Technical Memorandum CN 341.3

BOSTON HARBOR WATERSHED
(MYSTIC, NEPONSET, WEYMOUTH/WEIR)
2009 BENTHIC MACROINVERTEBRATE BIOASSESSMENT

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Commonwealth of Massachusetts
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INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Barbour et al. 1995, Plafkin et al. 1989). Impacts to the benthic community are typically indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low total taxa richness; or shifts in community composition relative to the reference station (Plafkin et al. 1989).

As part of the Massachusetts Department of Environmental Protection/Division of Watershed Management's (MassDEP/DWM) 2009 Boston Harbor Watershed assessment, aquatic benthic macroinvertebrate biomonitoring was conducted to evaluate the biological health of selected stream reaches in the Mystic, Neponset and Weymouth/Weir subwatersheds to determine their status with respect to the support of the *Aquatic Life* use, as designated in the *Massachusetts Surface Water Quality Standards* (SWQS) (MassDEP 2006). These assessments form the basis for reporting and listing waters pursuant to sections 305(b) and 303(d) of the Clean Water Act (CWA). A total of 28 stations were sampled to investigate the effects of potential point and nonpoint sources of pollution—both historical and current—on the aquatic macroinvertebrate populations throughout the watershed. While specific monitoring locations and protocols governing sample collection and data analysis differed over time, MassDEP biologists had previously assessed some of the streams in 1999 (Fiorentino and Maietta 2000). Repeated sampling at the same station allows for comparisons of the biological conditions over time.

The Boston Harbor Watershed contains three subwatersheds: Mystic, Neponset and Weymouth/Weir (The Charles River, also tributary to Boston Harbor, is examined on a separate schedule). The observed conditions of resident benthic macroinvertebrate communities from these three subwatersheds are reported within this technical memorandum.

To provide information for making *Aquatic Life* use-support determinations, macroinvertebrate communities present at biomonitoring stations in the Boston Harbor Watershed were compared with the community occurring at a regional reference station. The reference station should represent least-impaired conditions as evidenced by a low Human Disturbance Index score (HDI) (Meek, 2013). The HDI is measured on a scale of 0-5, with a lower score signifying less human disturbance. All the 2009 Boston Harbor stations had scores ranging from 4.0 to 5.0. As such, a reference station was established at the West Branch Palmer River (B0777) in southeastern Massachusetts. This station received a HDI score of three, and was sampled during the same year as the Boston Harbor Watershed stations. This reference station was sampled on September 9, 2009, however, whereas the Boston Harbor stations were sampled during July. To examine potential temporal variability, station B0143 (Massapoag Brook) was sampled twice; once on July 13, 2009, and again on September 18, 2009. The 2009 sampling location descriptions, along with station identification numbers, sampling dates and coordinates are presented in Tables 1A, 1B, and 1C.

METHODS

Macroinvertebrate Sampling - RBPIII

Macroinvertebrate sampling activities employed for the 2009 Boston Harbor Watershed survey were conducted in accordance with the Sampling & Analysis Plans (SAP) for the Mystic River Watershed (Carr 2009), the Neponset River Watershed (MassDEP 2009), and the Weymouth/Weir River Watershed (Reardon 2009). The sampling procedures are described in the standard operating procedures (Nuzzo 2003), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Plafkin et al. 1989). The macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream. Sampling was conducted by MassDEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system.

Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the MassDEP/DWM lab for further processing.

Table 1A. List of Mystic biomonitoring stations sampled during the 2009 Boston Harbor watershed survey, including stream names, identification numbers, coordinates, sampling site descriptions, and sampling dates.

Stream Name	Unique ID	Latitude Longitude	Sampling Site Description	Sampling Date
UNT aka Wellington Brook	B0757	42.39423 -71.1723	~25 meters upstream of culvert, Cottage Street, Belmont	7-AUG-2009
Shaker Glen Brook	B0756	42.47137 -71.1742	upstream at Totman Drive, Woburn	6-AUG-2009
Mill Brook[1]	B0130	42.41783 -71.1585	upstream/west from Mill St, Arlington	7-AUG-2009
Aberjona River	B0755	42.44683 -71.1387	upstream at Washington Street, Woburn	6-AUG-2009
Pond Brook	B0754	42.45776 -71.1403	~150 meters upstream of Lake Street, Winchester	6-AUG-2009
Aberjona River[1]	B0131	42.039301 -71.514262	~75 meters downstream/south from USGS gage, Winchester	6-AUG-2009
West Branch Palmer River[R]	B0777	41.860199 -71.256372	~500 meters downstream from Danforth Street, Rehoboth	9-SEP-2009

[R] Reference Station
[1] Sampled in 1999

Table 1B. List of Neponset biomonitoring stations sampled during the 2009 Boston Harbor watershed survey, including stream names, identification numbers, coordinates, sampling site descriptions, and sampling dates.

Stream Name	Unique ID	Latitude Longitude	Sampling Site Description	Sampling Date
Bubbling Brook	B0764	42.19299 -71.2424	~65 meters downstream from Trailside Drive, Walpole	15-JUL-2009
Pecunit Brook	B0760	42.19231 -71.1482	~ 205 meters upstream of Interstate 95, Canton	14-JUL-2009
UNT aka Meadow Brook	B0762	42.1791 -71.1879	~70 meters upstream of Dean Street, Norwood	14-JUL-2009
UNT aka Spring Brook	B0763	42.14856 -71.2532	~90 meters upstream from the confluence with the Neponset River, Walpole	15-JUL-2009
Mill Brook[1]	B0140	42.19261 -71.2794	~100 meters downstream/south from Millbrook Road, Medfield	13-JUL-2009
Beaver Brook[1]	B0139	42.13452 -71.1762	~200 meters downstream/northeast from Maskwonicut Street, Sharon	13-JUL-2009
Traphole Brook[1]	B0142	42.15858 -71.2078	~150 meters downstream/northeast from Coney Street, Walpole	18-SEP-2009
Ponkapog Brook	B0761	42.20366 -71.1361	~ 100 meters downstream of Elm Street, Canton	14-JUL-2009
Massapoag Brook[1,3]	B0143	42.12052 -71.1643	between Manns Pond and Billings Street, Sharon	13-JUL-2009 18-SEP-2009
UNT to Steep Hill Brook[2]	B0780	42.13113 -71.1294	~50 meters downstream/northwest from Central Street, Stoughton	14-JUL-2009
Steep Hill Brook	B0759	42.13999 -71.1387	~80 meters upstream of the "pipeline crossing clearing" north of Erin Road, Stoughton	14-JUL-2009
West Branch Palmer River[R]	B0777	41.86019 -71.2564	~ 500 meters downstream from Danforth Street, Rehoboth	9-SEP-2009

[R] Reference station
[1] Sampled in 1999
[2] Proximal station (B0138) sampled in 1999
[3] Two sampling events occurred at this station in 2009

Table 1C. List of Weymouth/Weir biomonitoring stations sampled during the 2009 Boston Harbor watershed survey, including stream names, identification numbers, coordinates, sampling site descriptions, and sampling dates.

Stream Name	Unique ID	Latitude Longitude	Sampling Site Description	Sampling Date
UNT to Plymouth River	B0749	42.18843 -71.9016	~ 80 meters downstream from the most northerly Cushing Street crossing, Hingham	23-JUL-2009
Mary Lee Brook	B0751	42.15125 -71.0405	~ 5 meters upstream of the footbridge crossing of the western end of Joyce Circle, Randolph	23-JUL-2009
Cranberry Brook	B0753	42.18364 -71.0111	~90 Meters upstream of Washington Street (Route 37), Braintree	23-JUL-2009
Accord Brook	B0748	42.1913 -71.8652	upstream at Prospect Street, Hingham	17-JUL-2009
Old Swamp River	B0750	42.18172 -71.9358	~110 meters upstream of Elm Street, Weymouth	20-JUL-2009
Furnace Brook	B0744	42.25702 -71.0116	~30 meters upstream of Newport Avenue, Quincy	20-JUL-2009
Accord Brook	B0747	42.21034 -71.8599	~140 meters upstream of Union Street, Hingham	17-JUL-2009
Town Brook	B0745	42.24822 -71.997	~ 90 meters downstream from Miller Stile Road, Quincy	20-JUL-2009
Farm River	B0752	42.19914 -71.024	~90 meters upstream of Pond Street, Braintree	23-JUL-2009
Weir River[1]	B0758	42.24181 -71.8596	~100 meters upstream of East Street (Route 228), Hingham	17-JUL-2009
Monatiquot River	B0746	41.22096 -71.9802	~ 170 meters upstream of Commercial Street, Braintree	20-JUL-2009
West Branch Palmer River[R]	B0777	41.86019 -71.2564	~ 500 meters downstream from Danforth Street, Rehoboth	9-SEP-2009

[R] Reference station
[1] Proximal station (B0132) sampled in 1999

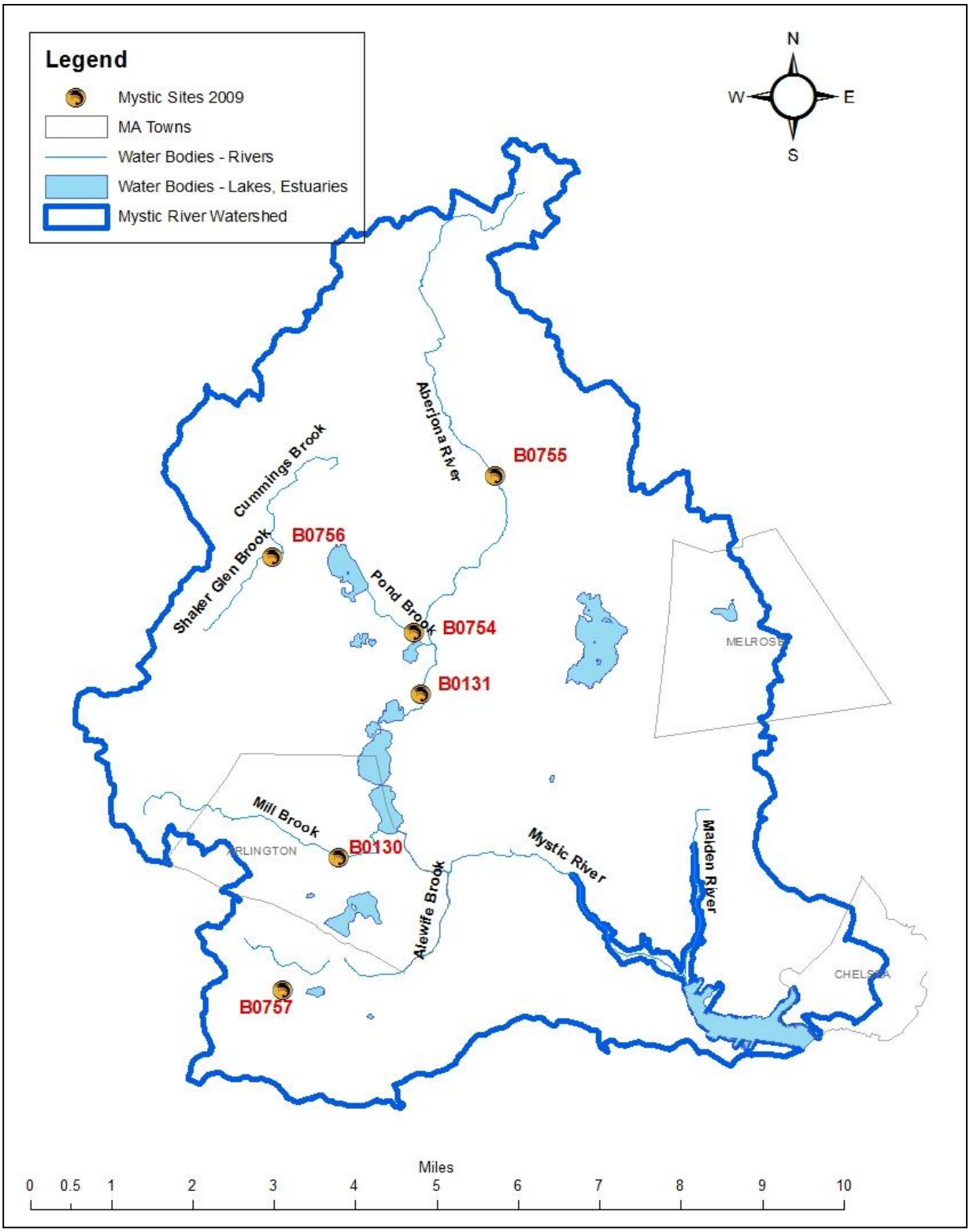

Figure 1A. Geographic locations of benthic macroinvertebrate sampling locations in the Mystic subwatershed during the 2009 Boston Harbor Watershed survey.

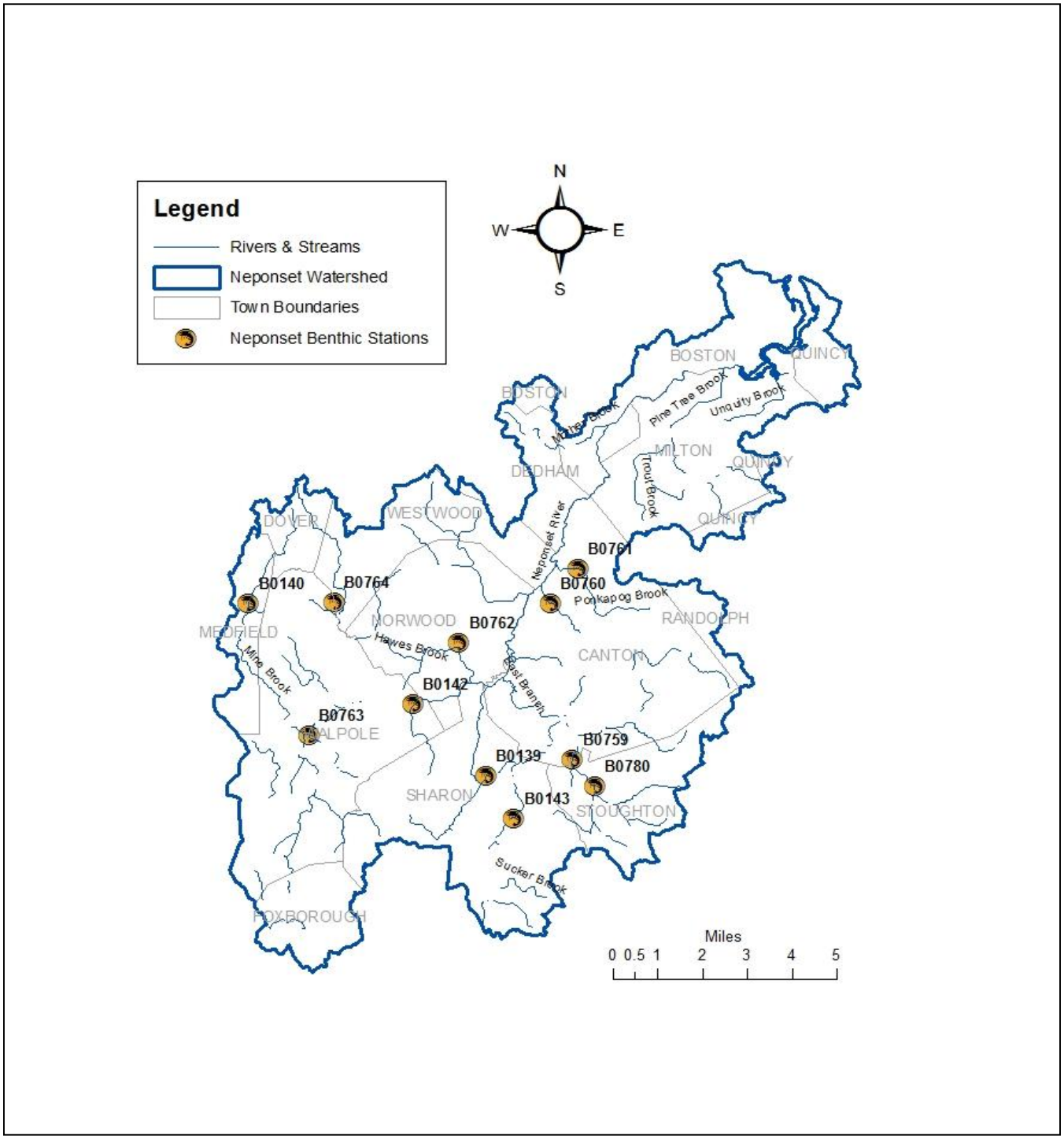

Figure 1B. Geographic locations of benthic macroinvertebrate sampling locations in the Neponset subwatershed during the 2009 Boston Harbor Watershed survey.

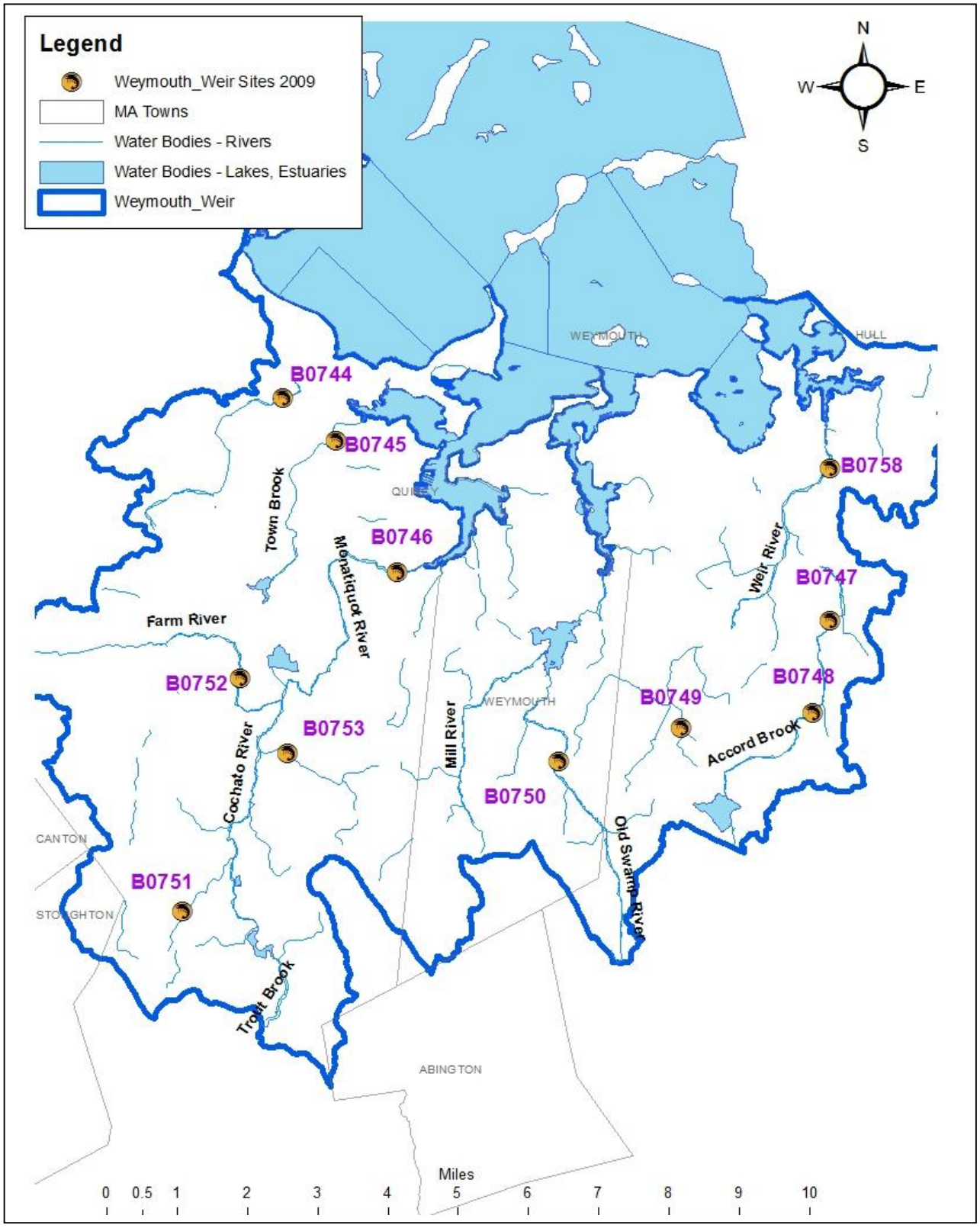

Figure 1C. Geographic locations of benthic macroinvertebrate sampling locations in the Weymouth/Weir subwatershed sampled during the 2009 Boston Harbor watershed survey.

Macroinvertebrate Sample Processing and Data Analysis

The macroinvertebrate sample processing and analysis procedures employed for the 2009 Boston Harbor Watershed biomonitoring samples are described in the standard operating procedures (Nuzzo 2003). Macroinvertebrate sample processing entailed distributing whole samples in pans, randomly selecting grids within the pans, and sorting specimens from the other materials in the selected grids until approximately 100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity.

Based on the taxonomy, various community, population, and functional parameters, or "metrics", were calculated that allow measurement of important aspects of the biological integrity of the macroinvertebrate community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated, and the deficiency of any one metric should not invalidate the entire approach (Plafkin et al. 1989). Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Plafkin et al. 1989). The modifications were: substitution of "reference site affinity" (RSA) for the Community Loss Index and elimination of the shredder/total ratio (no separate leaf-pack material was collected). The reference site affinity metric is a modification of Percent Model Affinity (Novak and Bode 1992). Instead of using the model's percentages for Oligochaeta, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Chironomidae, and "other," these percentages were taken from the reference site data. The RSA score is then calculated as:

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

where δ is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBP III scores as follows: 0 points for <35%; 2 points in the range from 35 to 49%; 4 points for 50 to 64%; and 6 points if ≥65%. The entire suite of metrics used for the analysis was:

- Richness—the total number of different species present in the subsample plus those detected from a "large/rare" search of the whole sample (those taxa missed in subsampling);

- HBI—Hilsenhoff Biotic Index (Hilsenhoff 1982, 1987), as modified in Nuzzo (2003); the HBI is the sum of the products of each taxon's abundance and its corresponding pollution tolerance value, divided by the total count in the subsample;

- EPT—sum of richness among the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) as determined from the specimens in the subsample plus those detected in a "large/rare" search of the whole sample; these orders tend to be dominated by species generally considered to be pollution sensitive;

- $EPT_a/Chiro_a$—ratio of total abundance among EPT taxa to total abundance among Chironomidae taxa;

- SC/FC—ratio of the proportion of sample that is represented by individuals that predominantly feed by scraping to those that are primarily filter-feeders;

- % Dominant—most abundant taxon as a percent of the assemblage; >20% is generally considered hyperdominant and indicative of a stressor impact;

- RSA—reference site affinity (described above).

Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for the selected "least-impacted" reference station yielded an impairment score for each site. RBP III analysis separates sites into four categories: "non-impaired", "slightly impaired", "moderately impaired", and "severely impaired". Each impairment category corresponds to a specific *Aquatic Life* use-support determination used in the CWA

Section 305(b) water quality reporting process—non-impaired and slightly impaired benthic invertebrate communities are generally indicative of conditions supporting the *Aquatic Life* use, whereas water bodies exhibiting moderately or severely impaired communities are generally assessed as "non-support."

Habitat Assessment

Habitat qualities were scored for each sampling reach using the assessment procedure in Plafkin et al. (1989), as modified in Barbour et al. (1999). An evaluation of physical habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Plafkin et al. 1989). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). The matrix used to assess habitat quality is based on key physical characteristics of the water body and the immediate riparian area. Most parameters evaluated are instream physical attributes that are potential sources of limitation to the aquatic biota (Plafkin et al. 1989). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left bank vegetative protection, right and left bank stability, and right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to the reference station to infer the extent to which the condition of the habitat, rather than water quality effects, may account for differences in macroinvertebrate community structure at the study sites.

RESULTS AND DISCUSSION

Reference station data from the West Branch Palmer River (B0777) was used to evaluate the ecological health of the Boston Harbor watersheds. Station B0777 had a Human Disturbance Index (HDI) score of 3.0, whereas all the sampled stations in the Boston Harbor Watershed had HDI scores ranging from 4.0 – 5.0. The lower score observed at B0777 indicates that this station can represent least-disturbed conditions in comparison to the Boston Harbor stations. Furthermore, the reference station (B0777) had an impervious cover of 6%. All stations within the Boston Harbor Watershed had more than 10% impervious cover. The reference station was sampled in September, but the Boston Harbor stations were sampled in July. Station B0143 (Massapoag Brook) was sampled both in July and September. The comparison between these two sampling events at B0143 shows no differences in *Aquatic Life* use determination, and lends credence to using the September 9, 2009 sampling event at station B0777 (West Branch Palmer River) as the reference condition for this technical memorandum.

Instream and riparian habitat conditions at B0777 were quite good, but not the best observed during this survey. Several of the stations in the Boston Harbor Watershed scored better than B0777 (Appendices 1A, 1B, and 1C). However, habitat conditions were comparable between stations.

Geomorphic and land-use characteristics, at the subwatershed scale, were also examined. StreamStats (USGS, 2012) data describes the contributing watershed of each benthic sampling location (Tables 2A, 2B, and 2C). Stream length could not be accurately calculated for station B0757 as this unnamed tributary (also known as "Wellington Brook") flows through pipes for much of its course upstream of the sampling location. B0757 "day-lights" immediately upstream of its sampled location.

Taxonomic lists of the macroinvertebrate organisms collected at each sampling station during the 2009 biomonitoring survey are provided in Appendices 2A, 2B, and 2C. Included in the lists are total organism counts, the functional feeding group designation (FFG) for each macroinvertebrate taxon, and the tolerance value (TV) of each taxon. Tables 3A, 3B, and 3C are summaries of the habitat and RBP III macroinvertebrate data analyses for stations within the three subwatersheds examined. Included for each sampling site are the habitat comparability to the reference condition, biological metric calculations, metric scores, and impairment designations.

Table 2A. Subwatershed-scale habitat measures for the Mystic River during the 2009 Boston Harbor Watershed Benthic Macroinvertebrate Survey; USGS StreamStats (USGS 2012), MassDEP Human Disturbance Index (HDI) (Meek 2013), MassDEP Benthic Habitat Assessment Scores. Stations are sorted by watershed area.

Site Name	UNT aka Wellington Brook	Shaker Glen Brook	Mill Brook	Aberjona River	Pond Brook	Aberjona River	West Branch Palmer River[R]
Site Number	B0757	B0756	B0130	B0755	B0754	B0131	B0777
Watershed Area (mi^2)	1.2	2.7	4.9	8.1	10.0	24.8	6.8
Stream Length (mi)	Just Day-lighted*	6.4	11.5	14	21.6	44.8	18.1
Stream Density	---	2.4	2.3	1.7	2.2	1.8	2.7
% Impervious Cover	45.4	25.0	32.2	38.0	33.5	39.1	6.0
HDI Score	5	5	5	5	5	5	3
Habitat Score	101	126	108	155	119	139	161

* Stream emerged from culvert just upstream of station B0757. Unable to measure true stream length.
[R] Reference Station

Table 2B. Subwatershed-scale habitat measures for the Neponset River during the 2009 Boston Harbor Watershed Benthic Macroinvertebrate Survey; USGS StreamStats (USGS 2012), MassDEP Human Disturbance Index (HDI) (Meek 2013), MassDEP Benthic Habitat Assessment Scores. Stations are sorted by watershed area.

Site Name	Bubbling Brook	Pecunit Brook	UNT aka Meadow Brook	UNT aka Spring Brook	Mill Brook	Beaver Brook	Traphole Brook	Ponkapog Brook	Massapoag Brook	UNT to Steep Hill Brook	Steep Hill Brook	West Branch Palmer River[R]
Site Number	B0764	B0760	B0762	B0763	B0140	B0139	B0142	B0761	B0143	B0780	B0759	B0777
Watershed Area (mi^2)	0.4	0.9	1.1	2.1	2.4	2.5	2.7	4.0	4.5	4.7	5.7	6.8
Stream Length (mi)	0.9	1.2	0.5	4.5	5.8	6.2	4.2	6	5.8	9.4	11.1	18.1
Stream Density	2.2	1.3	0.4	2.1	2.5	2.5	1.6	1.5	1.3	2.0	2.0	2.7
% Impervious Cover	17.0	42.2	42.2	17.8	10.8	10.4	17.8	13.7	11.3	23.1	23.1	6.0
HDI Score	4.5	4.5	4.5	4.5	4.5	4.5	4	4.5	4	5	5	3
Habitat Score	162	169	100	149	177	174	165	179	182	158	166	161

[R] Reference Station

Table 2C. Subwatershed-scale habitat measures for the Weymouth/Weir River during the 2009 Boston Harbor Watershed Benthic Macroinvertebrate Survey; USGS StreamStats (USGS 2012), MassDEP Human Disturbance Index (HDI) (Meek 2013), MassDEP Benthic Habitat Assessment Scores. Stations are sorted by watershed area.

Site Name	UNT to Plymouth River	Mary Lee Brook	Cranberry Brook	Accord Brook	Old Swamp River	Furnace Brook	Accord Brook	Town Brook	Farm River	Weir River	Monatiquot River	West Branch Palmer River[R]
Site Number	B0749	B0751	B0753	B0748	B0750	B0744	B0747	B0745	B0752	B0758	B0746	B0777
Watershed Area (mi^2)	0.6	0.8	1.6	2.7	3.7	3.8	4.1	4.1	12.3	14.6	28.6	6.8
Stream Length (mi)	1.2	1.5	2.6	4.4	1.2	5.5	7.3	6.2	26.7	36.5	56	18.1
Stream Density	2.1	1.8	1.6	1.6	0.3	1.4	1.8	1.5	2.2	2.5	2.0	2.7
% Impervious Cover	17.6	20.1	20.1	10.4	24.9	28.2	10.4	41.2	25.7	17.6	32.8	6.0
HDI Score	4.5	5	5	4.5	5	5	4.5	5	5	4.5	5	3
Habitat Score	158	133	177	143	144	105	158	77	164	167	160	161

[R] Reference Station

Table 3A. Summary of RBP III analysis of macroinvertebrate communities sampled in the Mystic subwatershed during the Boston Harbor Watershed survey on 6-7 August and 9 September 2009. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (B0777), and the corresponding assessment designation for each biomonitoring station. Complete habitat evaluations are presented in Appendix 1A. Refer to Table 1A for a listing and description of sampling stations.

SAMPLING STATION	B0777		B0757		B0756		B0130		B0755		B0754		B0131	
STREAM	West Branch Palmer River		UNT aka Wellington Brook		Shaker Glen Brook		Mill Brook		Aberjona River		Pond Brook		Aberjona River	
HABITAT SCORE	161		101		126		108		155		119		139	
HABITAT % REFERENCE	--		63%		78%		67%		96%		74%		86%	
HABITAT COMPARABILITY	--		Partial Support		Support		Partial Support		Comparable		Partial Support		Support	
TAXA RICHNESS	28	*6*	15	*2*	17	*4*	15	*2*	14	*2*	9	*0*	10	*0*
BIOTIC INDEX	4.03	*6*	7.06	*2*	5.25	*4*	5.69	*4*	6.54	*2*	5.50	*4*	6.04	*2*
EPT INDEX	7	*6*	0	*0*	2	*0*	2	*0*	2	*0*	2	*0*	2	*0*
EPT/CHIRONOMIDAE	1.14	*6*	0	*0*	0.19	*0*	0.43	*2*	2.36	*6*	2.64	*6*	7.70	*6*
SCRAPER/FILTERER	0.97	*6*	0	*0*	0.85	*6*	0.08	*0*	0	*0*	0	*0*	0	*0*
REFERENCE AFFINITY	100%	*6*	35%	*0*	77%	*6*	66%	*6*	49%	*2*	47%	*2*	40%	*2*
% DOMINANT TAXON	13%	*6*	18%	*6*	32%	*2*	23%	*4*	51%	*0*	52%	*0*	47%	*0*
TOTAL METRIC SCORE	*42*		*10*		*22*		*18*		*12*		*12*		*10*	
% COMPARABILITY TO REFERENCE	--		24%		52%		43%		29%		29%		24%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**MODERATELY IMPAIRED**		**SLIGHTLY / MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**	

Table 3B. Summary of RBP III analysis of macroinvertebrate communities sampled in the Neponset subwatershed during the Boston Harbor Watershed survey on 13, 14, 15 July, and 9, 18 September 2009. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (B0777), and the corresponding assessment designation for each biomonitoring station. Complete habitat evaluations are presented in Appendix 1B. Refer to Table 1B for a listing and description of sampling stations.

SAMPLING STATION	B0777		B0764		B0760		B0762		B0763		B0140		B0139		B0142		B0761		B0143		B0143		B0780		B0759	
STREAM	West Branch Palmer River		Bubbling Brook		Pecunit Brook		UNT aka Meadow Brook		UNT aka Spring Brook		Mill Brook		Beaver Brook		Traphole Brook		Ponkapog Brook		Massapoag Brook A[1]		Massapoag Brook B[2]		UNT to Steep Hill Brook		Steep Hill Brook	
HABITAT SCORE	161		162		169		100		149		177		174		165		179		182		180		158		166	
HABITAT % REFERENCE	--		101%		105%		62%		93%		110%		108%		102%		111%		113%		112%		98%		103%	
HABITAT COMPARABILITY	--		Comparable		Comparable		Partial Support		Comparable		Comparable		Comparable		Comparable		Comparable		Comparable		Comparable		Comparable		Comparable	
TAXA RICHNESS	28	*6*	20	*4*	21	*4*	12	*2*	20	*4*	27	*6*	21	*4*	19	*4*	22	*4*	25	*6*	17	*4*	20	*4*	18	*4*
BIOTIC INDEX	4.03	*6*	5.62	*4*	5.37	*4*	8.27	*0*	5.52	*4*	4.93	*4*	3.61	*6*	3.88	*6*	5.44	*4*	5.24	*4*	4.67	*6*	4.79	*4*	4.91	*4*
EPT INDEX	7	*6*	4	*0*	3	*0*	0	*0*	3	*0*	4	*0*	8	*6*	7	*6*	5	*2*	9	*6*	7	*6*	8	*6*	6	*4*
EPT/CHIRO	1.14	*6*	0.33	*2*	0.33	*2*	0	*0*	1.85	*6*	0.23	*0*	1.93	*6*	4.71	*6*	1.00	*6*	2.84	*6*	7.10	*6*	2.19	*6*	4.45	*6*
SCRAPER/ FILTERER	0.97	*6*	0	*0*	0.33	*4*	0	*0*	0.09	*0*	2.00	*6*	1.03	*6*	2.39	*6*	0.68	*6*	0.12	*0*	0.11	*0*	0.72	*6*	0.60	*6*
REFERENCE AFFINITY	100 %	*6*	63%	*4*	55%	*4*	31%	*0*	64%	*4*	69%	*6*	67%	*6*	54%	*4*	76%	*6*	64%	*4*	60%	*4*	65%	*6*	62%	*4*
% DOMINANT TAXON	13%	6	28%	*4*	33%	*2*	42%	*0*	36%	*2*	26%	*4*	14%	6	26%	*4*	13%	6	15%	6	19%	6	15%	*6*	34%	*2*
TOTAL METRIC SCORE	*42*		*18*		*20*		*2*		*20*		*26*		*40*		*36*		*34*		*32*		*32*		*38*		*30*	
% METRIC COMPARABILITY TO REFERENCE	--		43%		48%		5%		48%		62%		95%		86%		81%		76%		76%		90%		71%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**		**SEVERELY IMPAIRED**		**MODERATELY IMPAIRED**		**SLIGHTLY IMPAIRED**		**NOT IMPAIRED**		**NOT IMPAIRED**		**NOT/ SLIGHTLY IMPAIRED**		**SLIGHTLY IMPAIRED**		**SLIGHTLY IMPAIRED**		**NOT IMPAIRED**		**SLIGHTLY IMPAIRED**	

[1] Massapoag Brook A was sampled on July 13, 2009
[2] Massapoag Brook B was sampled on September 18, 2009

Table 3C. Summary of RBP III analysis of macroinvertebrate communities sampled in the Weymouth/Weir subwatersheds during the Boston Harbor Watershed survey on 17, 20, 23 July, and 9 September 2009. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (B0777), and the corresponding assessment designation for each biomonitoring station. Complete habitat evaluations are presented in Appendix 1C. Refer to Table 1C for a listing and description of sampling stations.

SAMPLING STATION	B0777		B0749		B0751		B0753		B0748		B0750		B0744		B0747		B0745		B0752		B0758		B0746	
STREAM	West Branch Palmer River		UNT to Plymouth River		Mary Lee Brook		Cranberry Brook		Accord Brook		Old Swamp River		Furnace Brook		Accord Brook		Town Brook		Farm River		Weir River		Monatiquot River	
HABITAT SCORE	161		158		133		177		143		144		105		158		77		164		167		160	
HABITAT % REFERENCE	--		98%		83%		110%		89%		89%		65%		98%		48%		102%		104%		99%	
HABITAT COMPARABILITY	--		Comparable		Support		Comparable		Support		Comparable		Partial Support		Comparable		Non-Support		Comparable		Comparable		Comparable	
TAXA RICHNESS	28	*6*	17	*4*	16	*2*	15	*2*	9	*0*	19	*4*	17	*4*	19	*4*	19	*4*	17	*4*	22	*4*	14	*2*
BIOTIC INDEX	4.03	*6*	4.45	*6*	4.94	*4*	5.63	*4*	6.71	*2*	4.95	*4*	5.86	*2*	5.69	*4*	6.85	*2*	5.50	*4*	4.89	*4*	4.35	*6*
EPT INDEX	7	*6*	4	*0*	5	*2*	2	*0*	1	*0*	6	*4*	2	*0*	7	*6*	2	*0*	3	*0*	7	*6*	3	*0*
EPT/CHIRO	1.14	*6*	1.44	*6*	2.86	*6*	0.46	*2*	0.05	*0*	0.40	*2*	0.11	*0*	0.15	*0*	1.37	*6*	0.80	*4*	0.79	*4*	1.81	*6*
SCRAPER/ FILTERER	0.97	*6*	1.63	*6*	0.07	*0*	0.79	*6*	0	*0*	4.23	*6*	0	*0*	0.14	*0*	0	*0*	0.08	*0*	1.00	*6*	0.40	*4*
REFERENCE AFFINITY	100%	*6*	71%	*6*	54%	*4*	70%	*6*	53%	*4*	60%	*4*	56%	*4*	39%	*2*	45%	*2*	57%	*4*	80%	*6*	61%	*4*
% DOMINANT TAXON	13%	*6*	25%	*4*	24%	*4*	26%	*4*	63%	*0*	43%	*0*	30%	*2*	48%	*0*	26%	*4*	19%	*6*	13%	*6*	23%	*4*
TOTAL METRIC SCORE	*42*		*32*		*22*		*24*		*6*		*24*		*12*		*16*		*18*		*22*		*36*		*26*	
% METRIC COMPARABILITY TO REFERENCE	--		76%		52%		57%		14%		57%		29%		38%		43%		52%		86%		62%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**SLIGHTLY IMPAIRED**		**SLIGHTLY/ MODERATELY IMPAIRED**		**SLIGHTLY IMPAIRED**		**SEVERELY IMPAIRED**		**SLIGHTLY IMPAIRED**		**MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**		**MODERATELY IMPAIRED**		**SLIGHTLY/ MODERATELY IMPAIRED**		**NOT IMPAIRED**		**SLIGHTLY IMPAIRED**	

The benthic macroinvertebrate community at B0777 ranked best in terms of the Taxa Richness metric (28). This condition indicates that B0777 had the most diverse resident biota. Station B0777 scored third best with regards to the Biotic Index metric (4.03). This score demonstrates that B0777 had a good density of pollution-intolerant taxa. Also, B0777 scored second best in terms of Percent Dominant Taxa (13%), signifying that no single taxon was excessively abundant.

The Mystic River subwatershed revealed no sites without impairment (Table 3A). Extensive dominance of filter feeding trichopterans (Hydropsychidae) was encountered at five of the six sampled stations. The abundance of these insects indicates organic enrichment. There were no trichopterans (or ephemeropterans or plecopterans) collected at station B0757 (UNT known as Wellington Brook). Instead, the sample was dominated by worms and chironomids. These conditions are, potentially, indicative of organic processing. These perceived impairments may also be exacerbated by poor habitat conditions (Appendix 1A). All sampled stations in the Mystic subwatershed were located in areas exhibiting high (>10%) impervious cover. Impervious cover in excess of 5% has been observed to correlate with declines in water quality and macroinvertebrate community health (Schiff and Benoit. 2007).

The Neponset River subwatershed fared a bit better than the Mystic, with three of the 12 stations showing no impairment. However, the Neponset River Watershed station B0762 (UNT known as Meadow Brook) had the lowest combined metric score (two out of a possible 42) of all stations examined in the Boston Harbor Watershed. Station B0762 received a determination of *Severely Impaired*. This station was dominated (42%) by tubificid worms, and supported no EPT taxa. Also, there were no taxa collected with a tolerance value less than six (Appendix 2B). These findings indicate a highly enriched condition with reduced dissolved oxygen. This station also had the lowest habitat score (100) of all stations within the Neponset subwatershed (Table 3B) which also likely contributed to benthic community changes observed at B0762.

Station B0143 (Massapoag Brook), in the Neponset subwatershed was sampled on two occasions - once on July 13, 2009 ("Massapoag Brook A"), and again on September 18, 2009 ("Massapoag Brook B"). This was done to examine any potential variations over time in the benthic community structure and within-reach habitat conditions. This additional sampling event was necessary, as the reference station (B0777) was sampled on September 9, 2009, and the majority of Boston Harbor Watershed stations were sampled in July. There was no difference in *Aquatic Life* use support status between the two sampling events. On both occasions B0143 obtained a *Slightly Impaired* designation (Table 3B). There were negligible differences between habitat scores (Appendix 1B) and collected taxa (Appendix 2B) between the two sampling occasions.

Only one of the 11 stations sampled in the Weymouth/Weir subwatershed (B0758) was determined to be *Not Impaired*. All other stations displayed at least some measurable impairment when compared to the reference condition. Two stations were established on Accord Brook (B0748 and B0747). Station B0748 was located 1.1 miles upstream of B0747 and received a determination of *Severely Impaired*. Station B0747 received a determination of *Moderately Impaired*. Between these two stations Accord Brook is bordered by contiguous forest lacking any impervious cover. It is likely that upstream impacts are reduced through natural processes as this stream flows through this area of relatively undisturbed watershed.

Station B0745 (Town Brook) yielded the worst habitat score (77) of all stations examined in the Boston Harbor Watershed. This stream's upstream drainage also comprised 41.2% impervious cover. The resulting determination of *Moderately Impaired* is most likely due, in part, to habitat limitations. However, with such an elevated percentage of impervious cover, it is likely that water quality is also an issue. This hypothesis is supported by the numerous worms and filter-feeders that populated the benthic sample collected at B0745.

Eight of the Boston Harbor stations examined in 2009 were previously examined by MassDEP/DWM in 1999 (Fiorentino and Maietta 2000). Table 4 presents four selected benthic invertebrate community metrics and the overall impairment status derived for each station from both surveys. This summary is provided for informational purposes and should not be interpreted as a true and accurate assessment of trends in the water quality conditions at these sites. A more thorough analysis of the conditions reflected by the benthic invertebrate community at these sites over time would require a thorough evaluation of

additional variables that shape community structure, such as flow, precipitation, habitat and other prevailing sampling conditions in the respective sampling years.

Table 4. Selected macroinvertebrate RBPIII community metrics and impairment status for nine sampling stations in the Boston Harbor Watershed sampled by MassDEP/DWM in 1999 and 2009. See text for a description of the metrics.

Water Body	Year	Community Metrics				Impairment Status
		Total Richness	EPT Richness	Biotic Index	% Dominant Taxon	
Mill Brook, Arlington (B0130)	1999	25	0	7.50	19	Slight
	2009	15	2	5.69	23	Moderate
Aberjona River, Winchester (B0131)	1999	14	2	6.13	39	Moderate
	2009	10	2	6.04	47	Moderate
Massapoag Brook, Sharon (B0143)	1999	9	5	5.03	34	Slight
	2009	25	9	5.24	15	Slight
Beaver Brook, Sharon (B0139)	1999	31	6	4.35	10	Non / Slight
	2009	21	8	3.61	14	Non
Mill Brook, Medfield (B0140)	1999	26	5	5.36	15	Slight
	2009	27	4	4.93	26	Slight
UNT to Steep Hill Brook, Stoughton (B0138 - 1999)(B0780 – 2009)*	1999	22	5	4.83	25	Slight
	2009	20	8	4.79	15	Non
Traphole Brook, Walpole (B0142)	1999	21	6	2.67	35	Reference
	2009	19	7	3.88	26	Non
Weir River, Hingham (B0132 – 1999) (B0758 – 2009)*	1999	24	6	5.14	17	Non / Slight
	2009	22	7	4.89	13	Non

* The distance between the two stations assigned to UNT to Steep Hill Brook, Stoughton and the two stations assigned to Weir River, Hingham are great enough to warrant a distinction between the stations.

SUMMARY

Sampling of the benthic macroinvertebrate community was carried out in 2009 at 28 stations in the Boston Harbor Watershed to evaluate the biological health of selected streams and to determine their status with respect to the support of the *Aquatic Life* use, as designated in Massachusetts' Surface Water Quality Standards. Results of these assessments form the basis for reporting and listing waters under sections 305(b) and 303(d) of the Clean Water Act. Field and laboratory methods and data analysis were based on the USEPA's Rapid Biomonitoring Protocols. Station B0777 on West Branch Palmer River served as the reference station for all streams.

Thirteen of the sampled stations received either a *Not Impaired* or *Slightly Impaired* finding, suggesting that these 13 stations will support their *Aquatic Life* use designations. However, more than half (15) of the stations sampled in the Boston Harbor Watershed received either a *Moderately Impaired* or *Severely Impaired* finding. Most likely, these 15 stations will not support their *Aquatic Life* use designations.

There are many perturbations within the Boston Harbor Watershed, and most are of human origin. Most striking is the amount of impervious cover within this highly developed watershed. Stations within the Boston Harbor Watershed had impervious coverages ranging from 10% to 45% (Tables 2A, 2B, and 2C). Noting that disturbances to the benthic community have been observed in streams with as little as 5% impervious cover (Schiff and Benoit 2007), it is quite likely that impervious cover within the Boston Harbor

is having a deleterious effect upon the instream biota. Impervious cover can affect streams in several ways. Physically, impervious cover allows storm events to rush into a stream without being slowed by natural vegetation and/or bare earth. These higher volume and velocity flow events can easily carry particulates into the stream that would otherwise remain on land. Also, these increased inputs can be heated beyond that which would occur under natural conditions. Warmer waters cannot contain as much oxygen as colder waters. Furthermore, nutrient inputs to the receiving stream are increased as the vegetation is removed from the riparian zone. Mitigation of stormwater run-off, and increases in the amounts and types of riparian vegetation will improve the biotic conditions found in the Boston Harbor Watershed.

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Appendix 1A. Habitat assessment summary for Mystic subwatershed biomonitoring stations sampled during the 2009 Boston Harbor Watershed survey. For within-reach parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For riparian parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Maximum habitat score for any site = 200. Refer to Table 1 for a listing and description of sampling stations.

STATION	UNT aka Wellington Brook	Shaker Glen Brook	Mill Brook	West Branch Palmer River	Aberjona River	Pond Brook	Aberjona River
Station Code	**B0757**	**B0756**	**B0130**	**B0777**	**B0755**	**B0754**	**B0131**
INSTREAM PARAMETERS (range is 0-20)	SCORES						
INSTREAM COVER	3	9	6	16	17	3	14
EPIFAUNAL SUBSTRATE	15	17	17	14	13	18	14
EMBEDDEDNESS	9	14	12	16	11	19	13
CHANNEL ALTERATION	2	15	4	20	16	11	14
SEDIMENT DEPOSITION	15	7	9	14	13	13	14
VELOCITY-DEPTH COMBINATIONS	7	10	13	11	18	9	16
CHANNEL FLOW STATUS	16	18	17	14	18	19	18
RIPARIAN ZONE PARAMETERS (range is 0-10 for each bank)	SCORES						
BANK VEGETATIVE PROTECTION left	3	6	5	10	10	3	6
BANK VEGETATIVE PROTECTION right	2	6	8	10	9	3	6
BANK STABILITY left	9	7	8	8	9	9	7
BANK STABILITY right	9	7	7	8	9	9	8
RIPARIAN VEGATIVE ZONE WIDTH left	3	5	1	10	2	1	7
RIPARIAN VEGATIVE ZONE WIDTH right	8	5	1	10	10	2	2
TOTAL SCORE	**101**	**126**	**108**	**161**	**155**	**119**	**139**

Appendix 1B. Habitat assessment summary for Neponset subwatershed biomonitoring stations sampled during the 2009 Boston Harbor Watershed survey. For within-reach parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For riparian parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Maximum habitat score for any site = 200. Refer to Table 1 for a listing and description of sampling stations.

STATION	**Bubbling Brook**	**Pecunit Brook**	**UNT aka Meadow Brook**	**UNT aka Spring Brook**	**Mill Brook**	**Beaver Brook**	**Traphole Brook**	**Ponkapog Brook**	**Massapoag BrookA[1]**	**Massapoag BrookB[2]**	**UNT to Steep Hill Brook**	**Steep Hill Brook**	**West Branch Palmer River**
Station Code	**B0764**	**B0760**	**B0762**	**B0763**	**B0140**	**B0139**	**B0142**	**B0761**	**B0143**	**B0143**	**B0780**	**B0759**	**B0777**
INSTREAM PARAMETERS (range is 0-20)	SCORES												
INSTREAM COVER	10	11	5	18	14	16	17	16	19	19	17	16	16
EPIFAUNAL SUBSTRATE	15	15	7	12	17	18	15	15	18	18	16	9	14
EMBEDDEDNESS	17	16	8	10	17	13	14	17	19	19	13	18	16
CHANNEL ALTERATION	19	19	11	13	18	19	19	19	16	16	12	20	20
SEDIMENT DEPOSITION	20	16	4	14	18	18	10	16	18	18	12	16	14
VELOCITY-DEPTH COMBINATIONS	8	13	5	10	16	10	16	18	18	17	17	13	11
CHANNEL FLOW STATUS	18	19	15	15	18	20	18	18	20	19	19	18	14
RIPARIAN ZONE PARAMETERS (range is 0-10 for each bank)	SCORES												
BANK VEGETATIVE PROTECTION left	10	10	10	10	10	10	10	10	9	9	10	10	10
BANK VEGETATIVE PROTECTION right	10	10	6	10	10	10	9	10	9	9	10	10	10
BANK STABILITY left	10	10	10	10	10	10	9	10	8	8	10	10	8
BANK STABILITY right	10	10	10	10	10	10	9	10	8	8	10	6	8
RIPARIAN VEGATIVE ZONE WIDTH left	5	10	8	10	9	10	10	10	10	10	8	10	10
RIPARIAN VEGATIVE ZONE WIDTH right	10	10	1	7	10	10	9	10	10	10	4	10	10
TOTAL SCORE	**162**	**169**	**100**	**149**	**177**	**174**	**165**	**179**	**182**	**180**	**158**	**166**	**161**

1, Massapoag Brook A was sampled on July 13, 2009

2, Massapoag Brook B was sampled on September 18, 2009

Appendix 1C. Habitat assessment summary for Weymouth/Weir subwatersheds biomonitoring stations sampled during the 2009 Boston Harbor Watershed survey. For within-reach parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For riparian parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Maximum habitat score for any site = 200. Refer to Table 1 for a listing and description of sampling stations.

STATION	UNT to Plymouth River	Mary Lee Brook	Cranberry Brook	Accord Brook	Old Swamp River	Furnace Brook	Accord Brook	Town Brook	West Branch Palmer River	Farm River	Weir River	Monatiquot River
Station Code	**B0749**	**B0751**	**B0753**	**B0748**	**B0750**	**B0744**	**B0747**	**B0745**	**B0777**	**B0752**	**B0758**	**B0746**
INSTREAM PARAMETERS (range is 0-20)	SCORES											
INSTREAM COVER	7	16	16	13	5	10	13	2	16	15	10	16
EPIFAUNAL SUBSTRATE	15	16	18	8	16	17	15	16	14	16	19	18
EMBEDDEDNESS	17	19	18	18	16	12	18	14	16	19	17	17
CHANNEL ALTERATION	19	13	19	12	18	6	18	0	20	16	16	14
SEDIMENT DEPOSITION	16	19	19	19	16	11	15	3	14	20	18	13
VELOCITY-DEPTH COMBINATIONS	8	10	9	4	8	12	10	7	11	14	8	18
CHANNEL FLOW STATUS	17	16	18	18	18	17	14	15	14	19	20	20
RIPARIAN ZONE PARAMETERS (range is 0-10 for each bank)	SCORES											
BANK VEGETATIVE PROTECTION left	10	5	10	10	10	3	10	0	10	10	10	9
BANK VEGETATIVE PROTECTION right	10	2	10	10	7	3	10	0	10	7	10	10
BANK STABILITY left	9	3	10	10	9	9	8	10	8	10	10	7
BANK STABILITY right	10	3	10	10	8	4	8	10	8	9	10	10
RIPARIAN VEGATIVE ZONE WIDTH left	10	10	10	10	10	0	10	0	10	7	10	1
RIPARIAN VEGATIVE ZONE WIDTH right	10	1	10	1	3	1	9	0	10	2	9	7
TOTAL SCORE	**158**	**133**	**177**	**143**	**144**	**105**	**158**	**77**	**161**	**164**	**167**	**160**

Appendix 2A. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Mystic subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1A for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Mystic River Benthic Stations						
				B0777[R]	B0757	B0756	B0130	B0755	B0754	B0131
Physidae	Physidae	GC	8		1					
Pisidiidae	Pisidiidae	FC	6					1		
Pisidiidae	*Pisidium* sp.	FC	6	1						
Naididae	Naididae	GC	9		1					
Naididae	*Nais communis/variabilis*	GC	8		14					
Naididae	*Pristina aequiseta*	GC	8		3					
Naididae	*Pristinella jenkinae*	GC	10		2					
Tubificidae	Tubificidae IWB	GC	10		9			5		
Lumbriculidae	Lumbriculidae	GC	7		9					
Glossiphoniidae	*Glossiphonia complanata*	PR	8			1				
Crangonyctidae	*Crangonyx* sp.	GC	6			2		3		
Gammaridae	*Gammarus* sp.	GC	6			14			5	13
Lebertiidae	*Lebertia* sp.	PR	6				1			
Sperchonidae	*Sperchonopsis* sp.	PR	6	1						
Baetidae	*Baetis flavistriga*	GC	4	2						
Heptageniidae	*Maccaffertium* sp.	SC	3	3						
Heptageniidae	*Maccaffertium modestum*	SC	1	5						
Leptophlebiidae	*Paraleptophlebia* sp.	GC	1	8						
Calopterygidae	*Calopteryx* sp.	PR	6	1						
Perlidae	*Acroneuria* sp.	PR	0	1						
Hydropsychidae	*Cheumatopsyche* sp.	FC	5	6		2	1	8	23	28
Hydropsychidae	*Hydropsyche betteni*	FC	7	7		6	19	51	6	49
Philopotamidae	*Chimarra aterrima*	FC	4	1						
Elmidae	Elmidae	SC	4	1						
Elmidae	*Macronychus glabratus*	SH	5			1				
Elmidae	*Microcylloepus pusillus*	GC	3	1						
Elmidae	*Optioservus* sp.	SC	4	6						
Elmidae	*Oulimnius latiusculus*	SC	4	3		6				
Elmidae	*Promoresia tardella*	SC	2	4		2				
Elmidae	*Stenelmis* sp.	SC	5	1		14				
Elmidae	*Stenelmis crenata*	SC	5				3			
Psephenidae	*Psephenus herricki*	SC	4	5						
Chironomidae	*Polypedilum* sp.	SH	6							1
Chironomidae	*Polypedilum aviceps*	SH	4	12						
Chironomidae	*Polypedilum flavum*	SH	6					11		3
Chironomidae	*Polypedilum halterale* gr.	SH	6					3		
Chironomidae	*Polypedilum illinoense* gr.	SH	6							1
Chironomidae	*Xenochironomus* sp.	PR	0							2
Chironomidae	*Micropsectra* sp.	GC	7	3			3			
Chironomidae	*Corynoneura* sp.	GC	4	4						
Chironomidae	*Rheotanytarsus pellucidus*	FC	5			3				

Appendix 2A. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Mystic subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1A for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Mystic River Benthic Stations						
				B0777[R]	B0757	B0756	B0130	B0755	B0754	B0131
Chironomidae	*Tanytarsus* sp.	FC	6					1		
Chironomidae	Orthocladiinae	GC	5				23			
Chironomidae	*Cardiocladius obscurus*	PR	5				4	1		
Chironomidae	*Cricotopus* sp.	SH	7		5				2	1
Chironomidae	*Cricotopus bicinctus*	GC	7		16	2			3	
Chironomidae	*Cricotopus intersectus* gr.	SH	7		2					
Chironomidae	*Cricotopus/Orthocladius* sp.	GC	7		1					
Chironomidae	*Eukiefferiella* sp.	GC	6		2					
Chironomidae	*Eukiefferiella devonica* gr.	GC	4	1						
Chironomidae	*Eukiefferiella claripennis* gr.	GC	8		2	1	3			
Chironomidae	*Eukiefferiella coerulescens* gr.	GC	4		9					
Chironomidae	*Nanocladius* sp.	GC	7						3	
Chironomidae	*Orthocladius dubitatus*	GC	6						1	
Chironomidae	*Parachaetocladius* sp.	GC	2	2						
Chironomidae	*Parametriocnemus* sp.	GC	5	4		2				
Chironomidae	*Rheocricotopus* sp.	GC	6	1						
Chironomidae	*Synorthocladius* sp.	GC	6				1		2	
Chironomidae	*Tvetenia paucunca*	GC	5			34	12	5		1
Chironomidae	*Prodiamesa* sp.	GC	3		3					
Chironomidae	*Natarsia* sp.	PR	8					2		
Chironomidae	*Thienemanniella* sp.	GC	6	1						
Chironomidae	*Thienemannimyia* gr.	PR	6	1	5			2		1
Empididae	Empididae	PR	6				7			
Empididae	*Hemerodromia* sp.	PR	6				1		1	
Empididae	*Neoplasta* sp.	PR	6		4		1			
Phoridae	Phoridae	GC	8		1					
Psychodidae	Psychodidae	GC	10				1			
Simuliidae	*Simulium* sp.	FC	5	14		13	20	6	55	5
Simuliidae	*Simulium verecundum* cplx.	FC	5			2				
Simuliidae	*Simulium vittatum* complex	FC	9						4	
Tipulidae	Tipulidae	SH	5					1		
Tipulidae	*Dicranota* sp.	PR	3	7						
Tipulidae	*Limonia* sp.	SH	6		1					
Tipulidae	*Tipula* sp.	SH	6	1		1				
	TOTALS			**108**	**90**	**106**	**100**	**100**	**105**	**105**

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

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

[R] Reference station

Appendix 2B. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Neponset subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1B for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Neponset River Benthic Stations												
				B0777[R]	B0764	B0760	B0762	B0763	B0140	B0139	B0142	B0761	B0143A	B0143B	B0780	B0759
Viviparidae	*Campeloma decisum*	SC	6										1			
Pisidiidae	Pisidiidae	FC	6		4	3		1	5					1		
Pisidiidae	*Pisidium* sp.	FC	6	1			2					2	7			1
Pisidiidae	*Sphaerium* sp.	FC	6											1		
Naididae	Naididae	GC	9						1							
Naididae	*Nais behningi*	GC	6					1	1							
Naididae	*Nais communis/variabilis*	GC	8		1	4	3									1
Naididae	*Pristina aequiseta*	GC	8				3									
Tubificidae	Tubificidae IWB	GC	10				42				1					
Tubificidae	Tubificidae IWH	GC	10				1									
Lumbriculidae	Lumbriculidae	GC	7			1			1		16	4	2	2	1	
Erpobdellidae	Erpobdellidae	PR	8				2									
Asellidae	*Caecidotea* sp.	GC	8		8				2							
Asellidae	*Caecidotea communis*	GC	8									8				
Crangonyctidae	*Crangonyx* sp.	GC	6									2				
Gammaridae	*Gammarus* sp.	GC	6							6		14			1	7
Hygrobatidae	*Hygrobates* sp.	PR	6					1								
Lebertiidae	*Lebertia* sp.	PR	6		1				2							
Sperchonidae	*Sperchonopsis* sp.	PR	6	1												
Torrenticolidae	*Torrenticola* sp.	PR	6													
Baetidae	*Baetis* sp.	GC	6								10	1	1		2	
Baetidae	*Baetis flavistriga*	GC	4	2										9		1
Baetidae	*Baetis* (subeq. term.) sp.	GC	6										1			
Ephemerellidae	*Eurylophella* sp.	GC	2						1							
Heptageniidae	*Maccaffertium* sp.	SC	3	3						1			5	7		
Heptageniidae	*Maccaffertium modestum*	SC	1	5											2	3

Appendix 2B. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Neponset subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1B for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Neponset River Benthic Stations												
				B0777[R]	B0764	B0760	B0762	B0763	B0140	B0139	B0142	B0761	B0143A	B0143B	B0780	B0759
Leptophlebiidae	*Paraleptophlebia* sp.	GC	1	8												
Aeschnidae	*Boyeria vinosa*	PR	2													
Calopterygidae	*Calopteryx* sp.	PR	6	1												
Capniidae/ Leuctridae	Capniidae/Leuctridae	SH	2													
Leuctridae	*Leuctra* sp.	SH	0							9						
Perlodidae	Perlodidae	PR	2	1							3					
Corydalidae	*Nigronia serricornis*	PR	0										1		1	
Glossosomatidae	*Glossosoma* sp.	SC	0			2				1		1		1	6	2
Hydropsychidae	Hydropsychidae	FC	4		3	1										
Hydropsychidae	*Cheumatopsyche* sp.	FC	5	6	3	4		36		4		10	4	7	4	35
Hydropsychidae	*Diplectrona modesta*	FC	0		8				4	4	3					
Hydropsychidae	*Hydropsyche* sp.	FC	4								1				3	
Hydropsychidae	*Hydropsyche betteni*	FC	7	7	3	13		10				8	15	12	16	6
Hydropsychidae	*Hydropsyche morosa* gr.	FC	6										1			
Hydropsychidae	*Hydropsyche sparna*	FC	6							3	1		14		6	2
Lepidostomatidae	*Lepidostoma* sp.	SH	1								1					
Limnephilidae	Limnephilidae	SH	4													
Philopotamidae	Philopotamidae	FC	3										1	2		
Philopotamidae	*Chimarra aterrima*	FC	4	1	1			2	1	6		1	5	20	6	
Philopotamidae	*Chimarra obscura*	FC	4										5	13	1	
Philopotamidae	*Dolophilodes* sp.	FC	0								11					
Rhyacophilidae	*Rhyacophila* sp.	PR	1						1	1	1					
Rhyacophilidae	*Rhyacophila fuscula*	PR	0								2					
Uenoidae	*Neophylax oligius*	SC	3										2			
Elmidae	Elmidae	SC	4	1												
Elmidae	*Ancyronyx variegata*	GC	5													1
Elmidae	*Microcylloepus pusillus*	GC	3	1						11			8	5	3	
Elmidae	*Optioservus* sp.	SC	4	6						2		1				

Appendix 2B. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Neponset subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1B for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Neponset River Benthic Stations												
				B0777[R]	B0764	B0760	B0762	B0763	B0140	B0139	B0142	B0761	B0143A	B0143B	B0780	B0759
Elmidae	*Optioservus immunis*	SC	4								2					
Elmidae	*Oulimnius latiusculus*	SC	4	3		3			15	6	27	12			10	13
Elmidae	*Promoresia tardella*	SC	2	4					2	14	13					
Elmidae	*Stenelmis* sp.	SC	5	1		6		6		6		12			16	
Elmidae	*Stenelmis crenata*	SC	5						27							13
Psephenidae	*Ectopria nervosa*	SC	5								1					
Psephenidae	*Psephenus herricki*	SC	4	5					4							
Ceratopogonidae	*Dashyhelea* sp.	PR	99													
Chironomidae	*Microtendipes* sp.	FC	5			1										
Chironomidae	*Microtendipes pedellus* gr.	FC	6						1							
Chironomidae	*Microtendipes rydalensis* gr.	FC	6							1		3				
Chironomidae	*Paratendipes* sp.	GC	6			1										
Chironomidae	*Phaenopsectra* sp.	SC	7													
Chironomidae	*Polypedilum* sp.	SH	6				2									
Chironomidae	*Polypedilum aviceps*	SH	4	12					2	4		1	1			
Chironomidae	*Polypedilum flavum*	SH	6		3	4	1	7				2	2	5	1	4
Chironomidae	*Polypedilum illinoense* gr.	SH	6					1								
Chironomidae	*Polypedilum scalaenum*	SH	6				2									
Chironomidae	*Xenochironomus* sp.	PR	0													1
Chironomidae	*Micropsectra* sp.	GC	7	3	28		22		13	2	2					
Chironomidae	*Paratanytarsus* sp.	FC	6									1				
Chironomidae	*Rheotanytarsus* sp.	FC	6										2			
Chironomidae	*Rheotanytarsus exiguus* gr.	FC	6					8					3	3	3	
Chironomidae	*Rheotanytarsus pellucidus*	FC	5		2	3			3				1			
Chironomidae	*Stempellinella* sp.	GC	2									2				
Chironomidae	*Tanytarsus* sp.	FC	6			2			2			1				
Chironomidae	*Zavrelia* sp.	FC	4			3										

Appendix 2B. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Neponset subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1B for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Neponset River Benthic Stations												
				B0777[R]	B0764	B0760	B0762	B0763	B0140	B0139	B0142	B0761	B0143A	B0143B	B0780	B0759
Chironomidae	*Diamesa* sp.	GC	5										1		1	
Chironomidae	Orthocladiinae	GC	5			1										
Chironomidae	*Brillia* sp.	SH	5			7										
Chironomidae	*Corynoneura* sp.	GC	4	4	1											
Chironomidae	*Cricotopus bicinctus*	GC	7					2						1		
Chironomidae	*Cricotopus/Orthocladius* sp.	GC	7				1	2			1					
Chironomidae	*Diplocladius cultriger*	GC	8		2			2					2			1
Chironomidae	*Eukiefferiella* sp.	GC	6				11			3						
Chironomidae	*Eukiefferiella claripennis* gr.	GC	8			1	8	1	1							
Chironomidae	*Eukiefferiella coerulescens* gr.	GC	4			1										
Chironomidae	*Eukiefferiella devonica* gr.	GC	4	1					1							
Chironomidae	*Heterotrissocladius marcidus*	GC	4								1					
Chironomidae	*Nanocladius minimus*	GC	3						1							
Chironomidae	*Parachaetocladius* sp.	GC	2	2					1							
Chironomidae	*Parametriocnemus* sp.	GC	5	4	4	2			1			2	1		4	2
Chironomidae	*Rheocricotopus* sp.	GC	6	1				1								
Chironomidae	*Thienemanniella* sp.	GC	6	1	1			1								
Chironomidae	*Tvetenia paucunca*	GC	5		12	33		1	3	5	3	9	6	1	12	3
Chironomidae	*Tanypodinae*	PR	7			1			1							
Chironomidae	*Thienemannimyia* gr.	PR	6	1	2											
Empididae	Empididae	PR	6							1						
Empididae	*Hemerodromia* sp.	PR	6											2		
Empididae	*Neoplasta* sp.	PR	6		1											
Simuliidae	*Simulium* sp.	FC	5	14	9	3		12	8	6	2	12	4	10	6	8
Simuliidae	*Simulium verecundum*	FC	5		3					5			4	4	2	

Appendix 2B. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Neponset subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1B for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Neponset River Benthic Stations												
				B0777[R]	B0764	B0760	B0762	B0763	B0140	B0139	B0142	B0761	B0143A	B0143B	B0780	B0759
	cplx.															
Simuliidae	*Simulium vittatum* complex	FC	9					1								
Tipulidae	*Antocha* sp.	GC	3					4						1		
Tipulidae	*Dicranota* sp.	PR	3	7							2					
Tipulidae	*Tipula* sp.	SH	6	1	1											
	TOTALS	---	---	**108**	**101**	**100**	**100**	**100**	**105**	**101**	**104**	**109**	**100**	**107**	**107**	**104**

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

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

[R] Reference station

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Appendix 2C. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Weymouth/Weir subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1C for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Weymouth/Weir River Benthic Stations											
				B0777[R]	B0749	B0751	B0753	B0748	B0750	B0744	B0747	B0745	B0752	B0758	B0746
Physidae	Physidae	GC	8		6		3								
Pisidiidae	Pisidiidae	FC	6	1								1		3	
Pisidiidae	*Pisidium* sp.	FC	6						1						
Naididae	Naididae	GC	9							2		1			
Naididae	*Nais communis/variabilis*	GC	8							2		21	2		
Naididae	*Pristina aequiseta*	GC	8							1		1			
Naididae	*Pristinella jenkinae*	GC	10									6			
Lumbriculidae	Lumbriculidae	GC	7		3	1	6		5	1		2		1	1
Asellidae	*Caecidotea* sp.	GC	8					6					1	1	
Asellidae	*Caecidotea communis*	GC	8			12									
Crangonyctidae	*Crangonyx* sp.	GC	6			1	1								
Gammaridae	*Gammarus* sp.	GC	6		1			18	3				1	12	3
Trombidiformes	--	PR	6							1		1			
Sperchonidae	*Sperchonopsis* sp.	PR	6	1											
Arrenuride	*Arrenurus* sp.	PR	6					1							
Lebertiidae	*Lebertia* sp.	PR	6						1						
Baetidae	*Baetis flavistriga*	GC	4	2											
Heptageniidae	*Maccaffertium* sp.	SC	3	3							1			3	
Heptageniidae	*Maccaffertium modestum*	SC	1	5											
Leptophlebiidae	Leptophlebiidae	GC	2						1					1	
Leptophlebiidae	*Paraleptophlebia* sp.	GC	1	8											
Calopterygidae	*Calopteryx* sp.	PR	6	1											
Cordulegastridae	*Cordulegaster* sp.	PR	3		1										
Capniidae/Leuctridae	Capniidae/Leuctridae	SH	2		5	2					6				

Appendix 2C. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Weymouth/Weir subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1C for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Weymouth/Weir River Benthic Stations											
				B0777[R]	B0749	B0751	B0753	B0748	B0750	B0744	B0747	B0745	B0752	B0758	B0746
Leuctridae	*Leuctra* sp.	SH	0		3										
Perlidae	*Acroneuria* sp.	PR	0	1											
Perlidae	*Perlesta placida*	PR	5								1			1	
Glossosomatidae	*Glossosoma* sp.	SC	0		3	1			1						23
Hydropsychidae	Hydropsychidae	FC	4		2	9	1		2				3		
Hydropsychidae	*Cheumatopsyche* sp.	FC	5	6			7	3	1	5		6	2	10	10
Hydropsychidae	*Diplectrona modesta*	FC	0		5	14			2		2				
Hydropsychidae	*Hydropsyche* sp.	FC	4						2			7		3	
Hydropsychidae	*Hydropsyche betteni*	FC	7	7	5	13	10			1	1	28	19	2	16
Hydropsychidae	*Hydropsyche sparna*	FC	6								1				
Limnephilidae	*Pycnopsyche* sp.	SH	4											1	
Odontoceridae	*Psilotreta* sp.	SC	0								1				
Philopotamidae	*Chimarra aterrima*	FC	4	1					1				12	5	
Philopotamidae	*Dolophilodes* sp.	FC	0			1									
Elmidae	Elmidae	SC	4	1	1									3	
Elmidae	*Microcylloepus pusillus*	GC	3	1											
Elmidae	*Optioservus* sp.	SC	4	6					11						
Elmidae	*Oulimnius latiusculus*	SC	4	3	27									1	
Elmidae	*Promoresia tardella*	SC	2	4									3		
Elmidae	*Stenelmis* sp.	SC	5	1									3	7	2
Elmidae	*Stenelmis crenata*	SC	5		12		26		43						
Psephenidae	*Ectopria nervosa*	SC	5		1	4									
Psephenidae	*Psephenus herricki*	SC	4	5										13	
Ceratopogonidae	*Probezzia* sp.	PR	6			1									
Chironomidae	*Microtendipes pedellus* gr.	FC	6					1							
Chironomidae	*Microtendipes rydalensis* gr.	FC	6											3	

Appendix 2C. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Weymouth/Weir subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1C for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Weymouth/Weir River Benthic Stations											
				B0777[R]	B0749	B0751	B0753	B0748	B0750	B0744	B0747	B0745	B0752	B0758	B0746
Chironomidae	*Phaenopsectra* sp.	SC	7												
Chironomidae	*Polypedilum aviceps*	SH	4	12							1				
Chironomidae	*Polypedilum flavum*	SH	6								3		1	2	
Chironomidae	*Polypedilum illinoense* gr.	SH	6						1		1				
Chironomidae	*Tribelos* sp.	GC	7					1							
Chironomidae	Tanytarsini	FC	6										1		
Chironomidae	*Micropsectra* sp.	GC	7	3	3	8		58	1	27	51	3	3		
Chironomidae	*Rheotanytarsus* sp.	FC	6												
Chironomidae	*Rheotanytarsus exiguus* gr.	FC	6				7						4		13
Chironomidae	*Rheotanytarsus pellucidus*	FC	5				1	3	3		2	3	11	1	8
Chironomidae	*Stempellinella* sp.	GC	2								3				
Chironomidae	*Tanytarsus* sp.	FC	6							1	2		11		
Chironomidae	*Diamesa* sp.	GC	5							2		2			1
Chironomidae	Orthocladiinae	GC	5		1					8			1		2
Chironomidae	*Brillia* sp.	SH	5							1					1
Chironomidae	*Cardiocladius obscurus*	PR	5										2		
Chironomidae	*Corynoneura* sp.	GC	4	4			1								
Chironomidae	*Cricotopus bicinctus*	GC	7									9			
Chironomidae	*Cricotopus tremulus* gr.	SH	7									1			
Chironomidae	*Cricotopus/Orthocladius* sp.	GC	7						1	1		3			
Chironomidae	*Diplocladius cultriger*	GC	8			1			3		2				
Chironomidae	*Eukiefferiella* sp.	GC	6							1					1
Chironomidae	*Eukiefferiella claripennis* gr.	GC	8			1	6			3		3			
Chironomidae	*Eukiefferiella coerulescens* gr.	GC	4				2			4		1			
Chironomidae	*Eukiefferiella devonica* gr.	GC	4	1										5	
Chironomidae	*Heterotrissocladius marcidus*	GC	4												

Appendix 2C. Taxonomic list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from Weymouth/Weir subwatershed stations during the 2009 Boston Harbor Watershed survey. Refer to Table 1C for a listing and description of sampling stations.

Family	Genus / Species	FFG[1]	TV[2]	Weymouth/Weir River Benthic Stations											
				B0777[R]	B0749	B0751	B0753	B0748	B0750	B0744	B0747	B0745	B0752	B0758	B0746
Chironomidae	*Parachaetocladius* sp.	GC	2	2											
Chironomidae	*Parametriocnemus* sp.	GC	5	4	3						2			8	
Chironomidae	*Rheocricotopus* sp.	GC	6	1											
Chironomidae	*Thienemanniella* sp.	GC	6	1						1	1				
Chironomidae	*Thienemannimyia* gr.	PR	6	1											
Chironomidae	*Tvetenia paucunca*	GC	5		8	3	22		16	8	19	4	8	13	1
Chironomidae	*Tvetenia vitracies*	GC	5											1	
Chironomidae	*Thienemannimyia* gr.	PR	6		1	1		1				1	3		
Empididae	Empididae	PR	6									3			
Empididae	*Hemerodromia* sp.	PR	6									1			
Empididae	*Neoplasta* sp.	PR	6		1										
Simuliidae	*Simulium* sp.	FC	5	14	11	26	6		1	30	6		9		16
Simuliidae	*Simulium verecundum* cplx.	FC	5		4	9	1								
Tipulidae	*Dicranota* sp.	PR	3	7											
Tipulidae	*Tipula* sp.	SH	6	1											
	TOTALS	---	---	**108**	**107**	**108**	**100**	**92**	**100**	**100**	**106**	**108**	**100**	**100**	**98**

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

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

[R] Reference station