow stain; sandy bottom; sparse aquatic plant cover over entire pond, some moderate patches of floating leaf plants at the north end
Harrobs Corner Bog Pond, Plympton MA94061	E	Tea stained; very dense aquatic plant cover over about 80% of the pond
Hedges Pond, Plymouth MA94065	U	Clear; sandy bottom; sparse surface plant cover throughout pond
Hobomock Pond, Pembroke MA94177	U	Very clear; sandy bottom covered mostly with organic debris; slight (green) algal mats on bottom; sparse plant cover
Hoyts Pond, Plymouth MA94070	U	Very clear; sandy bottom; moderate plant cover
Indian Head Pond, Hanson MA94071	U	Cloudy turbidity; sheens on surface in some areas; sandy bottom; sparse surface plant cover
Indian Pond, Kingston/ Plympton MA94072	E	Slight yellow stain; some algae on bottom; very dense plant cover over the entire pond
Island Creek Pond, Duxbury MA94073	E	Tea stain and brown turbidity at beach, milky turbidity in other areas; dense submergent plant cover over entire pond; emergent plants encroaching around shore; non-native aquatic species (**Cc**)
Island Pond, Plymouth MA94074	U	Clear; some debris on sandy bottom; sparse surface plant cover throughout pond
Island Pond, Plymouth MA94075	U	Very clear; sandy bottom; sparse surface plant cover overall but northeast cove has moderate plant cover; non-native aquatic species (**Cc**)
Island Pond, Plymouth MA94076	U	Fairly clear; very dense low-growing submergent plant cover, floating leaf plants cover < 10% of surface

Table C1 continued. 1996 South Coastal Watershed Summer lake observations and trophic status estimates.

Lake Name, Location Waterbody Identification Code	Trophic Status Estimate	Survey Observations
Jacobs Pond, Norwell MA94077	E	Slight tea stain; some floating, bubbly green algal blooms; gravel, sand, rock bottom with moderate algae on rocks; very dense floating leaf plants cover about 30% of the pond, submergent plants very dense throughout; non-native aquatic and wetland species (**Cc, Ls, Mh**)
Keene Pond, Duxbury MA94079	E	Moderate tea stain; sand/rock bottom; dense cover of aquatic plants overall
Little Herring Pond, Plymouth MA94082	U	No stain; slight green/gray turbidity; sparse to moderate surface plant cover
Little Pond, Plymouth MA94182	U	Slight yellow/green stain; very sparse surface plant cover over entire pond
Little Sandy Bottom Pond, Pembroke MA94085	U	Slight yellow/green stain; sand bottom with some areas of decomposing matter; sparse surface plant cover throughout the pond
Little South Pond, Plymouth MA94087	U	Very clear; sand bottom; very sparse surface plant cover throughout the pond
Long Island Pond, Plymouth MA94088	U	Slight milky turbidity; bottom mostly decaying leaf litter; sparse surface plant cover throughout the pond; non-native aquatic species (**Cc, Mh**)
Loring Bogs Pond, Duxbury MA94089	E	Slight gray/milky turbidity; surface sheen in some areas; much decaying plant matter on bottom; very dense plant cover over entire pond; non-native aquatic species (**Mh**)
Lout Pond, Plymouth MA94090	U	Slight yellow stain; sandy bottom; sparse surface plant cover throughout the pond
Lower Chandlers Pond, Duxbury/ Pembroke MA94091	E	Tea stained; some turbidity; surface algal blooms; much decaying matter over sandy bottom; very dense submergent plant cover to the surface throughout the pond; non-native aquatic and wetland species (**Cc, Ls**)
Maquan Pond, Hanson MA94096	U	Clear; sandy bottom; very sparse surface plant cover throughout the pond
Mill Pond, Duxbury MA94101	E	Tea stain; slight turbidity; sand bottom with much organic matter; moderate cover of emergent plants encroaching (about 10% of pond area affected), floating leaf plants cover about 50% of the pond surface
Morey Hole Pond, Plymouth MA94102	U	Clear; some algal blooms; soft sand and mud bottom; spare surface plant cover throughout the pond
Musquashcut Pond, Scituate (now reported as an estuarine waterbody segment MA94-33) MA94105	E	Heavy red/green/brown algae covers almost the entire pond; emergent plants cover about 20% of the shore; non-native wetland species (**Ls, Pa**)
North Hill Marsh Pond, Duxbury MA94109	E	Slight tea stain; moderate plant cover throughout much of the pond; 25% of pond is dominated by emergent plants and shrubs; **M. spp**. suspected
North Triangle Pond, Plymouth MA94110	E	Slight tea stain; slight turbidity; green algae blooms near storm drain; very dense floating leaf plant cover over 90% of the pond
Old Oaken Bucket Pond, Scituate MA94113	E	Tea stained; slight turbidity (< 1.2 m Secchi disk estimate); sheens over black muck on bottom; dense emergent plants encroaching and floating leaf plants cover about 20% of the pond; non-native wetland species (**Ls**)
Oldham Pond, Pembroke/Hanson MA94114	U	Slight turbidity; sparse surface plant cover throughout the pond; non-native wetland species (**Ls**)
Pembroke Street South Pond, Kingston MA94117	E	Tea stained; white foam on surface; very dense floating leaf and submergent plants cover about 80% of the pond; non-native aquatic species (**Cc**)

Table C1 continued. 1996 South Coastal Watershed Summer lake observations and trophic status estimates.

Lake Name, Location Waterbody Identification Code	Trophic Status Estimate	Survey Observations
Pine Lake, Duxbury MA94120	E	No water quality observations; pond almost entirely covered with very dense emergent and floating leaf plants; islands and stumps emerging
Pine Street Pond, Duxbury MA94121	E	No water quality observations; about 75% covered by very dense floating leaf plants
Reeds Millpond, Kingston MA94126	E	Tea stained; very dense floating leaf and submergent plants cover more than 50% of the pond; non-native aquatic species (**Cc**)
Reservoir, Pembroke MA94127	U	Dike blown out; mostly terrestrials with a few stands of emergents
Round Pond, Duxbury MA94131	U	Moderate tea stain; sparse surface plant cover throughout the pond
Russell Millpond (Russell Pond), Plymouth MA94132	E	Moderate gray/yellow/brown turbidity; surface scum in areas; algal blooms (green and blue-green clumps); dense plant cover throughout the pond; non-native wetland species (**Ls**)
Russell Pond, Kingston MA94133	E	Fairly clear; large algal mats in clumps under the surface; sand bottom; dense plant cover; non-native wetland species (**Ls)**
Savery Pond, Plymouth MA94136	U	Slight green/brown turbidity; some algal blooms at beach; much decomposing plants causing brown floc on bottom near shore; moderate plant cover throughout the pond
Shallow Pond, Plymouth MA94140	E	No water quality observations; very dense floating leaf plants cover about 50% of the pond; moderate cover of emergents encroaching around the margins
Ship Pond, Plymouth MA94142	E	Tea stained; moderate turbidity; oil-like sheen in places; sulphur smell and blackish sediment pulled from the bottom; non-native wetland plants (**Ls, Pa**) around the pond (affecting about 75%)
Silver Lake, Kingston/Pembroke/Plympton/ MA94143	U	Very slight tea stain; sandy bottom with rocks; sparse surface plant cover throughout the pond
Smelt Pond, Kingston MA94184	E	Slight brown turbidity; small patches of blue-green clumps; sand bottom; dense plant cover over about 50% of the pond; non-native aquatic species (**Mh**)
South River Pond, Duxbury MA94148	E	Fairly clear; some algae blooms and blue- green mat on sand bottom; dense floating leaf and submergent plant cover throughout the pond
South Triangle Pond, Plymouth MA94149	E	Clear; some areas of decaying organic matter on sandy bottom; dense plant cover throughout the pond; possible non-native aquatic species (**M sp**.)
Studleys Pond (Reeds Pond, Spring Pond), Rockland MA94151	U	Slight tea stain; slight turbidity; much decaying organic matter on sandy bottom; sparse surface plant cover throughout the pond; non-native wetland species (**Ls**)
Tack Factory Pond, Scituate MA94152	U	Tea stained; slightly turbid (< 1.2 m Secchi disk estimate); sandy bottom; sparse surface plant cover throughout the pond
Torrey Pond, Norwell MA94157	E	Dark tea stain (< 1.2 m Secchi disk estimate); very dense floating leaf plant cover over about 75% of the pond; emergent encroachment consumes about 30% of the historic open water; non-native aquatic species (**Cc**)
Triangle Pond, Plymouth MA94160	U	Clear; some decaying organic matter in patches on sandy bottom; sparse surface plant cover throughout the pond
Upper Chandler Pond, Duxbury/Pembroke MA94165	E	Dark tea stain; slight gray/brown turbidity; dense plant cover throughout the pond; non-native aquatic species (**Mh**)

Table C1 continued. 1996 South Coastal Watershed Summer lake observations and trophic status estimates.

Lake Name, Location Waterbody Identification Code	Trophic Status Estimate	Survey Observations
Wampatuck Pond, Hanson MA94168	E	Heavy turbidity (< 1.2 m Secchi disk estimate); bright green algae bloom; sparse plant cover throughout the pond
West Chandler Pond, Pembroke MA94170	U	Dark tea stain; mud bottom; sparse surface plant cover throughout the pond
Winslow Cemetery Pond (Daniel Webster Pond), Marshfield MA94172	E	Tea stained, but clear; about 50% covered with dense floating leaf plants, most of bottom covered with submergents.
Wright Reservoir, Duxbury MA94174	E	Slight tea stain; slight turbidity; algae covers gravel/cobble bottom; very dense floating leaf and submergent plants cover about 75% of the pond

Trophic State: O= Oligotrophic, M= Mesotrophic, E= Eutrophic, H=Hypereutrophic, U= Undetermined
Non-native Wetland Plants: **Ls** = *Lythrum salicaria*, **Pa** = *Phragmites australis*
Non-native Aquatic Plants: **Cc** = *Cambomba caroliniana*, **Mh** = *Myriophyllum heterophyllum*, **Pc** = *Potamogeton crispis*.
Note: **M sp.** = Possible *Myriophyllum heterophyllum*, requires further confirmation when flowering heads are evident.

2001

In the South Coastal Watershed, baseline lake surveys were conducted in June, July, August, and September 2001 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Six ponds: Forge Pond, Hanover; Jacobs Pond, Norwell; Lower Chandler Pond, Duxbury; Old Oaken Bucket Pond, Scituate; Musquashcut Pond, Scituate; and Wampatuck Pond, Hanson, were sampled three times each (generally at monthly intervals). MassDEP's technical memorandum (CN167.0) by Dr. Mark Mattson entitled *Baseline Lake Survey 2001 Technical Memo* provides details of sample collection methods, results, data, and weed maps for the lakes surveyed in the Farmington, Westfield, Concord, Taunton and South Coastal Watersheds in 2001. Water quality data were excerpted from the technical memorandum and are presented in Tables C2 and C3. A subset of lakes from the Taunton and South Coastal watersheds were examined for impacts related to commercial cranberry operations. Additional samples were taken from the major inlets to these lakes, with notes on presence or absence of cranberry operations upstream from those tributaries. Data from these inlets and tributaries are presented in Table C3 immediately following the lake segment to which they flow.

In-situ measurements using a Hydrolab® multiprobe (measures dissolved oxygen, water temperature, pH, conductivity, and depth and calculates total dissolved solids and % oxygen saturation) were recorded. At deep hole stations measurements were recorded at various depths creating profiles. In-lake samples were also collected and analyzed for alkalinity, total phosphorus, apparent color, and chlorophyll *a* (an integrated sample). Procedures used for water sampling and sample handling are described in the MassDEP documents, *Sample Collection Techniques for DWM Surface Water Quality Monitoring* (CN 001.1), *Chlorophyll a Standard Operating Procedure* (CN003.2) and the *Hydrolab® Series 3/Series 4 Multiprobe Standard Operating Procedure* (CN004.1). The Wall Experiment Station (WES), the MassDEP analytical laboratory, supplied all sample bottles and field preservatives, which were prepared according to the WES *Laboratory Quality Assurance Plan and Standard Operating Procedures*. Both quality control and raw water samples were preserved in the field as necessary, transported on ice to WES, and analyzed according to WES Standard Operating Procedures. Apparent color and chlorophyll *a* were measured according to standard operating procedures at the MassDEP DWM office in Worcester (CN002.1 and CN003.2 respectively). An aquatic macrophyte survey was conducted at each lake. The aquatic plant cover (native and non-native) and species distribution was mapped and recorded.

Table C2. 2001 DWM South Coastal River Watershed Baseline Lakes *in-situ* Hydrolab® data

Forge Pond/Drinkwater River (Palis: 94037) (Saris: 9456900)
Unique_ID: W0954 Station: A, Mile Point: 0.6
Description: Deep hole, southeast quadrant of pond, Hanover

Date	OWMID	Time	Depth	Temp	pH	Cond @ 25°C	TDS	SAL	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
07/03/2001	LB-1808	09:40	1.0	18.3u	6.2	289	185	--	5.8	60
		09:47	2.0	17.0	6.2	291	186	--	6.5	66
08/02/2001	LB-1828	12:32	0.4	25.2u	9.1cu	540	346	--	13.6	161
		13:02	1.3	21.2	7.6cu	546	350	--	9.7u	106u
09/05/2001	LB-1848	10:31	0.5	20.3u	7.0c	449	287	--	9.6	105
		10:37	1.3	20.3u	7.0c	450	288	--	9.5	104
	LB-1852	10:45	0.5	20.4	7.1c	448	287	--	9.9	107
		10:51	1.3	20.3	7.1cu	450	288	--	9.9u	107u

Jacobs Pond (Palis: 94077)
Unique_ID: W0941 Station: A
Description: Deep hole, southern end of pond, Norwell

Date	OWMID	Time	Depth	Temp	pH	Cond @ 25°C	TDS	SAL	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/26/2001	LB-1520	13:44s	##ms	##ms	##ms	##ms	--	--	##ms	##ms
		13:47s	##ms	##ms	##ms	##ms	--	--	##ms	##ms
		13:51s	##ms	##ms	##ms	##ms	--	--	##ms	##ms
07/31/2001	LB-1546	11:04s	0.5s	24.0s	6.6s	314s	--	--	7.5s	88s
		11:08s	1.0s	23.0s	6.7s	313s	--	--	7.4s	85s
09/06/2001	LB-1588	13:37s	0.5s	23.9s	6.6s	293s	--	--	7.8s	91s
		13:41s	1.0s	21.3s	6.5s	290s	--	--	7.7su	85su

Lower Chandler Pond (Palis: 94091)
Unique_ID: W0933 Station: A
Description: Deep hole in southwest corner of pond, approximately 100 feet from outfall and road, Duxbury/Pembroke.

Date	OWMID	Time	Depth	Temp	pH	Cond @ 25°C	TDS	SAL	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/21/2001	LB-1284	11:37	0.5	25.5	6.2	157	100	--	6.3u	75u
		11:51	1.5	25.4	6.2	157	100	--	6.0u	72u
07/17/2001	LB-1377	14:27	0.5	24.4	6.4	157	100	--	7.2u	84u
		14:35	1.5	23.1	6.0	156	100	--	2.9u	33u
		14:40	1.9	22.0	6.0	159	102	--	<0.2u	<2u
	LB-1385	14:49	0.5	24.4	6.4	158	101	--	7.1	84
		14:56	1.5	23.0	6.0	158	101	--	2.3u	26u
		15:00	1.9	22.0	6.0	160	102	--	<0.2	<2
08/30/2001	LB-1470	11:40	0.5	25.5	6.6	155	99.0	--	8.7	103
		11:47	1.5	23.8u	6.1	155	99.0	--	4.1u	47u

Musquashcut Pond (Palis: 94105)
Unique_ID: W0951 Station: A
Description: Deep hole, approximately 250 feet southeast of Seagate Circle peninsula, Scituate

Date	OWMID	Time	Depth	Temp	pH	Cond @ 25°C	TDS	SAL	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/2001	LB-1222	12:48	0.8	28.1	8.3c	27,778	--	17.0	7.9	109
07/25/2001	LB-1315	10:43	0.5	27.2	7.4c	21,257s	--	12.7s	6.4u	85u
08/23/2001	LB-1408	13:07	0.5	26.2	8.3c	39,434	--	25.2	9.3u	130u

Old Oaken Bucket Pond (Palis: 94113)
Unique_ID: W0953 Station: A
Description: Deep hole, southern end of pond, triangulate 160 feet off of two outlet structures, Scituate

Date	OWMID	Time	Depth	Temp	pH	Cond @ 25°C	TDS	SAL	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/28/2001	LB-1227	14:54	0.7	##u	6.4u	278u	178u	--	<0.2i	<2i
07/25/2001	LB-1320	14:50	0.5	26.1	6.3	241	154	--	##u	##u
		14:56	1.0	18.8	5.9	243	156	--	##u	##u
	LB-1321	15:17	0.5	##u	6.3	241u	154u	--	4.5u	55u
		15:20	1.0	##u	5.9	242	155	--	2.2u	24u
08/23/2001	LB-1413	11:13	0.5	23.4	6.2	252	161	--	##u	##u
		11:20	1.0	20.9u	6.0u	261u	167u	--	<0.2	<2

Wampatuck Pond/Indian Head Brook (Palis: 94168) (Saris: 9456875)
Unique_ID: W0935 Station: A, Mile Point: 2.3
Description: Deep hole northern end of Wampatuck Pond (impoundment of Indian Head Brook), midway between island and eastern shore,

Date	OWMID	Time	Depth	Temp	pH	Cond @ 25°C	TDS	SAL	DO	SAT
		(24hr)	(m)	(C)	(SU)	(uS/cm)	(mg/l)	(ppt)	(mg/l)	(%)
06/21/2001	LB-1288	14:56	0.5	26.2	6.3u	145	93.0	--	6.3u	76u
		15:03	1.2	26.0	6.4	144	92.1	--	6.1	74
07/17/2001	LB-1381	10:52	0.5	24.2	8.0cu	143	91.4	--	10.8u	126u
		11:11	1.0	24.0	7.4cu	143	91.8	--	9.8u	114u
08/30/2001	LB-1474	14:00	0.5	26.7u	9.0cu	156	100	--	10.5u	128u
		14:09	1.0	24.2	6.5u	154	99.0	--	4.9u	57u

" -- " = No data (i.e., data not taken/not required)
" ## "= Censored data (i.e., data that has been discarded for some reason).
NOTE: Prior to 2001 data, "**" denoted either censored or missing data.
" 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).
" m " = **m**ethod 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 **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

Table C3. 2001 DEP DWM South Coastal Watershed Baseline Lakes *physico-chemical* data.

Forge Pond/Drinkwater River (Palis: 94037)/(Saris: 9456900)
Unique_ID: W0954 Station: A, Mile Point: 0.6
Description: Deep hole, southeast quadrant of pond, Hanover

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
07/03/2001	1.1	10:01	2.2	LB-1803	LB-1804	10:05	0.5	Surface	13	0.080	230m	--
				LB-1804	LB-1803	10:08	0.5	Surface	13	0.089	280m	--
				LB-1805	--	10:10	2.0	Bottom	13	0.089	260m	--
				LB-1807	LB-1806	10:13	0 - 1.5	Integrated	--	--	--	2.0f
				LB-1806	LB-1807	10:13	0 - 1.5	Integrated	--	--	--	1.4f
08/02/2001	1.4	12:23	1.5	LB-1823	LB-1824	12:48	0.5	Surface	34	0.047	75h	--
				LB-1824	LB-1823	12:49	0.5	Surface	34	0.049	70h	--
				LB-1825	--	13:15	1.0	Bottom	34	0.072	65h	--
				LB-1826	LB-1827	13:00	0 - 0.9	Integrated	--	--	--	18.5
				LB-1827	LB-1826	13:01	0 - 0.9	Integrated	--	--	--	21.4
09/05/2001	0.8	10:30	1.8	LB-1844	LB-1843	11:05	0.5	Surface	26	0.085	110	--
				LB-1843	LB-1844	11:05	0.5	Surface	26	0.083	120	--
				LB-1845	--	11:10	1.3	Bottom	26	0.086	120	--
				LB-1846	LB-1847	11:15	0 - 1.3	Integrated	--	--	--	35.7
				LB-1847	LB-1846	11:20	0 - 1.3	Integrated	--	--	--	36.3

Drinkwater River (Saris: 9456900)
Unique_ID: W0956 Station: C, Mile Point: 1.1
Description: inlet to Forge Pond, just upstream of confluence with French Stream, Hanover

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
07/03/2001	--	--	--	LB-1810	--	11:03	--	--	--	0.078	--	--
08/02/2001	--	--	--	LB-1830	--	15:24	--	--	--	0.048	--	--
09/05/2001	--	--	--	LB-1850	--	12:22	--	--	--	0.053	--	--

French Stream (Saris: 9456950)
Unique_ID: W0906 Station: FS104, Mile Point: 0.001
Description: approximately 30 feet upstream of confluence with Drinkwater River, Hanover

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
07/03/2001	--	--	--	LB-1809	--	11:01	--	--	--	0.084	--	--
08/02/2001	--	--	--	LB-1829	--	15:36	--	--	--	0.080	--	--
09/05/2001	--	--	--	LB-1849	--	12:15	--	--	--	0.081	--	--

Unnamed Tributary to French Stream
Unique_ID: W0907 Station: FS105, Mile Point: 0.1
Description: approximately 100 feet downstream of Rockland WWTP outfall pipe, Rockland.

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
07/03/2001	--	--	--	LB-1811	--	11:29	--	--	--	0.15	--	--
08/02/2001	--	--	--	LB-1831	--	10:40	--	--	--	0.15	--	--
09/05/2001	--	--	--	LB-1851	--	12:55	--	--	--	0.16	--	--

Jacobs Pond (Palis: 94077)
Unique_ID: W0941 Station: A
Description: Deep hole, southern end of pond, Norwell

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/26/2001	>1.3	13:39	1.3	LB-1517	--	**	0.5	Surface	10	0.034b	100	--
				LB-1518	--	**	0.8	Bottom	18	0.031b	85	--
				LB-1519	--	**	0 - 0.8	Integrated	--	--	--	4.7
07/31/2001	1.1	11:00	1.2	LB-1543	--	11:10	0.5	Surface	8	0.041b	120	
				LB-1545	--	11:12	0 - 0.6	Integrated	--	--	--	7.8
09/06/2001	>1.5	13:30	1.5	LB-1585	--	13:45	0.5	Surface	8	0.038b	160	--
				LB-1587	--	13:45	0 - **	Integrated	--	--	--	3.1
10/02/2001	0.7	09:35	1.5	LB-1854	LB-1855	09:33	0.5	Surface	--	0.034h	--	--
				LB-1855	LB-1854	09:35	0.5	Surface	--	0.034h	--	--

Lower Chandler Pond (Palis: 94091)
Unique_ID: W0933 Station: A
Description: Deep hole in southwest corner of pond, approximately 100 feet from outfall and road, Duxbury/Pembroke.

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/21/2001	1.1	11:38	2.1	LB-1280	LB-1279	**	0.5	Surface	7	0.042b	120m	--
				LB-1279	LB-1280	**	0.5	Surface	8	0.042b	110m	--
				LB-1281	--	**	**	Bottom	8	0.039b	100m	--
				LB-1282	LB-1283	**	0 - **	Integrated	--	--	--	5.8
				LB-1283	LB-1282	**	0 - **	Integrated	--	--	--	5.5
				LB-1278	--	**	0 - **	Integrated	--	--	--	<1.0
07/17/2001	1.1	14:22	2.4	LB-1372	LB-1373	14:35	0.5	Surface	7	0.054b	130dh	--
				LB-1373	LB-1372	14:40	0.5	Surface	8	0.054b	100dh	--
				LB-1374	--	15:00	**	Bottom	9	0.047b	150h	--
				LB-1376	LB-1375	**	0 - 1.9	Integrated	--	--	--	12.7
				LB-1375	LB-1376	15:13	0 - 1.9	Integrated	--	--	--	12.5
08/30/2001	1.0	11:54	2.1	LB-1466	LB-1465	12:00	0.5	Surface	9	0.045d	120d	--
				LB-1465	LB-1466	12:00	0.5	Surface	9	0.036d	150d	--
				LB-1467	--	12:10	1.5	Bottom	9	0.037d	120	--
				LB-1468	LB-1469	12:15	0 - 1.5	Integrated	--	--	--	19.2
				LB-1469	LB-1468	12:20	0 - 1.5	Integrated	--	--	--	18.2
10/02/2001	1.5	11:30	2.1	LB-1857	--	11:35	0.5	Surface	--	0.032b	--	--

Musquashcut Pond (Palis: 94105)
Unique_ID: W0951 Station: A
Description: Deep hole, approximately 250 feet southeast of Seagate Circle peninsula, Scituate

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/28/2001	0.6	12:38	1.0	LB-1217	LB-1218	**	0.5	Surface	69	0.10	39d	--
				LB-1219	--	**	0.5	Surface	69	0.076	65	--
				LB-1218	LB-1217	**	0.5	Surface	69	0.11	60d	--
				LB-1220	LB-1221	**	0 - 0.5	Integrated	--	--	--	23.2
				LB-1221	LB-1220	**	0 - 0.5	Integrated	--	--	--	25.0
07/25/2001	>1.0	10:55	1.0	LB-1311	LB-1310	**	0.5	Surface	84	0.045b	37	--
				LB-1310	LB-1311	**	0.5	Surface	83	0.041b	31	--
				LB-1314	LB-1313	**	0 - 0.5	Integrated	--	--	--	4.1
				LB-1313	LB-1314	**	0 - 0.5	Integrated	--	--	--	4.5
08/23/2001	>1.0	12:52	1.0	LB-1404	LB-1403	13:02	0.5	Surface	87	0.065b	43	--
				LB-1403	LB-1404	13:02	0.5	Surface	88	0.045b	40	--
				LB-1406	LB-1407	12:55	** - **	Grab Composite	--	--	--	13.4
				LB-1407	LB-1406	12:55	** - **	Grab Composite	--	--	--	13.5

Unnamed Tributary to Musquashcut Pond
Unique_ID: W0952 Station: B, Mile Point: 0.03
Description: Inlet, Mann Hill Road, Scituate

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/28/2001	--	--	--	LB-1223	--	11:40	--	--	--	0.13	--	--
07/25/2001	--	--	--	LB-1316	--	13:50	--	--	--	0.26	--	--
08/23/2001	--	--	--	LB-1409	--	14:15	--	--	--	0.14	--	--

Old Oaken Bucket Pond (Palis: 94113)
Unique_ID: W0953 Station: A
Description: Deep hole, southern end of pond, triangulate 160 feet off of two outlet structures, Scituate

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/28/2001	1.1	14:35	1.5	LB-1224	--	**	0.5	Surface	11	0.065b	190	--
				LB-1225	--	**	**	Bottom	18	0.1b	280	--
				LB-1226	--	**	0 - **	Integrated	--	--	--	6.9
07/25/2001	0.8	14:45	1.5	LB-1317	--	14:45	0.5	Surface	12	0.071b	240	--
				LB-1318	--	14:45	1.0	Bottom	14	0.048b	220	--
				LB-1319	--	**	0 - 1.0	Integrated	--	--	--	9.5
08/23/2001	0.8	10:48	1.8	LB-1410	--	11:35	0.5	Surface	14	0.053b	160	--
				LB-1412	--	11:35	0 - **	Integrated	--	--	--	12.6
10/02/2001	1.0	10:30	1.5	LB-1856	--	10:30	0.5	Surface	--	0.055b	--	--

Wampatuck Pond/Indian Head Brook (Palis: 94168) (Saris: 9456875)
Unique_ID: W0935 Station: A, Mile Point: 2.3
Description: Deep hole northern end of Wampatuck Pond (impoundment of Indian Head Brook), midway between island and eastern shore, Hanson

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/21/2001	0.7	15:21	1.7	LB-1285	--	**	0.5	Surface	12	0.12b	210m	--
				LB-1286	--	**	**	Bottom	11	0.12b	180m	--
				LB-1287	--	**	0 - **	Integrated	--	--	--	22.4
07/17/2001	0.4	10:59	1.5	LB-1378	--	11:00	0.5	Surface	11.0	0.14b	240h	--
				LB-1379	--	11:05	1.0	Bottom	11	0.14b	260h	--
				LB-1380	--	11:10	0 - 1.0	Integrated	--	--	--	39.7
08/30/2001	0.4	14:15	1.5	LB-1471	--	14:15	0.5	Surface	19	0.11b	180	--
				LB-1472	--	14:29	1.0	Bottom	13	0.10b	210	--
10/02/2001	0.5	12:40	1.5	LB-1858	--	12:38	0.5	Surface	--	0.10b	--	--

INDIAN HEAD BROOK (Saris: 9456875)
Unique_ID: W0934 Station: B, Mile Point: 2.7
Description: inlet at culvert to Wampatuck Pond, Hanson

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/21/2001	--	--	--	LB-1289	--	15:53	--	--	--	0.18	--	--
07/17/2001	--	--	--	LB-1382	--	11:47	--	--	--	0.090	--	--
08/30/2001	--	--	--	LB-1475	--	14:42	--	--	--	0.12	--	--

Unnamed Tributary to Wampatuck Pond
Unique_ID: W0936 Station: D, Mile Point: 0.05
Description: approximately 250 feet upstream on an unnamed tributary at southern end of Wampatuck Pond, Hanson

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/21/2001	--	--	--	LB-1291	--	17:02	--	--	--	0.12	--	--
07/17/2001	--	--	--	LB-1384	--	12:15	--	--	--	0.15	--	--
08/30/2001	--	--	--	LB-1477	--	15:03	--	--	--	0.12	--	--

Unnamed Tributary to Wampatuck Pond
Unique_ID: W0937 Station: C, Mile Point: 0.05
Description: approximately 250 feet upstream on an unnamed tributary at southeastern end of Wampatuck Pond, Hanson (tributary not shown on 1978 Hanover quad, point is accurate overlayed on 2001 ortho photo)

Date	Secchi	Secchi Time	Station Depth	OWMID	QAQC	Time	Sample Depth	Relative Depth	Alkalinity	TP	Apparent Color	Chl a
	m	24hr	m			24hr	m		mg/l	mg/l	PCU	mg/m3
06/21/2001	--	--	--	LB-1290	--	16:07	--	--	--	0.18	--	--
07/17/2001	--	--	--	LB-1383	--	11:57	--	--	--	0.14	--	--
08/30/2001	--	--	--	LB-1476	--	14:50	--	--	--	0.16	--	--

" ** " = 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).
" d " = precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected
" h " = holding time violation (usually indicating possible bias low)
" m " = method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

APPENDIX D
MA DEP DWM 1995, 1996, 2001, 2002, and 2005 FISH TOXICS MONITORING IN THE SOUTH SHORE COASTAL WATERSHEDS

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

In the South Shore Coastal Watersheds fish contaminant monitoring surveys have been conducted by DEP DWM staff in several waterbodies including Billington Sea, Great Herring Pond, Island Pond, Great South Pond and Aaron River Reservoir as well as several surveys in the North River Subwatershed including Factory Pond, Forge Pond, Indian Head River and North River (Maietta undated a and MA DEP 2005a). Fish contaminant monitoring data provided here include surveys conducted between 1995 and 2005. In August 1995 fish toxics monitoring was conducted in Forge Pond, Hanover and the Ludhams Ford Impoundment of the Indian Head River, Hanover/Pembroke. In May and June 1996 fish toxics monitoring was conducted in Great Herring Pond, Plymouth/Bourne; Island Pond, Plymouth and PCB and pesticide testing was repeated in the Ludhams Ford Impoundment of the Indian Head River, Hanover/Pembroke. During the summer of 2001 fish toxics monitoring was conducted in Great South Pond and Aaron River Reservoir. In June 2002, as the result of a public request, fish toxics monitoring was conducted in the Indian Head River/North River in Hanover/Pembroke (downstream of the Ludhams Ford Dam). Fish were collected again in the Ludhams Ford Impoundment of the Indian Head River in May 2005. The objective of these surveys was to screen the edible fillets of fishes for potential contaminants (e.g., selected metals, PCBs and organochlorine pesticides). All results were submitted to the MDPH for review.

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

Fish toxics monitoring conducted prior to 1999 followed guidance outlined in the Biomonitoring Program Standard Operating Procedures (TSB 1990). Subsequent surveys were conducted under EPA-approved Fish Toxics Quality Assurance Project Plans (MA DEP 2001 and MA DEP 2003). Data quality objectives are presented in the above-mentioned QAPPs.

METHODS
Field Methods
Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish (MA DEP 2000, MA DEP 2001, MA DEP 2003 and MA DEP 2005b). The characteristics of each site determine the method(s) of sample collection. Waterbodies in the South Shore Coastal Watersheds were sampled by DWM using boat electrofishing, gill nets, and/or rods and reels. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody, and collecting most fish shocked. Fish collected by electrofishing were stored in a live well filled with site water until the completion of sampling. Fish to be included in the sample were stored on ice and transported to the DWM laboratory in Worcester. Rod and reel fishing was performed by casting lures into fish holding cover and retrieving lures, and at times fish.

Gill nets were set in various locations and either checked every two hours or on occasion left overnight. Gill nets set overnight were retrieved the following morning. After removal from the gill nets or lure, fish to be included in the sample were stored on ice and transported to the DWM laboratory in Worcester. In all cases, live fish, which were not included as part of the sample, were released.

DWM Laboratory Methods (Sample processing)
Fish brought to the MA DEP DWM laboratory in Worcester were processed using protocols designed to assure accuracy and prevent cross-contamination of samples (MA DEP 2000, MA DEP 2001, MA DEP 2003 and MA DEP 2005b). Specimen lengths and weights were recorded along with notes on tumors, lesions, or other anomalies noticed during an external visual inspection. Scales, spines, or pectoral fin ray samples were obtained for use in age determination. Species, length, and weight data can be found in Tables D1, D2, D3, D4 and D5. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and or after each sample. Samples (individual or composite) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR high density polyethylene (HDPE) cups with covers. Composite samples were composed of three fillets from like-sized individuals of the same species (occasionally the same genus). Samples were tagged and frozen for subsequent delivery to the Department's Wall Experiment Station (WES).

WES Laboratory Methods (Analytical)
All analyses for cadmium, lead and selenium were conducted using EPA method 200.7. All analyses for PCBs and organics were conducted using AOAC method 983.21. All mercury analyses prior to 2005 were conducted using EPA method 245.1. In 2005 the EPA method 7473 was used for the mercury analysis (Batdorf 2005). Additional information on analytical techniques used at WES is available from the laboratory.

In 1995 and 1996, methods at WES for metals analysis include the cold vapor method using a VGA hydride generator for mercury. Varian 1475 flame atomic absorption was used for all remaining metals (arsenic, cadmium, lead and selenium). PCB congener and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector (Maietta undated b and MA DEP 1996).

In 2001 and 2002 mercury was analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System), which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead were analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emmission Spectrophotometer. Arsenic and selenium were analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer. PCB Arochlor, PCB congener, and organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector "according to the modified AOAC 983.21 procedure for the analysis of PCB Arochlors, Congeners, and Organochlorine Pesticides" (Maietta *et al*. 2002 and Maietta *et al*. 2004).

In 2005 mercury in fish tissue was analyzed with a DMA-80 Milestone analyzer (Batdorf 2005). Cadmium, lead, and selenium were analyzed using a Perkin Elmer, Optima 3000 XL ICP - Optical Emmission Spectrophotometer while arsenic was analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer.

RESULTS
All fish tissue data met DWM data quality objectives and passed QC acceptance limits of the WES laboratory without qualification unless otherwise noted below. Fish toxics monitoring survey data can be found in Tables D1 through D5.

*2001 (*Maietta *et al*. 2002): The lab duplicate precision estimates for metals (Hg, Pb, Cd, As and Se) were acceptable at 30% RPD or less, except for one sample for selenium (37%) and one for Hg (40%). The lab fortified matrix sample spike recovery for PCB Arochlor 1260 was 59%, resulting in "J" (estimated) qualification by WES. The lab fortified blank spike recovery for PCB 1260 was 62%. These QC data suggest potential poor recovery of PCB Arochlor 1260 in samples. Lab fortified blank spike recovery for PCB Arochlor 1242 was 75%. Although organics data have been reported and

generally accepted without qualification, potential users of data involving poor spike recoveries (as referenced above) are advised to consider the potential error in sample data for specific PCB analytes.

2002 (Maietta *et al*. 2004)*:* Fish tissue data passed the QC acceptance limits of the WES laboratory. WES reported a number of lab-validated data with "qualification". All but one of these "qualified" data points were for very low concentrations of either PCBs (Congeners and Arochlors) and/or organochlorine pesticides. One data point for arsenic at the detection limit was also qualified. The lab fortified matrix spike recovery for toxaphene was 50% resulting in "J" (estimated) qualification by WES. These QC data suggest potential poor recovery of toxaphene in samples. Lab accuracy estimates for metals (all analytes) using lab-fortified matrix samples were acceptable ranging from 80-112 % recovery except for two selenium samples at 126 and 128 % recovery and one lead sample at 130% recovery. QC sample recoveries were acceptable ranging from 83-117%. Lab accuracy estimates for metals (all analytes) using lab fortified blanks were acceptable ranging from 82 to 111 % recovery except for one lead sample at 128% recovery.

2005: These data have just been released by the Wall Experiment Station and are presented here prior to thorough review by DWM.

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

Table D1. 1995 Fish Toxics Monitoring data Forge Pond, Hanover and Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (Maietta undated b). Results are reported in mg/kg wet weight unless otherwise specified.

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)
Forge Pond, Hanover (MA94037)														
95054	FGF95-1	08/09/95	B	C	20.9	180								
	FGF95-2	08/09/95	B	C	21.0	190	<0.20	<1.00	0.403	<0.040	0.165	0.14	ND	ND
	FGF95-3	08/09/95	B	C	21.0	200								
95055	FGF95-4	08/09/95	LMB	C	36.8	770								
	FGF95-5	08/09/95	LMB	C	33.9	500	<0.20	<1.00	0.275	<0.040	0.143	0.089	ND	ND
	FGF95-6	08/09/95	LMB	C	31.8	450								
95056	FGF95-7	08/09/95	CP	C	35.2	220								
	FGF95-8	08/09/95	CP	C	34.8	220	<0.20	<1.00	0.238	<0.040	0.066	0.089	ND	ND
	FGF95-9	08/09/95	CP	C	35.0	200								
95057	FGF95-10	08/09/95	AE	C	53.1	250								
	FGF95-11	08/09/95	AE	C	56.5	320	<0.20	<1.00	0.380	<0.040	0.146	0.44	ND	ND
	FGF95-12	08/09/95	AE	C	50.5	230								
95058	FGF95-13	08/09/95	BB	I	24.5	210	<0.20	<1.00	0.097	<0.040	0.060	*	*	*

[1]**Species Code:**
AE = American eel (*Anguilla rostrata*)
B = bluegill (*Lepomis macrochirus*)
BB = brown bullhead (*Ameiurus nebulosus*)
CP = chain pickerel (*Esox niger*)
LMB = largemouth bass (*Micropterus salmoides*)

[2]**Sample Type** (All samples were fillets with skin off.):
C = Composite
I = Individual
ND Not Detected
***** This sample analyzed for metals only

Table D1 cont. 1995 Fish Toxics Monitoring data Forge Pond, Hanover and Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (Maietta undated b). Results are reported in mg/kg wet weight unless otherwise specified.

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)
Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (MA94-04)														
95048	IHF95-1	08/09/95	LMB	C	41.0	1130								
	IHF95-2	08/09/95	LMB	C	36.0	750	<0.20	<1.00	1.23	<0.040	0.109	0.19	ND	ND
	IHF95-3	08/09/95	LMB	C	32.0	500								
95049	IHF95-4	08/09/95	BC	C	24.0	180								
	IHF95-5	08/09/95	BC	C	24.0	190	<0.20	<1.00	1.52	<0.040	0.113	0.085	ND	ND
	IHF95-6	08/09/95	BC	C	22.7	160								
95050	IHF95-7	08/09/95	CP	C	37.1	350								
	IHF95-8	08/09/95	CP	C	35.6	250	<0.20	<1.00	1.29	0.194	0.405	0.030	ND	ND
	IHF95-9	08/09/95	CP	C	34.3	250								
95051	IHF95-10	08/09/95	WS	C	39.0	620								
	IHF95-11	08/09/95	WS	C	46.4	960	<0.20	<1.00	0.784	<0.040	0.198	0.77	ND	ND
	IHF95-12	08/09/95	WS	C	38.6	640								
95052	IHF95-13	08/09/95	AE	C	68.6	680								
	IHF95-14	08/09/95	AE	C	60.1	420	<0.20	<1.00	1.02	<0.040	0.199	0.021	ND	ND
	IHF95-15	08/09/95	AE	C	63.0	550								
95053	IHF95-16	08/09/95	B	C	19.3	140								
	IHF95-17	08/09/95	B	C	18.0	120	<0.20	<1.00	0.828	<0.040	0.144	0.11	ND	ND
	IHF95-18	08/09/95	B	C	17.9	100								

[1]**Species Code:**
AE = American eel (*Anguilla rostrata*)
B = bluegill (*Lepomis macrochirus*)
BC = black crappie (*Poxomis nigromaculatus*)
CP = chain pickerel (*Esox niger*)
LMB = largemouth bass (*Micropterus salmoides*)
WS = white sucker (*Castomus commersoni*)

[2]**Sample Type** (All samples were fillets with skin off.):
C = Composite
I = Individual
ND Not Detected

Table D2. 1996 Fish Toxics Monitoring data Great Herring Pond, Plymouth/Bourne, Island Pond, Plymouth, and Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (MA DEP 1996). Results are reported in mg/kg wet weight unless otherwise specified.

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)
Great Herring Pond, Plymouth/Bourne (MA94050)														
96001	GHF96-01	05/29/96	WS	C	39.0	620.0								
	GHF96-02	05/29/96	WS	C	41.0	650.0	<0.20	<1.00	0.120	0.108	0.415	1.3	ND	ND
	GHF96-03	05/29/96	WS	C	33.0	390.0								
96002	GHF96-04	05/29/96	LMB	C	35.0	550.0								
	GHF96-05	05/29/96	LMB	C	32.5	460.0	<0.20	<1.00	0.430	0.095	0.246	0.08	ND	ND
	GHF96-06	05/29/96	LMB	C	31.5	440.0								
96003	GHF96-07	05/29/96	SMB	C	37.3	670.0								
	GHF96-08	05/29/96	SMB	C	30.1	350.0	<0.20	<1.00	0.651	0.094	0.299	0.10	ND	ND
	GHF96-09	05/29/96	SMB	C	33.0	430.0								
96004	GHF96-10	05/29/96	YP	C	25.3	190.0								
	GHF96-11	05/29/96	YP	C	23.0	170.0	<0.20	<1.00	0.302	0.060	0.420	0.12	ND	ND
	GHF96-12	05/29/96	YP	C	28.1	240.0								
96005	GHF96-13	05/29/96	WP	C	27.6	280.0								
	GHF96-14	05/29/96	WP	C	28.2	280.0	<0.20	<1.00	0.488	0.093	0.627	0.44	ND	ND
	GHF96-15	05/29/96	WP	C	28.0	290.0								

[1]**Species Code:**
LMB = largemouth bass (*Micropterus salmoides*)
SMB = smallmouth bass
WP = white perch (*Morone americana*)
WS = white sucker (*Castomus commersoni)*
YP = yellow perch (*Perca flavescens*)

[2]**Sample Type** (All samples were fillets with skin off.):
C = Composite
I = Individual
ND = Not Detected

Table D2 cont. 1996 Fish Toxics Monitoring data Great Herring Pond, Plymouth/Bourne, Island Pond, Plymouth, and Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (MA DEP 1996). Results are reported in mg/kg wet weight unless otherwise specified.

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)
Island Pond, Plymouth (MA94075)														
96006	IPF96-01	05/30/96	LMB	C	33.3	560.0								
	IPF96-02	05/30/96	LMB	C	36.6	700.0	<0.20	<1.00	0.379	0.069	0.352	0.09	ND	ND
	IPF96-03	05/30/96	LMB	C	32.8	520.0								
96007	IPF96-04	05/30/96	BB	C	29.9	380.0								
	IPF96-05	05/30/96	BB	C	31.0	420.0	<0.20	<1.00	0.166	0.068	0.149	0.59	ND	DDE 0.040
	IPF96-06	05/30/96	BB	C	28.7	320.0								
96008	IPF96-07	05/30/96	CP	C	45.5	460.0								
	IPF96-08	05/30/96	CP	C	38.1	320.0	<0.20	<1.00	0.345	0.059	0.335	0.06	ND	ND
	IPF96-09	05/30/96	CP	C	38.1	340.0								
96009	IPF96-10	05/30/96	YP	C	19.9	100.0								
	IPF96-11	05/30/96	YP	C	17.9	70.0	<0.20	<1.00	0.219	0.052	0.498	0.24	ND	ND
	IPF96-12	05/30/96	YP	C	18.2	70.0								
96010	IPF96-13	05/30/96	B	C	18.6	150.0								
	IPF96-14	05/30/96	B	C	18.6	140.0	<0.20	<1.00	0.168	0.092	0.535	0.17	ND	ND
	IPF96-15	05/30/96	B	C	17.6	130.0								
Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (MA94-04)														
96011	IHF96-01	06/03/96	BT	C	22.5	120.0								
	IHF96-02	06/03/96	BT	C	22.9	120.0	N/A	N/A	N/A	N/A	N/A	2.0	ND	ND
	IHF96-03	06/03/96	BT	C	23.8	130.0								
96012	IHF96-04	06/03/96	BT	C	26.2	200.0								
	IHF96-05	06/03/96	BT	C	26.6	190.0	N/A	N/A	N/A	N/A	N/A	3.1	0.24*	ND
	IHF96-06	06/03/96	BT	C	25.5	190.0								

[1]**Species Code:**
B = bluegill (*Lepomis macrochirus*)
BB = brown bullhead (*Ameiurus nebulosus*)
BT = brown trout (*Salmo trutta*)
CP = chain pickerel (*Esox niger*)
LMB = largemouth bass (*Micropterus salmoides*)
YP = yellow perch (*Perca flavescens*)

[2]**Sample Type** (All samples were fillets with skin off.):
C = Composite
I = Individual
ND Not Detected
N/A Not Applicable

Table D3. 2001 Fish Toxics Monitoring data, Great South Pond, Plymouth and Aaron River Reservoir, Cohasset (Maietta *et al*. 2002). 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)
Great South Pond, Plymouth (MA94054)													
GSF01-1	7/23/01	LMB	41.4	1100	2001021 (L2001310-1) (L2001311-1)	<0.08	<0.8	0.77	<0.060	0.80	0.06	ND	ND
GSF01-2	7/23/01	LMB	48.2	1580									
GSF01-3	7/23/01	LMB	43.0	1150									
GSF01-4	7/23/01	SMB	40.4	1080	2001022 (L2001310-2) (L2001311-2)	<0.08	<0.8	0.95	<0.060	0.72	0.79	ND	ND
GSF01-5	7/23/01	SMB	43.0	1180									
GSF01-6	7/23/01	SMB	32.3	550									
GSF01-7	7/23/01	WP	31.3	510	2001023 (L2001310-3) (L2001311-3)	<0.08	<0.8	0.33	<0.060	1.8	2.6	ND	DDE – 0.036
GSF01-8	7/23/01	WP	32.6	500									
GSF01-9	7/23/01	WP	33.0	510									
Aaron River Reservoir, Cohasset (MA94178)													
ARF01-1	7/17/01	LMB	33.9	960	2001016 (L2001285-1) (L2001286-1)	<0.080	<0.80	0.95	<0.060	0.36	0.07	ND	DDE – 0.018
ARF01-2	7/17/01	LMB	30.5	450									
ARF01-3	7/17/01	LMB	37.4	720									
ARF01-4	7/17/01	CP	49.4	900	2001017 (L2001285-2) (L2001286-2)	<0.080	<0.80	1.3	<0.060	0.31	0.04	ND	ND
ARF01-5	7/17/01	CP	39.1	360									
ARF01-6	7/17/01	CP	37.6	350									
ARF01-7	7/17/01	YP	22.3	140	2001018 (L2001285-3) (L2001286-3)	<0.080	<0.80	1.1	<0.060	0.27	0.15	ND	ND
ARF01-8	7/17/01	YP	26.4	200									
ARF01-9	7/17/01	YP	23.5	160									
ARF01-10	7/17/01	B	19.7	140	2001019 (L2001285-4) (L2001286-4)	<0.080	<0.80	0.55	<0.060	0.24	0.16	ND	DDE – 0.029
ARF01-11	7/17/01	B	19.7	160									
ARF01-12	7/17/01	B	16.9	100									
ARF01-13	7/17/01	BC	21.6	130	2001020 (L2001285-5) (L2001286-5)	<0.080	<0.80	0.71	<0.060	0.31	0.10	ND	ND
ARF01-14	7/17/01	BC	21.8	120									
ARF01-15	7/17/01	BC	18.9	100									

[1]**Species**: B = bluegill (*Lepomis macrochirus*)
BC = black crappie (*Pomoxis nigromaculatus*)
CP = chain pickerel (*Esox niger*)
LMB = largemouth bass (*Micropterus salmoides*)
SMB = smallmouth bass (*Micropterus dolomieu*)
WP = white perch (*Morone americana*)
YP= yellow perch (*Perca flavescens*)

ND = Not Detected

Table D4. 2002 Fish Toxics Monitoring data for Indian Head/North River (downstream Luddoms Ford Impoundment), Hanover/Pembroke (Maietta *et al*. 2004). Results, reported in wet weight, are from composite samples of fish fillets with skin off.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Arochlors and Congeners (μg/g)	Pesticides (μg/g)
IHF02-1 IHF02-2 IHF02-3	6/11/02 6/11/02 6/11/02	WS WS WS	49.4 44.7 38.0	1460 1060 680	2002024 (L2002193-1) (L2002197-1)	<0.040	<0.20	0.73	<RDL (0.080)	0.22	2.1	A1254-0.048 A1260-0.079 BZ#118-0.0052 BZ#180-0.0087 BZ#170-0.0024J	DDD-0.016 DDE-0.046
IHF02-4 IHF02-5 IHF02-6	6/11/02 6/11/02 6/11/02	P P P	19.9 15.7 15.5	190 100 90	2002025 (L2002193-2) (L2002197-2)	<0.040	<0.20	0.65	0.08	0.21	0.17	ND	ND
IHF02-7 IHF02-8 IHF02-9	6/11/02 6/11/02 6/11/02	BT BT BT	18.5 16.2 16.6	70 50 50	2002026 (L2002193-3) (L2002197-3)	<0.040	<0.20	0.050	0.22	0.24	0.77	BZ#118-0.0034J	DDE-0.0069J

[1]**Species**: BT = brown trout (*Salmo trutta*)
P = pumpkinseed (*Lepomis gibbosus*)
WS = white sucker (*Catostomus commersoni*)

J = estimated value, concentration <RDL or certain QC criteria not met
ND = Not Detected
RDL = reporting detection limit
< = result not detected above method detection limit, unless otherwise noted

Table D5. 2005 South Coastal Watershed Fish Toxics Monitoring data for Indian Head River (Luddoms Ford Impoundment), Pembroke/Hanover (MA DEP 2005b). Results reported in wet weight are from samples of fish fillets with skin off except if noted as offal. Preliminary data available as of 5 October 2005.

Sample ID	Collection Date	Species Code[1]	Length (cm)	Weight (g)	Sample Type[2]	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)
IHRF05-1	5/18/05	LMB	51.5	1720	I	2005005 (2005079-001)	--	--	2.0	--	--	--	--	--
IHRF05-2	5/18/05	LMB	36.6	720	I	2005006 (2005079-002)	--	--	1.6	--	--	--	--	--
IHRF05-3	5/18/05	LMB	34.4	600	I	2005007 (2005079-003)	--	--	1.4	--	--	--	--	--
IHRF05-4	5/18/05	LMB	37.8	900	I	2005008 (2005079-004)	--	--	1.5	--	--	--	--	--
IHRF05-5 IHRF05-6 IHRF05-7	5/18/05	WS	52.1 47.4 51.0	1500 1160 1300	C	2005009 (2005079-005)	--	--	1.2	--	--	--	--	--
IHRF05-8 IHRF05-9 IHRF05-10	5/18/05	WP	24.0 24.4 23.0	180 200 160	C	2005010 (2005079-006)	< 0.10	< 0.10	0.86	< 0.080	0.41	na	na	na
	offal from above sample			412.7	C	2005013 (2005079-009)	< 0.10	0.51	0.51	< 0.080	0.87	na	na	na
IHRF05-11 IHRF05-12 IHRF05-13	5/18/05	BC	23.9 25.5 27.4	200 200 330	C	2005011 (2005079-007)	< 0.10	< 0.10	2.1	< 0.080	0.23M	na	na	na
	offal from above sample			542.4	C	2005014 (2005079-010)	< 0.10	0.49	0.94	< 0.080	0.42	na	na	na
IHRF05-14 IHRF05-15 IHRF05-16	5/18/05	B	18.9 19.0 19.1	150 140 130	C	2005012 (2005079-008)	< 0.10	< 0.10	0.57	< 0.080	0.26M	na	na	na
	offal from above sample			322.9	C	2005015 (2005079-011)	< 0.10	0.66	0.27	< 0.080	0.34	na	na	na

[1] **Species**: **B** = bluegill (*Lepomis macrochrus*)
BC = black crappie (*Pomoxis nigromaculatus*)
LMB = largemouth bass (*Micropterus salmoides*)
WP = white perch (*Morone americana*)
WS = white sucker (*Catostomus commersoni*)

[2] **sample type**: = **I -** individual **C** - composite
< = result not detected above method detection limit, unless otherwise noted
na = data not available at this time
Note: qualifiers reported in table are WES lab qualifiers
M = analyte concentration > MDL but < RDL
-- = No data (i.e., data not taken/not required)

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APPENDIX E

NPDES AND WMA PERMITS

Table E1. South Coastal Watershed NPDES Wastewater Discharge Facilities.

Permitee	NPDES #	Issuance	Flow (MGD)	Comments	Receiving Water (Segment)
Battelle Duxbury Operations	MA0025852	August 1999 and modified in February 2000	0.29 MGD culture water 0.000597 MGD non-contact cooling water	EPA no longer requires toxicity testing from this facility.	Duxbury Bay (MA94-15)
Camp Pembroke	MA0027006	March 1981	0.004 GPD	EPA is investigating alternative wastewater treatment operations	Oldham Pond (MA94114)
Cohasset Water Department	MA0103098	General permit issued May 2005; individual permit terminated by EPA. Ave monthly flow 0.11 MGD, max daily flow 0.23 MGD.			Lily Pond (MA94179)
Cohasset WWTP	MA0100285	October 2000	0.3	System upgraded in 2000 with a Zenon Membrane Filtration Process	Cohasset Cove (MA94-32)
ENGC - Pilgrim Nuclear Power Plant	MA0003557	29 April 1991, modified 30 August 1994, transferred to Entergy Nuclear from Boston Edison on 22 September 1999	Outfall 001: 447 MGD (510 MGD max daily) condenser cooling water Outfall 002: 255 MGD (when in use) thermal backwash for biofowling control Outfall 003: 4.1 MGD intake screen wash (fish sluice water) Outfall 008: 0.73 MGD sea foam suppression discharge Outfall 010: 19.4 MGD plant service cooling water Outfall 011: 0.015 MGD makup water and demineralizer waste discharge Outfalls 004, 005, 006, and 007: yard drains.		Cape Cod Bay (not a segment but see Plymouth Bay MA94-17 for information)
Golden Rooster Restaurant	MA0005797	September 1999	0.0028 treated sanitary wastewater	Permit terminated by EPA effective 6 August 2004. Now operated as The River Club, with inground system and discharge points were cemented over.	The Gulf (MA94-19)
Marshfield WWTP	MA0101737	September 2001	2.1	System upgrade: Gaseous chlorination to Ultraviolet disinfection.	Massachusetts Bay (not a segment)
Plymouth WWTP	MA0100587	November 2004	1.75*	A portion of discharge is directed to the ground in the Eel River Subwatershed (MA94-23) Ground water Permit # 0-677	Plymouth Harbor (MA94-16)
Rockland WWTP	MA0101923	August 1999	2.5		French Stream (MA94-03)
Scituate WWTP	MA0102695	November 2004	1.6*		Tidal Creek to Herring River (MA94-07)
Stellwagen Bank National Marine Sanctuary	MA0090531	August 1999 and transferred June 2002 from the US Coast Guard	0.002	sanitary wastewater (actual discharge is 0.0002 MGD average monthly)	Scituate Harbor (MA94-02)

* limit is applied as the average monthly flow reported as the rolling annual average (current and 11 prior months).

Table E2. South Coastal Watershed NPDES General Permits.

Permitee	NPDES #	Issuance	Type of Discharge	Receiving Water (Segment)
Abington-Rockland Joint WTP, Rockland	MAG640010	April 2001	SIC code 4941 - Water Treatment Plant	wetlands to Ben Mann Brook (trib to Drinkwater River MA 94-21)
Broadway WTP, Hanover	MAG640063	March 2004	SIC code 4941 - Water Treatment Plant	wetlands to Iron Mine Brook (MA 94-24)
Brockton Water Filtration Plant	MAG640029	June 2001	SIC code 4941 - Water Treatment Plant Note: The elimination of the surface water discharge is proposed for June 2006.	lagoon to Silver Lake (MA94143) (see also Jones River MA94-12)
Harborview Place	MAG250020	December 2002	SIC code 6512 - Operators of Non-Residential Buildings (Non-contact Cooling Water)	Plymouth Harbor (MA94-16)
Lily Pond WTP	MAG640070	May 2005	SIC code 4941 - Water Treatment Plant	Lily Pond (MA94179)
Old Oaken Bucket WTP	MAG640042	September 1998 but terminated January 2003	SIC code 4941 - Water Treatment Plant	Herring River (MA94-07)
Pond Street WTP, Hanover	MAG640043	February 2001	SIC code 4941 - Water Treatment Plant	Old Pond Meadows (wetland to MA94-27)

Table E3. South Coastal Watershed NPDES Industrial Storm Water Permits.
Note: Permitees are listed for all towns that are wholly or partially located in the South Coastal Watershed, therefore a specific facility may be physically located in an abutting watershed.

Permitee	NPDES Number	Issuance	Town
Cohasset Heights Landfill	MAR05C366	05/01/2002	Cohasset
Graham Waste Services	MAR05C365	05/01/2002	Cohasset
Bayside Marine Corp	MAR05C016	01/26/2001	Duxbury
Hewitts Cove Marina	MAR05B975	01/26/2001	Hingham
Hingham Pump Station	MAR05B636	12/07/2000	Hingham
Landfall Marina	MAR05B985	01/26/2001	Hingham
First Student Inc	MAR05C325	11/02/2001	Pembroke
Recycling Center	MAR05C505	03/10/2003	Pembroke
Plymouth & Brockton St Rwy Co	MAR05B971	01/25/2001	Plymouth
Level 1, Inc.	MAR05C535	05/15/2003	Rockland
Serono Inc	MAR05C348	01/11/2002	Rockland
TACC	MAR05C208	02/27/2001	Rockland
Plymouth & Brockton St Rwy Co	MAR05B970	01/25/2001	Scituate
Scituate WWTP	MAR05C530	04/08/2003	Scituate
Fore River Station	MAR05C255	05/17/2001	Weymouth
Southeastern Concrete Inc	MAR05C048	01/29/2001	Weymouth
Tern Harbor Marina	MAR05B979	01/26/2001	Weymouth
Weymouth Plant	MAR05C095	01/29/2001	Weymouth

Table E4. Status of Phase II Stormwater Permits for South Coastal Watershed Communities.
NOTE: All General Stormwater Permits expire 1 May 2008.

TOWN	NPDES PERMIT NO.	PERMIT ISSUED	MAPPED REGULATED AREA IN COMMUNITY
Bourne	MAR041094	08/28/2003	Partial
Cohasset	MAR041032	10/09/2003	Partial
Duxbury	MAR041034	10/23/2003	Partial
Halifax	MAR041035	09/18/2003	Partial
Hanover	MAR041036	09/19/2003	Partial
Hanson	MAR041037	09/16/2003	Partial
Hingham	MAR041038	09/18/2003	Partial
Kingston	MAR041041	09/26/2003	Partial
Marshfield	MAR041048	09/12/2003	Partial
Norwell	MAR041052	10/02/2003	Partial
Pembroke	MAR041054	09/25/2003	Partial
Plymouth	MAR041150	09/09/2003	Partial
Plympton	Waiver	05/16/2003	Exempt
Rockland	MAR041058	09/26/2003	Total
Scituate	MAR041060	09/29/2003	Partial
Weymouth	MAR041070	12/05/2003	Total

Table E5. WMA Water Withdrawals in the South Coastal Watershed (excluding cranberry growers).

System	Registered Volume (MGD)	20 year Permitted Volume (MGD)	Source Name	Source(s)	Segment
Abington & Rockland Joint Water Works Registration 42125101 Permit N/A Public Water Supply ID 4001000	2.21	N/A	Great Sandy Bottom Pond Hingham Street Reservoir	4001000-01S 4001000-02S	MA94053 and MA94-05 MA94-21
Brockton DPW - Water Division Registration 42104401 Permit N/A Public Water Supply ID 4044000	11.11	N/A	Furnace Pond Silver Lake Filtration Plant	4044000-03S 4044000-01S	MA94043 MA94-12
Cohasset Water Department Registration 32106501 Permit N/A Public Water Supply ID 3065000	0.65	N/A	Sohier Street-G.P. Well 1 Lily Pond Aaron River Reservoir Ellms Meadow Sohier Street-G.P. Well 2	3065000-01G 3065000-02S 3065000-01S 3065000-02G 3065000-03G	MA94-32 MA94179 MA94178 and MA94-28 MA94-32 MA94-32
Duxbury Water Department Registration 42108205 Permit 9P42108201 Public Water Supply ID 4082000	1.23	0.62	Millbrook #2 Partridge Road Depot Street Lake Shore Drive Tremont I Tremont II Evergreen I Evergreen II Mayflower/East Mayflower #2 Damon #1 - Proposed Damon #2 - Proposed	4082000-01G 4082000-02G 4082000-03G 4082000-04G 4082000-05G 4082000-06G 4082000-07G 4082000-08G 4082000-09G 4082000-10G 4082000-11G 4082000-12G	MA94-15 MA94-29 MA94-29 MA94-12 MA94-29 MA94-29 MA94-15 MA94-15 MA94-15 MA94-15 MA94-15 MA94-15
Duxbury Yacht Club Registration 42108212 Permit N/A	0.1	N/A	Duxbury Yacht Club Duxbury Yacht Club Well #1	01S 01G	MA94-29 MA94-29

Table E5 continued. WMA Water Withdrawals in the South Coastal Watershed (excluding cranberry growers).

System	Registered Volume (MGD)	20 year Permitted Volume (MGD)	Source Name	Source(s)	Segment
Hanover Water Department Registration 42112202 Permit 9P342112201 Public Water Supply ID 4122000	1.27	0.11	#1 Pond Street #1 Hanover Street #2 Hanover Street Well #2 Pond Street #1 Broadway Well #2 Broadway #3 Pond Street Phillip Beal Well #1 Phillip Beal Well #2	4122000-01G 4122000-03G 4122000-04G 4122000-05G 4122000-06G 4122000-07G 4122000-08G 4122000-09G 4122000-10G	MA94-27 MA94-24 MA94-24 MA94-27 MA94-24 MA94-24 MA94-27 MA94-22 MA94-22
Hatherly Country Club Registration V42126402 Permit N/A	0.06	N/A	Hatherly Country Club	01G	MA94-01
Kingston Water Department Registration 42114508 Permit 9P42114501 Public Water Supply ID 4145000	0.99	0.57	Soules Pond Pump Station South St. Pump Station Winthrop St. Pump Station Millgate Pump Station Grassy Hole Pump Sta. Trackle Pond Well	4145000-02G 4145000-03G 4145000-04G 4145000-05G 4145000-06G 4145000-07G	MA94-13 MA94-13 MA94-14 MA94-13 MA94-14 MA94-13
Marshfield Water and Sewer Registration 42117105 Permit 9P42117101 Public Water Supply ID 4171000	3.07	0.23	Mt Skirgo Wellfield Parsonage St Well #1 Parsonage St Well #2 Furnace Brook Well #1 Furnace Brook Well #2 Furnace Brook Well #3 Furnace Brook Well #4 South River Street Well School Street Well Webster Well #1 Ferry Street Well Webster Well #2 Church Street Well Union Street Well #1 Union Street Well #2 Spring Street Well	4171000-01G 4171000-02G 4171000-03G 4171000-04G 4171000-05G 4171000-06G 4171000-07G 4171000-08G 4171000-09G 4171000-10G 4171000-11G 4171000-12G 4171000-13G 4171000-14G 4171000-15G 4171000-16G	MA94-08 MA94-09 MA94-10 MA94-08 MA94-08 MA94-08 MA94-08 MA94-09 MA94-08 MA94-10 MA94-09 MA94-15 MA94-09 MA94-05 MA94-05 MA94-05

Table E5 continued. WMA Water Withdrawals in the South Coastal Watershed (excluding cranberry growers).

System	Registered Volume (MGD)	20 year Permitted Volume (MGD)	Source Name	Source(s)	Segment
Marshfield Country Club Registration 42117102 Permit N/A	0.1	N/A	Well #1 Well #2 Well #3	01G 02G 03G	MA94-10 MA94-10 MA94-10
Mayflower Sand & Gravel Registration 42112201 Permit N/A	1	N/A	Well #1	01G	MA94-15
North Sagamore Water District Registration 42103603 Permit 9P342103601 Public Water Supply ID 4036002	0.18	0.35	Beach Well #1 (Off Line) Black Pond Well #2 Church Lane Well #3	4036002-01G 4036002-02G 4036002-03G 4036002-04G	N/A N/A N/A N/A
Norwell Water Department Registration 42121902 Permit 9P42121901 Public Water Supply ID 4219000	0.68	0.4	Well #1 Well #4 Well #6 Well #7 Well #8 Well #9 (Inactive) Well #10 (Boston Harbor) Well #11 (Inactive)	4219000-01G 4219000-04G 4219000-06G 4219000-08G 4219000-09G 4219000-10G 4219000-11G 4219000-12G	MA94-27 MA94-27 MA94-27 MA94-27 MA94-27 MA94-27 N/A MA94-27
OS Golf Club Registration N/A Permit 9P442123909	N/A	0.22	Well #1	01G	MA94-35
Pembroke Country Club Registration 42123107 Pemit N/A	0.13	N/A		01G 01S	MA94-04 MA94-04
Pembroke Water Department Registration 42123101 Permit 9P42123101 Public Water Supply ID 4231000	0.99	0.27	Hobomock GPW #1 Center St GPW #2 GPW #3 Bryantville Well #4 Windswept Well #5 (Inactive)	4231000-01G 4231000-02G 4231000-03G 4231000-04G 4231000-05G	MA94-05 MA94-05 MA94-05 MA94-05 MA94-05

Table E5 continued. WMA Water Withdrawals in the South Coastal Watershed (excluding cranberry growers).

System	Registered Volume (MGD)	20 year Permitted Volume (MGD)	Source Name	Source #	Segment
Pine Hills LLC Registration N/A Permit 9P342123903 Public Water Supply ID 4239055	N/A	0.46	Main Well Backup Well Jockey Well Four irrigation wells: Forest Edge Well Stonebridge Well Summerhouse Well Winslowe's View Well	4239055-01G 4239055-02G 4239055-03G N/A N/A N/A N/A	MA94-35 MA94-35 MA94-35 MA94-35 MA94-35 MA94-35 MA94-35
Pine Hills LLC, Golf Club Registration N/A Permit 9P442123904	N/A	0.39	Interceptor Well #1 Interceptor Well #2 Interceptor Well #3 Interceptor Well #4	01G 02G 03G 04G	MA94075 MA94075 MA94075 MA94075
Plymouth Country Club Registration N/A Permit 9P442123907	N/A	0.11	Well #1 Well #2	01 02	MA94-35
Plymouth DPW Water Division Registration N/A Permit 9P42123901 Public Water Supply ID 4239000	N/A	6	Lout Pond Well Wannos Pond Well Ship Pond Well North Plymouth Well Bradford Well Ellisville Well South Pond Well #1 South Pond Well #2 Savery Pond Well Great South Pond Little South Pond	4239000-01G 4239000-02G 4239000-03G 4239000-05G 4239000-06G 4239000-07G 4239000-09G 4239000-10G 4239000-11G 4239000-01S 4239000-02S	MA94-16 N/A N/A MA94-16 MA94-16 N/A MA94-16 MA94-16 MA94-34 MA94054 MA94087
Scituate DPW Water Division Registration 42126401 Permit 9P44126402 Public Water Supply ID 4234000	1.49	0.24	Well #10 Websters Meadow Well #11 Websters Meadow Well #17 Stearn Meadow Well #18a Boston Sand Well #19 Edison Station Well #22 Barnes Meadow Well 18b Boston Sand First Herring Brook Old Oaken Bucket Pond	4264000-01G 4264000-02G 4264000-03G 4264000-04G 4264000-05G 4264000-11G 4264000-12G 4264000-01S 4264000-01S	MA94-07 MA94-07 MA94-25 inactive MA94-25 MA94-25 MA94-07 inactive MA94113

Table E5 continued. WMA Water Withdrawals in the South Coastal Watershed (excluding cranberry growers).

System	Registered Volume (MGD)	20 year Permitted Volume (MGD)	Source Name	Source #	Segment
White Cliffs Comm Association Registration 42123928 Permit N/A	0.01	N/A	Eastside Well Well at Third Hole Westside Well	01G 02G 03G	N/A
Widows Walk Golf Course Registration N/A Permit 9P442126401	N/A	0.09	Kent Street Well	01G	MA94-07

APPENDIX F
GRANT AND LOAN PROGRAM AWARDS

Grant awards received for water quality improvements in the South Coastal Watershed are summarized in this appendix. The following state grant programs are included in this summary.

Massachusetts Department of Environment Protection - Massachusetts Watershed Initiative, Wellhead Protection, 104(b)(3) Wetlands and Water Quality, 319 Nonpoint Source, Source Water Protection Technical Assistance, Water Loss Prevention Grant Program, the State Revolving Loan Fund (SRF), and the Community Septic Management Program.

Massachusetts Coastal Zone Management Office – Coastal Pollution Remediation and Coastal Nonpoint Source Programs

Massachusetts Department of Conservation and Recreation – Lakes and Ponds Program

Massachusetts Watershed Initiative Roundtable

U.S. Army Corps of Engineers – Planning Assistance to States Program

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

Excerpted from the MA DEP World Wide Web sites, http://www.state.ma.us/dep/brp/mf/files/glprgm.pdf and http://www.state.ma.us/dep/brp/mf/othergrt.htm.

Massachusetts Watershed Initiative Projects
EOEA Watershed Teams - a partnership of environmental representatives from State and Federal agencies, municipal governments, regional planning agencies, universities, local watershed associations, businesses and other groups - developed annual work plans between 1998 and 2003 to identify the priority issues for each watershed and to target technical and financial assistance that address those needs. Projects funded under the MWI include hydrologic and water quality monitoring and assessment, habitat assessment, non-point source assessment, hydrologic modeling, open space and growth planning, technical assistance and outreach. MWI projects administered by MassDEP in the South Coastal Watersheds are described below.

99-07/MWI *Establishment of a Technical Advisory Committee for the Eel River Nutrient Management Plan.* The purpose of this project was to establish and convene a multi-disciplinary Eel River Technical Advisory Committee (TAC) to assist resource managers evaluate nutrient related issues affecting the Eel River System in Plymouth. The overall goal of the Eel River TAC was to help evaluate the nutrient related ecological health of the Eel River System under current conditions and to determine its potential change under projected alterations in nutrient. Final report dated July 2001 is on file with the MassDEP Groundwater Discharge Permitting Section, Boston.

99-12/MWI *Pilot Project for Identification of Unmapped Tributaries and Intermittent Streams.* The goal was to develop and test statistically based hydrologic methodologies that can be used to better identify perennial and intermittent streams as applicable to the Massachusetts Rivers Protection Act. This pilot led to a two-phase statewide project funded under 104(b)(3) that assists in the intermittent & perennial stream determination (see projects numbered 00-03 and 01-07).

99-13/MWI *Pilot Project for Technical Assistance to Local Officials on Environmental Strategies to Preserve, Protect and Restore Natural Resources.* This project was to provide technical assistance for local officials to protect and restore watershed resources such as water quality, habitat, open space and recreational resources. Specifically, technical documents and circuit rider planning assistance was available to all communities as well as residential build-out analysis for selected towns in the watershed. GeoSyntec Consultants submitted the Final Report dated April 3, 2002 in electronic format to the MassDEP -DWM, Worcester.

01-07/MWI *South Coastal Nonpoint Source Assessment. A* comprehensive nonpoint source pollution assessment in the three towns of Plymouth, Kingston, and Pembroke evaluated the factors that affect water quality in 24 lakes, 4 rivers and 1 estuary. An inventory of each water body was conducted for possible sources of pollution from field inspections and compilation of existing information including GIS layers and community level resource protection measures. A web-based, interactive map was developed that allows the user to access relevant data for a particular water body, including potential sources of impairment, land use in watershed, nutrient loadings and recommended actions to improve water quality. A prioritized list for TMDL development was recommended. GeoSyntec Consultants submitted the Final Report in electronic and paper format to the MassDEP -DWM, Worcester in December 2002.

02-26/MWI *Town of Cohasset - Storm Drain Mapping Initiative Project*. An inventory of Cohasset's storm drain system was conducted that included mapping of storm drain structures over the Town's 10mi^2 land area and compiling information into a user friendly GIS format. This project also supported the town's Phase II stormwater permit requirements. A final report was submitted by Environmental Partners Group, Inc. in October 2003.

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. In the last five years, the following WHP awards were granted in the South Coastal Watershed.

01-11/WHP *Marshfield Wellhead Protection Project.* This project was to determine the origin of threats detected in the Town of Marshfield's water supplies. Specifically, groundwater was sampled for nitrates and MTBE, a survey was conducted to locate USTs, a nitrate loading analysis was performed, and stormwater drainage BMPs were to be designed and installed. Duration 2002-2003.

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

99-06/104 *Lake Surveys for TMDL Development*. The objective for this statewide study is to provide a database for lakes listed as impaired on the 303d list. Data such as secchi, bathymetry, nutrients, aquatic plant species composition and plant coverage will be compiled to determine optimal plant coverage for fisheries. Additionally, the Division will provide technical assistance and transfer of fisheries data to government agencies and private organizations involved in watershed management and assist in the development of volunteer and watershed participant action plans. One pond in the South Coastal Watershed, Jacobs Ponds, was sampled as part of this project in 2001.

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 meet the following 5 criteria. Namely to: 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; and address activities that are identified in the Massachusetts NPS Management Program Plan. In the last five years, the following 319 have been awarded in the South Coastal Watershed.

94-09/319 *Billington Sea Nonpoint Source Pollution Control Demonstration Project.* The purpose of the project is to reduce nutrient and pathogen loading from existing on-site septic systems. An innovative on-site septic disposal system was installed in 1999 for five residences along the Billington

Sea shoreline where water tables, soils and land availability present difficult conditions for upgrading existing systems. The installation was accompanied by an extensive public education effort on NPS of pollution, data on individual lots, and water quality monitoring. Volunteers from the Association for the Betterment of Billington Sea (ABBS) with funding from the Mass. Bays Program monitored the following water quality parameters from 1993 to 1995: temperature, DO, pH, clarity (secchi depth), total phosphorus, fecal coliform and total nitrogen. (Final report by Pilgrim RC&D on file at MassDEP /DWM Worcester.)

98-08/319 *Protection of First Herring Brook*. This project focuses on the protection of First Herring Brook from nonpoint source pollution through the installation of infiltration best management practices (BMPs). First Herring Brook is a tributary to Old Oaken Bucket Pond, the source of the town's drinking water supply. Direct discharge of stormwater has led to the degradation of water quality in the brook. Duration 1998-2000.

01-08/319 *Gray's Beach Park Restoration, Kingston*. This project is part of Kingston's 2000 Stormwater Project that seeks to install stormwater BMPs at a number of sites to improve water quality in the Jones River, Kingston Bay and Plymouth Bay. This phase of the overall project is the redesign of the Gray's Beach Park recreation area to reduce soil erosion and pollution caused by stormwater runoff. BMPs to be installed include swales, sand filters, curbing, and deep sump catch basins. Anticipated environmental benefits will be to treat and redirect stormwater away from Kingston's only public swimming beach, and to begin the work needed to reopen the shellfish beds in Kingston Bay that have been closed for several years. This project complements the NPS reductions from ongoing sewer installation in the Rocky Nook area of Kingston and from a nonpoint source pollution remediation project funded through the CZM CPR Program. Duration 2001-2004.

01-19/319 *Oldham and Furnace Pond Stormwater Treatment.* A 1993 D/F study found high levels of nutrients and invasive aquatic vegetation in both Oldham Pond and Furnace Pond. Stormwater impacts were also noted in the study. A subsequent MA DCR study made specific recommendations for stormwater BMPs. This project will implement structural and non-structural BMPs to prevent the key pollutant, phosphorus, from entering the ponds. This will be done by converting 29 catch basins to leaching catch basins; cleaning, widening, and reseeding a drainage ditch; and strengthening local controls on sedimentation and erosion. Duration 2002-2005.

02-09/319 *Stormwater Remediation for Plymouth Harbor and Plymouth Bay.* Plymouth Harbor is listed on the 1998 303(d) list of impaired waters due to bacterial contamination from stormwater runoff. This bacterial contamination has caused beach closures and has contributed to the prohibition of shell fishing in Plymouth Harbor and Plymouth Bay. This project will fund and implement the third and final phase of the Town of Plymouth's comprehensive program to address bacterial pollution in the area. The first two phases, which are fully funded and underway, are the expansion and improvement of the Plymouth Wastewater Treatment Plant and the initiation of the Plymouth Harbor Pump-Out Program. The latter provides a pump-out boat that services recreational vessels in the harbor, and provides a shore-side pump-out facility that can accommodate larger commercial boats and the residential fleet. The 319 award for the third phase of the Town's clean-up program, will address the impacts of non-point source pollution due to stormwater runoff from the watershed. Three infiltration stormwater treatment devices will be designed and installed in locations that have been selected to provide the maximum amount of bacterial reduction. Water quality monitoring will be conduced before and after installation, in accordance with a Quality Assurance Project Plan, in order to measure and document project success. Development and implementation of an Operation and Maintenance Plan will ensure that the BMPs continue to function properly. The town will promote outreach and education about this project through a variety of activities including press releases, local events, and through the Town's web site. Duration 2003-2006.

03-03/319 *South Coastal Inter-Municipal Water Quality Improvement Project.* This project is part of a tri-community effort to cooperatively reduce stormwater contaminants from entering 15 303(d) listed waterbodies in the towns of Pembroke, Hanover, and Hanson. In 2001 the Towns of Pembroke and Hanson jointly purchased a weed harvester, and in 2000 the same towns jointly applied for and received a CPR grant to install several BMPs for the Indian Head River. The 319 award will purchase

a Johnston 605 PM-10 vacuum street sweeper for the three communities to remove nutrients, toxics, and other pollutants in roadside sediment that currently enter the stormwater infrastructure. A strategic Pavement Cleaning Program will be developed to target the 15 303d-listed waterbodies within the boundaries of the three towns. Storm drain markers, signage, and an intensive public education and outreach program will also be implemented under this proposal. Pembroke is the lead applicant for this cooperative proposal. Duration 2003-2006.

03-12/319 *Stormwater BMPs for Peppermint Brook and Lily Pond.* This project will design and install BMP stormwater control devices to improve the water quality and protect Lily Pond, the primary drinking water supply for the Town of Cohasset. BMP designs will utilize structural improvements and will incorporate Low Impact Development urban retrofit strategies wherever possible to contain and minimize off-site flows and pollutant loading in the Peppermint Brook subwatershed. Structural BMP improvement options to be considered will include hooded catch basins, bioretention facilities, rain gardens, roadside swales with biofilters, and spill containment facilities. Anticipated pollutant load removal is 658 kg/yr of nitrogen and 22 kg/yr of phosphorus. Duration: 2004 – 2007. (This project is also funded through SRF-CW see Project #04-1945.)

00-17/319 *Local Development of Stormwater Best Management Practices on Residential Property: Overcoming Barriers to Implementation.* The Riverways Program will identify the barriers and motivations to people implementing stormwater Low Impact Development BMPs on their property, and will apply that information to the development of a targeted outreach and education program in two areas including the First Herring Brook subwatershed. Residents will become involved in developing projects that begin to reduce the amount of lawn cultivated, replacing that area with rain gardens, trees, and native plantings. This will reduce the volume of stormwater runoff and the amount of nonpoint source pollution being contributed to stormwater from residential property. The project is an implementation measure of the Source Water Assessments **00-07/SWT** and **00-14/SWT** described below. Duration: 2004 – 2007

03-11/319 *Billington Sea Stormwater Remediation Project.* The Town of Plymouth plans to improve the water quality in Billington Sea by mitigating the adverse impacts of stormwater runoff and sedimentation through the implementation of Best Management Practices along Billington Sea Road and Black Cat Road. The project is being done in concert with several other pollution remediation projects along Town Brook to significantly improve water quality in the subwatershed. Targeted pollutants include fecal coliform, e. coli, total phosphorus, suspended sediments, and nitrogen. It is anticipated that phosphorus loading will be reduced from 52 lbs/yr to 15.6 lbs/yr, and nitrogen loads from 546.70 lbs/yr to 218.70 lbs/yr. BMPs include deep sump/hooded catch basins followed by infiltration galleys and extensive public outreach and education. Duration: 2004 – 2007

04-02/319 *Innovative Stormwater Technology Transfer and Evaluation Project - STATE-WIDE.* The goal of this project is for UMass/Amherst to provide technology transfer information about innovative stormwater BMPs to MassDEP, conservation commissions, local officials, and other BMP Users. The project will develop a validated source of technical information on stormwater BMPs, provide end users with qualified information to make appropriate technology implementation decisions, and will assist communities to maximize environmental benefits of grant programs by focusing efforts on technologies that have the most promising potential to reach specific water quality objectives. Duration: 2004 – 2007

04-03/319 *Low Impact Development Training and Technical Assistance for Local Decision Makers.* Low Impact Development (LID) is a site design strategy for residential and commercial development that mimics the predevelopment site hydrology with a goal of reducing water quality impacts. LID uses site design techniques that store, infiltrate, evaporate, and detain runoff. Use of these techniques helps to reduce off-site runoff and ensure adequate groundwater recharge. Through this project, the North and South Rivers Watershed Association will provide direct training and technical assistance to four communities (Plymouth, Kingston, Pembroke and Hanover) that will promote and implement LID techniques through changes in local regulations and through implementation of direct LID control measures. A conceptual LID design will be developed for each of the four communities. Duration: 2004 – 2007.

04-09/319 *Stormwater Management Retrofits for the Samoset Street Outfall to Plymouth Harbor.* The Samoset Street outfall, which discharges to the harbor on the southern side of Town Wharf, drains approximately 118 acres of roadway and high-density residential and commercial property. The outfall is of great concern because of its proximity to 2,204 acres of closed shellfish beds. The goal of this project is to improve the quality of surface water runoff entering Plymouth Harbor at the Samoset Street outfall. Bioretention facilities will be constructed at three priority sites to capture and treat surface runoff. Designs for the work were produced under a 2003 Coastal Pollution Remediation grant from the CZM program. The pollutant of concern is bacteria, although it is anticipated that other pollutants will also be removed by the BMPs. The project will be evaluated through development and implementation of a MassDEP - and EPA-approved QAPP. Duration: 2005 – 2008.

2005-06/319 *Pembroke Low Impact Development Retrofit Implementation Project*. Conceptual designs will be finalized and implemented for the multiple LID BMPs at the Town Hall and the Oldham Pond Boat Ramp.

2005-07/319 *Retrofit Implementation at the Kingston Intermediate School.* A series of LID BMPs will be installed at the Kingston Intermediate School, and the work will be used to further outreach and education about the benefits of low impact development.

2005-09/319 *Old Oaken Bucket Pond Watershed NPS Improvements*. This project in the town of Scituate builds upon a previous 319 project (98-08/319) and will install LID BMPs at five locations within the watershed to encourage infiltration and recharge as well as water quality improvement.

604(b) Water Quality Planning Grant Program

This grant program is authorized under Section 604(b) of the Federal Clean Water Act. The program is designed to assist eligible recipients in providing water quality assessment and planning assistance to local communities. Priority is given to projects that provide diagnostic information to support the MassDEP's watershed management activities and to projects located in one of the priority watersheds targeted for assessment work by the MassDEP. In the last five years, the following 319 have been awarded in the South Coastal Watershed.

95-03/604 *South Shore Nonpoint Source Management Plan*. This project will provide data for the Department and local officials to characterize the problems of nonpoint sources of pollution in the South Coastal Watershed and provide management tools that can be implemented by communities under their home rule authority. (Final Report dated July 1998 by MAPC is on file at MassDEP /DWM, Worcester.)

03-04/604 *South Coastal Estuaries Monitoring.* The Town of Kingston in conjunction with the Towns of Duxbury and Plymouth will conduct a water quality monitoring in the Jones River, Eel River and Town Brook sub-watersheds and the Kingston Bay, Duxbury Harbor, Plymouth Harbor and Ellisville Harbor estuaries consistent with the Massachusetts Estuaries Project water quality data requirements. The data collected will be employed in assessments, development of TMDLs, and nutrient management for these coastal watersheds. The Town of Kingston will recruit, train and oversee a Volunteer Monitoring effort to complete the sampling effort. Duration 2003-2006.

SOURCE WATER PROTECTION TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM

The Source Water Protection Technical Assistance/Land Management Grant Program provides funds to public water suppliers and third party technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface drinking water supplies. In the last five years, the following Source Water Protection grants have been awarded in the South Coastal Watershed.

99-04/SWT *Aaron Reservoir & Lily Pond Source Water Protection Project*. A Surface Water Supply Protection Plan will be developed to protect the Aaron River Reservoir and Lily Pond watersheds. Lily Pond is the only surface water supply for the Town of Cohasset and serves over 7,000 residents. The development and implementation of this protection plan provides full understanding of the

sources and pathways of pollutants, and a strategy to effectively prevent them from contaminating the water supply. (Final report dated June 2002 is on file with the MassDEP/DWM, Worcester.)

00-07/SWT *First Herring Brook Source Water Protection Project*. A shoreline survey and an assessment of the First Herring Brook will be conducted in the Town of Scituate, and findings will be presented for public education. In order to maximize the educational potential of this project, science curriculum units will be made available to local schools. This project will be conducted in concert with the MassDEP SWAP program, and the comprehensive Surface Water Supply Protection Plan (SWSPP) being developed by Comprehensive Environmental, Inc. (CEI) as part of the Source Water Protection Project 00-14 SWT, see below. Duration 2001-2003.

00-14/SWT *Old Oaken Bucket Pond Source Water Protection Project*. A Surface Water Supply Protection Plan will be developed for 3 lakes in the Town of Scituate. It will identify potential sources and pathways of contamination, and provide a plan to reduce nonpoint source discharges to the Tack Factory Pond, Scituate Reservoir, and Old Oaken Bucket Pond. Alternative road standards will be reviewed to reduce the threat on the public water supply of stormwater from impervious surfaces and other future developments. This project will be conducted in concert with a shoreline survey conducted by the North and South Rivers Watershed Association as part of Project 00-07 SWT, above. Duration 2001-2003.

WATER LOSS PREVENTION GRANT PROGRAM

The purpose of the Water Loss Prevention Grant Program is to assist public water systems to address drinking water supply and distribution systems water losses and to support projects that promote the implementation of drinking water conservation programs. Priority given to those public water systems who have withdrawal points located within medium or highly stressed basin and as per the Water Resources Commission. Stressed basins have been identified y the Water Resources Commission as having: the volume of streamflow significantly reduced; a significant environmental concern that would benefit from a reduction in demand or; having an identified issue where the public water system cannot meet deman (i.e., MassDEP authorized Emergency Declaration).

04/08/WLP Department of Correction Water Loss Prevention Grant Project. The project will identify and reduce unaccounted for water loss from the Massachusetts Department of Correction drinking water works and distribution systems that serve MCI-Bridgewater, MCI-Norfolk, MCI-Shirley, and MCI-Plymouth. Duration 2005-2006.

STATE REVOLVING FUND (SRF) - DRINKING WATER 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 MassDEP, Division of Municipal Services, and the Massachusetts Water Pollution Abatement Trust (Trust) jointly administer the DWSRF Program. The following projects in the South Coastal Watershed were awarded Drinking Water SRF loans/grants.

Abington/Rockland (DWSRF 04-1984) *Upgrades to the Joint Abington/Rockland Water Treatment Plants.* This project includes improvements and upgrades to the Joint Water Works' three treatment plants. These include mix and flocculation upgrades, sludge collection, clearwell baffling at the Hingham Street Plant; tube settlers and security monitors at the Great Sandy Bottom Plant; and a replacement well and new roof at the Myers Avenue Plant. The improvements will improve chemical mixing and flocculation, improve sludge collection abilities, improve disinfections capabilities, improve the finished water turbidity, reduce energy use, improve operations, increase plant security, automate the facilities, and improve the water quality output from all the plants.

Norwell (DWSRF – 1697) *South Street Well Field Improvements.* There are three project components. Namely, one public water supply well will be removed and reinstalled out of the surface water Zone Of Contribution; a Zenon membrane filtration plant will be built for chlorine and aeration

treatment, and the water main will be extended 400 linear feet to connect the two service areas of Norwell and add SCADA.

Cohasset (DWSRF –1992) *System Wide Capital Improvement Program*. This is a multi-phase project involving distribution system and source water improvements in Contract 2004-1 and water treatment plant and watershed improvements in Contract 2004-2. Watershed improvements include repair of sludge dewatering lagoons to better handle, contain and process the residuals, dredging Lily Pond and repairing a leak in the Bound Brook Control Structure. Improvements of note to the overall system include installing a new raw water intake at Aaron River Reservoir to provide a secondary source of water for the Lily Pond Treatment Plant and to connect the Cohasset public water supply infrastructure to the Town of Hingham public water supply system so that Hingham may meet water system demand without exceeding its WMA permit limits. (See other improvements to Lily Pond watershed funded by 319 and SRF, projects 03-12/319 and SRF CW 04-1945.)

Plymouth/Carver Region (2005-01/SRF) *Ground-Water Resources of the Plymouth-Carver Region, Massachusetts: Evaluating Competing Water Needs and Demand.* This project will be conducted by USGS to enhance the understanding of the ground and surface water resources of the Plymouth-Carver region in southeastern Massachusetts. The results of the study will have direct application to similar coastal aquifer systems. Ground-water flow models (steady state and transient) will be developed and made available to local and state water-resources managers.

State Revolving Loan Fund (SRF) - Clean Water 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. MassDEP, Division of Municipal Services, and the Massachusetts Water Pollution Abatement Trust jointly administered the SRF Program. Each year the MassDEP 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. The following projects in the South Coastal Watershed were awarded CWSRF loans.

Cohasset (CWSRF-168) *Construct Phase II Collectors.* Upgrade and expand the wastewater treatment plant and collection system including the construction of a new effluent outfall diffuser.

Cohasset (CWSRF-169) *Construct Wastewater Treatment Plan Interceptors.* Upgrade and expand the WWTP including the construction of a new outfall, major collection system interceptor and pumping stations.

Cohasset (CWSRF 04-1945) *Non-Point Source Pollution Control*. This project will design and install BMP stormwater control devices to improve the water quality and protect Lily Pond, the primary drinking water supply for the Town of Cohasset. BMP designs will utilize structural improvements and will incorporate Low Impact Development urban retrofit strategies wherever possible to contain and minimize off-site flows and pollutant loading in the Peppermint Brook sub-basin of Lily Pond drainage area (King Street and Route 3A) and for areas discharging into Aaron Reservoir. Structural BMP improvement options to be considered will include hooded catch basins, bioretention facilities, rain gardens, roadside swales with biofilters, and spill containment facilities. Anticipated pollutant load removal is 658 kg/yr of nitrogen and 22 kg/yr of phosphorus. Duration: 2004 – 2007. (This project is also funded through 319 see Project #03-12/319.)

Duxbury (CWSRF ---) Construction of Community Septic Systems in Duxbury contributed to the water quality improvements in Kingston Bay that permitted the shellfish beds to be opened. Was this Shared Title V system for 28 residences on Bay Road (Project ID 239)? Project 575 or 913?

Kingston (CWSRF-411) *Construction of the Wastewater Treatment Plant, Interceptor and Pumping Station.* This construction loan will continue the previous financing of the Town of Kingston's

Wastewater Management facilities. The proposed construction over three calendar years (1999-2001) includes a collection system to serve the Rocky Nook area, Kingston Center and other priority areas with failing septic systems. The project includes a new WWTP with advanced treatment processes. Disposal of the effluent will be through leaching changers at a private gold course. Reclaimed water from this project will be provided to the golf course for turf irrigation. The project will enhance the surface water quality in the Jones River and Duxbury Bay. The project will eliminate a major risk to public health due to elimination of several failing or marginal septic systems.

Kingston (CWSRF 03-1734) *Construct Sewers on Route 3A (Contract #7).* The sewer collection system was extended approximately 47,000 feet as recommended in the 1998 final facilities plan. The sewer extension will service the existing commercial area along Route 3A and also the existing residential homes in the environmentally sensitive area between the Jones River and Smelt Brook. Completion of this project will continue the water quality improvements for the shellfish beds in Kingston Bay.

Kingston (CWSRF 05-1918). *Construct Sewers on Route 3A (Contract #7)* This project represents the fourth area of sewer construction in the town, incorporating approximately 35,800 linear feet of gravity sewer, 7,800 linear feet of pressure sewer, 82 individual grinder pumps, 3 pumping stations, and 4,000 feet of force main in the Route 3A area. This area has had numerous public health concerns for many years associated with failed septic systems and breakouts. The objective is to improve water quality in the adjacent and down gradient waters of the Jones River and Kingston Bay, which have been impacted by high bacterial counts.

Hanover (CWSRF-911). *Stormwater Management and Water Supply Plan.* This planning award will allow the Town to begin to protect its four water supply well fields that are close to potentially polluted stormwater sources as well as manage stormwater impacts to the North River and its tributaries within Hanover.

Marshfield (CWSRF-909) *Construction of the Ocean Street Interceptor, Pumping Station, Force Main and Collectors.* This award provided for the construction of 8.7 miles of sewers on the Ocean Street and abutting neighborhoods.

Plymouth (CWSRF-324) *Manomet Landfill Capping*. This project will reduce the impacts from an unlined landfill on the Plymouth/Carver Sole Source Aquifer and near Long Island Pond. Heavy metals and nutrients contained win the leachate and groundwater emanating from the landfill has impacted Long Pond.

Plymouth (CWSRF-599) *Construction of a new Wastewater Treatment Plant modified pumping station and force mains.* The 3.5 MGD wastewater treatment plant at the “Camelot” site will provide advanced wastewater treatment with both a groundwater and ocean discharge. The proposed wastewater facilities will eliminate the existing water quality problems in Plymouth Harbor caused by outdated treatment units and the existing WWTP’s discharge. The groundwater quality of the Plymouth/Carver Sole Source Aquifer will be protected and enhanced by the elimination of failing on-site septic systems.

Plymouth (CWSRF-1116) *Eel River Nutrient Management Plan/EIR.* PAC #02-21.

Rockland (CWSRF 04-1929) Planning funds to develop a Stormwater Management and Aquifer Protection Plan

Scituate (CWSRF-1129) *Stormwater Management Plan.* PAC #02-29.

Scituate (CWSRF-1130) *Construct Greenbush Sanitary Sewers. PA*C #02-22.

Scituate (CWSRF 04-1937) *Construction of Cliffs Area Sanitary Sewers*. The project will construct sewers in the three areas of the Cliffs section of town, identified as needs areas in the 1995 Final Facilities Plan, that have documented small lot sizes, poor soils and high groundwater levels. The

project will consist of 22,000 feet of lateral sewers, 4,500 feet of force main, 500 feet of grinder pump pressure mains and three pumping stations. The goal of this project is to improve the water quality in the North River and Scituate Harbor reducing bacterial contamination to shellfish beds and public beaches.

COMMUNITY SEPTIC MANAGEMENT PROGRAM

The enactment of the Open Space Bond Bill in March of 1996 provided new opportunities and stimulated new initiatives to assist homeowners with failing septic systems that threaten ground and surface waters. The law appropriated $30 million to the MassDEP for a state & locally administered revolving fund known as the Community Septic Management Program. Working together, the MassDEP and the Massachusetts Water Pollution Abatement Trust provide this permanent loan program with three options from which a local government can provide low interest loans to eligible homeowners for septic system improvements. Currently, there are nine municipalities in the South Coastal Watershed participating in the Community Septic Management Program. They are Bourne, Duxbury, Halifax, Hanson, Kingston, Norwell, Pembroke, Plymouth, and Scituate.

MASSACHUSETTS COASTAL ZONE MANAGEMENT OFFICE

The **Coastal Pollution Remediation (CPR) Grant Program** provides competitive grant funding to the 220 municipalities in the Massachusetts Coastal Zone. The CPR program is funded annually through the Massachusetts Environmental Bond; awards can be used for construction of stormwater remediation system, assessment studies to identify the source(s) of pollution and design remediation systems, and the installation of marine pump-out facilities. The four primary goals are to: identify and treat urban stormwater runoff from municipal roadways; improve coastal resources such as shellfish beds and fish habitat and spawning areas; demonstrate traditional and innovative remediation systems; and educate the public about stormwater runoff. The CPR grant program works on a reimbursement basis, with municipalities required to provide a 25% match of the total project cost (cash or in-kind services) *and* complete *the project by* the end of the State Fiscal Year, June 30. Fiscal year 2004 marks the ninth year of the program, and over the past eight years the program has awarded nearly 4 million dollars to fund 82 projects. The following grants were awarded in the South Coastal Watershed between 1998 and 2003.

Hanover/Pembroke – FY 2001: Through a cooperative effort between the Towns of Hanover and Pembroke an engineering design was developed for a stormwater mitigation to the Indian Head River. The Elm Street drainage consists of a series of shallow catch basins that is releasing sediment and bacterial pollution into the anadromous fish habitat. FY2002 funds were used to install the BMP. Pre-construction water quality data are available from CZM files.

Hanover/Pembroke – FY 2002: The stormwater design funded by CPR in FY2001 was installed with a FY2002 award. Deep sump catch basins directed into leaching catch basins for infiltration were installed at the Elm Street outfall to Indian Head River. Pre-construction water quality data is available from CZM files.

Kingston – FY 2000: The Town of Kingston developed BMP engineering plans for a stormwater BMP in the Rocky Neck area as a compliment to the sewer extension in the same area. The project goal was to remove sediment from stormwater runoff into adjacent waters that had been responsible for shellfish closures in Kingston Bay and violated State water quality standards for primary contact recreation. Water quality data is available from CZM files.

Kingston – FY 2001: The Town of Kingston installed the stormwater BMP on Rocky Nook Avenue that was designed through the CPR FY00 assessment grant. A stormwater drainage and mitigation system composed of deep sump catch basins, drainage conduit, a proprietary technology pre-treatment system and an infiltration system to remove sediments.

Marshfield – FY 2004: The Town of Marshfield received an award to develop a comprehensive assessment study to identify sources of pollution and define remedial actions to control stormwater runoff for a 440-acre watershed draining to an unnamed tributary to the South River in Marshfield. The Town of Marshfield, the Marshfield Stormwater Working Group, the North and South Rivers

Watershed Association, and Horsley & Witten will collaborate in the development of the assessment to recommend appropriate BMPs and lead an effort to develop remediation plans at least to 25% design level. If successful, the town would seek additional funding in FY2005 to implement the designs.

Plymouth – FY 2003: The Town of Plymouth received an award to assess the Samoset Street drainage area and design appropriate Best Management Practice(s) to minimize the impact of stormwater runoff from this site, considered one of the four top priority sites of stormwater into Plymouth Harbor. This action is part of a comprehensive program by the Town of Plymouth to address bacterial pollution into Plymouth Harbor that included upgrades to the wastewater treatment plant (CWSRF-599 and CWSRF-1116), the installation and operation of pump-out facilities for boat waste, stormwater BMPs at three other sites (02-09/319) and baseline water quality monitoring for the Estuaries Project (03-04/614).

Plymouth - FY 2003: The Town of Plymouth reconstructed the stormwater drainage in the parking lot at the base of Main Street Extension. A stormwater infiltration basin (BMP) was installed.

Scituate – FY 2000: The Town of Scituate mitigated stormwater impacts from three sub-basins to First Herring Brook by installing three BMP technologies (vegetated swale, wetland/swale and a proprietary technology Vortechnics). No water quality data is available.

Scituate – FY 2001: The Town of Scituate project was a continuation of a BMP implementation in First Herring Brook subwatershed that was initiated in FY00 as a comprehensive resource protection approach. It entailed the installation of two BMPs, a wetland swale and vegetated filter strip, on Eisenhower Lane and Satuit Trail to mitigate stormwater runoff to First Herring Brook. First Herring Brook supports an anadromous fish run and is a direct tributary to the North River that contains shellfish resources that are often closed due to bacteria contamination immediately downstream of the brook. Related projects: SWP 00-07, 319--- and CPR FY2000.

The primary goal of the **Coastal Nonpoint Source Grant Program** (formerly known as the Coastal Pollution Remediation Plus grant program) is to improve coastal water quality by reducing or eliminating nonpoint sources of pollution through measures and strategies consistent with the Massachusetts Coastal Nonpoint Source Control Program. This grant program was developed to complement our Coastal Pollution Remediation grant program and to address more general areas of nonpoint source control. Projects eligible for funding include, but are not limited to: assessment, identification, and characterization of nonpoint sources; the development of transferable tools (nonstructural best management practices), such as guidance documents, model by-laws, and land use planning strategies to improve nonpoint source control and management; and the implementation of innovative and unique demonstration projects that utilize nonpoint source best management practices.

FY 2003: The Town of Plymouth reconstructed the stormwater drainage in the parking lot at the base of Main Street Extension. A stormwater infiltration basin (BMP) was installed.

FY 2004: The project calls for the development of a model stormwater bylaw that incorporates the concepts and principles of low impact design/development and conservation planning in the Towns of Duxbury, Marshfield, Plymouth

FY 2005: The Cohasset Center for Student Coastal Research received $16,712 for an NPS assessment project in the Gulf River Watershed (Scituate and Cohasset).

FY 2005: The North & South Rivers Watershed Association received $35,000 for its *Greenscapes* outreach campaign.

FY 2005: The Storm Windows program is a three to five year, multi-faceted outreach campaign to educate the public about polluted stormwater runoff.

MASSACHUSETTS WATERSHED INITIATIVE ROUNDTABLE

EOEA Watershed Teams - a partnership of environmental representatives from State and Federal agencies, municipal governments, regional planning agencies, universities, local watershed associations, businesses and other groups - developed annual work plans between 1998 and 2003 to identify the priority issues for each watershed and to target technical and financial assistance that address those needs. Projects funded under the MWI include hydrologic and water quality monitoring and assessment, habitat assessment, non-point source assessment, hydrologic modeling, open space and growth planning, technical assistance and outreach. In addition to the MWI projects managed by the MassDEP and described above, the MWI financed the following water quality improvement projects in the South Coastal Watershed during the period from 1998 through 2003. The state agency that managed the project is identified.

Jones River, Kingston: *Water Quality Inventory of the Jones River Watershed*. Funds from FY 2002 were provided to the MA DCR to manage this project. A draft report was submitted in July 2002 by GZA consultants to MA DCR.

Town Brook/Billington Sea, Plymouth: *Town Brook Dam Removal and Alewife Habitat Restoration.* The town of Plymouth, MA DFG, Riverways Program, and numerous partners breached the Billington Street Dam on Town Brook utilizing MWI funds from FY 2000 and NOAA's Community-Based Restoration Program. During September 2002, the US Army Reserves removed the dam, restored 80 linear feet of bank and 3500 square feet of natural pool and riffle complex, and provided passage for alewife and blueback herring to reach the spawning grounds in Billington Sea. This was the first coastal river restoration of anadromous fish habitat managed by the River Restore Program.

Cohasset, Scituate and Norwell: *Inventory and Mapping of the South Coastal Watershed Storm Water Drainage.* Funds from FY 2002 were managed by MassGIS to log GPS coordinates and attributes for each storm drain outfall in the three municipalities of Cohasset, Scituate and Norwell. The contract awarded in June 2002 to the Town of Cohasset from which the project is being coordinated.

South Coastal Watershed: *Regional Open Space Plan for the South Coastal Watershed.* Funds from FY 2002 were managed by the EOEA/MWI. GeoSyntec was awarded the contract to prepare a regional open space plan. The plan was presented in January 2004 at a meeting of the South Coastal Watershed Network.

DEPARTMENT OF CONSERVATION AND RECREATION
LAKES AND PONDS GRANT PROGRAM

The Department of Conservation and Recreation, Lakes and Ponds Program, provides grant funding and technical assistance to communities and citizen groups, helps to monitor water quality at various public beaches to ensure public safety, and provides educational materials to the public about various lake issues. For more information on the Lakes and Ponds Grants Program, see http://www.mass.gov/dcr/waterSupply/lakepond/lakepond.htm. Since 1994, twelve Lakes and Pond grant have been awarded within the South Coastal Watershed as summarized below.

Cohasset – Lily Pond (FY 2002): The Town of Cohasset prepared a lake and watershed management plan for Lily Pond. The plan studied the ecological impacts of accelerated eutrophication primarily due to nutrients and aquatic nuisance vegetation and will recommend appropriate long and short-term solutions.

Duxbury – **Island Creek Pond** (FY 1995): The Town of Duxbury prepared a lake and watershed management plan for Island Creek Pond (WBID MA94073) that determined the cause for excessive weed growth was nutrient inputs. Remediation recommendations were included.

Duxbury – **Island Creek Pond** (FY 1999): The Town of Duxbury seeded three test plots with native plants in an innovative and experimental method for controlling non-native Milfoil and Fanwort in Island Creek Pond (WBID MA94073). The goal was to replace the invasive plants with native vegetation that grows along the lake bottom in a carpet-like fashion so as not to fill the water column.

Duxbury and Pembroke – **Lower Chandler Pond** (FY 1997): The Towns of Pembroke and Duxbury used the herbicide SONAR to control the exotic plant, Fanwort (*Cabomba*) at Lower Chandler Pond (WBID MA94091). Fanwort has adversely impacted recreational activities on the pond.

Hanson – **Wampatuck Pond** (FY 1998): The Town of Hanson will control shoreline erosion at Wampatuck Pond (WBID MA94168) by channeling stormwater from an adjacent parking area into infiltration basins.

Kingston – **Smelt Pond** (FY 1994): The Town of Kingston identified through monitoring the potential sources excessive nutrient inputs to Smelt Pond (WBID MA94184) was from cranberry fertilization and septic system leachate. A management plan with recommended best management practices was prepared.

Kingston – **Crossman Pond** (FY 1996): The Town of Kingston performed hydrological testing, identified aquatic plants and methods to control nuisance weeds, then implemented the BMP to control weeds at Crossman Pond (WBID MA94032).

Kingston – **Silver Lake** (FY 2002): The Town of Kingston & Jones River Watershed Association will acquire environmental information for Silver Lake (WBID MA94143) that includes bathymetric data, storage volumes and water quality data. Also included is a community awareness program that works with local government agencies on managing the lake and educating local residents on protecting the lake.

Norwell – **Jacobs Pond** (FY1994): The Town of Norwell developed a three phase project for Jacobs Pond (WBID MA94077) that included the following components: a management plan was prepared; public access was improved through trail work, signage and maps; and a dock was constructed for fishing and launching canoes and small sailboats.

Pembroke – **Oldham Pond** (FY 2000): The Town of Pembroke prepared a study of the sources of phosphorous inputs to Oldham Pond (WBID MA94114) and recommended appropriate best management practices to address these sources. This was an implementation action of a 1993 Diagnostic/Feasibility Study prepared by Baystate Environmental Consultants.

Plymouth – **Billington Sea** (FY 1998): The Town of Plymouth and the Billington Sea Association developed an educational brochure for the residents in the Billington Sea watershed (WBID MA94007). Emphasis was on proper management of septic systems, fertilizers, and household hazardous material products. Also included was an algaecide treatment to improve water quality.

Scituate – **Musquashcut and Chain Ponds** (FY 1999): The Town of Scituate prepared a lake and watershed management plan for Musquashcut (WBID MA94105) and Chain Ponds to control water quality. Study components included watershed mapping, a hydrologic budget, water quality sampling, and recommended actions.

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Scituate – **Musquashcut Ponds:** US ACOE will prepare a tidal flushing study for the Town of Scituate. The town-owned tide gate is currently open once a month on the high tide. The study will analyze the effect of opening the gate more frequently to control the midge population and to reduce salinity stresses on the fish population. As of July 2003, the scope was complete but the study was put on hold until further funding becomes available. (US ACOE July 31, 2003).

APPENDIX G

DMF SHELLFISH DATA, SOUTH SHORE COASTAL WATERSHED

It is the mission of the Massachusetts Division of Marine Fisheries (DMF) to manage, develop, and protect the Commonwealth's renewable living marine resources to provide the greatest public benefit. DMF fosters protection of the marine environment by cooperating with other state and federal agencies on pollution abatement, coastal wetlands protection and other programs concerning coastal waters and marine life. DMF monitors coastal contaminant levels in fish and shellfish, operates a shellfish depuration facility, and evaluates the impacts of coastal development on marine fish and their habitats. DMF provides assistance to local shellfish officers on matters affecting the management of shellfish, and provides expertise on anadromous fish and construction assistance on fishways. Other DMF programs assist commercial and recreational fishermen and educate the public on marine resource issues and values.

The DMF Shellfish Management Program manages shellfish growing areas in compliance with the National Shellfish Sanitation Program (NSSP). The NSSP is a federal/state cooperative program recognized by the U.S. Food and Drug Administration (USFDA) and the Interstate Shellfish Sanitation Conference (ISSC). One goal of this program is the sanitary control of shellfish harvested and sold for human consumption. Growing areas are managed with respect to shellfish harvest for direct human consumption and comprise at least one or more classification areas. The classification areas are the management units, and range from being Approved to Prohibited (six different classification types in all) with respect to shellfish harvest (Tables G1 and G2).

Table G1. DMF Shellfish Management Program Managed Shellfish Growing Area Classifications.

CLASSIFICATION TYPE	Definition
Approved	Open for harvest of shellfish for direct human consumption.
Conditionally Approved	During the time the area is approved, it is open for harvest of shellfish for direct human consumption subject to local rules and state regulations.
Conditionally Restricted	During the time the area is restricted, it is only open for the harvest of shellfish with depuration subject to local rules and state regulations.
Restricted	Open for harvest of shellfish with depuration subject to local rules and state regulations for the relay of shellfish.
Management Closure	Closed for the harvest of shellfish. Not enough testing has been done in the area to determine whether it is fit for shellfish harvest or not.
Prohibited	Closed for the harvest of shellfish.

Table G2. Summary of Shellfish Classification Area Information as of July 2000.

Classification Type	Area (Acres)
Approved	113449
Conditionally Approved	395
Restricted	0
Conditionally Restricted	0
Prohibited	14355
Management Closure	0
TOTAL	**128199**

As of July 2000 DMF classified approximately128199 acres in the South Coastal Watershed. Classification Area Codes and Growing Area Names identify each DMF shellfish area (Table G3). The South Coastal Watershed 2001 Water Quality Assessment Report describes each shellfish growing area (converted to square miles) by its classification area code within the appropriate MA DEP DWM assessment segment. However, the total acreage of DMF identified shellfish growing areas, including areas not within an MA DEP assessment segment, is displayed in Table G3.

Table G3. DMF - Shellfish Project Classification Area Information as of July 2000.

Growing Area Name	Classification Area Code	Classification Type	Area (Acres)
Sandwich North Coastal	CCB35.0	Approved	3700*
Bourne North Coastal	CCB38.0	Approved	2833
Plymouth South Coastal	CCB39.0	Approved	17476
Plymouth South Coastal	CCB39.1	Prohibited	1090
Plymouth South Coastal	CCB39.2	Prohibited	5
Plymouth South Coastal	CCB39.3	Approved	348
Ellisville Harbor	CCB40.0	Prohibited	8
Plymouth North Coastal	CCB41.0	Approved	22235
Plymouth North Coastal	CCB41.1	Prohibited	736
Plymouth North Coastal	CCB41.2	Approved	96
Plymouth Harbor	CCB42.0	Approved	649
Plymouth Harbor	CCB42.1	Prohibited	2206
Plymouth Harbor	CCB42.3	Prohibited	970
Kingston Bay	CCB43.1	Approved	133
Kingston Bay	CCB43.2	Prohibited	989
Kingston Bay	CCB43.3	Prohibited	131
Jones River	CCB44.0	Prohibited	66
Duxbury Bay	CCB45.0	Approved	4523
Duxbury Bay	CCB45.1	Prohibited	1
Duxbury Bay	CCB45.2	Conditionally Approved	31
Duxbury Bay	CCB45.20	Approved	46
Duxbury Bay	CCB45.21	Approved	16
Duxbury Bay	CCB45.3	Prohibited	1
Bluefish River	CCB46.1	Approved	27
Bluefish River	CCB46.2	Conditionally Approved	47
Bluefish River	CCB46.3	Prohibited	3
Bluefish River	CCB46.5	Prohibited	8
Bluefish River	CCB46.5	Prohibited	9
Back River	CCB47.0	Approved	405
Duxbury Beach	MB1.0	Approved	13549
Cohasset Harbor	MB10.0	Approved	400
Cohasset Harbor	MB10.1	Prohibited	225
Cohasset Harbor	MB10.2	Prohibited	16
Cohasset Harbor	MB10.3	Conditionally Approved	16
Cohasset Harbor	MB10.4	Prohibited	12
Cohasset Harbor	MB10.5	Conditionally Approved	2
Little Harbor	MB11.0	Prohibited	157

Growing Area Name	Classification Area Code	Classification Type	Area (Acres)
Nantasket Beach	MB12.0	Prohibited	6201
Marshfield East Coastal	MB2.0	Approved	9552
Marshfield East Coastal	MB2.2	Prohibited	268
Green Harbor	MB3.0	Prohibited	50
Scituate South Coastal	MB4.0	Approved	13420
North River	MB5.1	Conditionally Approved	299
North River	MB5.2	Prohibited	186
North River	MB5.3	Prohibited	49
North River	MB5.4	Prohibited	7
North River	MB5.5	Prohibited	15
South River	MB6.0	Prohibited	464
Scituate Harbor	MB7.0	Prohibited	206
Scituate North Coastal	MB8.0	Approved	13658
Scituate North Coastal	MB8.1	Approved	12
Cohasset North Coastal	MB9.0	Approved	10372
Cohasset North Coastal	MB9.1	Prohibited	278

*Approximate acreage in South Coastal Watershed. Growing area is also a portion of the Boston Harbor Watershed.

APPENDIX H

Technical Memorandum For The Record
By: Gerald M. Szal, MassDEP, Division of Watershed Management
Subject: Pilgrim Nuclear Power Station: Review Of Intake And Discharge Effects To Finfish
Date: December 5, 2005

Estimated impacts to aquatic life from the operation of the Pilgrim Nuclear Power Station are divided into two categories: those from the intake of cooling water, and those from the discharge of heated effluent. Intake effects are further divided into two categories: those from impingement on intake screens at the entry of the intake bay; and those from entrainment of fish eggs and larvae through the facility. Discharge effects discussed include those from the cooling water discharge and those from the heated backwash used to control biofouling in the intake bays.

Intake Effects

Impingement

Effects to winter flounder:
Impingement effects to this species are typically small at the Pilgrim facility. An estimated total of slightly over 2,000 winter flounder were impinged in year 2004. Most, if not all, of these were young of the year. This is the second highest impingement rate in the past 25 years of monitoring, but does not appear to represent a significant impact to the population.

Effects to other finfish species:
The following fish species were considered those suffering the greatest numerical losses due to impingement over the last 11 years of monitoring at Pilgrim (Table 3, Impingement Section, Environmental Protection Group 2005):

Table 1

Year	Atlantic silverside	Atlantic menhaden	blueback herring	grubby	rainbow smelt	alewife
1994	36,498	58	269	1,094	9,464	123
1995	13,085	1,560	1,244	648	2,191	39,884
1996	16,615	2,168	2,462	1,347	3,728	216
1997	6,303	1,329	424	405	1,978	317
1998	6,773	1,423	134	335	1,656	158
1999	8,577	42,686	550	628	875	610
2000	25,665	34,354	5,919	1,105	13	2,443
2001	4,987	3,599	229	517	879	1,618
2002	4,430	53,304	943	1,087	335	334
2003	23,149	119,041	1,968	237	532	438
2004	13,107	10,431	2,046	2,257	1,092	145

Of particular interest are the rainbow smelt. These fish are an anadromous species and smelt impinged at Pilgrim most probably come from the Jones River population. Although there are two other rainbow smelt runs (Town Brook and Eel River) in the Plymouth/Kinston/Duxbury Bay area, they are apparently quite small in comparison to that from the Jones River (based on pers. comm., Brad Chase, MA Division of Marine Fisheries [DMF] to Gerald Szal, DEP). Rainbow smelt are not known to reproduce elsewhere in streams entering Cape Cod Bay or in streams elsewhere on Cape Cod.

During the late 1970s, there were a number of rainbow smelt impingement events at the Pilgrim facility. In 1978 an estimated 6,200 rainbow smelt died during a three-week period in December from impingement episodes at the facility. At the time, a group of state, federal, university and facility personnel met regularly to address potential impacts from the facility. Concern was expressed by these biologists that impingement events from Pilgrim could be significantly affecting the Jones River smelt population. This prompted DMF to conduct an intensive, three-year (1978-1981) study (see Lawton, et al., 1990) to

develop an estimate of the adult rainbow smelt population size in the Jones River so that an assessment of the plant's effects could be evaluated.

Results of the Lawton, et al., study state that, based on an estimate of egg production, an unbiased sex ratio, and age-specific fecundity, rainbow smelt spawning stock abundance was estimated to be 4,180,000 adults in 1981. The 6,200-fish loss due to impingement was projected to have reduced the Jones River spawning population by less than one percent, and was not considered to have a significant, negative effect on that population.

Based on a recent interview with personnel at the Division of Marine Fisheries, there have been no recent quantitative estimates of the adult rainbow smelt population in the Jones River. However, judging from visual information on both egg density and adult movement, Brad Chase, DMF (pers. comm. to G. Szal, August 29, 2005) estimates that there has been a sharp decline in the rainbow smelt population in the Jones River since the time when the Lawton, et al. (1990), studies were conducted. Unfortunately, without a quantitative evaluation of the rainbow smelt population size in the Jones river, Mr. Chase felt it was not possible to assess the potential impact of Pilgrim's impingement events on the Jones River smelt population.

Entrainment

Effects to winter flounder:

Organisms entrained at power plants are typically subjected to a number of stresses including mechanical stress, stress from pressure drop and stress from rapid heating (delta temperature effects). Winter flounder are the primary species of concern at many facilities along coastal Massachusetts due to their intrinsic economic value and recent population decreases. The Pilgrim Nuclear facility employs several methods of evaluating the impact of the intake on the local winter flounder population adjacent to the facility. The first is the "equivalent adult" method in which the estimated number of eggs and larvae entrained (and assumed killed) by the facility are theoretically "grown up" into adults of different age categories based on literature reports on percent survival from one life stage to the next in wild populations. The number of equivalent adults of a particular adult age (e.g., 3-year olds) can be compared with the number of actual adults, of many year classes, found per square mile in areas adjacent to the facility to form an index of impact.

Density of adult winter flounder was assessed primarily in Plymouth/Kingston/Duxbury Bay (PKDB) and adjacent waters, as these areas were thought to be the primary spawning ground that produced the larvae and eggs entrained by the facility. Researchers conducted sampling in this area using a commercial "otter trawl", a device used to capture bottom fish. The number of equivalent adults cropped by the facility divided by the mean number of flounder found per square mile of PKDB and adjacent areas was used to provide a rough idea of the effect of the facility's impacts due to entrainment of winter flounder.

There are a number of difficulties to be overcome if one is to use this approach. First there are issues encountered in sampling both the adult population in the field as well as the egg and larval population entrained. For example, researchers conducting this work have assumed an otter trawl efficiency of 50%, but the actual efficiency may be much lower (or higher), which would alter the number of fish in the study area per square mile and the apparent impact. Second, entrainment sampling results, in addition, are quite variable. Third, it is difficult to determine the accuracy, and therefore, the applicability, of the survival matrix used in estimating equivalent adults.

Three age-specific survival matrices were provided by Entergy Nuclear (Environmental Protection Group 2005). One matrix uses un-staged larval information (i.e., all larvae are considered to be the same age); the other two use survival data from one stage to the next for four different larval life stages. Because staged larval survival data should provide a greater degree of accuracy, we discarded the un-staged information for this review. Of the two remaining matrices, we chose that provided by Gibson (1993) which was used to evaluate winter flounder issues in Mt. Hope Bay.

A fourth difficulty in estimating impact is choosing a particular adult age class for equivalent adults entrained. We assume (see below) that the number of Age-4 equivalent adults entrained is proper for

comparison to the estimate of the number of adults (all ages) per square mile found in the study area. Many winter flounder are fully mature at Age-3, but some are not (pers. comm. Robert Lawton, MADMF to Gerald Szal, MADEP). We used Age-4 because almost all winter flounder in the Cape-Cod Bay area are mature at Age-4 (pers. comm. R. Lawton to G. Szal). A more accurate estimate of impact could be prepared if a matrix of length-age-survival data were available for the field population.

The following table provides estimates of entrainment impacts at the Pilgrim Nuclear Power Plant facility in Plymouth, MA, on the local winter flounder population. Estimates are based on data in Environmental Protection Group (2005).

Table 2

Year	No. Adult Winter Flounder in study area[1]	No. Adult Winter Flounder per square mile[2]	Estimate age-3 adults entrained[3]	Estimate age-4 adults entrained[4]	Square miles age-4 adults lost to entrainment[5]
1995	212,989	2,063	9,703	5,919	2.9
1996	316,986	3,070	15,401	9,395	3.1
1997	313,959	3,041	47,091	28,726	9.4
1998	264,812	2,565	77,394	47,210	18.4
1999	176,271	1,707	2,383	1,454	0.9
2000	464,176	4,496	4,521	2,758	0.6
2001	400,812	3,882	33,626	20,512	5.3
2002	476,263	4,613	19,703	12,019	2.6
2003	262,604	2,544	2,951	1,800	0.7
2004	157,532	1,526	50,851	31,019	20.3

Footnotes:

1. Adults were those fish that were $\geq$ 280 mm in total length (taken from Table 1, pg. 8 of the Environmental Protection Group, 2005 report).
2. The size of the study area changed over the course of the evaluations. According to J. Scheffer (Pilgrim) all estimates in this column are corrected to the same study area size. They have been based on the area swept by the otter trawl used to capture winter flounder and a trawl efficiency of 50%. The current (2004) size of the study area is about 103 square miles.
3. The equivalent adult method of estimating how many adult of age 3-years would have resulted from the eggs and larvae entrained by the facility, based on literature growth and survival data, was used to obtain these figures. Age-3 adult data were taken directly from Entergy Nuclear, 2005 (Table 5, pg. 86); literature data used to calculate survival from one stage to the next was that from Gibson, 1993, as reported by Entergy Nuclear, 2005.
4. Age-4 adult numbers were estimated based on a survival of 0.61 (pers. comm., Robert Lawton, MADMF to Gerald Szal, MADEP, 2/6/2001) from Age-3 to Age-4.
5. Calculated as: (Age-4 adults entrained)/(No. winter flounder per square mile). Because the study area is about 100 square miles (actually 103), these figures are approximately equivalent to the percentage loss to the population in the study area.

Entrainment loss as square miles of adult flounder, using Age-4 equivalent adults entrained, ranged from 0.6 to 20.3 square miles over the 10 years of evaluations. Because the study area was approximately 100 square miles in size, the square mile losses in this last column approximate a percentile loss to the population at large, although the caveats mentioned above should be kept in mind when viewing these estimates. Whether or not these levels of impact are a “significant” detriment to the population, and will result in slowing the return of much higher population densities, is currently not known. In addition, to the author’s knowledge, a policy statement regarding losses on a square mile basis has not been issued by any of the state or federal agencies involved with this project. EPA Region 1 has stated in the past that population impacts of 5% or greater are typically of concern, but, to the author’s knowledge, the bounds of this particular population have not been agreed upon by state or federal agencies.

A second method of evaluating entrainment impact to winter flounder used by the facility was to estimate the percentage of the total larval population passing in front of the facility that is entrained. Estimates of percent entrainment were very low: less than 1%.

The third method used by the facility to evaluate impact was the RAMAS (Risk Analysis Management Alternative System; Ferson, 1993) winter flounder model. It was used from 1999-2001 to further evaluate the effects of the facility on the Cape Cod Bay winter flounder population. Results suggested that stock reductions from 2.3 to 5.2% might occur as the direct result of entrainment at the facility.

Effects to other finfish species:
Several species, besides winter flounder, suffer substantial entrainment losses at the Pilgrim facility. These are cunner, mackerel, menhaden and atlantic herring. Numbers of equivalent adults (of different ages) estimated by the facility to have been lost due to entrainment effects are listed in Table 3. Numerical values in this table are estimates of the equivalent numbers of adult fish (age) entrained by Pilgrim over the past 11 years (based on data in Environmental Protection Group, 2005). Note that Atlantic herring figures are for entrainment/impingement combined and could not be separated due to the manner in which they were reported.

Table 3

Year	Cunner (1)	Mackerel (3)	Menhaden (2)	Atlantic herring (3)
1994	174,726	830	732	10,774
1995	525,573	6,245	2,452	25, 518
1996	313,002	3,526	1,781	6,096
1997	465,986	942	10,531	16,091
1998	1,542,772	1,824	7,564	2,697
1999	332,601	60	4,072	7,518
2000	319,247	1,216	178	8,120
2001	473,361	311	349	2,701
2002	101,668	482	1,382	2,425
2003	82,467	514	1,187	699
2004	188,107	304	50	3,169

Screenwash and Fish-Return System:
Intake screen wash: The cooling water intake bay at Pilgrim has a number of fine-mesh screens within it that are used to keep fish (but not most fish larvae and eggs) from being entrained into the facility. Fish impinged upon these screens can suffer negative acute or chronic effects. At Pilgrim, impinged fish are knocked off the screens by a salt-water spray system. Under normal operation, screens are rotated only once per 8-hour shift. At the end of the shift, the screens are rotated, and the spray system is operated to dislodge fish from the screens. These fish are shunted to a holding tank where they are counted and further shunted to the intake embayment about 100 yards upstream of the intake. To the author's knowledge no studies have been done to evaluate re-impingement rates. Although large-scale impingement events (>100,000 fish) have taken place at the facility, most of these have been with young-of-the year.

If the number of fish during one of the 8-hour screen-rotation periods exceeds 160 fish (a rate of 20 fish/hour) an "impingement event" is declared. During such an event, the screens are put into constant rotation, and the event is monitored (i.e., fish are counted) until the event is over. The event is reported as soon as possible after it begins and information on species involved, life stages and numbers of fish is related to the permitting authorities and the Massachusetts Division of Marine Fisheries.

The pressure-wash spray system has two sets of nozzles. The first to come in contact with impinged fish is a low-pressure wash (20 pounds per square inch [psi] or less) which is used to remove most fish from the intake screens. The second is a high-pressure wash (80-100 psi) which removes any remaining fish and/or debris. Water for the spray wash is drawn from the saltwater service system and is de-chlorinated prior to use. Reasons for chlorinating this system are explained below.

There are five salt service water pumps at Pilgrim, each with a capacity of 2,500 gallons per minute. The salt service water system has two purposes. It is used to supply cooling water to a number of components within the plant, but is also used for emergency cooling. Typically, four pumps are kept running and the other is kept in reserve. Because the salt water service system must constantly be available for emergency cooling, chlorine alone is used to prevent biofouling within the system. Thermal backwashing

(see below), a method used to control biofouling in the intake bays, is not allowed by the Federal Nuclear Regulatory Commission within this system because the water in the salt water service system must constantly be kept cool. The target concentration for chlorine within this system is 0.25 mg/L but the system concentration may reach 1.0 mg/L. Water for this system is taken from the intake bay; chlorinated water from this system is released through the 010 discharge into the primary discharge canal (discharge number 001). Because the 001 discharge is so large (310,000 gpm), the chlorine concentration (after mixing) in the discharge canal due to the 010 release should not reach levels that are above water quality standards.

Discharge Effects

Cooling water discharge:

The Pilgrim Nuclear facility's discharge is located in an open-coastal environment and is well situated for rapid mixing of its heated discharge. Effects of the heated discharge on finfish, benthos and Irish Moss were studied for more than twenty years. Primary impacts include at least two well-documented events of gas-bubble disease in finfish in the 1970s. Since that time, to the author's knowledge, no other major events appear to have taken place. In addition, due to effects on Irish Moss, the facility reimbursed one harvester for losses. Effects of the discharge on the benthic community appear to be primarily limited to scouring. Judging from diver-assisted studies conducted in the late 1990s, it appears that no more than 1-2 acres of the benthic community were negatively affected by the plant's discharge.

Thermal backwash:

About four to five times a year, for a period of about 1.5 to 2 hours, heated water from the downstream end of the steam condensers is re-routed back through the system and out through the intake embayment. This is done to control macro-fouling, primarily from mussels. To accomplish this, the facility shuts down one of the two intake pumps and pushes hot water back through half the system. During this period (about 34-45 minutes) the water within the half of the system receiving the backwash is typically heated to between 105°F and 110°F, but may reach as high as 120°F. The second half of the system is treated in the same manner. Because the facility has to reduce load during these times, which is expensive, the duration and number of backwashes per year is kept to a minimum.

In summary, during a thermal backwash, about 155,000 gpm of heated water (>105°F) is sent into the intake embayment for a period of about 1.5-2 hrs. Studies to evaluate potential impacts of the thermal backwash have not been performed to the knowledge of the author.

Recommendations to minimize impacts from Pilgrim:

1. The resource agencies in concert with the permit agencies should consider further evaluation of the intake effects to winter flounder. If effects are found to be substantial, these agencies should determine what steps need to be taken to reduce the impacts of the facility on the winter flounder population.

2. Because impinged fish from the intake screens are shunted back into the intake, there is a concern that these fish, weakened from impingement, will simply be re-impinged. An assessment of re-impingement rates, especially during large-scale events, should be considered by the permitting and resource agencies. These studies should also include an evaluation of the best point for locating the screen-wash discharge such that it would have the smallest negative impact on the populations of impinged species.

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