Technical Memorandum CN 234.3

TAUNTON RIVER WATERSHED
2006 BENTHIC MACROINVERTEBRATE BIOASSESSMENT

Division of Watershed Management
Watershed Planning Program
Worcester, MA

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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).

As part of the Massachusetts Department of Environmental Protection/Division of Watershed Management's (MassDEP/DWM) 2006 Taunton River Watershed assessment, aquatic benthic macroinvertebrate biomonitoring was conducted to evaluate the biological health of selected streams in two major subwatersheds (i.e. Matfield and Threemile) 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 2006a). 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 thirteen sites on eleven named streams were sampled to investigate the effects of potential point and nonpoint sources of pollution—both historical and current—on the aquatic invertebrate populations throughout the watershed. While specific monitoring locations and protocols governing sample collection and data analysis differed over time, MassDEP biologists had previously assessed several of the streams studied in 2006 (Fiorentino 1996a, 1996b, 2004, Nuzzo 1985, Nuzzo and Kennedy 1992) and an additional goal of the present study was to determine whether the biological condition of these streams had changed over time. The 2006 sampling location descriptions, along with station identification numbers, sampling dates and biomonitoring history are presented in Table 1.

To provide information for making *Aquatic Life* use-support determinations, macroinvertebrate communities present at biomonitoring stations in the Taunton River Watershed were compared with the community occurring at a regional reference station unaffected by point sources of water pollution, and assumed (based on historical water quality data, topographic map examinations, and field reconnaissance) to be minimally impacted (relative to other portions of the Taunton Watershed) by nonpoint sources. Station TR01 on the Canoe River (Mill River Subwatershed) was considered most representative of "least disturbed" conditions in the Taunton Watershed and served as the reference condition to which the other sites were compared. The Canoe River had also served as the reference condition for earlier investigations. 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).

METHODS

Macroinvertebrate Sampling - RBPIII

Macroinvertebrate sampling activities employed for the 2006 Taunton River Watershed survey were conducted in accordance with the Sampling & Analysis Plan (SAP) for the Taunton River Watershed (MassDEP 2006b). The sampling procedures are described in the standard operating procedures *Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates* (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 1. List of biomonitoring stations sampled during the 2006 Taunton River watershed survey, including station and unique identification numbers, drainage areas, sampling site descriptions, and sampling dates. Sites at or near which previous MassDEP benthic macroinvertebrate assessments were performed are indicated along with the protocols used for those assessments: RBP = EPA Rapid Bioassessment Protocols, MRB = Macroinvertebrate Rapid Bioassessment.

Station ID	Unique ID	Drainage Area (mi^2)	Sampling Site Description	Sampling Date
Mill River Subwatershed				
TR01[1,2,4]	B0184	2.3	Canoe River, ~400 meters downstream from Willow Street, Foxborough	1-Aug-2006
Matfield River Subwatershed				
SALBK00[3]	B0609	8.2	Salisbury Brook, ~50 meters upstream from Otis Street, Brockton	1-Aug-2006
TRTBK00[3]	B0329	6.9	Trout Brook, ~100 meters upstream from confluence with Salisbury Brook, Brockton	1-Aug-2006
BVRBK00A	B0608	8.5	Beaver Brook, ~130 meters downstream from Elm Street, East Bridgewater	2-Aug-2006
TR03[1,2,5]	B0186	20.8	Salisbury Plain River, ~300 meters downstream from Belmont Street, East Bridgewater	2-Aug-2006
MDWBK01	B0607	6.3	Meadow Brook, ~350 meters upstream from Water Street, East Bridgewater	2-Aug-2006
STKR01	B0602	20.3	Satucket River, ~110 meters downstream from Bridge Street, East Bridgewater	2-Aug-2006
MATR01[5]	B0606	31.2	Matfield River, ~170 meters downstream from West Union Street, East Bridgewater	2-Aug-2006
Threemile River Subwatershed				
WR08A[4]	B0352	19.5	Wading River, upstream from Balcolm Street, Mansfield	3-Aug-2006
NB06WAD	B0603	43.4	Wading River, ~200 meters downstream from Route 140, Norton	3-Aug-2006
TR06[1,2,4]	B0189	5.7	Rumford River, ~575 meters downstream from Cocasset Street, Foxborough	1-Aug-2006
TR06B[1]	B0471	12.5	Rumford River, ~300 meters downstream from Willow Street, Mansfield	3-Aug-2006
TH09[1,4]	B0350	72.9	Threemile River, downstream from Harvey Street, Taunton	3-Aug-2006

[1] RBP III performed here by MassDEP/DWM in 2001 (Fiorentino 2004)
[2] RBP II performed here by MassDEP/DWM in 1996 (Fiorentino 1996b)
[3] RBP III performed here by MassDEP/DWM in 1989 (Nuzzo and Kennedy 1992)
[4] RBP III performed here by MassDEP/DWM in 1988 (Fiorentino 1996a)
[5] MRB performed at a site near here by MassDEP/DWM in 1983 (Nuzzo 1985)

Macroinvertebrate Sample Processing and Data Analysis

The macroinvertebrate sample processing and analysis procedures employed for the 2006 Taunton River 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 sample until approximately 100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity.

Based on the taxonomy, various community, population, and functional parameters, or "metrics", were calculated which allow measurement of important aspects of the biological integrity of the 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), 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 and biological 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 riverfront 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 (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to 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

Habitat quality was excellent at the reference site on the Canoe River (TR01), scoring 85% of the maximum attainable value of 200 (Appendix 1) and substantiating further its use as the reference condition. The mean habitat scores for the streams in the Matfield and Threemile subwatersheds were 137 and 150, respectively (Tables 2 and 3), and habitat scores for all but one site compared favorably with that of the reference site. Only station TRTBK00 on Trout Brook exhibited severe habitat limitations. Channel alteration, instream cover, sediment deposition, bank vegetative protection (both banks) and riparian vegetative zone width (both banks) all scored poorly in the habitat assessment of Trout Brook (Appendix 1).

A taxonomic list of the macroinvertebrate organisms collected at each sampling station during the 2006 biomonitoring survey is provided in Appendix 2. Included in the list are total organism counts, the functional feeding group designation (FG) for each macroinvertebrate taxon, and the tolerance value (TV) of each taxon. Tables 2 and 3 present summaries of the habitat and RBP III macroinvertebrate data analyses for sites in the Matfield and Threemile subwatersheds, respectively. Included for each sampling site are the habitat comparability to the reference condition, biological metric calculations, metric scores, and impairment designations.

The benthic macroinvertebrate community at Station TR01 on the Canoe River ranked first or second of all of the sites investigated in several key metrics (e.g., Total and EPT richness, Biotic Index, % Dominant taxon), supporting its designation as the reference condition to which the remaining sampling sites are to be compared (Table 2).

The macroinvertebrate communities present at all of the sites in the Matfield Subwatershed exhibited reductions in the numbers of total and EPT taxa and substantially higher Biotic Index values when compared to the reference community at TR01, and the results of the RBP III analyses ranged from “slightly impaired” to “moderately/severely impaired” (Table 2). The invertebrate communities at all of the streams in this subwatershed appeared to be structured in response to varying degrees of organic enrichment, though habitat factors also likely contributed to the impairment of Salisbury and Trout brooks. The bioassessments of these brooks, as well as the sites on the Salisbury Plain and Matfield rivers all led to the determination that the *Aquatic Life Use* was not supported by these water bodies. By contrast, the sampling sites on Beaver and Meadow brooks and the Satucket River exhibited only slight deviations from the reference condition and were judged to be in support of the designated *Aquatic Life Use.*

Results of the RBP III analyses of sites in the Threemile Subwatershed ranged from “non-impaired” at Station TH09 on the Threemile River to “moderately impaired” at Station TR06B on the Rumford River. The remaining sampling sites in this subwatershed were at least 76% comparable to the reference

community, resulting in assessments of either “slightly/non-impaired” (Stations WR08A and NB06WAD on the Wading River) or “slightly impaired” (Station TR06 on the Rumford River). Thus, Station TR06B on the Rumford River was the only site where it was determined that the *Aquatic Life Use* was not supported. Despite 87% habitat comparability, the benthic macroinvertebrate community at TR06B was only 48% comparable to the reference community. While the EPT Index and Scraper/Filterer metrics compromised the total metric score the most, the Biotic Index also scored poorly. Since habitat characteristics did not appear to limit the biological potential at this site, adverse impacts on the macroinvertebrate community can be attributed primarily to water quality conditions.

Table 2. Summary of habitat analysis (i.e. comparability to the reference habitat condition) and RBP III analysis of macroinvertebrate communities sampled in the Matfield Subwatershed during the Taunton River Watershed survey between 1 and 2 August 2006. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (TR01), and the corresponding assessment designation for each biomonitoring station. Complete habitat evaluations are presented in Appendix 1. Refer to Table 1 for a listing and description of sampling stations.

SAMPLING STATION	TR01		SALBK00		TRTBK00		BVRBK00A		TR03		MDWBK01		STKR01		MATR01	
STREAM	Canoe River		Salisbury Brook		Trout Brook		Beaver Brook		Salisbury Plain River		Meadow Brook		Satucket River		Matfield River	
HABITAT SCORE	169		125		78		164		158		146		145		141	
HABITAT % REFERENCE	--		74%		46%		97%		93%		86%		86%		83%	
HABITAT COMPARABILITY	--		Partially supporting		Non-supporting		Comparable		Comparable		Supporting		Supporting		Supporting	
TAXA RICHNESS	25	*6*	23	*6*	13	*2*	20	*4*	15	*4*	22	*6*	17	*4*	17	*4*
BIOTIC INDEX	3.75	*6*	5.78	*2*	6.24	*2*	5.37	*4*	6.76	*2*	5.10	*4*	4.91	*4*	6.06	*2*
EPT INDEX	12	*6*	2	*0*	2	*0*	5	*0*	--	*0*	7	*0*	4	*0*	2	*0*
EPT/CHIRONOMIDAE	1.41	*6*	4.13	*6*	0.05	*0*	2.38	*6*	--	*0*	5.89	*6*	4.08	*6*	0.06	*0*
SCRAPER/FILTERER	0.17	*6*	0.04	*2*	--	*0*	0.07	*4*	--	*0*	0.25	*6*	0.98	*6*	--	*0*
REFERENCE AFFINITY	100%	*6*	55%	*4*	50%	*4*	64%	*4*	49%	*2*	50%	*2*	50%	*4*	53%	*4*
% DOMINANT TAXON	16%	*6*	41%	*0*	71%	*0*	26%	*4*	38%	*2*	31%	*2*	18%	*6*	30%	*2*
TOTAL METRIC SCORE	*42*		*20*		*8*		*26*		*10*		*26*		*30*		*12*	
% COMPARABILITY TO REFERENCE	--		48%		19%		62%		24%		62%		71%		29%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**MODERATELY IMPAIRED**		**MODERATELY/ SEVERELY IMPAIRED**		**SLIGHTLY IMPAIRED**		**MODERATELY IMPAIRED**		**SLIGHTLY IMPAIRED**		**SLIGHTLY IMPAIRED**		**MODERATELY IMPAIRED**	

Table 3. Summary of habitat analysis (i.e. comparability to the reference habitat condition) and RBP III analysis of macroinvertebrate communities sampled in the Threemile Subwatershed during the Taunton River Watershed survey between 1 and 3 August 2006. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (TR01), and the corresponding assessment designation for each biomonitoring station. Complete habitat evaluations are presented in Appendix 1. Refer to Table 1 for a listing and description of sampling stations.

SAMPLING STATION	TR01		WR08A		NB06WAD		TR06		TR06B		TH09	
STREAM	Canoe River		Wading River		Wading River		Rumford River		Rumford River		Threemile River	
HABITAT SCORE	169		136		136		152		147		179	
HABITAT % REFERENCE	--		80%		80%		90%		87%		106%	
HABITAT COMPARABILITY	--		Supporting		Supporting		Comparable		Supporting		Comparable	
TAXA RICHNESS	25	*6*	23	*6*	21	*6*	29	*6*	17	*4*	21	*6*
BIOTIC INDEX	3.75	*6*	5.07	*4*	4.87	*4*	4.70	*4*	5.75	*2*	3.64	*6*
EPT INDEX	12	*6*	11	*6*	9	*2*	8	*0*	7	*0*	10	*4*
EPT/CHIRONOMIDAE	1.41	*6*	2.54	*6*	2.07	*6*	1.30	*6*	2.22	*6*	5.73	*6*
SCRAPER/FILTERER	0.17	*6*	--	*0*	0.06	*4*	0.83	*6*	0.02	*0*	0.88	*6*
REFERENCE AFFINITY	100%	*6*	68%	*6*	70%	*6*	63%	*4*	65%	*4*	49%	*2*
% DOMINANT TAXON	16%	*6*	19%	*6*	19%	*6*	13%	*6*	27%	*4*	17%	*6*
TOTAL METRIC SCORE	*42*		*34*		*34*		*32*		*20*		*36*	
% COMPARABILITY TO REFERENCE	--		81%		81%		76%		48%		86%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	**REFERENCE**		**SLIGHTLY/ NON-IMPAIRED**		**SLIGHTLY/ NON-IMPAIRED**		**SLIGHTLY IMPAIRED**		**MODERATELY IMPAIRED**		**NON-IMPAIRED**	

Eight of the sites investigated in 2006 were the subjects of previous bioassessments performed by the MassDEP/DWM (Table 1). Four indicative community metrics from the RBP III analyses and the overall impairment status assessments resulting from those analyses were compared from year to year to determine whether the biological condition had changed at those sites (Table 4). While a determination of true statistical trends is not possible using screening level techniques such as the RBP, the overall assessment of most sites remained consistent over the time represented by these surveys. For example, whereas the Wading River in Mansfield and the Rumford River in Foxborough remained slightly impaired from 1988 – 2006, Salisbury and Trout brooks were consistently found to be moderately impaired within that same time period. Furthermore, the Salisbury Plain River and the Rumford River in Mansfield were

also found to be moderately impaired although over a much shorter time interval (i.e., 2001 – 2006). Only the Threemile River in Taunton exhibited an apparent gradual improvement in the condition of the benthic macroinvertebrate community. Most of the individual community metrics improved with each successive survey and the overall impairment level at this site progressed from Moderate (1988) through Slight (2001) to Non-impaired in 2006.

Table 4. Selected macroinvertebrate RBPIII community metrics and impairment status for eight sampling stations in the Taunton River Watershed sampled by MassDEP/DWM in 2006 and on at least one previous occasion. See text for a description of the metrics.

Water Body	Year	Community Metrics				Impairment Status
		Total Richness	EPT Richness	Biotic Index	% Dominant Taxon	
Canoe River, Foxborough	1988	26	10	4.27	28	Reference
	2001	25	10	4.37	18	Reference
	2006	25	12	3.75	16	Reference
Salisbury Brook, Brockton	1989	11	1	6.51	65	Moderate
	2006	23	2	5.78	41	Moderate
Trout Brook, Brockton	1989	15	2	6.49	42	Moderate
	2006	13	2	6.24	71	Moderate - Severe
Salisbury Plain R., E. Bridgewater	2001	13	2	5.97	38	Moderate
	2006	15	0	6.76	26	Moderate
Wading River, Mansfield	1988	23	12	3.70	26	Slight
	2006	23	11	5.07	19	Non-Slight
Rumford River, Foxborough	1988	21	7	5.18	30	Slight
	2001	27	6	5.32	22	Slight
	2006	29	8	4.70	13	Slight
Rumford River, Mansfield	2001	13	7	5.37	41	Moderate
	2006	17	7	5.75	27	Moderate
Threemile River, Taunton	1988	13	6	4.14	63	Moderate
	2001	19	6	4.66	21	Slight
	2006	21	10	3.64	17	Non-impaired

SUMMARY

Sampling of the benthic macroinvertebrate community was carried out in August, 2006 at thirteen sites in the Taunton River 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 TR01 on the Canoe River in Foxborough served as the reference site. The macroinvertebrate community structure at seven sampling stations ranged between "non-impaired" and "slightly impaired" and the water bodies represented by these sites were considered to be supporting the *Aquatic Life Use.* At five sites the benthic macroinvertebrate community was degraded to the point where the *Aquatic Life Use* was not supported. Low EPT richness and high Biotic Index scores at these sites are characteristic of invertebrate communities structured in response to organic enrichment. Eight of the sites investigated in 2006 were the subjects of previous

bioassessments performed by the MassDEP/DWM. RBP III community metrics and impairment levels were compared from year to year to determine whether the biological condition had changed at these sites. The overall assessment of most sites remained consistent over the time represented by the surveys. Only the Threemile River in Taunton exhibited an apparent gradual improvement in the condition of the benthic macroinvertebrate community.

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Appendix 1. Habitat assessment summary for biomonitoring stations sampled during the 2006 Taunton River 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	SALBK00	TRTBK00	BVRBK00A	TR03	MDWBK01	STKR01	MATR01	TR01	TR06	WR08A	TR06B	NB06WAD	TH09
PRIMARY PARAMETERS (range is 0-20)	**SCORE**												
INSTREAM COVER	8	3	17	19	16	17	10	17	18	11	17	8	19
EPIFAUNAL SUBSTRATE	17	16	19	19	17	18	18	17	15	13	16	18	19
EMBEDDEDNESS	14	11	16	12	15	16	10	19	14	15	11	10	14
CHANNEL ALTERATION	13	0	19	17	20	16	15	20	20	11	20	16	20
SEDIMENT DEPOSITION	17	5	16	14	10	14	15	17	13	10	13	11	11
VELOCITY-DEPTH COMBINATIONS	7	6	13	17	13	12	11	10	7	7	10	9	19
CHANNEL FLOW STATUS	8	13	8	19	9	10	18	15	9	18	10	15	19
SECONDARY PARAMETERS (range is 0-10 for each bank)	**SCORE**												
BANK VEGETATIVE PROTECTION left	10	2	10	10	10	9	10	10	10	10	10	8	10
BANK VEGETATIVE PROTECTION right	9	2	10	10	10	9	10	10	10	10	10	10	10
BANK STABILITY left	10	9	8	6	4	3	3	7	8	9	5	8	9
BANK STABILITY right	9	9	8	3	3	7	5	7	9	10	5	7	9
RIPARIAN VEGETATIVE ZONE WIDTH left	1	1	10	10	9	4	10	10	10	2	10	7	10
RIPARIAN VEGETATIVE ZONE WIDTH right	2	1	10	2	10	10	6	10	9	10	10	9	10
TOTAL SCORE	**125**	**78**	**164**	**158**	**146**	**145**	**141**	**169**	**152**	**136**	**147**	**136**	**179**

Appendix 2. Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2006 Taunton River Watershed survey from 1 to 3 August 2006. Refer to Table 1 for a listing and description of sampling stations.

TAXON	FFG[1]	TV[2]	Sampling Stations												
			SALBK00	TRTBK00	BVRBK00A	TR03	MDWBK01	STKR01	MATR01	TR01[3]	TR06	WR08A	TR06B	NB06WAD	TH09
Hydrobiidae	SC	8												1	
Cipangopaludina chinensis	SC	6												1	
Physidae	GC	8	2			3									
Menetus dilatatus	SC	6	1												
Pisidiidae	FC	6	1					5			6	7	12		
Enchytraeidae	GC	10		1											
Nais communis/variabilis	GC	8	3	6							2				3
Nais simplex	GC	6							2						
Tubificidae IWB	GC	10	1			8			6		1				
Tubificidae IWH	GC	10							1						
Lumbriculidae	GC	7			2		1			9		3			
Erpobdella punctata	PR	8				1									
Caecidotea sp.	GC	8				3			1		1				
Crangonyx sp.	GC	6											2		
Gammarus sp.	GC	6									3		3		1
Hygrobates sp.	PR	6	1												
Lebertia sp.	PR	6	2												
Baetidae	GC	4													1
Baetis flavistriga	GC	4			6		4					1	1	3	3
Plauditus sp.	GC	4										1			
Pseudocloeon sp.	GC	6			1										
Eurylophella sp.	GC	2								2					
Maccaffertium sp.	SC	3					1	12		1	8		2	2	7
Isonychia sp.	FC	2												2	
Leptophlebiidae	GC	2									1				
Calopterygidae	PR	5	1								1				
Capniidae	SH	1										1			
Leuctra sp.	SH	0								11	3				
Perlidae	PR	1										1		1	
Acroneuria sp.	PR	0								2					
Perlodidae	PR	2								2					
Corydalus cornutus	PR	4												4	
Nigronia serricornis	PR	0			2		4			4	5				1
Apatania sp.	SC	3								1					
Brachycentrus numerosus	FC	1										7		6	15
Micrasema sp.	SH	2													1
Glossosoma sp.	SC	0													8
Hydropsychidae	FC	4	2		1				1			2			
Cheumatopsyche sp.	FC	5	44	2	1		3	11	2	2	3	2	21	5	5
Diplectrona modesta	FC	0								4	3				
Hydropsyche sp.	FC	4			7		3							19	
Hydropsyche betteni	FC	7	20	3	28		32	15	1	2	12	17	29	8	
Hydropsyche sparna	FC	6												12	4
Macrostemum sp.	FC	3										5			
Pycnopsyche sp.	SH	4								1	2				
Chimarra aterrima	FC	4			13		8			15	3	19	2	2	1
Chimarra obscura	FC	4						11				5	4		17
Dolophilodes distinctus	FC	0											1		
Lype sp.	SC	3								2					
Neophylax oligius	SC	3					2								1
Macronychus glabratus	SH	5										1			
Microcylloepus pusillus	GC	3						2						1	
Optioservus sp.	SC	4			1			12							1
Optioservus ovalis	SC	4					7								
Oulimnius latiusculus	SC	4								1	14				7

TAXON	FFG[1]	TV[2]	Sampling Stations												
			SALBK00	TRTBK00	BVRBK00A	TR03	MDWBK01	STKR01	MATR01	TR01[3]	TR06	WR08A	TR06B	NB06WAD	TH09
Promoresia tardella	SC	2					1	2							
Stenelmis sp.	SC	5	2		3			18			7			1	
Stenelmis crenata	SC	5													12
Dineutus sp.	PR	4											1		
Psephenus herricki	SC	4			1		6								2
Ceratopogonidae	PR	6								2					
Chironomus sp.	GC	10				4									
Cryptochironomus sp.	PR	8						1							
Microtendipes pedellus gr.	FC	6								1					
Microtendipes rydalensis gr.	FC	6											1	1	
Polypedilum sp.	SH	6					1		1						
Polypedilum aviceps	SH	4					1			8	1				
Polypedilum flavum	SH	6		2	9	1	1	4	8		6			2	4
Polypedilum illinoense gr.	SH	6		77		38			12		1	1			
Polypedilum laetum	SH	6									2				
Polypedilum scalaenum gr.	SH	6	3			1			2						
Micropsectra sp.	GC	7	2			18			3	3					
Rheotanytarsus exiguus gr.	FC	6			4	1	1	1	23			1	15	16	
Rheotanytarsus pellucidus	FC	5					2		1	2		10	8	6	1
Tanytarsus sp.	FC	6						2		3	2			2	
Zavrelia sp.	FC	4									1				
Diamesa sp.	GC	5	1												
Brillia sp.	SH	5				1	1		3						
Cardiocladius albiplumus	PR	5	2												
Cardiocladius obscurus	PR	5							1	1					
Corynoneura sp.	GC	4						1							
Cricotopus bicinctus	GC	7		3		5						2			
Diplocladius sp.	GC	8			1							7	1		
Eukiefferiella claripennis gr.	GC	8		4	1	2			7						
Eukiefferiella gracei gr.	GC	4								1					
Hydrobaenus sp.	GC	8										1			
Limnophyes sp.	GC	8										1			
Parametriocnemus sp.	GC	5									3				
Rheocricotopus sp.	GC	6	1		3			1			1		2	2	1
Synorthocladius sp.	GC	6	2												
Thienemanniella sp.	GC	6	4	1					1			1			
Tvetenia paucunca	GC	5	1	2	5	1	1			12	4				
Tvetenia vitracies	GC	5						1							5
Nilotanypus fimbriatus	PR	8						1							
Thienemannimyia gr.	PR	6		2	1		1			1	6				
Hemerodromia sp.	PR	6	3												
Phoridae	GC	8	1												
Psychoda sp.	GC	10		1											
Simulium sp.	FC	5	7	4	14	12	20		33		5	3	1	3	
Dicranota sp.	PR	3			3		1				1				
Tipula sp.	SH	6	1		1										
TOTAL			**108**	**108**	**108**	**99**	**102**	**100**	**109**	**93**	**108**	**99**	**106**	**100**	**101**

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

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

[3] Reference station