Wood-Pawcatuck Watershed Association

2004
FRESHWATER BENTHIC MACROINVERTEBRATE SAMPLING NEAR SMALL DAMS IN THE PAWCATUCK WATERSHED

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ABSTRACT:
Benthic macroinvertebrates were sampled in connection with a study done by the Wood-Pawcatuck Watershed Association (WPWA) concerning small dam effects on low order streams. The study was conducted on four streams with a total of 12 sites sampled using EPA Rapid Bioassessment Protocols. All organisms were collected in the field, preserved, and taken to WPWA offices to be identified. Coarse level identification was done, often down to family level, by WPWA staff. Two types of multi-metric analyses to determine water quality were used: Rhode Island Wadeable Streams Condition Index (RI WSCI) and the New York State Biological Assessment Profile (NYS BAP). Results showed that although there was a decrease of water quality at the site of the dams, the macroinvertebrate communities tended to recover at relatively short distances downstream. This may due in part to the to the high habitat quality and good stream buffers found at the sampling sites. WPWA preferred to utilize the NYS BAP instead of the RI WSCI for three reasons: a) it uses fewer, more robust metrics, b) it accounts for all macroinvertebrate families collected during sampling, and c) it employs an easier to use scoring system.

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INTRODUCTION

In the summer of 2004 Wood-Pawcatuck Watershed Association (WPWA) personnel performed several studies, including small dam physical measurements, flow evaluations, stream temperature, and fish assemblages on low order streams in the Pawcatuck Watershed (Saila, et. al, 2004) that can sustain native brook trout (*Salvelinus fontinalis*). Field observations revealed that at least one small dam has been built on nearly every low order stream in the Pawcatuck watershed. These dams are often left over from former agricultural practices, such as irrigation ponds or watering sites for livestock. Often the dams create a small pond, or reservoir, upstream of the dam which is between ½ to 3 acres (0.2 to 1.2 ha) in surface area.

WPWA was interested in examining the effects these dams have on stream habitat, especially as it applies to brook trout. Brook trout are believed to be the only native salmonid in Rhode Island. It is possible that before the 18th century Atlantic salmon could have been found in small numbers in the watershed. However, it does not appear that the watershed streams provide adequate habitat to sustain populations of this species.

WPWA conducted aquatic benthic macroinvertebrate sampling at and below selected small dams. There were two objectives for this project. First, in conjunction with the brook trout study, WPWA used a multi metric index to determine impacts dams may have had on the downstream macroinvertebrate populations. According to Karr and Chu (2000) “Biological

monitoring, especially multimetric approaches such as index of biological integrity, acknowledges the importance of rivers' biotic integrity and offers one of the strongest available tools for diagnosing, minimizing, and preventing river degradation." In line with this concept, WPWA has been conducting macroinvertebrate studies for water quality assessment over the past several years (Burgess, 2002). Second, the samples collected for this study where also used to evaluate the multi metric indexes currently in use in Rhode Island and other parts of New England. The two indexes evaluated were the RI Wadeable Stream Condition Index (RI WSCI) and the NYS Biological Assessment Profile (BAP).

Low (first and second) order streams have become a focus for monitoring by WPWA. Land use and human constructions near streams can have a significant impact on rivers and streams (Karr, 1999). Low order streams are the most susceptible to stressors due to their small watersheds, low volume of flow, and minimum protection. They often provide critical habitat to native plants and animals. Many of the low order streams are less than 10 feet in width, which means that wetland regulations only require 100 foot (30 m) buffer around them (RI DEM, 2000). Some are vulnerable to reduced flow from groundwater and surface water withdrawals.

Currently the Pawcatuck Watershed is subject to a great deal of developmental pressures from residential and commercial sources and an increasing demand for water supply. Residential areas near streams often have vegetation cut down to the stream banks by homeowners ignorant of wetland regulations. This type of activity is visible along the Beaver River in Richmond, as well as many other streams throughout the watershed. Other risks to small streams in residential areas come from new road crossings, lawn and road runoff, and domestic pet waste. This study was done in combination with chemical and physical monitoring in order to document current water quality in certain low order streams and track changes over time from human activities in

the watershed. It is believed that information from these and other monitoring programs will prevent or mitigate adverse impacts on small stream. This report presents the results of WPWA's aquatic benthic macroinvertebrate study for 2004.

METHODS

Using the EPA methodology for Rapid Bioassessment Protocol (US EPA, 1997 and 1999), WPWA sampled 12 sites on 4 streams. Three replicates were collected at each site and each replicate was sorted separately. Nine sites where at riffle areas, where a kick net method was used to collect the samples. The other three sites were above small dams. An Ekman dredge was used to collect samples from three separate locations in the reservoir formed by the dam. All organisms from the kick net and substrate were collected and identified. The organisms were identified to order and, when appropriate, down to family level. All organisms were preserved and saved in 70% ethanol.

Riffles were selected to sample upstream and downstream of small dam obstructions. This was to establish relative water quality upstream and to determine if there were any changes to the water quality downstream of the dam. Most multi metric indices used to determine water quality are based on macroinvertebrates found at riffle sites. An 18 in. x 8 in. (45.72 cm x 20.32 cm) rectangular collection net with a 0.59 mm mesh was used at these sites. Collections were done for three minutes at each area, for a total of 3 replicates at each riffle site. Rocks were picked up within a 1 square foot square (0.3 m) area in front of the net, rubbed into the net, and saved in a bucket to be examined for more organisms. Substrate was then kicked up into the net for 3 minutes. All organisms were collected from the rocks and net at the site, preserved in 95% alcohol, and taken to WPWA headquarters for identification.

Most aquatic benthic macroinvertebrate protocols call for a random subsampling of 100, 200, or 300 organisms. For the purpose of this study, it was decided to identify all the organisms collected from the sampling. Because this is a program still being developed by WPWA, it was important to obtain a reasonable idea of what organisms are found in these stream sites. Kicks were collected separately in most of the samples so that an evaluation could be made as to whether or not they were reflective of the organisms at that site. A chi-square test was done comparing the three replicate kicks with the mean of the kicks to determine if there were any significant statistical differences among individual samples.

Three areas at each dam were sampled from a kayak using an Ekman dredge. These were: a) at the inlet to the pond, b) mid-pond, and c) just above the dam. Substrate from the dredge was collected into a bucket. The substrate was sorted at the site, and all organisms were collected, preserved in 95% alcohol, and taken to WPWA headquarters for identification.

All identification was done by WPWA staff down to order and, when appropriate, families. Initial sorting and identification was performed by either URI Coastal Fellow, Andrea Guillmot or Program Assistant, Danielle Aube. They used identification keys, guide books, and a dissecting microscope to make an initial identification. Resources and key guides used included Living Waters (Dates and Byrne 1997), Freshwater Macroinvertebrates of Northeastern North America (Peckarsky et. al, 1990), A Guide to Common Freshwater Invertebrate of North America (Voshell 2002), Aquatic Insects of North America (Merritt and Cummings, 1996) and slides from the Aquatic Macroinvertebrate Identification Workshop sponsored by the Hudson Basin River Watch (Nolan, 2004). Every sample was then checked again by Program Director, Denise Poyer, with corrections made as necessary. Ms. Poyer attended the Benthic Macroinvertebrate Identification Workshop conducted by J. Kelly Nolan in August of 2004. For

quality control purposes, several of the samples were brought to this workshop and checked by both Ms. Poyer and Mr. Nolan. Worksheets for each of the sites listing all of the organisms identified are found in Appendix A.

MULTI METRIC ANALYSIS

As part of this study, a review was done of several state programs to examine the metrics used to evaluate and quantify water quality utilizing invertebrates. For the purposes of reporting water quality, WPWA utilized the metric formulas used by NYS DEC, known as the Biological Assessment Profile (NY BAP) based on a Family Level Benthic Macroinvertebrate Data Analysis Sheet. This method of assessing water quality seemed the most valuable for several reasons. First, NY BAP focuses on only four key indices: a) EPT (Ephemeroptera, Plecoptera, and Trichoptera) Richness, b) Family Richness, c) Family Biotic Index (FBI), and d) Percent Model Affinity (PMA). (See Appendix B for explanation of each). These indices seem to be the four most effective metrics in that they are sensitive to changes due to human influence (Schaefer, Gido, and Smith, 2005; Karr, 1999). Once these indices have been calculated, they can be converted to a scale of 1 to 10 for a more comprehensible comparison (TABLE 2). A relative water quality index of Non-, Slight, Moderate, or Severe Impact can be assigned, based on the scores (Appendix C). Although the Hudson Basin River Watch (HBRW) worksheets were used, some changes were made to reflect RI conditions. To calculate the Family Biotic Index the tolerance levels for families in Rhode Island, as developed by Dr. Mark Gould and revised by Sara DaSilva and Ben Jessup in 2003, were utilized (Jessup, 2003). Stream sample results from the Wood River for 2001, the same data used by the RIDEM as a reference site for the state (DaSilva, 2003), were used for the model reference.

WPWA data was also applied to a modified version of the RI Wadeable Stream Condition Index (WSCI) (TABLE 1a & b). This is a draft of a multimetric index developed by Tetra Tech, Inc. and RIDEM, Office of Water Resources (Carey, 2005, personal communication). Tetra Tech was contracted by RI DEM to devise a data base, named RI BioQual, to maintain the biological data of surface waters in RI (benthic macroinvertebrate sampling) and its associated chemical and physical data. WSCI was an initial draft attempt by RIDEM at developing a new index for evaluating macroinvertebrate data and to assist in development of a biological condition (as opposed to a reference site). RIDEM is aware of the limitations of this initial index draft (some of which are discussed further in this report) and therefore never published this work (beyond the report developed by Tetra Tech under contract to RIDEM) nor used them for assessments. Although RIDEM has never used the WSCI to evaluate any stream or river in RI, they hope that with the acquisition of new biologist for the Office of Water Resources, they will be able to take this initial work and build upon it. The WSCI is used in this report for information only, as is the NY BAP. It is interesting to note that despite the limitations, the WCSI results correlate very strongly with NY BAP results when applied to the WPWA data.

WCSI was developed using fine scale taxonomic data (genus and species). The version used by WPWA was modified by Sara DaSilva to use family level data. Until a new index is reference condition index is developed, the RI DEM has been using a Rapid Bioassessment Protocol (RBP) based on a set of 30 taxa devised in 1990 by Dr. Mark Gould, from the Roger Williams University, and Bob Richardson from RIDEM, Office of Water Resources. These metrics also use coarse resolution data (family level). In her 2003 thesis, Ms. DaSilva compared the use of coarse level data in the RBP to fine level data in the WSCI. She determined that there

was no significant differences between the two indexes. This is very useful for the purposes of WPWA programs, since the costs and skills needed to identify all organisms down to genus and species are prohibitive.

Ms. DaSilva stated some concerns about the WSCI and the Gould/Richardson index in her 2003 thesis. The 30 taxa selected by Dr. Gould have been used since 1990 to score streambed macroinvertebrates in RI, although it is unclear why these particular taxa were chosen. It has been suggested that the groupings should be reevaluated (DaSilva, 2003). Use of the taxa in the WSCI proved cumbersome for the purposes of this WPWA project because only one Trichoptera family and two Trichoptera genera are included. There is no option to include other Trichoptera families. Similar circumstances also exist in regard to Ephemeroptera and Plecoptera where there was little or no distinction made between families. This meant that the EPT index does not necessarily reflect all EPT families. It was also important to this project to account for all the macroinvertebrate families identified in order to have an adequate baseline record. The worksheet of the HBRW Family Level Benthic Macroinvertebrate Data Analysis Sheet was used because it can serve as a data record for organisms encountered in the streams as well as for calculating several indices.

Another concern of the WSCI is it may be using metrics that are not very robust. Measurements of functional groups, for instance, do not necessarily correspond well to habitat disturbance (DaSilva, 2003). So inclusion of these metrics may modify the final score in unpredictable ways.

A chi-square test for heterogeneity between the WSCI and the NY BAP scores was performed. Expected values do not differ significantly from the observed values, so that both scores seem to be measuring the same thing. A Pearson correlations test and Spearman rank

correlation test were performed between the two scores. The Pearson test showed a 0.87 correlation between the two while the Spearman rank test showed a 0.75 correlation. Both WSCI and NY BAP use a Family Biotic Index (FBI) score as one of their metrics, so a comparison was made using just this metric. There was similarly strong correlations; 0.90 and 0.77 respectively. However, when a One-Way AOV was performed on the two FBI scores, there was statistically significant differences between them. Although the two FBI scores correlated well, the RI WSCI score consistently presented higher responses than the NY BAP.

DISCUSSION

Parris Brook

Originally it was thought that Parris Brook would serve as a control site for the entire study, including fish assemblage and temperature measurements, because it does not contain any impoundments or small dams. Parris Brook does originate from a pond in West Greenwich, which is typical of many of the streams in the Pawcatuck Watershed. The site selected, however, yielded very few organisms, a total of only 41 after 3 kicks. No Plecoptera were recovered, which greatly decreased the EPT Index (TABLE 3). Because so few organisms were obtained, the Family Richness Index was also low. The families that were identified had very low tolerance levels, so the Family Biotic Index was very high (APPENDIX A).

The reason for the scarcity of organisms is unknown at this point. The site did show signs of excessive periphyton on almost every rock in the stream, possibly due to excessive nutrients in the system. This could particularly affect the Plecoptera, which are primarily crawlers and cling to the surface of rocks in swift moving water. The periphyton may impede their ability to utilize the rocks. It is also possible that this site dries out from time to time, which

could have an adverse effect on Orders such as Odonata and Megaloptera, which can spend several years in the larval stage in a stream bed. The fact that almost all the organisms found at the site are low tolerance Families indicates that the sites, at the time of sampling, was well oxygenated and cool, usually an indication of good water quality. Further investigations would have to be done before any additional explanations could be offered. Because Parris Brook had such low indices scores, it was decided to instead compare each river to its own upstream and downstream sites, rather than using a common control site.

Beaver River:

The Beaver River is a scenic stream located almost entirely in Richmond, RI. It is approximately 10 miles (16 km) long, and is mainly a second order stream for at least 9 miles. It arises from James Pond in Exeter and empties into the Pawcatuck River near Shannock. WPWA study sites on this river were all within the protected area of the DeCoppett Estate, a 2,000 acre (809 ha) parcel that is held in trust as a conservation area. There is a small dam, approximately 3 feet (0.9 meter) high that backs up a ½ acre (0.2 ha) pond on the property, just to the east of Hillsdale Road. Otherwise the sites were in relatively pristine wooded areas. A total of 5 sites- two upstream of the dam, one at the pond of the dam, and two downstream of the dam- where sampled. This entire river, except for the impoundment, had a high habitat score. Brook trout (Salvelinus fontinalis) were the dominant species at three of the sampling sites (Saila et. al, 2005). Although its headwaters consists of two impounded ponds about 1 mile (1.6 km) apart, the rest of the river flows entirely through forested areas with very little human disturbance, until it reaches Rt. 138. The river does cross under Hillsdale Road through a culvert between Site 1 and 2.

Beaver River had 6 families of Plecoptera (stoneflies) from 4 of the sites, not including the dam (APPENDIX A). One of the sites had 4 families, including a large number of Leuctridae, which are listed as 0 on the tolerance scale, or no tolerance for disturbance. The other three sites also had Leuctridae organisms in their samples. Eight families of Trichoptera (caddisflies) were identified along with five families of Ephemeroptera (mayflies). The high number of families especially among the EPT orders indicate a good quality natural system (Dates and Byrne, 1997) (TABLE 4). All four sites were rated as No Water Quality Impact based on the metrics used. The first site did show some Slight Impact based on the Percent Model Affinity (PMA). However, when averaged out with the other metrics, all the scores were 9.5 or higher. There was no statistically significant difference between the upstream and downstream sites.

The site at the dam near Hillsdale Road showed Moderate to Severe Impact. While this may not be a completely valid comparison due to different collection methods and habitat considerations, it does suggest that the dam has a substantial impact on the macroinvertebrates at that site. What is interesting and statistically significant is that just 0.3 miles downstream (Beaver River Site 4) the composition of the benthic macroinvertebrate community recovered completely according to this metric comparison, with average scores nearly identical to the upstream sites. However, there was a marked decrease in the number of organisms recovered at this site, only 114 in 3 kicks, as compared to over 900 at Site 1 or over 300 at Site 2. At 1 mile below the dam, organisms are again more abundant, with over 300 organism recovered at Site 5.

Queen River

The Queen River is another important river in the Pawcatuck Watershed. An Odonata Atlas conducted by Ginger Brown for the Rhode Island Natural History Survey (RINHS) demonstrated a very high diversity of dragonflies and damselflies on this river (personal communication, 2004). The Nature Conservancy (TNC) has included the Queen River Watershed on its priority list for acquisition and protection. The Queen is approximately 13 miles (20.8 km) long, arising from Dead Swamp in West Greenwich. Fisherville, Sherman, Locke, and Glen Rock Brooks drain into it above the Usquepaugh Dam near Rt. 138. Downstream of the dam it is known as the Usquepaugh River, continuing for 4 more miles (6.4 km) until it empties into the Pawcatuck River on the southwest side of the Great Swamp Management Area.

There is a small dam on the Queen River, just north of Williams Reynolds Road, that is on private property. The 4 foot (1.2 m) dam and its ½ acre (0.2 ha) reservoir was installed to ensure adequate domestic water supply for the house on the property. It was created after the Exeter Country Club installed their golf course. According to the property owner, Peter Brownelle, maintenance of the golf course caused a noticeable change in hydrology, just under a mile downstream. Flow was unusually decreased, apparently during times of irrigation of the golf course. Both the land owner and Dave Armstrong, a hydrologist with USGS, have observed a sudden decrease or increase of flow not associated with any natural phenomena (personal communication, 2003).

For comparative purposes, samples were taken at a site on a TNC property, (north of Rt. 102 and the Exeter Country Club), above the dam (south of the golf course), at the pond formed by the dam, and just below the dam. As expected, scores from the site at the dam were in the Moderate to Sever Impact range (TABLE 5). Scores from the TNC site were in the Non-Impact

Range, as were scores from the sites above and below the dam. However, below the dam the sample contained a high percentage of Trichoptera, especially Hydropsychidae, and the PMA was in the Slight Impact range (APPENDIX C). Interestingly, there were a very large number of organisms recovered from this site – over 1000. This also seems to indicate fairly rapid recovery of the macroinvertebrate community after the disturbance of the dam. Again, there was no significant differences between the upstream and downstream scores.

Shunnock River

This river in Stonington, CT is of interest because of a proposed fishway restoration project on an old mill pond known as Parke Pond. There is an historic, 6-foot slate dam that backs up a small pond of approximately 2 acres (0.8 ha). Samples were taken from the pond and 0.3 miles (0.4 km) downstream of the dam. It was not possible to obtain samples upstream at this time. Samples from the pond indicated Moderate to Severe Impact while samples downstream showed Non to Slight Impact (mean 7.6) (TABLE 6). There seemed to be somewhat less recovery here, with Trichoptera accounting for over 75% of the sample. However, EPT Index was 8, including 2 Ephemeroptera families and 2 Plecoptera families with low tolerance levels. Immediately upstream of Parke Pond, for about 0.5 miles (0.8 km), the Shunnock flows through a suburban area that includes cleared stream banks as well as a small section of channelized stream bed. The impacted area upstream of the pond may limit the species capable of migrating to the downstream site.

General Discussion

Ephemeroptera appeared to be under represented at all the sites sampled. At the reference model site for NYS for example, 40% of the organisms in the sample were Ephemeroptera. In the sampling done in the Pawcatuck Watershed, the Wood River reference site contained 16% Ephemeroptera. One site on the Beaver River contained 7%, and one site on the Queen River contained 5%. All the other sites had less 5% or none. However, the Plecoptera appeared to be relatively abundant, especially in the Beaver River. Four out of the five sites showed at least 10% Plecoptera. The only site that did not was at the dam, a highly impacted site. One site on the Beaver River had 23% Plecoptera. The Wood River reference model contained 10% Plecoptera, but the NYS reference site contained only 5%. Regional as well as seasonal differences may explain some of the variations. Early spring samples may yield more mayflies, which tend to emerge as adults during the spring and early summer. However, it was unknown when the reference sample for NYS was taken. All of the WPWA samples were taken in July or August.

This study used all of the organisms recovered from each sampling "kick". Sample sizes therefore varied greatly, from as little as 9 to as many as 500 organisms from each sampling effort. Composite samples from each site ranged from 41 to 1091. Metrics were based on percentage of families from each sample, rather than number of organisms out of 100. Because of this, comparisons with other studies may not be precise. Recent studies on sample size differences suggest that a subsample of 100 organisms, as is commonly used by many programs, may also have limitations (Chaffee, 2004). Increasing sample size to 200 or even 300 for would provide better accuracy. Otherwise, families can be missed or an imprecise distribution of families is presented.

RESULTS

There were no statistically significant differences among each replicate collection done at a site and a mean of the three kicks (TABLE 7). This fact enabled use of the composite sample to compare upstream and downstream scores (TABLES 3,4,5, and 6). These scores showed that small dams do have a negative impact on water quality based on benthic macroinvertebrate indices. All samples taken from dam sites showed Moderate to Severe Impact rating. However, there appears to be a rapid recovery of the macroinvertebrate community within in relatively short distances downstream of the dam. Samples taken within 0.1 to 0.3 miles of three dams showed an improvement of water quality to Non or Slight Impact. On two of these streams there was no significant difference between the upstream and downstream scores. The third stream had no upstream score for comparison. The rapid recovery may be due in part to the high dissolved oxygen content of the streams found below dams. Often the water is shallow but flows rapidly over exposed rocks. Because the reservoirs behind the dams were small, at least some organisms from upstream sites may have been able to successfully migrate downstream. Once past the dams they were assumed to find appropriate habitat in the highly oxygenated riffles.

On one stream, macroinvertebrate populations did not recover as well until at least a mile downstream of the dam. Another stream had a rapid increase in the number of organisms found downstream, over 1000. However, 75% of these were Trichoptera, with 42% Hydropsychidae, and another 9% were Oligochaeta. The water quality indices were still good for this site because of the high Family and EPT Richness scores.

CONCLUSIONS:

In the summer of 2004 WPWA conducted macroinvertebrate sampling on four low order stream in the Pawcatuck Watershed in conjunction with a study of small dams effect on stream habitat. Macroinvertebrates were identified to the level of family when appropriate. By sampling macroinvertebrates above, at, and below the dams, water quality impacts from the dams could be assessed using multi metric indexes. The data also provides for future comparative studies using macroinvertebrates for water quality assessments.

Two multi metric indexes were used, RI WCSI and NYS BAP, both of which indicate that dams on three low order streams in this study do have an immediate impact on the habitat quality. In particular, indices showed a marked decrease in family and EPT richness. Based on these same indexes it appears that this impact is moderated fairly quickly downstream. In two cases the macroinvertebrates sampled within 0.1 to 0.3 miles downstream had nearly identical scores to sites sampled above the dams. One explanation for the rapid improvement is that samples were taken from streams in relatively pristine settings with heavily vegetated stream banks. The natural buffer may contribute greatly to the streams ability to recover from effects the dam may have on the habitat. It is possible that samples taken from streams in disturbed areas may yield different results, or required a longer distance to recover from impacts. However, this study does not examine those differences.

At one of the downstream study sites, the number of organisms was greatly reduced when compared to upstream sites. The dam may have interfered with recruitment for colonizing sites immediately downstream. At another site the dominate taxa, Hydropsychidae, had a population that was disproportionate to the rest of the community. This Trichoptera family, also called common netspinners, is a filter feeder. They are commonly found below dams in large numbers due to the abundant algae produced in the reservoir being released downstream (Voshell, 2002).

A second part of the study compared two multi metric indexes. The examination found that of the two indexes, the RI Wadeable Stream Condition Index currently used to assess RI streams may not be an adequate tool. It uses a discrete set of taxa that does not account for all the families found in RI streams. It also uses at least two metrics (ratio of scrapers to filterers and percent shredders) that do not correlate well with RBP scores. These metrics may undermine the strength of the RI WSCI to identify negative impacts to streams. Also, the RI WSCI yields a score that compares to a reference or reference sites. This score does not actually indicate what the water quality is, only how it compares to a site considered representative of good water quality for this region.

In contrast, the NY BAP uses all the families found in the sample or subsample. It uses four robust indices that correlate well with impacts of human disturbance, including comparison with a reference site. This index also produces a score that quantifies relative water quality based on all four metrics. Although a score for water quality contains inherent uncertainties (Karr 1999), it provides a more comprehensible picture to the general public and governing authorities.

This study has also provided valuable baseline data on the macroinvertebrate communities to be found on four of the Pawcatuck Watershed's small streams – Beaver River, Queen River, Parris Brook, and Shunock River. WPWA intends to use these data to document current water quality on these streams and assess possible impacts due to any land use changes.

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Table 1a

RI Wadeable Stream Condition Index - WPWA 2004 Data										
(modification: Family Biotic Index for Hilsenhoff Biotic Index)										
Taxa	Ins	Non-I	Sc	TL	Wood	Beaver 1	Beaver 2	Beaver 3	Beaver 4	Beaver 5
Hirudinea		1		10		1		6		
Tubificidae		1		10						
Oligochaeta		1		9	1		2	93		
Isopoda		1		8				64		
Amphipoda		1		7			1	7		
Decapoda		1		8	1					
Gastropoda		1	1	6						
Pelecypoda		1		8	2					
Coleoptera	1		1	4	16	132	115		18	117
Lepidoptera	1			5						
Tipulidae	1			4	1	19	27		25	10
Simulidae	1			6	3	7	17			16
(D)Tabanidae	1			5						
(D)Culicidae	1			9						
Chironomidae	1			6	6		15	21		1
Plecoptera	1			1	10	219	41		13	36
(E)Siphlonuridae	1			7	2					
(E)(H)Stenonema	1		1	3			1			
Limnephilidae	1			4	8				1	1
(T)(Hyd)Hydropsyche	1			5	15	331	93		5	110
(T)(Phil)Chimarra	1			4	12		10	2		
Hemiptera	1		1	10						
Diptera	1			5		16	7			5
Porifera		1		2						
Megaloptera	1			8	3	24	21	1	6	8
Sialidae	1			4						
Odonata	1			2	6	7	14		3	11
Ephemeroptera	1		1	5	14	13	17			26
Nematoda		1		0						
Total Number					100	769	381	194	71	341
Taxa Richness					15	10	14	7	7	11
Insect Taxa					12	9	12	3	7	10
Non-insect Taxa					3	1	2	4	0	1
pEPT (w/o Hydropsychidae)					46.0	30.17	18.11	1.03	23.94	14.08
pPlecoptera					10.0	28.48	10.76	0.00	18.31	10.56
FBI (subs.for HBI)					4.40	3.75	4.33	8.25	3.90	4.09
pScrapers					30.0	18.86	34.91	0.00	29.58	37.54
Metric Scores										
Taxa Richness						3	6	3	3	3
Insect Taxa						3	6	0	3	6
Non-insect Taxa						6	3	0	6	6
pEPT(w/oHydrops)						3	0	0	3	0
pPlecoptera						6	6	0	6	6
FBI						6	6	0	6	6
pScrapers						6	6	0	6	6
Total (Assessment Score)					**Ref**	**78.57**	**78.57**	**7.14**	**78.57**	**78.57**

Table 1b											
RI Wadeable Stream Condition Index - WPWA 2004 Data											
(modification: Family Biotic Index for Hilsenhoff Biotic Index)											
Taxa	Ins	Non-I	Sc	TL	Queen 1	Queen 2	Queen 3	Queen 4	Parris	Shunnock	Parke Pond
Hirudinea		1		10							
Tubificidae		1		10							
Oligochaeta		1		9	25	45	93	100			
Isopoda		1		8			4				24
Amphipoda		1		7	24			2	1	2	23
Gastropoda		1	1	6							9
Pelecypoda		1		8			2				
Coleoptera	1		1	4	40	41		30	1	13	1
Lepidoptera	1			5							
Tipulidae	1			4	34	6		7	3		
Simulidae	1			6				11			
(D)Tabanidae	1			5							
(D)Culicidae	1			9							
Chironomidae	1			6	9		2	2	1		7
Plecoptera	1			1	177	4		45		7	
(E)Siphlonuridae	1			7							
(E)(H)Stenonema	1		1	3					1	1	
Limnephilidae	1			4	3	7	1	6	1	45	1
(T)(Hyd)Hydropsyche	1			5	188	57		466		91	
(T)(Phil)Chimarra	1			4			2			11	
Hemiptera	1		1	10							
Diptera	1			5	25	19		23		18	
Porifera		1		2							
Megaloptera	1			8	15	6		9	5		
Sialidae	1			4			5				5
Odonata	1			2	6	9	3	14	4	1	
Ephemeroptera	1		1	5		12		35	2	8	
Nematoda		1		0							
Total Number					546	206	112	750	19	197	70
Taxa Richness					11	10	8	13	9	10	7
Insect Taxa					9	9	5	11	8	9	4
Non-insect Taxa					2	1	3	2	1	1	3
pEPT (w/o Hydropsychidae)					32.97	11.17	2.68	11.47	21.05	36.55	1.43
pPlecoptera					32.42	1.94	0.00	6.00	0.00	3.55	0.00
FBI (subs.for HBI)					3.90	5.49	8.35	5.24	4.95	4.50	6.81
pScrapers					7.33	25.73	0.00	8.67	21.05	11.17	14.29
Metric Scores											
Taxa Richness					3	3	3	6	3	3	3
Insect Taxa					3	3	3	6	3	3	0
Non-insect Taxa					3	6	0	3	6	6	0
pEPT(w/oHydrops)					3	0	0	0	3	3	0
pPlecoptera					6	0	0	6	0	3	0
FBI					6	3	0	3	3	3	0
pScrapers					0	6	0	3	6	3	3
Total (Assessment Score)					**57.14**	**50.00**	**14.29**	**64.29**	**57.14**	**57.14**	**14.29**

TABLE 2

Example of CONVERSION WORKSHEET FOR BIOLOGICAL ASSESSMENT PROFILE

FAMILY RICHNESS		
	>15	10.0
	>13	-0.6
	>9	0.5
	>6	-1.3
	<7	0.0
	0	0.0
FAMILY EPT RICHNESS		
	>10	10.0
	>7	1.7
	>2	4.0
	>0	1.3
	0	0.0
HILSENHOFF FAMILY BIOTIC INDEX		
	<2	10.0
	<4.51	12.0
	<5.51	12.5
	<7.01	14.2
	>7	8.3
PERCENT MODEL AFFINITY		
	>90	10.0
	>64	1.3
	>49	-2.9
	>34	-3.0
	<35	-3.4
	<20	0.0

	River Mile					Mean	Site	Median
		Family	**EPT**	**FBI**	**PMA**	**BAP**		**BAP**
	9							
	8							
	7							
	6							
	5							
	4							
	3							
	2							
	1							
	0							

	River Mile					Mean	Site	Median
		Family	**EPT**	**FBI**	**PMA**	**BAP**		**BAP**
	5							
	4.5							
	4							
	3.5							
	3							
	2.5							
	2							
	1.5							
	1							
	0.5							

TABLE 3
Biological Assessment Profile - Comparisons of all RI River Sites 2004

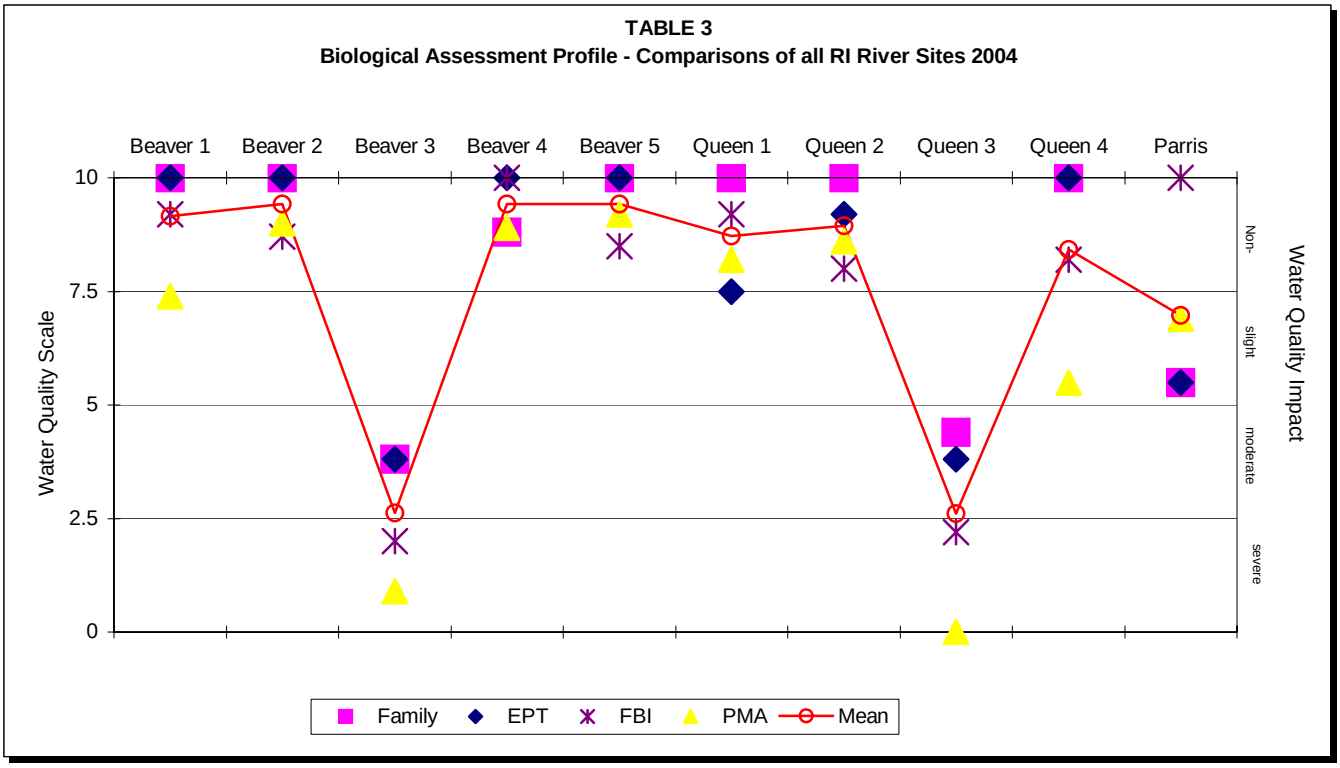


TABLE 4
Biological Assessment Profile - Beaver River

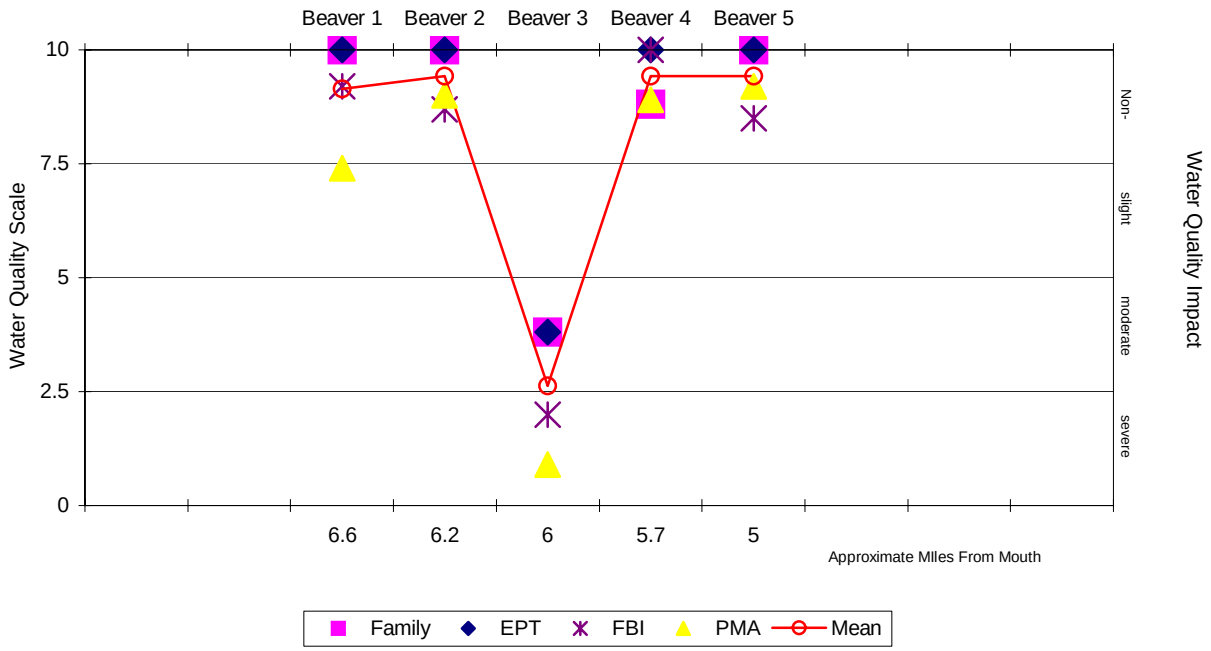


TABLE 5
Biological Assessment Profile - Queen River

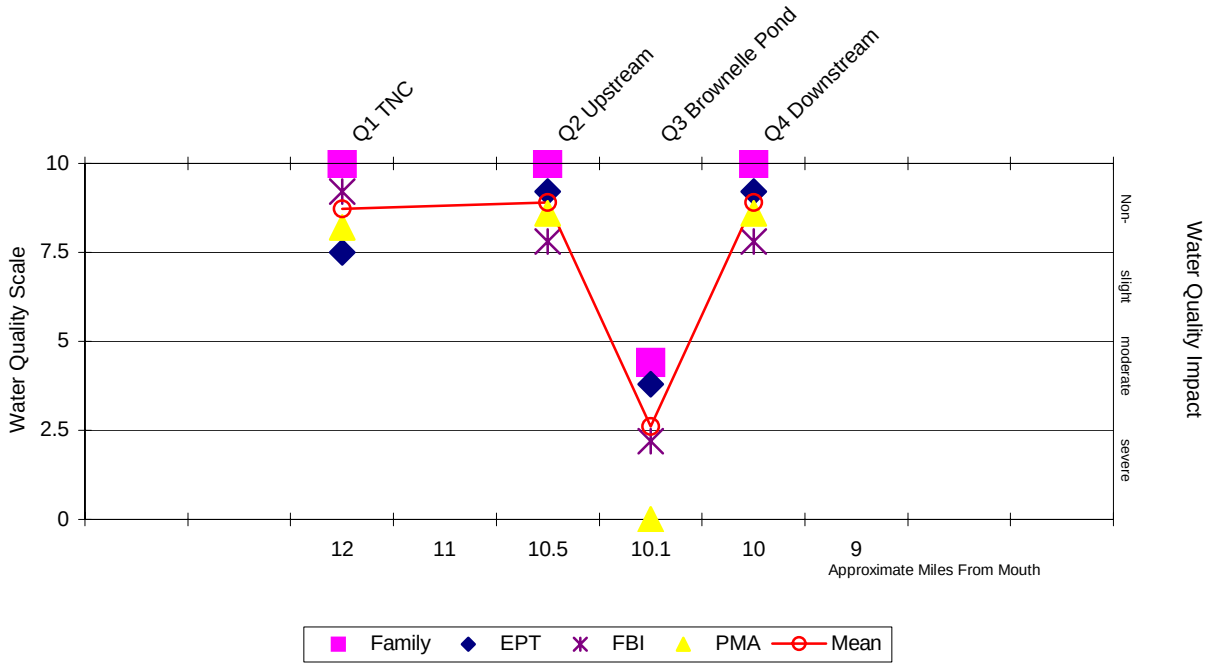


TABLE 6
Biological Assessment Profile - Shunnock River

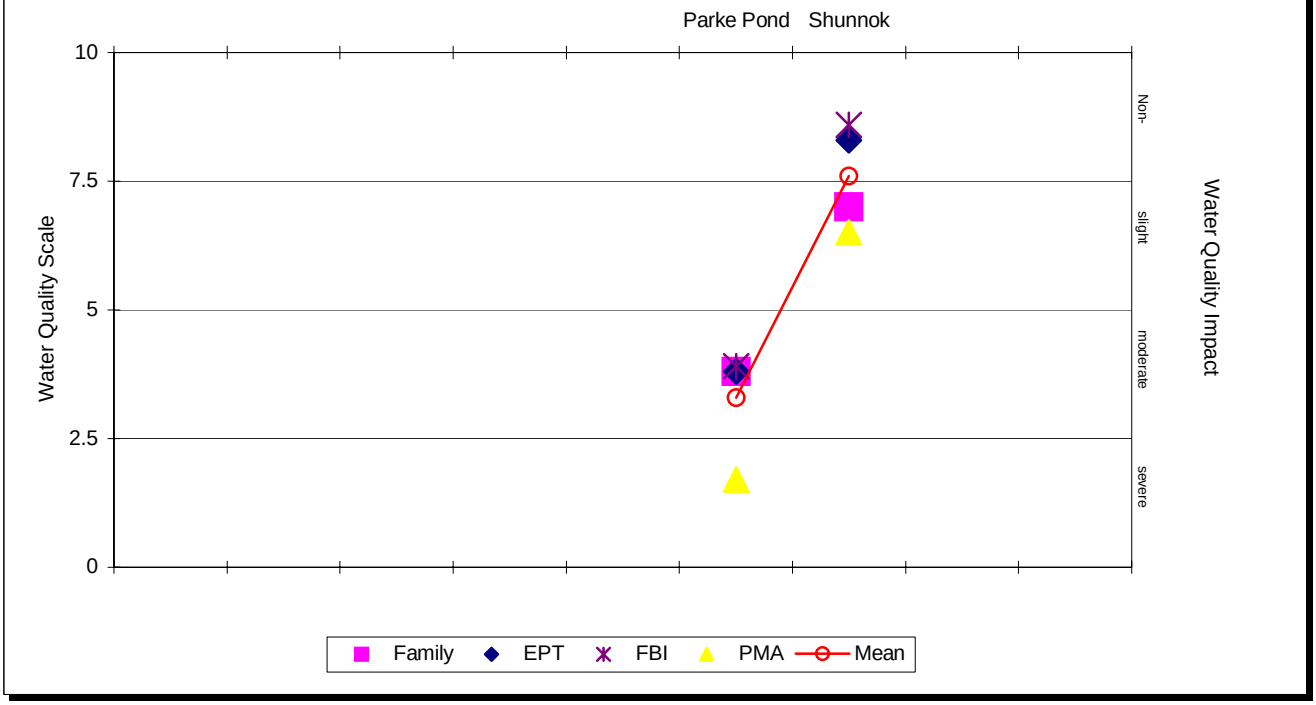
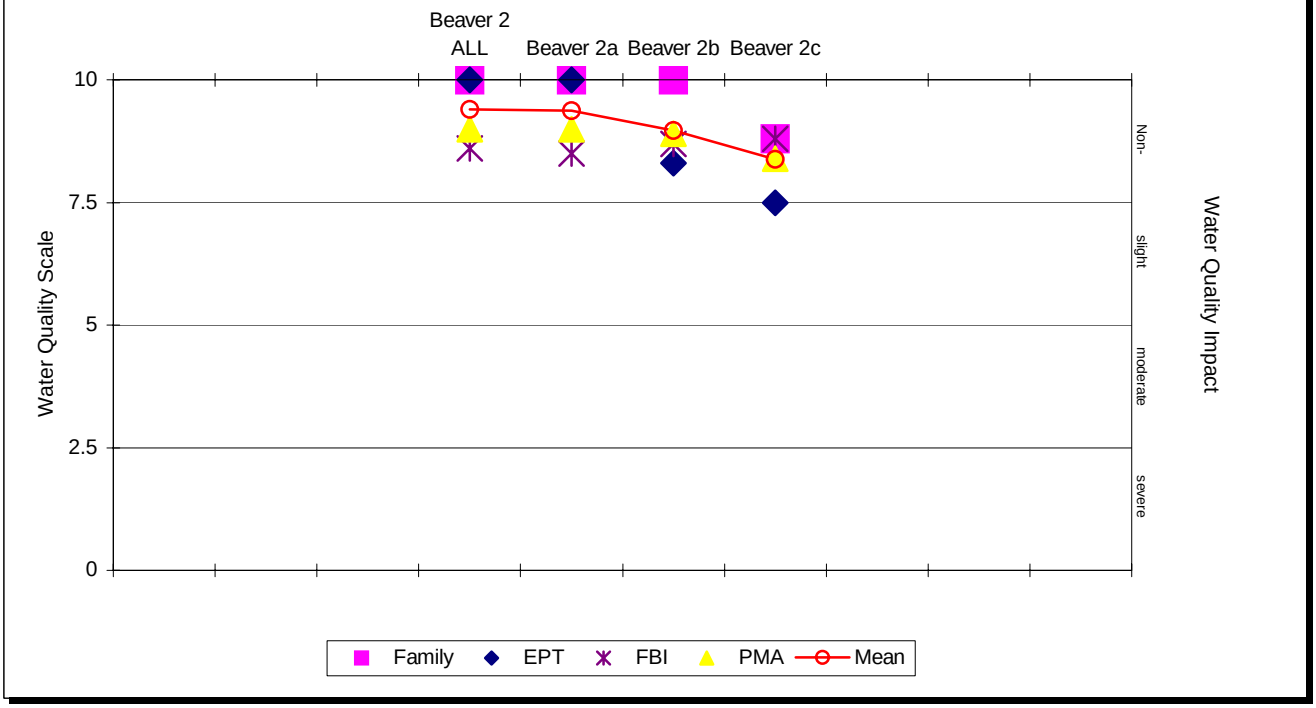


TABLE 7
BAP Example of 3 kicks and composite scores at Beaver River Site 2



APPENDIX A

Beaver River Site 1

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Beaver 1
River/Stream/Town: Beaver River, Richmond
W of Hillsdale Rd, just N of bridge, below breached dam
Date Sampled: 8/12/04
Name(s):
Date of Lab Work: 8/20/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	1	1	4	0.0011
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	4	4	16	0.0042
Heptageniidae	4	6	6	24	0.0064
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	2	2	4	0.0021
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			13	48	0.0138
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	135	135	0	0.1433
Nemouridae	2	1	1	2	0.0011
Peltoperlidae	2	48	48	96	0.051
Perlidae	1	24	24	24	0.0255
Perlodidae	2	8	8	16	0.0085
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		3	3	0	0.0032
Subtotal P			219	138	0.2325
MEGALOPTERA (M)					
Corydalidae	0	18	18	0	0.0191
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			18	0	0.0191
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	4	4	0	0.0042
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	331	331	1324	0.3514
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	1	1	0	0.0011
Philopotamidae	3	198	198	594	0.2102
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	6	6	6	0.0064
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			540	1924	0.5732
DIPTERA (D)					
Athericidae	2	16	16	32	0.017
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	19	19	76	0.0202
Empididae	6	0	0	0	0
Simuliidae	6	7	7	42	0.0074
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			42	150	0.0446
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Beaver 1 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	102	102	408	0.1083
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			102	408	0.1083
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	7	7	7	0.0074
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			7	7	0.0074
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	1	1	10	0.0011
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			1	10	0.0011

TOTALS	942	2685	1

Organism Density/Sample Unit	942
EPT Richness	15
Total Family Richness	22
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	2.85
% Contribution of Dominant Family	35%
% Model Affinity	64%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	4
# Plecoptera Families	6
# Trichoptera Families	5
EPT Richness (Total)	15

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		1%
PLECOPTERA		23%
TRICHOPTERA		57%
CHIRONOMIDAE		0%
OTHER DIPTERA		4%
COLEOPTERA		11%
ODONATA		1%
MEGALOPTERA		2%
LEPIDOPTERA		0%
AMPHIPODA		0%
ISOPODA		0%
OLIGOCHAETA		0%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Beaver River Site 2

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Beaver River 2
River/Stream/Town: Beaver River, Richmond, RI
Decoppet Estate, E of Hillsdale Rd, S of bridge
Date Sampled: 8/25/04
Name(s):
Date of Lab Work: 9/3/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	8	8	32	0.0205
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	9	9	36	0.023
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			17	68	0.0435
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	6	6	6	0.0153
Leuctridae	0	26	26	0	0.0665
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	6	6	6	0.0153
Perlodidae	2	3	3	6	0.0077
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			41	18	0.1049
MEGALOPTERA (M)					
Corydalidae	0	21	21	0	0.0537
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			21	0	0.0537
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	1	1	0	0.0026
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	93	93	372	0.2379
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	1	1	0	0.0026
Philopotamidae	3	17	17	51	0.0435
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	4	4	4	0.0102
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			116	427	0.2967
DIPTERA (D)					
Athericidae	2	5	5	10	0.0128
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	15	15	90	0.0384
Tipulidae	4	27	27	108	0.0691
Empididae	6	0	0	0	0
Simuliidae	6	17	17	102	0.0435
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		2	2	0	0.0051
Subtotal D			66	310	0.1688
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Beaver 2 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	113	113	452	0.289
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			113	452	0.289
ODONATA (O)					
Aeshnidae	3	2	2	6	0.0051
Calopterygidae	5	1	1	5	0.0026
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	11	11	11	0.0281
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			14	22	0.0358
AMPHIPODA (A)					
Crangonyctidae	6	1	1	6	0.0026
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			1	6	0.0026

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	2	2	18	0.0051
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			2	18	0.0051

TOTALS	391	1321	1

Organism Density/Sample Unit	391
EPT Richness	11
Total Family Richness	23
EPT/EPT+Chironomidae Ratio	0.92
Biotic Index	3.38
% Contribution of Dominant Family	29%
% Model Affinity	80%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	4
# Trichoptera Families	5
EPT Richness (Total)	11

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		4%
PLECOPTERA		10%
TRICHOPTERA		30%
CHIRONOMIDAE		4%
OTHER DIPTERA		13%
COLEOPTERA		29%
ODONATA		4%
MEGALOPTERA		5%
LEPIDOPTERA		0%
AMPHIPODA		0%
ISOPODA		0%
OLIGOCHAETA		1%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	4
Plecoptera	10	10
Tricoptera	35	30
Coleoptera	16	29
Chironomidae	6	4
Oligochaeta	1	1
Other	16	22

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Beaver River Site 3

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Beaver 3
River/Stream/Town: Beaver River, Richmond, RI
Decoppet Estate pond, E of Hillsdale, near dam across from gray house
Date Sampled: 7/20/04
Name(s): Server sampler
Date of Lab Work: 7/24/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	0	0	0	0
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			0	0	0
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	0	0	0	0
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			0	0	0
MEGALOPTERA (M)					
Corydalidae	0	0	0	0	0
Sialidae	4	1	1	4	0.006
		0	0	0	0
Other		0	0	0	0
Subtotal M			1	4	0.006
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	0	0	0	0
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	2	2	6	0.012
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		1	1	0	0.006
Subtotal T			3	6	0.0181
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	21	21	126	0.1265
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			21	126	0.1265
ISOPODA (I)					
Asellidae	8	38	38	304	0.2289
		0	0	0	0
Other		0	0	0	0
Subtotal I			38	304	0.2289

Beaver 3 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	0	0	0	0
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			0	0	0
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			0	0	0
AMPHIPODA (A)					
Crangonyctidae	6	7	7	42	0.0422
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			7	42	0.0422

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	0
# Plecoptera Families	0
# Trichoptera Families	2
EPT Richness (Total)	2

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	93	93	837	0.5602
Hirudinea	10	3	3	30	0.0181
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			96	867	0.5783

TOTALS	166	1349	1

Organism Density/Sample Unit	166
EPT Richness	2
Total Family Richness	8
EPT/EPT+Chironomidae Ratio	0.13
Biotic Index	8.13
% Contribution of Dominant Family	56%
% Model Affinity	25%

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		0%
PLECOPTERA		0%
TRICHOPTERA		2%
CHIRONOMIDAE		13%
OTHER DIPTERA		0%
COLEOPTERA		0%
ODONATA		0%
MEGALOPTERA		1%
LEPIDOPTERA		0%
AMPHIPODA		4%
ISOPODA		23%
OLIGOCHAETA		56%
GASTROPODA		0%
PELECYPODA		0%
OTHER		2%

Ephemeroptera	16	0
Plecoptera	10	0
Tricoptera	35	2
Coleoptera	16	0
Chironomidae	6	13
Oligochaeta	1	56
Other	16	30

Beaver River Site 4

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Beaver River 4
River/Stream/Town: Beaver River, Richmond, RI
Decoppet Estate, downstream of dam, E of Hillsdale Rd.
Date Sampled: 8/19/04
Name(s):
Date of Lab Work: 8/30/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	1	1	4	0.0088
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	1	1	4	0.0088
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			2	8	0.0175
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	8	8	0	0.0702
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	5	5	5	0.0439
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			13	5	0.114
MEGALOPTERA (M)					
Corydalidae	0	6	6	0	0.0526
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			6	0	0.0526
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	1	1	1	0.0088
Glossosomatidae	0	1	1	0	0.0088
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	5	5	20	0.0439
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	27	27	0	0.2368
Philopotamidae	3	2	2	6	0.0175
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	4	4	4	0.0351
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			40	31	0.3509
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	25	25	100	0.2193
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			25	100	0.2193
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Beaver 4 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	18	18	72	0.1579
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			18	72	0.1579
ODONATA (O)					
Aeshnidae	3	2	2	6	0.0175
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	8	8	8	0.0702
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			10	14	0.0877
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			0	0	0

TOTALS	114	230	1

Organism Density/Sample Unit	114
EPT Richness	10
Total Family Richness	15
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	2.02
% Contribution of Dominant Family	24%
% Model Affinity	79%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	2
# Trichoptera Families	6
EPT Richness (Total)	10

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		2%
PLECOPTERA		11%
TRICHOPTERA		35%
CHIRONOMIDAE		0%
OTHER DIPTERA		22%
COLEOPTERA		16%
ODONATA		9%
MEGALOPTERA		5%
LEPIDOPTERA		0%
AMPHIPODA		0%
ISOPODA		0%
OLIGOCHAETA		0%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	2
Plecoptera	10	11
Tricoptera	35	35
Coleoptera	16	16
Chironomidae	6	0
Oligochaeta	1	0
Other	16	36

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Beaver River Site 5

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Beaver River 5 — River/Stream/County: Beaver River,
Punch Bowl Trail — 1 mi downstream from dam at Decoppet
Date Sampled: 9/23/04 — Name(s): Poyer, Aube, Cerrulo
Date of Lab Work: 10/28 -11/1/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\bar{D}$	T x $\bar{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	10	10	40	0.0287356
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	7	7	7	0.0201149
Ephemeridae	4	0	0	0	0
Heptageniidae	4	9	9	36	0.0258621
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			26	83	0.0747126
PLECOPTERA (P)					
Capniidae	3	3	3	9	0.0086207
Chloroperlidae	1	0	0	0	0
Leuctridae	0	2	2	0	0.0057471
Nemouridae	2	0	0	0	0
Peltoperlidae	2	11	11	22	0.0316092
Perlidae	1	20	20	20	0.0574713
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			36	51	0.1034483
MEGALOPTERA (M)					
Corydalidae	0	8	8	0	0.0229885
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			8	0	0.0229885
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\bar{D}$	T x $\bar{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	110	110	440	0.3161
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	1	1	4	0.0029
Molannidae	6	0	0	0	0
Odontoceridae	0	1	1	0	0.0029
Philopotamidae	3	0	0	0	0
Phryganeidae	4	1	1	4	0.0029
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	5	5	5	0.0144
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			118	453	0.3391
DIPTERA (D)					
Athericidae	2	5	5	10	0.0144
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	1	1	6	0.0029
Tipulidae	4	10	10	40	0.0287
Empididae	6	0	0	0	0
Simuliidae	6	16	16	96	0.046
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			32	152	0.092
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Beaver 5 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	117	117	468	0.3362069
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			117	468	0.3362069
ODONATA (O)					
Aeshnidae	3	3	3	9	0.0086207
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	8	8	8	0.0229885
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			11	17	0.0316092
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			0	0	0

TOTALS	348	1224	1

Organism Density/Sample Unit	348
EPT Richness	12
Total Family Richness	20
EPT/EPT+Chironomidae Ratio	0.99
Biotic Index	3.52
% Contribution of Dominant Family	34%
% Model Affinity	82%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	3
# Plecoptera Families	4
# Trichoptera Families	5
EPT Richness (Total)	12

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		7%
PLECOPTERA		10%
TRICHOPTERA		34%
CHIRONOMIDAE		0%
OTHER DIPTERA		9%
COLEOPTERA		34%
ODONATA		3%
MEGALOPTERA		2%
LEPIDOPTERA		0%
AMPHIPODA		0%
ISOPODA		0%
OLIGOCHAETA		0%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	7
Plecoptera	10	10
Tricoptera	35	34
Coleoptera	16	34
Chironomidae	6	0
Oligochaeta	1	0
Other	16	14

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Queen River Site 1

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Queen 1 | River/Stream/County: Queen River, Exeter, RI
TNC Property @ Stony Road
Date Sampled: 7/27/04 | Name(s): Aube, Poyer, Cerrulo
Date of Lab Work: 8/4/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	0	0	0	0
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			0	0	0
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	162	162	0	0.2898
Nemouridae	2	0	0	0	0
Peltoperlidae	2	11	11	22	0.0197
Perlidae	1	4	4	4	0.0072
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			177	26	0.3166
MEGALOPTERA (M)					
Corydalidae	0	15	15	0	0.0268
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			15	0	0.0268
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	188	188	752	0.3363
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	2	2	2	0.0036
Leptoceridae	4	0	0	0	0
Limnephilidae	4	3	3	12	0.0054
Molannidae	6	0	0	0	0
Odontoceridae	0	4	4	0	0.0072
Philopotamidae	3	0	0	0	0
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			197	766	0.3524
DIPTERA (D)					
Athericidae	2	25	25	50	0.0447
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	9	9	54	0.0161
Tipulidae	4	34	34	136	0.0608
Empididae	6	0	0	0	0
Simuliidae	6	5	5	30	0.0089
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			73	270	0.1306
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Queen 1 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	36	36	144	0.0644
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	3	3	12	0.0054
		0	0	0	0
Other		0	0	0	0
Subtotal C			39	156	0.0698
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	2	2	18	0.0036
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	4	4	4	0.0072
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			6	22	0.0107
AMPHIPODA (A)					
Crangonyctidae	6	27	27	162	0.0483
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			27	162	0.0483

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	25	25	225	0.0447
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			25	225	0.0447

TOTALS	559	1627	1

Organism Density/Sample Unit	559
EPT Richness	7
Total Family Richness	18
EPT/EPT+Chironomidae Ratio	0.98
Biotic Index	2.91
% Contribution of Dominant Family	34%
% Model Affinity	71%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	0
# Plecoptera Families	3
# Trichoptera Families	4
EPT Richness (Total)	7

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		0%
PLECOPTERA		32%
TRICHOPTERA		35%
CHIRONOMIDAE		2%
OTHER DIPTERA		11%
COLEOPTERA		7%
ODONATA		1%
MEGALOPTERA		3%
LEPIDOPTERA		0%
AMPHIPODA		5%
ISOPODA		0%
OLIGOCHAETA		4%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	0
Plecoptera	10	32
Tricoptera	35	35
Coleoptera	16	7
Chironomidae	6	2
Oligochaeta	1	4
Other	16	20

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Queen River Site 2

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Queen 2 | River/Stream/County: Queen River, Exeter, RI
upstream of dam on Brownelle Property
Date Sampled: 7/16/04 | Name(s): Guillot, Grant, Aube, Poyer, Saila
Date of Lab Work: 7/20/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	3	3	12	0.0127
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	9	9	36	0.0381
Heptageniidae	4	0	0	0	0
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			12	48	0.0508
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	3	3	0	0.0127
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	1	1	1	0.0042
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			4	1	0.0169
MEGALOPTERA (M)					
Corydalidae	0	6	6	0	0.0254
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			6	0	0.0254
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	8	8	0	0.0339
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	57	57	228	0.2415
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	7	7	28	0.0297
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	9	9	27	0.0381
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	13	13	13	0.0551
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			94	296	0.3983
DIPTERA (D)					
Athericidae	2	19	19	38	0.0805
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	6	6	24	0.0254
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			25	62	0.1059
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Queen 2 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	29	29	116	0.1229
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	12	12	48	0.0508
		0	0	0	0
Other		0	0	0	0
Subtotal C			41	164	0.1737
ODONATA (O)					
Aeshnidae	3	5	5	15	0.0212
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	4	4	4	0.0169
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			9	19	0.0381
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	45	45	405	0.1907
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			45	405	0.1907

TOTALS	236	995	1

Organism Density/Sample Unit	236
EPT Richness	9
Total Family Richness	17
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	4.22
% Contribution of Dominant Family	24%
% Model Affinity	75%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	2
# Trichoptera Families	5
EPT Richness (Total)	9

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		5%
PLECOPTERA		2%
TRICHOPTERA		40%
CHIRONOMIDAE		0%
OTHER DIPTERA		11%
COLEOPTERA		17%
ODONATA		4%
MEGALOPTERA		3%
LEPIDOPTERA		0%
AMPHIPODA		0%
ISOPODA		0%
OLIGOCHAETA		19%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	5
Plecoptera	10	2
Tricoptera	35	40
Coleoptera	16	17
Chironomidae	6	0
Oligochaeta	1	19
Other	16	17

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Queen River Site 3

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Queen 3 | River/Stream/County: Queen River, Exeter, RI
Brownelle Pond
Date Sampled: 7/16/04 | Name(s): Guillot, Grant, Aube, Poyer, Saila
Date of Lab Work: 7/20/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	0	0	0	0
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			0	0	0
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	0	0	0	0
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			0	0	0
MEGALOPTERA (M)					
Corydalidae	0	0	0	0	0
Sialidae	4	5	5	20	0.0439
		0	0	0	0
Other		0	0	0	0
Subtotal M			5	20	0.0439
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	0	0	0	0
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	1	1	4	0.0088
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	3	3	9	0.0263
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			4	13	0.0351
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	2	2	12	0.0175
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			2	12	0.0175
ISOPODA (I)					
Asellidae	8	4	4	32	0.0351
		0	0	0	0
Other		0	0	0	0
Subtotal I			4	32	0.0351

Queen 3 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	0	0	0	0
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			0	0	0
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	3	3	3	0.0263
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			3	3	0.0263
AMPHIPODA (A)					
Crangonyctidae	6	1	1	6	0.0088
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			1	6	0.0088

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	93	93	837	0.8158
Hirudinea	10	0	0	0	0
Gastropoda	6	2	2	12	0.0175
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			95	849	0.8333

TOTALS	114	935	1

Organism Density/Sample Unit	114
EPT Richness	2
Total Family Richness	9
EPT/EPT+Chironomidae Ratio	0.67
Biotic Index	8.20
% Contribution of Dominant Family	82%
% Model Affinity	19%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	0
# Plecoptera Families	0
# Trichoptera Families	2
EPT Richness (Total)	2

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		0%
PLECOPTERA		0%
TRICHOPTERA		4%
CHIRONOMIDAE		2%
OTHER DIPTERA		0%
COLEOPTERA		0%
ODONATA		3%
MEGALOPTERA		4%
LEPIDOPTERA		0%
AMPHIPODA		1%
ISOPODA		4%
OLIGOCHAETA		82%
GASTROPODA		2%
PELECYPODA		0%
OTHER		0%

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Ephemeroptera	16	0
Plecoptera	10	0
Tricoptera	35	4
Coleoptera	16	0
Chironomidae	6	2
Oligochaeta	1	82
Other	16	13

Queen River Site 4

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Queen 4 — River/Stream/County: Queen River, Exeter, RI downstream of dam on Brownelle Property

Date Sampled: 8/1/04 — Name(s): Guillot, Grant, Aube, Poyer, Saila

Date of Lab Work: 8/4/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	23	23	92	0.0211
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	1	1	2	0.0009
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			24	94	0.022
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	42	42	0	0.0385
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	3	3	3	0.0027
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			45	3	0.0412
MEGALOPTERA (M)					
Corydalidae	0	9	9	0	0.0082
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			9	0	0.0082
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	2	2	0	0.0018
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	462	462	1848	0.4235
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	6	6	24	0.0055
Molannidae	6	0	0	0	0
Odontoceridae	0	4	4	0	0.0037
Philopotamidae	3	332	332	996	0.3043
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	8	8	8	0.0073
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			814	2876	0.7461
DIPTERA (D)					
Athericidae	2	23	23	46	0.0211
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	2	2	12	0.0018
Tipulidae	4	7	7	28	0.0064
Empididae	6	0	0	0	0
Simuliidae	6	11	11	66	0.0101
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			43	152	0.0394
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Queen 4 cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	30	30	120	0.0275
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	10	10	40	0.0092
		0	0	0	0
Other		0	0	0	0
Subtotal C			40	160	0.0367
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	14	14	14	0.0128
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			14	14	0.0128
AMPHIPODA (A)					
Crangonyctidae	6	2	2	12	0.0018
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			2	12	0.0018

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	100	100	900	0.0917
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			100	900	0.0917

TOTALS	1091	4211	1

Organism Density/Sample Unit	1091
EPT Richness	10
Total Family Richness	20
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	3.86
% Contribution of Dominant Family	42%
% Model Affinity	52%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	2
# Trichoptera Families	6
EPT Richness (Total)	10

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		2%
PLECOPTERA		4%
TRICHOPTERA		75%
CHIRONOMIDAE		0%
OTHER DIPTERA		4%
COLEOPTERA		4%
ODONATA		1%
MEGALOPTERA		1%
LEPIDOPTERA		0%
AMPHIPODA		0%
ISOPODA		0%
OLIGOCHAETA		9%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Ephemeroptera	16	2
Plecoptera	10	4
Tricoptera	35	75
Coleoptera	16	4
Chironomidae	6	0
Oligochaeta	1	9
Other	16	6

Parris Brook

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Parris Brook
River/Stream/County: Parris Brook, Exeter RI at Old Voluntown Rd
Date Sampled: 8/24/04
Name(s): Aube, Cerullo, Urso, Guillot
Date of Lab Work: 9/3/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	2	2	8	0.0488
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			2	8	0.0488
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	0	0	0	0
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			0	0	0
MEGALOPTERA (M)					
Corydalidae	0	5	5	0	0.122
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			5	0	0.122
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	0	0	0	0
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	1	1	4	0.0244
Molannidae	6	0	0	0	0
Odontoceridae	0	23	23	0	0.561
Philopotamidae	3	0	0	0	0
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			24	4	0.5854
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	1	1	6	0.0244
Tipulidae	4	3	3	12	0.0732
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			4	18	0.0976
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Parris Brook cont.
Shunnock River

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	1	1	4	0.0244
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			1	4	0.0244
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	1	1	5	0.0244
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	3	3	3	0.0732
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			4	8	0.0976
AMPHIPODA (A)					
Crangonyctidae	6	1	1	6	0.0244
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			1	6	0.0244

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			0	0	0

TOTALS	41	48	1

Organism Density/Sample Unit	41
EPT Richness	3
Total Family Richness	10
EPT/EPT+Chironomidae Ratio	0.96
Biotic Index	1.17
% Contribution of Dominant Family	56%
% Model Affinity	61%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	1
# Plecoptera Families	0
# Trichoptera Families	2
EPT Richness (Total)	3

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		5%
PLECOPTERA		0%
TRICHOPTERA		59%
CHIRONOMIDAE		2%
OTHER DIPTERA		7%
COLEOPTERA		2%
ODONATA		10%
MEGALOPTERA		12%
LEPIDOPTERA		0%
AMPHIPODA		2%
ISOPODA		0%
OLIGOCHAETA		0%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	5
Plecoptera	10	0
Tricoptera	35	59
Coleoptera	16	2
Chironomidae	6	2
Oligochaeta	1	0
Other	16	32

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Shunnock River

River/Stream/County: Shunnock River, N Stonington, CT

Downstream of Parke Pond dam

Date Sampled: 8/26/04

Name(s): Guillot, Aube, Urso

Date of Lab Work: 9/2/04

	1	Mean
# Squares Picked	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	2	2	8	0.0097
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	5	5	10	0.0242
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			7	18	0.0338
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	1	1	0	0.0048
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	6	6	6	0.029
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			7	6	0.0338
MEGALOPTERA (M)					
Corydalidae	0	0	0	0	0
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			0	0	0
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	101	101	404	0.4879
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	45	45	180	0.2174
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	12	12	36	0.058
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other (Beraeidae)		1	1	0	0.0048
Subtotal T			159	620	0.7681
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
Psychodide		18	18	0	0.087
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			18	0	0.087
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0

Shunnock River cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	7	7	28	0.0338
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	6	6	24	0.029
		0	0	0	0
Other		0	0	0	0
Subtotal C			13	52	0.0628
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	1	1	1	0.0048
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			1	1	0.0048
AMPHIPODA (A)					
Crangonyctidae	6	2	2	12	0.0097
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			2	12	0.0097

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			0	0	0

TOTALS	207	709	1

Organism Density/Sample Unit	207
EPT Richness	8
Total Family Richness	13
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	3.43
% Contribution of Dominant Family	49%
% Model Affinity	58%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	2
# Trichoptera Families	4
EPT Richness (Total)	8

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		3%
PLECOPTERA		3%
TRICHOPTERA		77%
CHIRONOMIDAE		0%
OTHER DIPTERA		9%
COLEOPTERA		6%
ODONATA		0%
MEGALOPTERA		0%
LEPIDOPTERA		0%
AMPHIPODA		1%
ISOPODA		0%
OLIGOCHAETA		0%
GASTROPODA		0%
PELECYPODA		0%
OTHER		0%

Ephemeroptera	16	3
Plecoptera	10	3
Tricoptera	35	77
Coleoptera	16	6
Chironomidae	6	0
Oligochaeta	1	0
Other	16	10

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Shunnock River – Parke Pond

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Parke Pond — River/Stream/County: Shunnock River, N Stonington, CT
Parke Pond at the dam
Date Sampled: 7/6/06 — Name(s): Guillot, Aube, Poyer, Grant
Date of Lab Work: 7/10/04

# Squares Picked	1	Mean
	1	1
Total # Squares in Tray Grid		1

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	0	0	0	0
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			0	0	0
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	0	0	0	0
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			0	0	0
MEGALOPTERA (M)					
Corydalidae	0	0	0	0	0
Sialidae	4	7	7	28	0.0805
		0	0	0	0
Other		0	0	0	0
Subtotal M			7	28	0.0805
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	0	0	0	0
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	1	1	4	0.0115
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	5	5	15	0.0575
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			6	19	0.069
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	7	7	42	0.0805
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			7	42	0.0805
ISOPODA (I)					
Asellidae	8	24	24	192	0.2759
		0	0	0	0
Other		0	0	0	0
Subtotal I			24	192	0.2759

Shunnock River – Parke Pond cont.

COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	1	1	4	0.0115
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			1	4	0.0115
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			0	0	0
AMPHIPODA (A)					
Crangonyctidae	6	33	33	198	0.3793
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			33	198	0.3793

DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	0	0	0	0
Gastropoda	6	9	9	54	0.1034
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			9	54	0.1034

TOTALS	87	537	1

Organism Density/Sample Unit	87
EPT Richness	2
Total Family Richness	8
EPT/EPT+Chironomidae Ratio	0.46
Biotic Index	6.17
% Contribution of Dominant Family	38%
% Model Affinity	30%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	0
# Plecoptera Families	0
# Trichoptera Families	2
EPT Richness (Total)	2

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		0%
PLECOPTERA		0%
TRICHOPTERA		7%
CHIRONOMIDAE		8%
OTHER DIPTERA		0%
COLEOPTERA		1%
ODONATA		0%
MEGALOPTERA		8%
LEPIDOPTERA		0%
AMPHIPODA		38%
ISOPODA		28%
OLIGOCHAETA		0%
GASTROPODA		10%
PELECYPODA		0%
OTHER		0%

Codes:

(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values

(2) D = Density

(3) % = percent composition

Ephemeroptera	16	0
Plecoptera	10	0
Tricoptera	35	7
Coleoptera	16	1
Chironomidae	6	8
Oligochaeta	1	0
Other	16	84

APPENDIX B

NYS DEC FAMILY-LEVEL MACROINVERTEBRATE INDICES

a) ***Family richness (FAMILY)****:* This is the total number of macroinvertebrate families found in a riffle kick sample. Expected ranges for 100-organism sub samples of kick samples in most streams in New York State are: greater than 13, non-impacted; 10-13, slightly impacted; 7-9, moderately impacted; less than 7, severely impacted.

b) ***Family EPT richness (EPT)****:* EPT denotes the orders of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera). These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). The number of EPT families found in a 100- organism sub sample is used for this index. Expected ranges from most streams in New York State are: greater than 7, non-impacted; 3-7, slightly impacted; 1-3, moderately impacted; and 0, severely impacted.

c) ***Family Biotic Index (FBI)***: The family-level Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage inputs, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each family by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). Values are listed in Hilsenhoff (1988); additional values for non-arthropods are assigned by the NYS Stream Biomonitoring Unit. The most recent values are listed in the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, nonimpacted; 4.51-5.50, slightly impacted; 5.51-7.00, moderately impacted; and 7.01-10.00, severely impacted.

d) ***Percent Model Affinity (PMA)***: This is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community based on reference stream sample. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

APPENDIX C

WATER QUALITY RATINGS

Non-impacted: Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 12 families in riffle habitats. Mayflies, stoneflies, and caddisflies are well represented; EPT family richness is greater than 7. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

Slightly impacted: Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Family richness usually is 9-12. Mayflies and stoneflies may be restricted, with EPT values of 4-7. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

Moderately impacted: Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Family richness usually is 6-8. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; EPT richness is 1-3. The biotic index value is 6.51-8.50. The percent model affinity value is 35-49. Water quality often is limiting to fish propagation, but usually not to fish survival.

Severely impacted: Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant Families. Family richness is less than 6. Mayflies, stoneflies, and caddisflies are rare or absent; EPT richness is 0. The biotic index value is greater than 8.51. Percent model affinity is less than 35. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.