

INDEX OF BIOTIC INTEGRITY



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**THE TENNESSEE IZAAK WALTON LEAGUE,
CLEAN WATER CENTER**

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INDEX OF BIOTIC INTEGRITY

BAKER CREEK

INTRODUCTION

This document represents data collected from Baker Creek in Knoxville, by the Tennessee Izaak Walton League for the City of Knoxville. Baker Creek was one of seven streams to be surveyed for I.B.I. during the 2003/ 2004 year. In this document we will state our objective, describe the study area, explain methodology, and discuss results found.

TENNESSEE IZAAK WALTON LEAGUE, BACKGROUND

The Tennessee Izaak Walton League has been addressing general water quality concerns since 1977 and specific impacts of sewage, silt and trash debris on water for the past six years. In June 2000, we opened an office with a full-time professional staff located at 956 Volunteer Landing Marina, Knoxville Waterfront.

Baker Creek is one of the seven urban streams we are studying in Knoxville, Tennessee. Our observations show that problems in Baker Creek include industrial disturbance, excessive impervious surface runoff and sewage overflow influence.

OBJECTIVES

1. Perform backpack electro-shocking, and macro-invertebrate study.
2. Perform a water quality test.
3. Score IBI and deliver write-up to the city of Knoxville.

STUDY AREA

Baker Creek is a 1673.49-acre drainage area that flows through South Knoxville and empties into the Tennessee River at two miles up stream of the waterfront development in downtown Knoxville (Figure 1). Baker Creek is listed in the draft of the 2002, 303d, (pg.51) for the state of Tennessee because of both "Other Habitat Alterations and Pathogens."

METHODS

The biotic condition of the stream was assessed by examining the fishes present and by examining the benthic macro invertebrates present in the upper Baker Creek drainage. One site was selected for conducting a biological assessment. Site selection was based upon topography, drainage area, access, and adjacent impacts to the stream.

Fisheries

The Index of Biotic Integrity (IBI) developed by Karr (1981) is used to examine fish communities. Tools used to conduct the Baker Creek IBI included a backpack shocker and a twenty-foot seine. The backpack shocker was used in run, riffle and pool habitats to stun fish into the seine net, fish were retrieved from the seine, identified to species and

then released. The sample area was measured to determine catch per unit effort; an average of fish per square feet yielded the score.

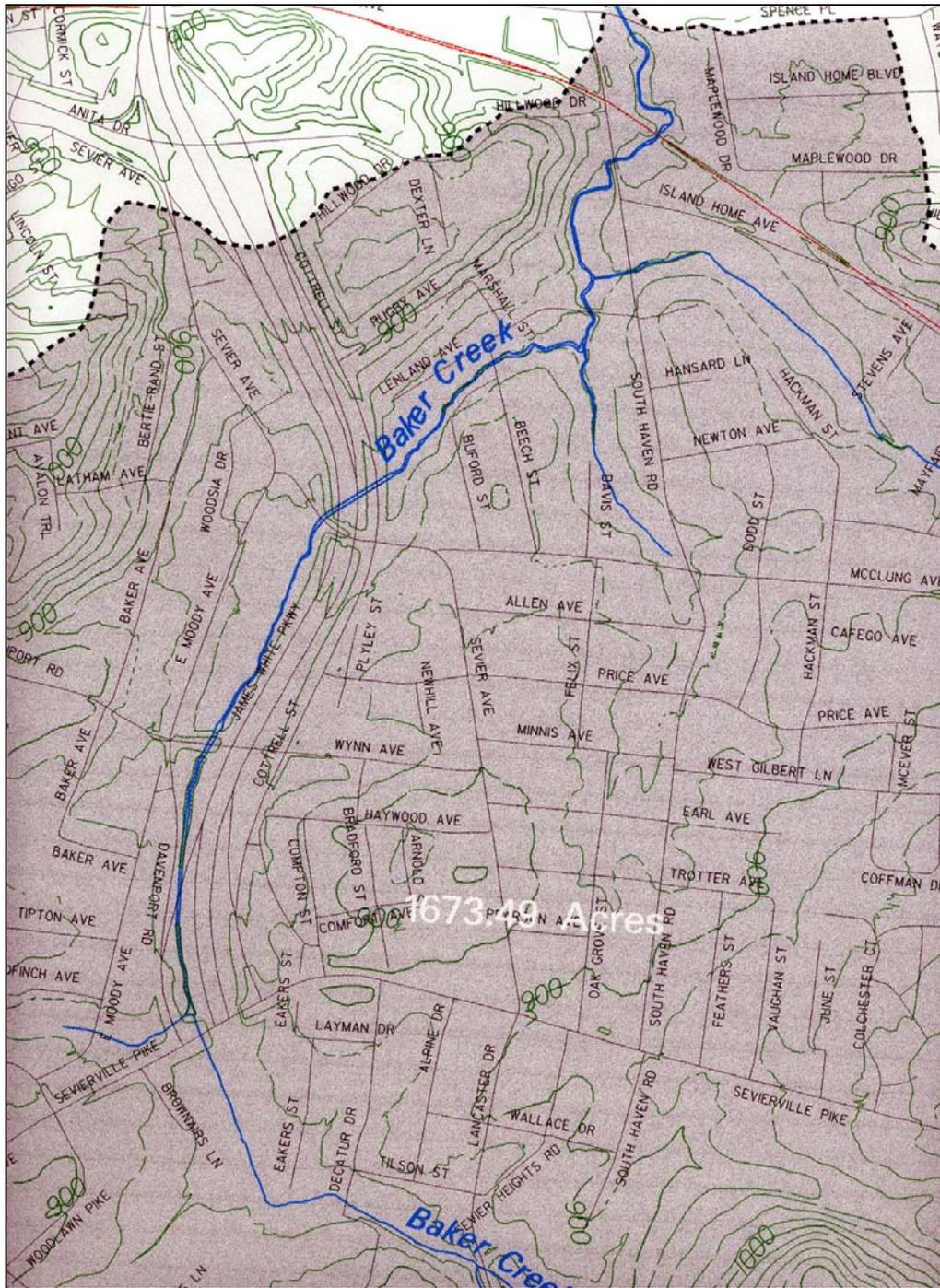


Figure 1. The Baker Creek Watershed Knoxville, Tennessee

The data were analyzed by the IBI method that uses 12 metrics to assess biotic integrity. The 12 metrics include 6 that describe species richness and composition, 3 that relate to trophic composition, and 3 that measure fish abundance and condition. Scores of 1, 3, or 5 are possible for each metric. The six metrics used to describe species richness and compositions are good indicators of stream degradation. Metrics one through four assess species richness. Metrics five and six are used to determine the presence of tolerant or intolerant fish. Three metrics address the trophic composition of the stream by identifying percentage of fishes that forage on selected levels. Metrics seven through nine assess the energy base within the food web of the community. They help identify shifts towards more generalized foraging that typically increase in degraded streams. Metrics ten through twelve measure fish abundance and condition. These metrics are most useful at the low end of the biological integrity scale. The sum of the 12 metric scores result in an overall score that ranges from 12 to 60 (very poor to excellent).

Benthic Macro invertebrates

A qualitative, family level EPT survey was used to examine the benthic macroinvertebrate populations of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddis flies (Tricoptera). A thorough search for benthic macro-invertebrates was conducted in riffle, leaf packs, wood, rocks, root wads, submersed or emergent vegetation, and pool substrate. All of the organisms were collected and identified to family level. The EPT score is a sum of the total number of families of EPT organisms represented in a sample. Scores of 0-5 are considered poor, 7-11 fair, and >13 good.

Water Quality

Tests were conducted using an In-Situ Water Quality Sampler. The parameters tested were turbidity, dissolved oxygen, pH, temperature and depth.

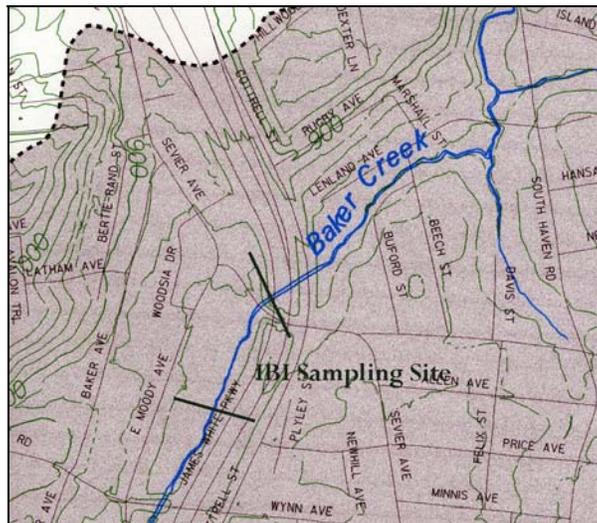


Figure 2. Baker Creek IBI site depicted, Knoxville Tennessee.

RESULTS

Fish

Fish sampling on November 11, 2003 yielded an IBI score of **30** that equates to poor. Average depth: .13 meters; Average width: 3.3 meters.

Benthic

Macro-invertebrate sampling at Baker Creek yielded an EPT score of **2** that equates to poor.

Water Quality

Water tests on November 12, 2003 yielded the following results:

Dissolved Oxygen= 9.9 mg (DO)/L	ORP= 211
Turbidity= 5.2 NTU's;	Barometer= 29.2
Temp= 52.3 F Conductivity= 307.5 mS	pH= 7.3
Depth= .02 meters;	

DISCUSSION

Baker Creek is listed in the draft of the 2002, 303d for the state of Tennessee because of Pathogens and other habitat alterations”, pg. 51. The Index of Biotic Integrity (I.B.I.) for Baker Creek received an overall score of poor. This score, amongst other variables, reflects the low number of intolerant species a high number of tolerant species and fish disease anomalies present. The absence of intolerant fish is likely connected to stream channel alteration, siltation and pathogens. The presence of disease is likely a result of pathogens in the water. Water quality of Baker Creek showed to have adequate pH, and temperature. The Benthic Macro-invertebrates received a score of poor. Only one group within the EPT distinction, the Order Caddis fly (Trichoptera), was found on-site. Fish abundance, benthic macro-invertebrates, and water quality all come together to give us a better understanding of Baker Creek.

CONCLUSION

This document represents data collected from Baker Creek in Knoxville by the Tennessee Izaak Walton League for the City of Knoxville, Engineering Department. Baker Creek has a good chance to make a come back with better buffer areas, more community awareness and some creative engineering to reduce flood events and, or provide better fish habitat. We look forward to further study of this creek.

Index of Biotic Integrity

Baker Creek -(mile 0.9) - 12/ 9/ 2003

Drainage Area 1673. Acres

Ecoregion: Central Appalachian Ridges and Valleys

Metric Description	Scoring Criteria			Observed	Score
	1	3	5		
Total number of native fish species	<10	(10 - 19)	>19	10	3
Number of darter species	<2	2	>2	1	1
Number of sunfish species, less <i>Micropterus</i>	<2	2	>2	1	1
Number of sucker species	<2	2	>2	2	3
Number of intolerant species	<2	2	>2	2	3
Percent of individuals as tolerant species	>33%	17% - 33%	<17%	60.00%	1
Percent of individuals as omnivores and stoneroller species	>40%	21% - 40%	<21%	40%	3
Percent of individuals as specialized insectivores	<19%	19% - 36%	>36%	20.00%	3
Percent of individuals as piscivores	<2 %	2 % - 4 %	>4 %	0.00%	1
Catch rate(average number of fish per 300 sq. ft. sampling unit)	<22	22 - 43.8	>43.8	18.5	1
Percent of individuals as hybrids	>1 %	TR-1 %	0%	0%	5
Percent of individuals with disease, tumors, fin damage, and other anomalies	>5%	2% - 5%	<2%	1.00%	5
IBI					30
IBI Classification					Poor

IBI Range: 0= No fish; 12-22= Very Poor; 23-34= Poor; 35-44= Fair; 45-52= Good; 53-60= Excellent

<u>E.P.T. Families Present</u>	Score: 2 (Poor)
E: none	
P: none	
T: Hydropsychidae, Helicopsychidae	
Comments: Reasonable bug diversity at this location	

INDEX OF BIOTIC INTEGRITY **WILLIAMS CREEK**

INTRODUCTION

This document represents data collected from Williams Creek in Knoxville, by the Tennessee Izaak Walton League for the City of Knoxville. Williams Creek was one of seven streams to be surveyed for I.B.I. during the 2003/ 2004 year. In this document we will state our objective, describe the study area, explain methodology, and discuss results found.

TENNESSEE IZAAK WALTON LEAGUE, BACKGROUND

The Tennessee Izaak Walton League has been addressing general water quality concerns since 1977 and specific impacts of sewage, silt and trash debris on water for the past six years. In June 2000, we opened an office with a full-time professional staff located at 956 Volunteer Landing Marina, Knoxville Waterfront.

Williams Creek is one of the seven urban streams we are studying in Knoxville, Tennessee. Our observations show that problems in Williams Creek include industrial disturbance, excessive impervious surface runoff and sewage overflow influence.

OBJECTIVES

4. Perform backpack electro-shocking, and macro-invertebrate study.
5. Perform a water quality test.
6. Score IBI and deliver write-up to the city of Knoxville.

STUDY AREA

Williams Creek is a 1,641.22 acre (664.2 hectare) drainage area that flows south 2.8 miles through East Knoxville and empties into the Tennessee River at two miles up stream of the waterfront development in downtown Knoxville. The upper half of the watershed is impacted by typical urban runoff, including a section of Interstate 40 and the heavily traveled, four lanes of Magnolia Avenue. The upper half is developed but flows through a magnificent high story riparian zone with large trees atypical of an urban stream. This section suffers from poorly maintained sewage laterals and large amounts of trash and debris. The lower half flows through a newly developed golf course, past the Vulcan materials plant and Knoxville Utilities Board before its confluence with the Tennessee River. This section contains a well-established riparian zone adjacent to the Vulcan Materials Plant. Williams Creek is listed in the draft of the 2002, 303d for the state of Tennessee because of both habitat alteration and urban runoff/ storm sewers.

METHODS

The biotic condition of the stream was assessed by examining the fishes present and by examining the benthic macro invertebrates present in the upper Williams Creek drainage. One site was selected for conducting a biological assessment. Site selection was based upon topography, drainage area, access, and adjacent impacts to the stream.

Fisheries

The Index of Biotic Integrity (IBI) developed by Karr (1981) is used to examine fish communities. Tools used to conduct the Williams Creek IBI included a backpack shocker and a twenty-foot seine. The backpack shocker was used in run, riffle and pool habitats to stun fish into the seine net, fish were retrieved from the seine, identified to species and then released. The sample area was measured to determine catch per unit effort; an average of fish per square feet yielded the score.



Figure 1. The Williams Creek Watershed Knoxville, Tennessee.

The data were analyzed by the IBI method that uses 12 metrics to assess biotic integrity. The 12 metrics include 6 that describe species richness and composition, 3 that relate to trophic composition, and 3 that measure fish abundance and condition. Scores of 1, 3, or 5 are possible for each metric. The six metrics used to describe species richness and compositions are good indicators of stream degradation. Metrics one through four assess species richness. Metrics five and six are used to determine the presence of tolerant or intolerant fish. Three metrics address the trophic composition of the stream by identifying percentage of fishes that forage on selected levels. Metrics seven through nine assess the energy base within the food web of the community. They help identify shifts towards more generalized foraging that typically increase in degraded streams. Metrics ten through twelve measure fish abundance and condition. These metrics are most useful at the low end of the biological integrity scale. The sum of the 12 metric scores result in an overall score that ranges from 12 to 60 (very poor to excellent).

Benthic Macro invertebrates

A qualitative, family level EPT survey was used to examine the benthic macroinvertebrate populations of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddis flies (Tricoptera). A thorough search for benthic macro-invertebrates was conducted in riffle, leaf packs, wood, rocks, root wads, submersed or emergent vegetation, and pool substrate. All of the organisms were collected and identified to family level. The EPT score is a sum of the total number of families of EPT organisms represented in a sample. Scores of 0-5 are considered poor, 7-11 fair, and >13 good.

Water Quality

Tests were conducted using an In-Situ Water Quality Sampler. The parameters tested were turbidity, dissolved oxygen, pH, temperature and depth.

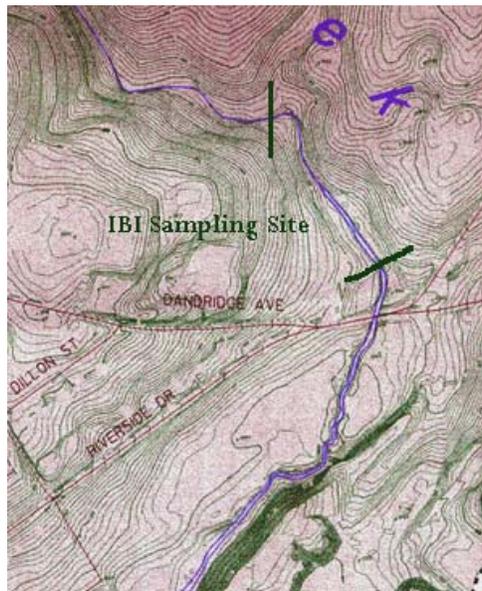


Figure2. Williams Creek IBI site depicted, Knoxville Tennessee.

RESULTS

Fish

Fish sampling on November 11, 2003 yielded an IBI score of **24** that equates to very poor. Average depth: .014 meters; Average width: 6.2 meters.

Benthic

Macro-invertebrate sampling at Williams Creek yielded an EPT score of **1** that equates to poor.

Water Quality

Water tests on November 12, 2003 yielded the following results:

Dissolved Oxygen= 9.5 mg (DO)/L	
Turbidity= 3.7 NTU's;	ORP= 218
Temp= 52 F Conductivity= 313 mS	Barometer= 29.2
Depth= .04 meters;	pH= 7.4

DISCUSSION

Williams Creek is listed in the draft of the 2002, 303d for the state of Tennessee because of Pathogens and other habitat alterations”, pg. 51. The Index of Biotic Integrity (I.B.I.) for Williams Creek received an overall score of very poor. This score, amongst other variables, reflects a low number of intolerant species, a high number of tolerant species, and a significant number of diseased fish. The absence of intolerant fish is likely connected to stream channel alteration, siltation and pathogens. The presence of disease is likely a result of pathogens in the water. Water quality of Williams Creek showed to have adequate pH, and temperature. The Benthic Macro-invertebrates received a score of poor. Only one group within the EPT distinction, the Order Caddis fly (Trichoptera), was found on-site. Fish abundance, benthic macro-invertebrates, and water quality all come together to give us a better understanding of Williams Creek, 2003.

CONCLUSION

This document represents data collected from Williams Creek in Knoxville by the Tennessee Izaak Walton League for the City of Knoxville, Engineering Department. Williams Creek has a good chance to make a come back with better buffer areas, more community awareness and some creative engineering to reduce flood events and, or provide better fish habitat. KUB has performed several upgrades to their sewage system along this creek since focus began back in 2002. It will be interesting to track the amount of Ecoli and other pathogens as they abate and cross-reference those numbers with the amount of diseased tumors found in fish—hope to see a linear regression. We look forward to further study of this creek.

Index of Biotic Integrity

Williams Creek -(mile 0.8) -12/8/ 2003

Drainage Area 1,641.22 acre

Ecoregion: Central Appalachian Ridges and Valleys

Metric Description	Scoring Criteria			Observed	Score
	1	3	5		
Total number of native fish species	<10	(10 - 19)	>19	6	1
Number of darter species	<2	2	>2	0	1
Number of sunfish species, less <i>Micropterus</i>	<2	2	>2	1	1
Number of sucker species	<2	2	>2	1	1
Number of intolerant species	<2	2	>2	0	1
Percent of individuals as tolerant species	>33%	17% - 33%	<17%	83.00%	1
Percent of individuals as omnivores and stoneroller species	>40%	21% - 40%	<21%	16%	5
Percent of individuals as specialized insectivores	<19%	19% - 36%	>36%	0.00%	1
Percent of individuals as piscivores	<2 %	2 % - 4 %	>4 %	0.00%	1
Catch rate(average number of fish per 300 sq. ft. sampling unit)	<22	22 - 43.8	>43.8	33.4	3
Percent of individuals as hybrids	>1 %	TR-1 %	0%	0%	5
Percent of individuals with disease, tumors, fin damage, and other anomalies	>5%	2% - 5%	<2%	4.00%	3
IBI					24
IBI Classification					Very Poor

IBI Range: 0= No fish; 12-22= Very Poor; 28-34= Poor; 40-44= Fair; 48-52= Good; 59-60= Excellent

<u>E.P.T. Families Present</u>	Score: 1 (Poor)
E: none	
P: none	
T: Hydropsychidae	
Comments: Poor bug diversity at this location	