WATER QUALITY
AND BIOASSESSMENT
FINAL REPORT

CENTRAL MUSCATATUCK RIVER WATERSHED
JEFFERSON AND SCOTT COUNTIES OF INDIANA

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Study Conducted By:

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EXECUTIVE SUMMARY

A rapid bioassessment of the macroinvertebrate community was conducted at 6 sites in the Central Muscatatuck River watershed in Jefferson an Scott Counties of, Indiana. The largest streams in this watershed are Big Creek and the Muscatatuck River, from its confluence with Big Creek to downstream from Austin, Indiana. In addition to bioassessment, aquatic habitat and water chemistry were evaluated at 15 sites in the watershed.

Of the two watersheds, Big Creek is in better ecological health. Its biotic integrity scores were close to what would be expected based on the habitat available and both the habitat and aquatic communities are among the best in Indiana. Upper areas of Big Creek are somewhat impacted and deserve attention with establishment of best management land use practices that preserve the riparian zone. The Little Creek subwatershed has somewhat degraded water quality, especially for E.coli.

The lower Muscatatuck River is clearly degraded, having biotic integrity scores much lower than its habitat would allow. Low dissolved oxygen in this river appears to be contributing to the degradation of water quality. Sources of oxygen-consuming substances in this area could not be determined from the data collected in this study. Soft sediments in the area may exert a "sediment oxygen demand" that could contribute to the problem.

INTRODUCTION

The Historic Hoosier Hills RC&D received a 319 water quality grant from the Indiana Department of Environmental Management (IDEM) and the United States Environmental Protection Agency (USEPA). The purpose of the grant is to prepare a watershed management plan for the Central Muscatatuck River watershed. The water quality assessment uses macroinvertebrate monitoring and aquatic habitat evaluation. Macroinvertebrate monitoring is a valuable tool to measure the ecological health of a stream. The numbers and kinds of animals present at a study site can be compared to an unimpacted reference site. This bioassessment technique results in a single biotic index value; the higher the value, the more ecologically healthy the stream. Healthy streams have good aquatic habitat. If the habitat is good but the stream does not support a health aquatic community, a diagnosis of poor water quality can be made.

This project was conducted in 2008 and 2009. The following report is data from macroinvertebrate and water chemistry sampling, and aquatic habitat evaluation.

Table 1. A total of 15 sites were chosen for study.

Site	Waterbody	Latitude	Longitude
1	Little Creek	38.44.16	85.32.35
2	Harbert's Creek	38.48.24	85.31.09
3	Hensley Creek	38.48.59	85.30.29
4	Big Creek	38.46.47	85.32.44
5	Middle Fork	38.49.57	85.31.11
6	Big Creek	38.50.00	85.31.32
7	Big Creek	38.55.57	85.21.53
8	Big Creek	38.47.22	85.35.24
9	Big Creek	38.48.42	85.38.18
10	Lewis Creek	38.47.38	85.38.31
11	Muscatatuck	38.48.15	85.40.25
12	Muscatatuck	38.47.23	85.48.25
13	Muscatatuck	38.44.35	85.50.35
14	Quick Creek	38.47.35	85.43.15
15	Coffee Creek	38.50.32	85.42.45

METHODS

Water Chemistry

Water chemistry samples (nitrite-nitrate, total phosphorus, total suspended solids, pH, dissolved oxygen, and conductivity) were collected 7 times at 15 sites during 2008 and 2009. Methods are detailed in the Quality Assurance Project Plan [7].

Aquatic Community

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change, benthic (bottom-dwelling) organisms were considered to be the primary tool to document the biological condition of the streams. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [3] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used a modification of this protocol developed by Ohio EPA [4]. This protocol relies upon comparison of the aquatic community to a “reference” condition. A reference site is a stream of similar size in the same geographic area which is least impacted by human changes in the watershed.

Habitat Evaluation

The aquatic habitat at each study site was evaluated according to the method described by Ohio EPA [4]. This method’s results assigns values to various habitat parameters (e.g. substrate quality, riparian vegetation, channel morphology, etc.) and results in a numerical score for each site. Higher scores indicate higher aquatic habitat value. The maximum value for habitat using this assessment technique is 100.

Sample Collection (Macroinvertebrates)

Macroinvertebrate samples in this study were collected by dipnet in riffle areas where current speed approached 30 cm/sec. All samples were preserved in the field with 70% isopropanol. Samples were collected twice, on May 21 and October 29, 2008.

Laboratory Analysis (Macroinvertebrates)

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the animals collected in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species) using standard taxonomic references [5,6]. As each new taxon was identified, a representative specimen was preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection.

Data Analysis (Macroinvertebrates)

Following identification of the animals in the sample, ten "metrics" are calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions and how the benthic communities of unimpacted ("reference") streams are usually organized. For example, mayflies and caddisflies are aquatic insects which are known to be more sensitive than most other benthic animals to degradation of environmental conditions. A larger proportion of these animals in a sample receives a higher score. The sum of all ten metrics provides an individual "biotic score" for each site. The metrics used in this study were adapted from Ohio EPA. Because Ohio EPA uses a larger sample size in its macroinvertebrate protocol, some of the metrics were modified to more closely correspond to a 100 organism sample. In addition, since a separate qualitative sample was not taken, the U.S. EPA metric “% Dominant Taxon” was substituted for the “EPT Qualitative Taxa” metric used in Ohio.

Table 2. Scoring values for metrics. (Adapted from Ohio EPA and U.S. EPA)

	6 points	4 points	2 points	0 points
# of Genera	>20	14 - 20	7 - 13	<7
# Mayfly Taxa	> 6	4 - 6	2 - 4	<2
# Caddisfly Taxa	> 4	3 - 4	1 - 2	0
# Diptera Taxa	>12	8 - 12	4 - 7	<4
% Tanytarsini	>25	11 - 25	1 - 10	0
% Mayflies	>25	11 - 25	1 - 10	0
% Caddisflies	>20	11 - 19	1 - 10	0
% Tolerant Species	0-10	11 - 20	21 - 30	>30
% non-Tanytarsids & non-insects	<25	25 - 45	46 - 65	>65
% Dominant Taxon	<20	21-29	30-39	>40

In addition, the data were also evaluated using IDEM's family-level macroinvertebrate index of biotic integrity (mIBI). The metrics used in this technique are shown below:

Table 3. IDEM's Macroinvertebrate Index of Biotic Integrity (mIBI)

	8 points	6 points	4 points	2 points	0 points
Family Level HBI	<4.1	4.1-4.5	4.5-5.1	5.1-5.6	>5.6
# of Taxa	>17	15-17	11-14	8-10	<8
# of Individuals	>350	214-349	130-212	80-129	>80
% Dominant Taxa	<22	22-31	31-44	44-62	>62
EPT Index	>7	6-7	4-5	3	<3
EPT Count	>195	92-194	43-91	20-42	<20
EPT Count / Total Count	>0.7	0.5-0.7	0.3-0.5	0.1-0.3	<0.1
EPT / Chironomids	>12	6-12	3-6	1-3	<1
Chironomid Count	<7	7-19	20-54	55-146	>146
Individuals / Squares Sorted	<410	172-410	72-171	30-71	<30

The scores for each metric (0 to 8) are added. The total is then be divided by 10 (10 metrics) to calculate an mIBI score for each site (a range of scores from 0 to 8).

RESULTS AND DISCUSSION

Quality Assurance and Quality Control

All blanks and duplicates collected as part of this project indicate that there were no quality control problems with either water chemistry or biological measurements [7]. No data had to be discarded in the decision-making process.

Data Quality Objectives

Accuracy/Bias

	Lab Chemistry	
Goal	0%	*No detects in blanks*
Achieved	*0%*	*No detects in blanks*

Precision

	Lab Chemistry	mIBI	QHEI
Goal	80-120%	90-110%	90-110%
Achieved	85-115%	100%	90%

Completeness

	Field Chemistry	Lab Chemistry	mIBI	QHEI
Goal	90%	90%	90%	90%
Achieved	97%	100%	100%	100%

Water Chemistry

Water chemistry data are included in the appendix. Figures 1-4 compare data for total phosphorus, nitrate, turbidity, and E.coli at each site. Nutrient levels (nitrogen and phosphorus) at most sites were quite low compared to other Indiana streams [8]. Dissolved oxygen at site 13 (Muscatatuck River downstream from Austin) fell below the Indiana water quality standard (5 mg/l).

Figure 1. Total phosphorus data

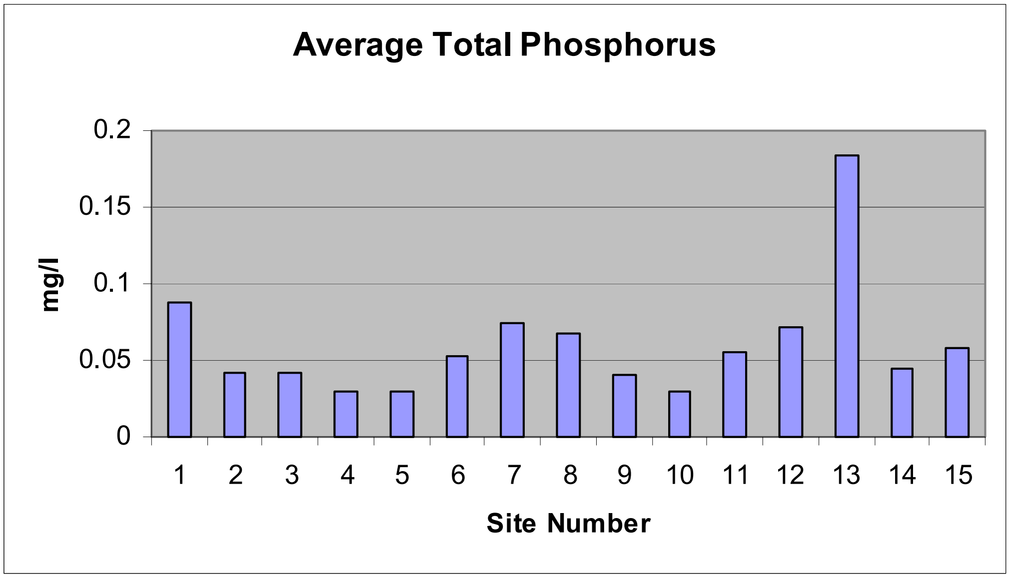


Figure 2. Nitrate data

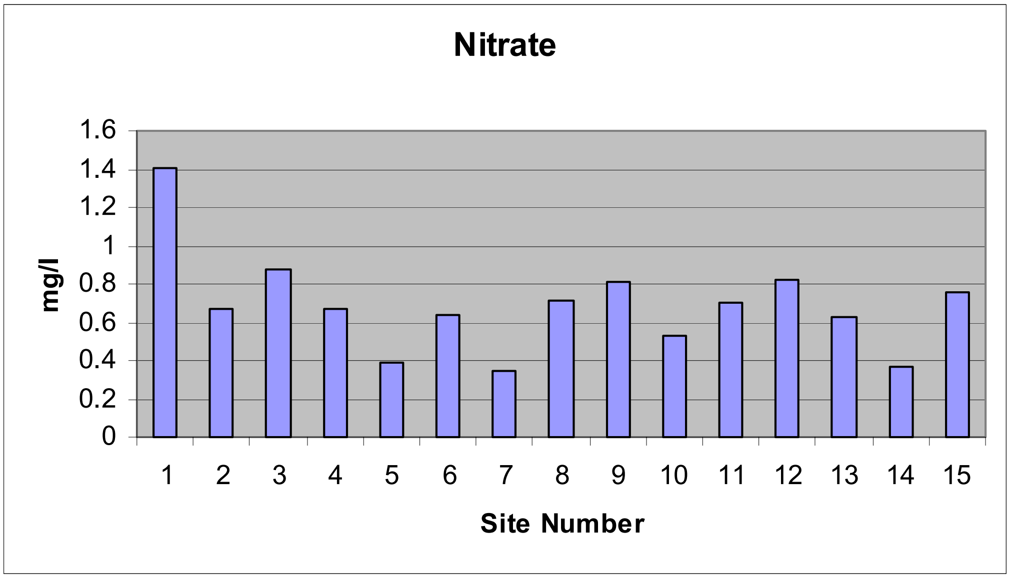


Figure 3.

Turbidity

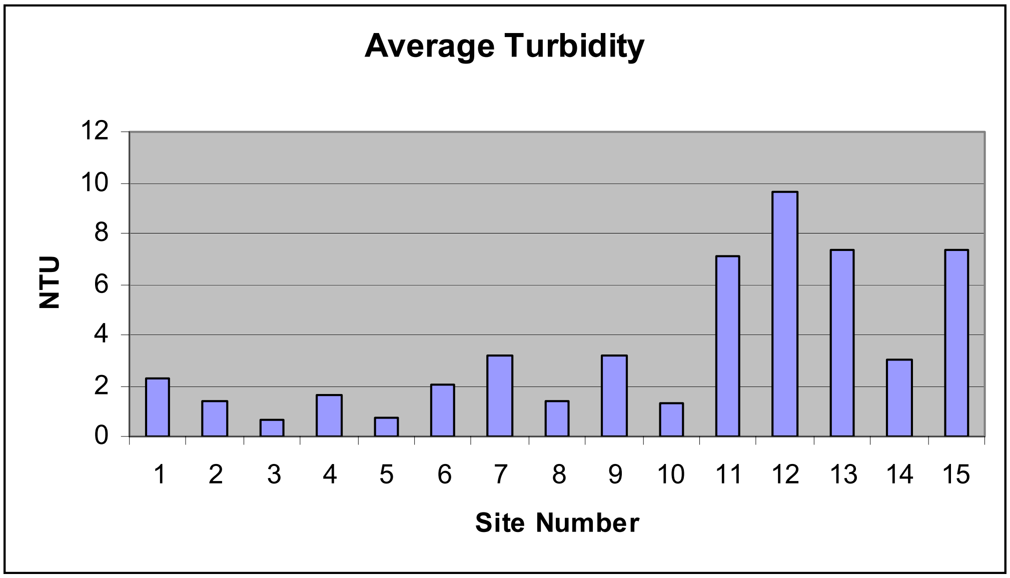
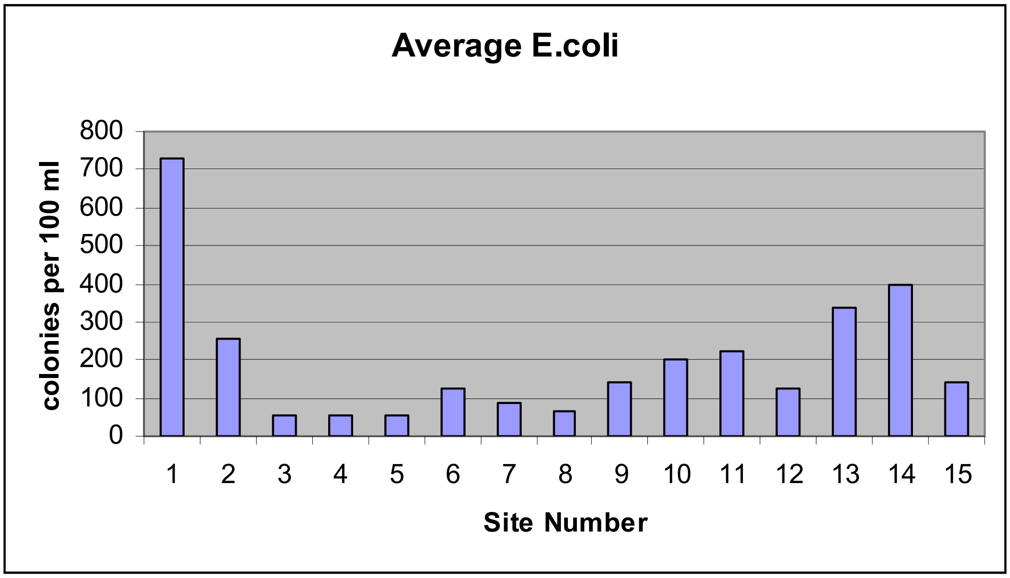


Figure 4. E.coli



In general, Big Creek was very clear, as measured by NTU turbidity measurements. The Muscatatuck River sites were much more turbid. E.coli concentrations were generally low. However, the standard for whole body recreational uses (a maximum of 235 colonies per 100 ml) was regularly exceeded at 3 sites (sites 1, 13, and 14).

Aquatic Habitat Analysis

Table 4 shows the results of the Quantitative Habitat Evaluation Index (QHEI) values for each site in the study. Aquatic habitat (QHEI) scores ranged from 51 to 88. Half the sites have "excellent" habitat (values greater than 70). The remaining half have "fair" habitat (values between 50 and 70).

Table 4. Aquatic habitat values (QHEI) of each study site.

Site	Waterbody	QHEI
1	Little Creek	65
2	Harbert's Creek	54
3	Hensley Creek	70
4	Big Creek	88
5	Middle Fork	65
6	Big Creek	76
7	Big Creek	51
8	Big Creek	77
9	Big Creek	74
10	Lewis Creek	68
11	Muscatatuck	62
12	Muscatatuck	53
13	Muscatatuck	54
14	Quick Creek	73
15	Coffee Creek	76

Macroinvertebrate Communities

The family-level mIBI and species-level IBI scores are shown in Table 5.

Table 5. Biological Integrity scores by site numbers.

Site	Waterbody	Family Level mIBI		Species Level IBI	
		Spring	Autumn	Spring	Autumn
4	Big Creek	4.8	5.8	63	60
6	Big Creek	4.4	3.6	47	47
8	Big Creek	5.6	5.6	67	70
9	Big Creek	6.6	4.4	73	77
11	Muscatatuck	4.6	2.4	70	33
13	Muscatatuck	2.8	2.6	23	30

IDEM considers mIBI scores greater than 2.2 to indicate “fully supporting” uses for aquatic life. All of the mIBI scores exceeded 2.2. However, there were clear differences between sites. On Big Creek, the upper part of the watershed above site 6 had scores that were lower than predicted by the habitat present. This usually indicates some kind of environmental perturbation. Big Creek scores increased downstream from site 6 and indicated very good biological conditions at the stream’s confluence with Muscatatuck River. Big Creek sites had higher scores than the Muscatatuck sites. The lowest score among all sites occurred at site 13 (Muscatatuck River downstream from Austin).

Diagnosis

One of the most useful aspects of biological monitoring is that we can use information on the way aquatic animals respond to different types of stress to diagnose a problem. For example, degraded biotic integrity can often be directly related to degraded habitat. Macroinvertebrates cannot thrive where habitat is lacking.

The aquatic community of the upper Big Creek watershed was characterized by reduced mayfly diversity, few caddisflies, and many tanypodid midge larvae. The dominant mayfly was *Baetis amplus*. This species requires good water quality but becomes very abundant when riparian habitat is disturbed, allowing increased sunlight and increased diatom production [9].

The lower Muscatatuck River’s aquatic community had few EPT taxa (animals that require good water quality) and had a high Hilsenhoff Biotic Index (indicating low dissolved oxygen). Dissolved oxygen at site 13 downstream from Austin was 3.6 to 4.0 mg/l during the summer monitoring periods.

CONCLUSIONS

Of the two watersheds, Big Creek is in better ecological health. Its biotic integrity scores were close to what would be expected based on the habitat available and both the habitat and aquatic communities are among the best in Indiana. Upper areas of Big Creek are somewhat impacted and deserve attention with establishment of best management land use practices that preserve the riparian zone. The Little Creek subwatershed has somewhat degraded water quality, especially for E.coli.

The lower Muscatatuck River is clearly degraded, having biotic integrity scores much lower than its habitat would allow. Low dissolved oxygen in this river appears to be contributing to the degradation of water quality. Sources of oxygen-consuming substances in this area could not be determined from the data collected in this study. Soft sediments in the area may exert a "sediment oxygen demand" that could contribute to the problem.

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APPENDICES

Water Quality Data
Macroinvertebrate Data
Habitat Data

Site		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
pH		7.7	8	8.1	7.8	8.1	7.6	8.2	7.7	7.5	7.8	7.3	7.2	7.5	7.4	7.4
		7.7	8.4	8.3	7.8	8.2	8	8.6	7.7	7.8	7.7	7.4	6.9	7	7.3	7.5
		7.9	7.7	7.7	7.8	7.8	7.7	8.4	7.8	7.5	7.6	6.7	6.6	6.5	6.8	7.6
		8	7.9	7.9	8	8	8	7.9	7.8	7.4	7.9	7.3	7	7.3	7.4	7.2
		8	8.1	8.3	8.1	8.2	8.1	8	8.1	8.1	8.1	7.9	7.8	7.5	7.8	7.8
		8	8.5	8.2	8.1	8.1	8	8.3	8.2	7.9	8.1	7.5	7.3	7.2	7.4	7.6
		8.1	8	8.2	8	8.3	8.1	8.4	8	8	7.9	8	7.5	7.3	7.4	8.1
	Ave	7.9	8.1	8.1	7.9	8.1	7.9	8.3	7.9	7.7	7.9	7.4	7.2	7.2	7.4	7.6
DO		13.6	14.6		11.2				11.8	10.1	13	9.4	8.1	6.9	10	11.6
		8	11.8	10.1	8.2	11	8.8	14.6	8.8	8.2	9.7	7.8	5.6	4	7	7.5
		7	9.5	9.3	6.9	11.1	8.1	12.4	8.6	8.9	8	6.2	3.9	3.6	6.4	7.6
		8.2	12	10.8	10.3	11.3	9.6	14.5	10.9	10	11.4	8.5	8.6	6.5	8.5	9.2
		13.2	14.8	14.2	13.7	13.9	13.5	12.8	14	13.8	14.6	13.1	13	11.7	11	12.3
		14	15	14	13.7	15	14.1	14.3	15.1	14	15	14	13.2	12	13.4	14.5
		11.6	11.1	12.1	10.3	12	10.8	13.3	11.2	9.8	11.1	9.9	9.9	8.2	10.1	11.4
	Ave	10.8	12.7	11.8	10.6	12.4	10.8	13.7	11.5	10.7	11.8	9.8	8.9	7.6	9.5	10.6
Cond.		372	308	315	298	290	270	275	308	320	380	330	306	309	142	356
		400	318	389	363	370	337	400	365	380	405	393	353	332	157	400
		395	433	396	364	359	304	259	326	347	392	336	280	273	208	336
		420	400	324	364	327	337	415	350	330	432	375	341	403	174	300
		567	450	515	365	390	363	333	360	365	475	372	327	300	335	500
		380	302	370	263	254	233	285	304	320	373	315	309	284	150	392
		300	270	270	220	200	185	195	244	250	295	250	230	175	160	350
	Ave	405	354	368	320	313	290	309	322	330	393	339	307	297	189	376
Temp.		15	20	17	14	20	18	22	14	13	13	13	14	15	13	11
		22	24	22	23	21	22	23	23	23	23	22	22	23	23	21
		21	23	23	20	22	21	26	22	22	20	20	21	21	18	19
		8	8	8	8	8	9	10	6	7	7	9	8	8	10	7
		0.2	0.2	0.1	0.2	0.1	0.1	1.1	0.2	0.2	0.2	0.1	0.5	1.1	1.1	0.6
		2.6	1.9	4.2	2.3	2.6	2.1	5.8	1.7	1.1	1.9	0.5	0.8	1.7	2.4	2.1
		10.6	10.8	10.6	11.1	10.5	11.3	10.8	10.2	10.9	9.9	10.6	10.7	11.1	11	9.3
	Ave	11.3	12.6	12.1	11.2	12.0	11.9	14.1	11.0	11.0	10.7	10.7	11.0	11.6	11.2	10.0
BOD		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2.1	<2
		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	5	<2	<2	<2	<2
		2.3	<2	2.1	2.6	<2	2.2	2.8	3	<2	<2	4.7	<2	3.4	2.1	2.5
		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
		<2	<2	<2	<2	<2	<2	<2	<2	2.3	<2	<2	2	2	2.5	<2
	Ave	2.3		2.1	2.6		2.2	2.8	3.0	2.3		4.9	2.0	2.7	2.3	2.5

NO 3		1.9	0.71	1.02	0.5	0.4	0.5	0.3	0.6	0.6	0.1	0.7	0.6	0.6	0.2	0.7
		2.2	0.3	1.1	1.2	0.6	1	0.2	1	1.1	0.8	1.5	1.5	1.2	0.2	1.6
		0.45	0.14	0.16	0.13	0.12	0.14	0.08	0.11	0.26	0.09	0.14	0.17	0.18	0.19	0.25
		0.2	0.13	0.12	0.14	0.11	0.27	0.13	0.1	0.09	0.1	0.09	0.08	0.1	0.23	0.11
		2.27	2.06	1.96	1.4	0.7	1.3	1	1.76	2.02	1.55	1.1	1.76	1.08	1.03	2.08
		1.25	0.76	0.84	0.8	0.47	0.64	0.61	0.89	0.01	0.75	0.94	0.96	0.303	0.173	0.98
		1.98	1.49	1.23	0.77	0.284	0.456	1.31	0.89	0.83	0.344	0.77	0.68	0.203	0.081	0.073
	Ave	1.5	0.8	0.9	0.7	0.4	0.6	0.5	0.8	0.7	0.5	0.7	0.8	0.5	0.3	0.8
Turb		1.2	1.7	0.8	1.8	0.8	1.6	3	1.4	1.9	1	2.7	5.7	6.1	3.5	1.2
		2.8	1.1	0.8	2.9	0.9	3.8	1	2.7	5.4	2.1	24	24	20	3.6	25
		4.3	3.7	1.3	2	1	1.5	2.6	1.6	3	0.8	2.6	6.7	2.4	3	2.41
		1.58	0.32	0.28	0.82	0.41	1.66	4.63	0.72	2.8	1.29	3.06	5.85	4.02	2.4	1.16
		2.95	5.09	1.29	6.4	3	5.77	11	13.5	11	4.1	19	14.6	28.8	7.76	7.02
		3.53	2.5	0.91	2.91	1.99	3.05	3.38	2.76	0.1	1.67	2.82	5.12	5.81	2.55	1.65
		8.99	6.14	5.72	7.36	5.81	7.85	10.1	8.05	9.51	2.54	12.8	23.2	48.6	3.42	3.1
	Ave	3.6	2.9	1.6	3.5	2.0	3.6	5.1	4.4	4.8	1.9	9.6	12.2	16.5	3.7	5.9
O.P		<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	0.05	<0.01	<0.01
		0.03	0.01	<0.01	0.01	<0.01	0.05	<0.01	0.02	<0.01	0.03	0.02	0.03	0.13	0.01	0.02
		0.02	0.01	0.03	0.01	<0.01	0.02	<0.01	<0.01	0.02	<0.01	0.01	0.03	0.21	0.03	0.01
		0.03	0.01	<0.01	<0.01	0.01	<0.01	0.01	0.01	<0.01	0.01	<0.01	0.02	0.18	<0.01	<0.01
		0.01	0.01	<.01	0.01	<.01	0.02	0.1	0.03	0.03	0.01	0.03	0.03	0.09	0.01	0.06
		<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	0.01	0.05	<.01	<.01
		0.02	0.01	<.01	0.01	<.01	0.02	0.03	0.02	0.02	<.01	0.02	0.04	0.1	<.01	<.01
	Ave	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
TP		<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.01	0.02	<0.01	<0.01
		0.09	0.03	0.07	0.03	0.02	0.07	0.03	0.04	0.05	0.04	0.06	0.08	0.2	0.03	0.05
		0.12	0.06	0.06	0.04	0.04	0.05	0.07	0.05	0.06	0.03	0.04	0.1	0.29	0.09	0.05
		0.06	0.05	0.03	0.03	0.04	0.05	0.09	0.04	0.04	0.04	0.05	0.12	0.28	0.03	0.04
		0.08	0.03	0.01	0.02	0.02	0.04	0.11	0.14	0.04	0.03	0.07	0.05	0.13	0.03	0.09
		0.04	0.03	0.02	0.03	0.02	0.04	0.04	0.03	0.03	0.02	0.03	0.04	0.08	0.04	0.03
		0.06	0.04	0.05	0.04	0.16	0.07	0.08	0.05	0.07	0.04	0.06	0.07	0.12	0.02	0.03
	Ave	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.0	0.0
E coli		358	260	26	15	17	36	12	34	48	36	129	53	42	23	70
		921	435	155	127	125	161	113	93	214	816	517	238	308	108	411
		1986	2400	38	32	58	345	141	11	219	26	101	50	22	1203	76
		172	140	11	8	30	22	27	16	48	63	36	53	120	64	65
		222	179	41	91	37	49	142	178	184	77	345	238	1203	579	99
		26	11	<1	4	5	3	7	3	6	32	22	41	613	20	38
		921	435	161	129	225	84	148	194	142	<1	248	291	613	23	119
	Ave	658	243	72	58	71	100	84	76	123	175	200	138	417	289	125

Macroinvertebrate Data - Fall 2008

Site	4	6	6-D	8	9	11	13
Chironomidae	21	53	66	16	43	85	30
Simulidae	1						2
Tipulidae		4	2				
Baetiscidae					1		
Heptageniidae	8	4	6	12	5	1	12
Oligoneuridae	5	3		13	4		
Ephemerllidae	1				1		
Caenidae	7	1	1	4	2	4	
Leptophlebidae					1	2	1
Polycentropidae			1			1	
Hydropsychidae	27	14	6	32	16		
Philopotamidae	23	13	2	14	5		
Helicopsychidae				2			
Elmidae	1		4	3	20	1	1
Psephenidae	2	5	7		1	1	
Hydrophilidae	1						
Corydalidae	1	2	3	4			
Coenagrionidae	2	1	2		1	1	
Cordulgastridae						4	
Isopoda							30
Amphipoda							24
Total	100	100	100	100	100	100	100
Family HBI	4.54	5.06	5.51	4.12	5.14	6.74	6.06
No.of taxa	13	10	11	9	12	9	7
No. of individuals	>350	>350	>350	>350	>350	>350	>350
percent dominant	27	53	66	32	43	85	30
EPT Index	6	5	5	6	8	4	2
EPT count	71	35	16	77	35	8	13
EPT count/individuals	0.71	0.35	0.16	0.77	0.35	0.08	0.13
EPT/chironomids	3.38	0.66	0.24	4.8	0.81	0.09	0.43
chironomid count	21	53	66	16	43	85	30
individuals/squares	>410	>410	>410	>410	>410	>410	>410
Family HBI	6	2	2	6	2	0	0
No.of taxa	4	2	4	2	4	2	0
No. of individuals	8	8	8	8	8	8	8
percent dominant	6	2	0	4	4	0	6
EPT Index	6	4	4	6	8	4	0
EPT count	4	2	2	4	2	0	0
EPT count/individuals	8	4	2	8	4	0	0
EPT/chironomids	4	0	0	4	0	0	0
chironomid count	4	4	2	6	4	2	4
individuals/squares	8	8	8	8	8	8	8
mIBI	5.8	3.6	3.2	5.6	4.4	2.4	2.6

Spring 2008 Data

Site	4	6	8	9	11	13
Chironomidae	39	15	24	8	45	35
Tabanidae	1					
Simulidae			1	1	1	
Baetidae	23	41	18	21	7	1
Heptageniidae	4	2	8	3	11	1
Oligoneuridae	1			1		
Ephemerllidae	2	1	12	16		
Caenidae	2	2	2	2	9	3
Leptophlebidae					1	
Perlidae	10	4	6	12	4	2
Hydropsychidae	4		8	13	1	
Lepidostomatidae			1			
Elmidae	7	3	18	16	11	
Psephenidae	2		1	2		
Corydalidae					1	
Coenagrionidae				2		
Decapoda	1	2	1	1	1	1
Isopoda	4	30				3
Amphipoda					1	2
Hirudinea					1	
Oligochaeta				1	2	52
Sphaeridae					4	
Corbiculidae				1		
Total	100	100	100	100	100	100
Family HBI	4.67	5.43	4.01	3.53	5.42	8.04
No.of taxa	13	9	12	15	15	9
No. of individuals	>410	>410	>410	>410	>410	>410
percent dominant	39	41	24	21	45	52
EPT Index	7	5	7	7	6	4
EPT count	46	50	55	68	33	7
EPT count/individuals	0.46	0.5	0.55	0.68	0.33	0.07
EPT/chironomids	1.17	3.33	2.29	8.5	0.73	0.2
chironomid count	39	15	24	8	45	35
individuals/squares	>410	>410	>410	>410	>410	>410
Family HBI	4	2	8	8	2	0
No.of taxa	4	2	4	6	6	2
No. of individuals	8	8	8	8	8	8
percent dominant	4	2	6	8	2	2
EPT Index	6	4	6	6	6	4
EPT count	4	4	4	4	2	0
EPT count/individuals	4	4	6	6	8	0
EPT/chironomids	2	4	2	6	0	0
chironomid count	4	6	4	6	4	4
individuals/squares	8	8	8	8	8	8
mIBI	4.8	4.4	5.6	6.6	4.6	2.8

Aquatic Habitat Scoring

	Site Number							
	1	2	3	4	5	6	7	8
SUBSTRATE	16	13	14	19	12	20	12	15
COVER	11	5	6	16	7	7	4	14
CHANNEL	16	13	14	20	17	19	13	16
RIPARIAN	4	5	9	9	9	8	4	8
POOL/ CURRENT	8	5	4	11	7	7	4	11
RIFFLE/ RUN	4	5	5	7	5	7	6	7
GRADIENT	6	8	8	6	8	8	8	6
TOTAL	65	54	70	88	65	76	51	77

	Site Number						
	9	10	11	12	13	14	15
SUBSTRATE	16	16	9	5	5	18	18
COVER	9	6	14	13	14	10	11
CHANNEL	17	16	14	14	14	16	18
RIPARIAN	9	8	5	5	5	8	8
POOL/ CURRENT	10	9	9	9	9	9	9
RIFFLE/ RUN	7	5	5	3	3	6	6
GRADIENT	6	8	6	4	4	6	6
TOTAL	74	68	62	53	54	73	76