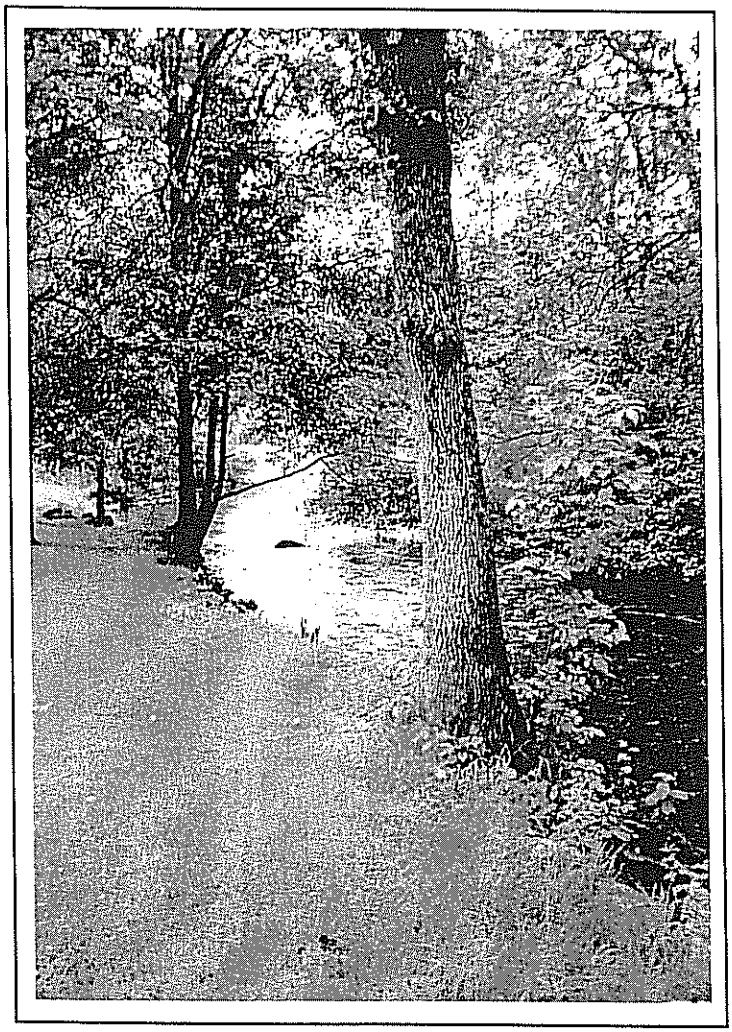
MACROINVERTEBRATE

MONITORING PROGRAM



GREEN TOWNSHIP
SUSSEX COUNTY, NEW JERSEY

PREPARED BY
ECOSYSTEMS ENVIRONMENTAL CONSULTANTS
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ACKNOWLEDGMENTS

Acknowledgments are merited by all the individuals and organizations who contributed their efforts and funding toward the accomplishment of this "Macroinvertebrate Monitoring Program" report, one of series of Sensitive Environmental Features reports.

In particular, Thanks goes to: **Dede Esenlohr**, who prepared the original grant application and for her cover photograph. Thanks also goes to the members of the Environmental Committee, for their efforts in completing the actual macroinvertebrate sampling. Special thanks to: **Richard Vohden** for coordinating the sampling programs and making the sampling site available to the committee and the public for sampling and training, **Cynthia Moyano** for help in assuring that the field data sheets were completed in an accurate manner, **Linda Neary** for her hands-on training and keeping our young volunteers motivated and doing such a fine job, **Bruce Mueller** and **Larry Putera** for their willingness to get wet and loosen the bugs from the bottom of the river, and **Jenny Kobilinski** and **Eric Derby** for arranging the participation of the Green Township Girl Scout Troops who did the actual sorting and counting. Thanks to all the members of the Green Township Environmental Committee for their efforts and commitment to the environment.

This document was prepared with the aid of a Grant from the New Jersey Department of Environmental Protection, Office of Intergovernmental Affairs, Environmental Services Program.

*

Additional copies of this report may be purchased at the Green Township Municipal Building, PO Box 65, Tranquility, NJ. 07879

July - 2001

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Section 1 **Lab Report** prepared by F. X. Brown Laboratories. Macroinvertebrate sampling of the Pequest River and Dead End Creek. Lab sampling took place at the same time the Environmental Committee sampled (June 2000). This lab report includes GIS mapwork labeled: Map of Sampling Stations(Base Map), Land Use, Environmental Sites, Wetlands, Soils, Bedrock Geology.

Section 2 **Macroinvertebrate Data Sheets** completed by the Green Township Environmental Committee. Sampling took place June 27, 2000 and June 27, 2001. Data sheets completed for the Green Township sampling station No. 3 the Pequest River at Huntsville.

Section 3 **Macroinvertebrate Data Sheets** completed for the sampling conducted by F. X. Brown Laboratories. Data sheets completed for the Green Township sampling station No. 1 the Pequest River at Brighton, and No. 2 Dead End Creek.

Section 4 **GIS Mapwork** indicating:
USGS Topographic Quad with the three sampling sites located.
NJDEP Watershed Map with the three sampling sites located.
Land Use Map of Green Township with sampling sites located.
Land Use Map of the drainage area above sampling site No. 1.
Land Use Map of the drainage area above sampling site No. 2.
Aerial Photo of Green Township with sampling sites located.

Section 5 **Photographs** taken during the Environmental Committee's June 2000 sampling of the Pequest River.

INTRODUCTION

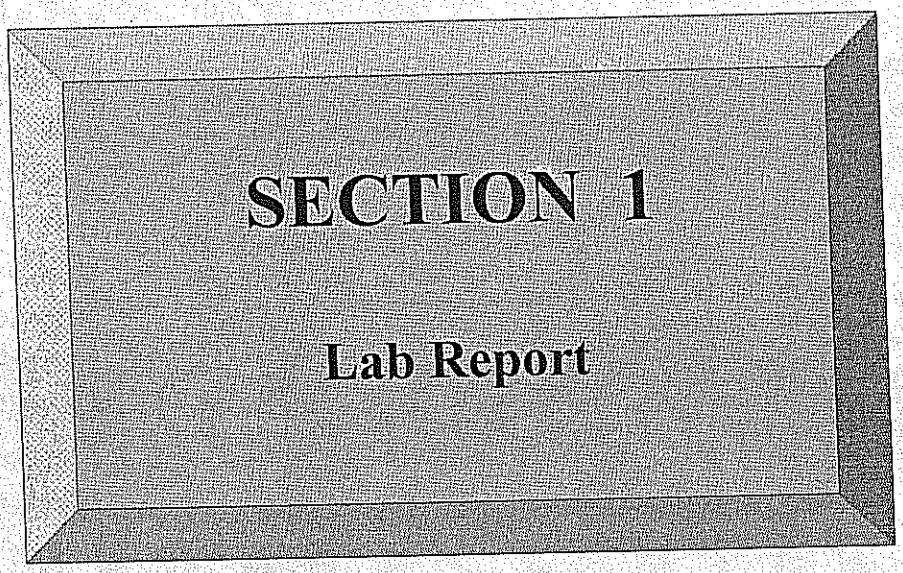
Macroinvertebrate Monitoring is the collection and analysis of stream insects and associated wildlife, used as indicators of water quality. *Macro*invertebrates can be seen with the naked eye, as compared with *Micro*invertebrates which require a microscope to view clearly. They are primarily bottom dwelling (benthic) animals, that are found in freshwater and saltwater environments. They are at the base of the food chain and play a important role in the aquatic food web.

In the Green Township's Biological Monitoring Program, the freshwater macroinvertebrates are primarily made up of insect larva, aquatic worms, mollusks (snails and clams) and crustaceans (scuds and crayfish). These benthic insects are readily collected and easily quantified by volunteer groups, such as environmental commissions, watershed groups, organizations similar to the Boy and Girl Scouts, and the general public. Macroinvertebrates occupy various niches in the stream, depending on their shape and feeding method, e.g. predators, filter and detritus feeders, scavengers etc.. Their presence and relative abundance is controlled by environmental conditions and by the pollution tolerance levels of their respective species. Their overall community health reflects the conditions of their environment.

The Green Township Environmental Committee used the Isaac Walton League of America's Monitor's Guide to Aquatic Macroinvertebrates. This Monitor's Guide is part of the league's "Save Our Streams Program" (SOS), a national volunteer stream protection program. The SOS program teaches citizens how to monitor, protect and restore the nation's rivers. The SOS program uses a simple and straightforward monitoring approach which involves: taking a "critter count"(looking at the number of different types of bugs), the relative number of organisms and their tolerance to pollutants, in order to determine the stream's health.

The technique is based on the fact that differ groups of stream macroinvertebrates have different tolerances to pollution, which means they can serve as useful indicators of water quality. This biological monitoring program was chosen because it provides an effective, easy to understand method for determining if a stream has been impacted by pollution sources. Macroinvertebrates live from several weeks to many years in a stream and directly depend on aquatic habitat and water quality for survival. As a result, macroinvertebrates can indicate pollution impacts from various, cumulative or multiple sources.

Biological monitoring provides insight into the nature of stream disturbance through an examination of the predominant feeding patterns (functional feeding groups) of the macroinvertebrate groups present. For example, increased proportions of scrapers may indicate nutrient runoff, while increased numbers of collectors may show organic enrichment.


SECTION 1
Lab Report

MACROINVERTEBRATE SURVEY
AND GIS DEVELOPMENT
GREEN TOWNSHIP, NJ

October, 2000

Submitted to:

Ecosystems
17 Indian Terrace
Lafayette, NJ 07848

Prepared By:

F. X. Browne, Inc.
1101 South Broad Street
Lansdale, PA 19446

FXB File No. NJ1500-01

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Executive Summary

Ecosystems, Inc. received funding from Green Township, in Sussex County, NJ to conduct macroinvertebrate sampling and limited Geographic Information Systems (GIS) analysis on two tributaries of the Pequest River that enter Green Township. During June 2000, F. X. Browne, Inc. performed aquatic benthic macroinvertebrate monitoring at two stations, Station 1 located on the Pequest River at the Brighton Bridge and the other located on Dead End Creek at the Route 519 Bridge. Macroinvertebrate (aquatic insect) samples were collected at each station using a kicknet in accordance with the U.S. EPA Rapid Bioassessment Protocol. In addition, the watershed of each station was delineated and GIS maps were prepared showing land use, environmental sites, wetlands, soils, and bedrock geology of each watershed.

Overall, the macroinvertebrate communities at both stream stations were somewhat compromised, indicating the presence of organic pollution. Both stations had similar water quality based on the metrics analyzed, despite the larger watershed of the Pequest River station. It is unclear why the Dead End Creek watershed had impacted water quality, since the watershed is only 7,000 acres, and no environmental sites exist in the watershed. It may be due to the fact that the Dead End Creek watershed is mostly agricultural land (48 percent) while the Pequest River watershed is mostly forested land (60 percent), with only 7 percent of the watershed in agricultural use.

We recommend sampling both streams at more stations over a whole summer to get a better idea of the overall water quality in each watershed. Water chemistry samples should be taken once a month from May through September, and macroinvertebrate samples should be taken during June, at the same time as the June water chemistry sampling date. Correlating water chemistry and macroinvertebrate samples will give a better picture of whether or not nonpoint source pollution is an issue in either watershed.

1.0 Introduction

Ecosystems, Inc. received funding from Green Township, in Sussex County, NJ to conduct macroinvertebrate sampling and limited Geographic Information Systems (GIS) analysis on two tributaries of the Pequest River that enter Green Township. During June 2000, F. X. Browne, Inc. performed aquatic benthic macroinvertebrate sampling at two stations as shown in Figure 1. Station 1 was located on the Pequest River at the Brighton Bridge and Station 2 was located on Dead End Creek at the Route 519 Bridge. In addition, the watershed of each station was delineated and GIS maps were prepared showing the land use, environmental sites, wetlands, soils, and bedrock geology of each watershed.

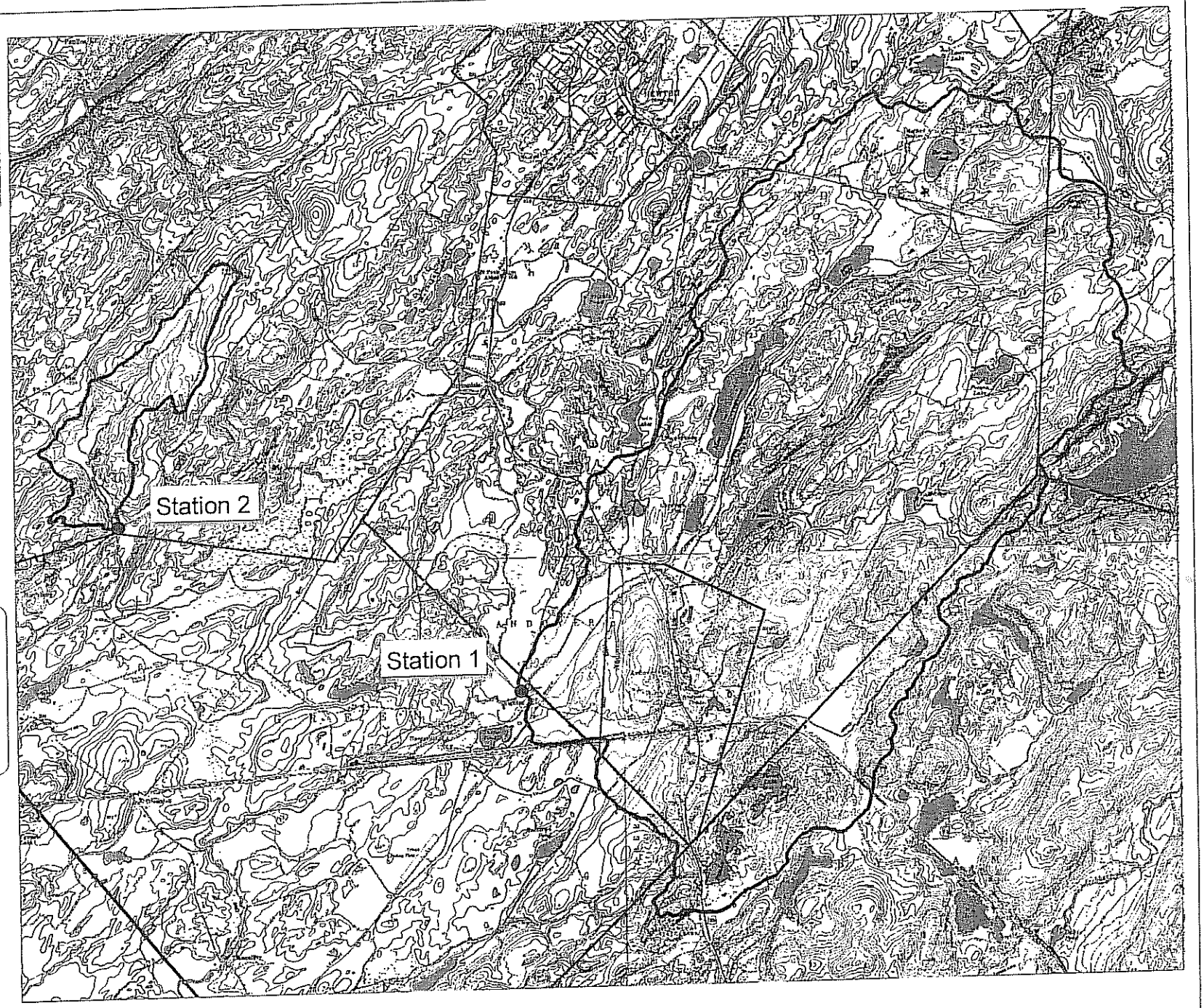
2.0 Methods of Analysis

Macroinvertebrate (aquatic insect) samples were collected at each station using a kicknet in accordance with the U.S. EPA Rapid Bioassessment Protocol. The samples were preserved in ethanol and taken to the F. X. Browne, Inc. laboratory for identification. Macroinvertebrate samples were analyzed according to the U.S. EPA Rapid Bioassessment Protocol. Approximately 100 individuals from each station were identified to the family level. The metrics were computed using guidance from the Pennsylvania Water Quality Monitoring Network (WQN). The metrics used in this study were Total Taxa-Chironomids, Hilsenhof Biotic Index (HBI), Modified EPT richness, Modified Percent EPT, Percent Dominant Taxon, and Percent Intolerant Taxa. Total taxa-chironomids represents the number of different taxa present when all the chironomids are counted as one family, *Chironomidae*, rather than different genera. HBI is a commonly used index of specific benthic macroinvertebrate tolerances to organic pollution. Modified EPT richness and Modified Percent EPT are indices of the three taxa that are most intolerant to pollution, Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichopera (caddisflies). The modified version doesn't include the taxa with HBI values higher than 5, which eliminates tolerant species. Percent dominant taxon is a measure of the relationship between the number of individuals in the most dominant taxon to the number of individuals in the population as a whole. Percent intolerant taxa measures the relationship between the number of individuals in taxa with an HBI less than 6 to the number of individuals in the population as a whole.

Evaluation of Two Streams Draining to Green Township

Figure 1

Base Map



Legend

- Sample Sites
- Watersheds
- Streams
- County Boundary
- Township Boundaries
- Lakes

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F. X. Browne, Inc.
Geographic Information Systems

3.0 Aquatic Benthic Macroinvertebrate Results

The total number of individuals in each taxa found in each of the three stations, as well as the Hilsenhof Biotic Index (HBI) number for each taxa, is shown in Table 2.

TABLE 1 - GREEN TOWNSHIP AQUATIC BENTHIC MACROINVERTEBRATES RESULTS				
TAXA	COMMON NAME	HBI	Station #1	Station #2
EPHEMEROPTERA				
Baetidae 1	mayfly	6		3
Baetidae 2	mayfly	6		13
PLECOPTERA				
Perlidae	stonefly	3		1
TRICHOPTERA				
Hydropsychidae	caddisfly	5	2	8
Philopotamidae	caddisfly	3		1
MEGALOPTERA				
COLEOPTERA				
Elmidae	riffle beetle	5	11	
Dysticidae	diving beetle	5		5
ISOPODA				
Asellidae	sowbug	8	1	
Gammaridae	scud	6	29	
GASTROPODA				
Lymnaeidae	snail	7	2	
Planorbidae	snail	6	2	
Physidae	snail	8	1	18
PELECYPODA				
Sphaeriidae	clam	8	3	
ODONATA				
Aeshnidae	dragonfly nymph	3	1	
Gomphidae	dragonfly nymph	4	1	
DIPTERA				
Chironomidae	midge larvae	6	17	30
Tipulidae	crane fly larvae	4	1	
Simuliidae	black fly larvae	6	6	9
OLIGOCHAETA	aquatic worm	10	25	12
CRUSTACEA				
Cambariidae	crayfish	6		2

The types of macroinvertebrates present in a stream are indicative of the quality of the water. A healthy stream will have good species diversity, with many different taxa represented in the sample. In an impacted stream, most of the individuals will be represented by only a few taxa. The quality of a stream is assessed by comparing different metrics, or indices. Each metric tells us something about the water quality in the stream. For example, an Hilsenhof Biotic Index (HBI) of 0-3.75 indicates excellent water quality with no organic pollution while an HBI greater than 6 represents poor water quality with respect to organic pollution (Klemm, *et. al*, 1990). A high EPT Index and Percent EPT represent good water quality since the three orders of macroinvertebrates represented by those metrics, Ephemeroptera, Plecoptera and Trichoptera, are intolerant to pollution and are usually not found in impacted streams. In streams with good water quality the percent dominant species will be low, which is an indication of high species diversity. A high percentage of intolerant taxa is also a sign that the water quality in the stream is good since species that are intolerant to pollution can only live in unimpacted streams.

The individual macroinvertebrates from each station were identified and classified by family. A summary of the metrics for each station is given in Table 3.

TABLE 2 - GREEN TOWNSHIP
BIOASSESSMENT SUMMARY

Metric	Station #1	Station #2
Total Taxa-Chironomids	14	11
Total number of individuals	102	102
Hilsenhof Biotic Index (HBI)	6.9	6.6
EPT Index*	1	3
Percent EPT*	7.1	21
Percent Dominant Taxon	28	29
Percent Intolerant Taxa	16	15

* The metrics that are listed as modified (*) do not include taxa with HBI values > 5.

Station 1, located on the Pequest River at the Brighton Bridge, shows the greater amount of species diversity with 102 individuals representing 14 different taxa. The HBI was 6.9 for that station, indicating relatively poor water quality with respect to organic pollution. The EPT Index and Percent EPT in Station 1 were low, also indicating poor water quality. The dominant species were scuds (HBI = 6) and aquatic worms (HBI = 10) which are species that are very tolerant of pollution. Intolerant taxa (HBI ≤ 5) made up only 16 percent of the population, which indicates that some degree of organic pollution is most likely present.

Station 2, located on Dead End Creek at the Route 519 Bridge, had slightly less species diversity than Station 1 with 102 individuals representing only 11 different taxa. The HBI was 6.6 at that station, which indicates relatively poor water quality with regards to organic pollution. The EPT Index and Percent EPT were higher than at Station 1, but are also indicative of relatively poor water quality. The dominant species was the Chironomid midge larvae (HBI = 6), which is a species tolerant of poor water quality. The percent dominant taxon was 29 percent, indicating low species diversity. Intolerant taxa make up only 15 percent of the population at this site.

4.0 Geographic Information Systems

The watersheds of the two sampling stations were delineated and mapped using GIS. The Dead End Creek watershed is approximately 7,000 acres and the Pequest River watershed is approximately112,000 acres. Each watershed was analyzed for the following parameters: land use, environmental sites, wetlands, soils, and bedrock geology. GIS maps of each of the parameters are included in Appendix A.

4.1 Land Use

The major land use in the Dead End Creek watershed is cropland, comprising 48 percent of the watershed. The majority of the rest of the watershed is forested (22 percent) or shrubland (21 percent), with 9 percent of the land in residential use. The major land use in the Pequest River watershed is forest, comprising about 60 percent of the watershed. Deciduous forest covers 49 percent of the watershed, with other types of forest making up 3 percent and shrubland making up8 percent. Agricultural land makes up 7 percent, residential/commercial land makes up approximately 16 percent, mining and industrial uses make up 1 percent, and lakes, ponds and reservoirs make up over 5 percent of the watershed. A Land Use map is included in Appendix A.

4.2 Environmental Sites

For the purposes of this report, environmental sites refers to mineral extraction sites (mines), dams or EPA permitted discharges (wastewater treatment plants) that could potentially have a negative impact on water quality. The Dead End Creek watershed has no sites that pose potential environmental problems. The Pequest River watershed, however, has four mineral extraction sites, eleven EPA permitted discharges, and twelve dams. For locations, refer to the Environmental Sites map in Appendix A.

4.3 Wetlands

The vast majority of the Dead End Creek watershed is uplands, comprising 81 percent of the watershed. 9 percent of the watershed is herbaceous wetland, 5 percent is deciduous wooded wetland, and 4 percent is modified agricultural wetland. The Pequest River watershed is 83 percent upland, with deciduous wooded wetland (7 percent) and artificial lakes (4 percent) comprising the majority of the wetland areas. A Wetlands map is included in Appendix A.

4.4 Soils

The most common of the ten different soil types in the Dead End Creek watershed is Nassau rocky silt loam 8 to 15 percent slope (31 percent). Other major soil types in the watershed are Albia gravelly loam 3 to 8 percent slopes (20 percent), Nassau-Rock outcrop complex 15 to 25 percent slopes (19 percent), and Chippewa silt loam 3 to 8 percent slopes (12 percent). The Pequest River watershed has 56 different soil types, with the most common soils being Rock outcrop-Rockaway association steep (12 percent), Rockaway very stony loam 5 to 25 percent slopes (12 percent), Rockaway-Rock outcrop association sloping and moderately steep (12 percent), and Wassaic-Rock outcrop association moderately steep (8 percent). A Soils map is included in Appendix A

4.5 Bedrock Geology

The Dead End Creek watershed is located completely on Martinsburg formation/ Martinsburg shale bedrock. The Pequest River watershed contains 16 different kinds of bedrock, including mixed gneiss (28 percent), Horneblende granite/ mostly Horneblende granite & gneiss (14 percent), Horneblende and biotite gneiss (10 percent), and Allentown formation (9 percent). A Bedrock Geology map is included in Appendix A

5.0 Conclusions and Recommendations

Overall, the macroinvertebrate communities at both stream stations were somewhat compromised, indicating the presence of organic pollution. Both stations had similar water quality based on the metrics analyzed, despite the larger watershed of the Pequest River station (Station 1). A stream station with a larger watershed often has poorer water quality than a station with a smaller watershed, since the water drains into the stream from a greater area of land, potentially picking up more nonpoint source pollution. It is unclear why the Dead End Creek watershed had impacted water quality, since the watershed is only 7,000 acres, and no environmental sites exist in the watershed. It may be due to the fact that the Dead End Creek watershed is mostly agricultural land (48 percent). Pequest River watershed is mostly forested land (60 percent), with only 7 percent of the watershed in agricultural use. Agriculture is typically a large contributor to nonpoint source pollution unless proper agricultural BMPs are in place.

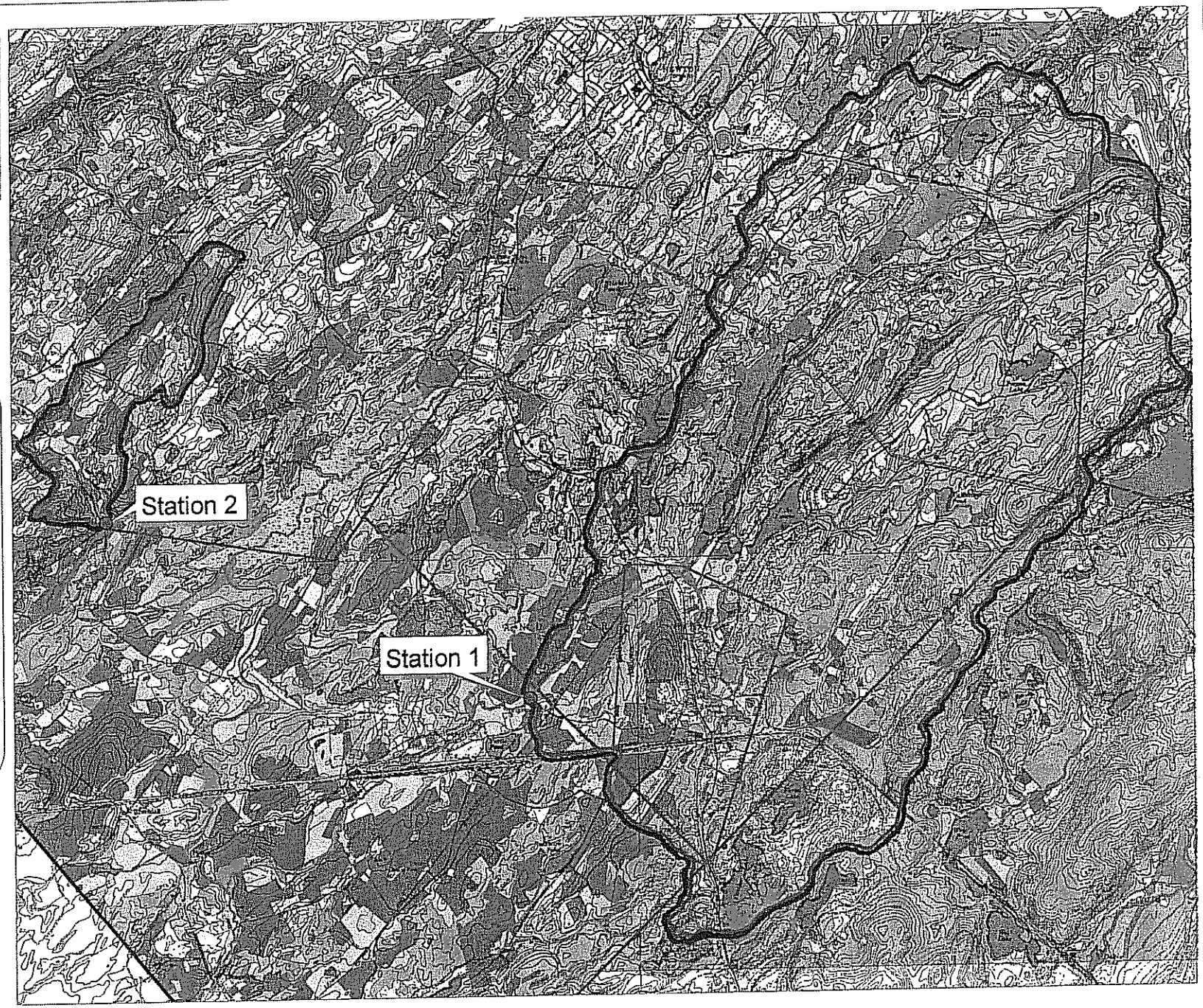
We recommend sampling both streams at more stations over a whole summer to get a better idea of the overall water quality in each watershed. Water chemistry samples should be taken once a month from May through September, and macroinvertebrate samples should be taken during June, at the same time as the June water chemistry sampling date. It is important to compare macroinvertebrate samples taken only at the same time as the previous year; otherwise any differences seen could be due to differences in species emergence or life stage. Correlating water chemistry and macroinvertebrate samples will give a better picture of whether or not nonpoint source pollution is an issue in either watershed.

Appendix A

GIS MAPS

Evaluation of Two Streams Draining to Green Township

Land Use



Legend

- Sample Sites
- Watersheds
- Streams
- County Boundary
- Township Boundaries
- Lakes

Land Use

- Altered Lands
- Athletic Fields (Schools)
- Bare Exposed Rock, Rock Slides, etc.
- Brush-Dominant and Bog Wetlands
- Brushland/Shrubland
- Commercial and Services
- Confined Feeding Operations
- Coniferous Forest
- Coniferous/Deciduous Forest
- Cropland and Pastureland
- Deciduous Forest
- Deciduous Wooded Wetlands
- Deciduous/Coniferous Forest
- Extractive Mining
- Industrial
- Lake or Pond
- Non-Tidal Marshes
- Orchards, Vineyards, Nurseries, Horticultural Areas
- Other Agriculture
- Other Urban or Built-up Land
- Recreational Land
- Reservoir
- Residential
- River Channel
- Transitional Areas
- Transportation/Communication/Utilities
- Undifferentiated Barren Lands

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Geographic Information Systems

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Evaluation of Two Streams Draining to Green Township

Environmental Sites

Legend

- USGS Gages
- Mineral Extraction
- Dams
- EPA Permitted Discharges
- Sample Sites
- Watersheds
- Streams
- County Boundary
- Township Boundaries
- Lakes

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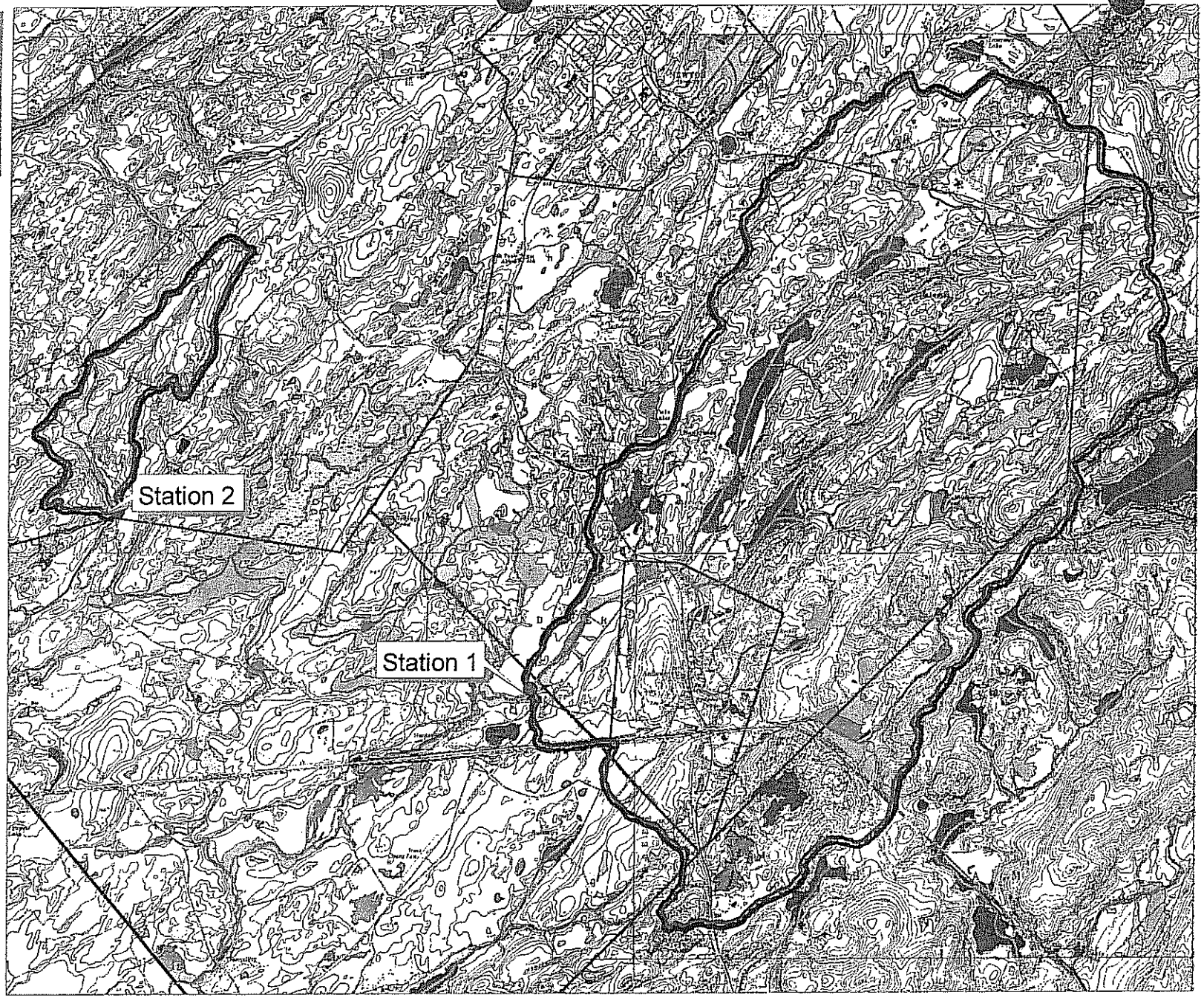
Geographic Information Systems

2 0 2 4 Miles

Evaluation of Two Streams Draining to Green Township

Wetlands



Legend

- Sample Sites
- Watersheds
- Streams
- County Boundary
- Township Boundaries

Wetlands

- AGRICULTURAL WETLANDS (MODIFIED)
- ARTIFICIAL LAKES
- CONIFEROUS SCRUB/SHRUB WETLANDS
- CONIFEROUS WOODED WETLANDS
- DECIDUOUS SCRUB/SHRUB WETLANDS
- DECIDUOUS WOODED WETLANDS
- DISTURBED WETLANDS (MODIFIED)
- HERBACEOUS WETLANDS
- MANAGED WETLANDS (MODIFIED)
- MIXED FORESTED WETLANDS (CONIFEROUS DOM.)
- MIXED FORESTED WETLANDS (DECIDUOUS DOM.)
- MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)
- MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)
- NATURAL LAKES
- STREAMS AND CANALS
- UPLANDS
- WETLAND RIGHTS-OF-WAY (MODIFIED)

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F. X. Browne, Inc.
Geographic Information Systems

2 0 2 4 Miles

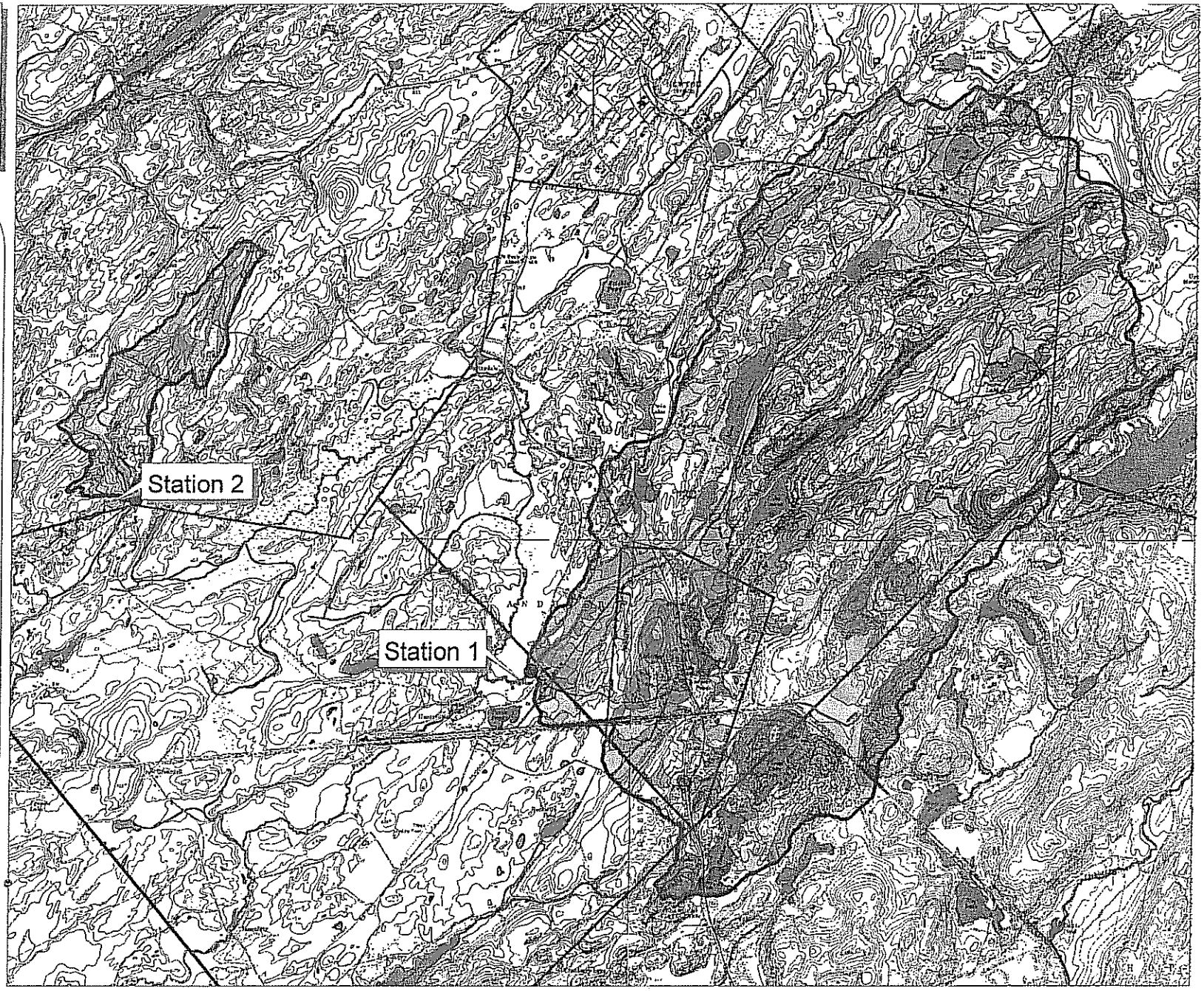
Evaluation of Two Streams Draining to Green Township

Soils

- Sample Sites
- Watersheds
- Streams
- County Boundary
- Township Boundaries
- Lakes

Soils

- Adrian gravelly loam, 3 to 8 percent slopes
- Adrian gravelly loam, 8 to 15 percent slopes
- Bath gravelly loam, 15 to 25 percent slopes
- Bath loam, 8 to 15 percent slopes
- Carlisle muck
- Chippewa extremely stony loam, 0 to 8 percent slopes
- Chippewa silt loam, 3 to 8 percent slopes
- Fredon loam, 0 to 3 percent slopes
- Halsey loam
- Hazen and Palmyra gravelly sandy loams, 25 to 45 percent slop
- Hazen gravelly loam, 0 to 3 percent slopes
- Hazen gravelly loam, 3 to 8 percent slopes
- Hazen gravelly loam, 8 to 25 percent slopes
- Hero loam, 0 to 3 percent slopes
- Hero loam, 3 to 8 percent slopes
- Hibernia gravelly loam, 3 to 8 percent slopes
- Hibernia very stony loam, 3 to 8 percent slopes
- Hibernia very stony loam, 8 to 25 percent slopes
- Lyons silt loam
- Lyons very stony silt loam
- Nassau rocky silt loam, 3 to 8 percent slopes
- Nassau rocky silt loam, 8 to 15 percent slopes
- Nassau-Rock outcrop complex, 15 to 25 percent slopes
- Nassau-Rock outcrop complex, 25 to 45 percent slopes
- Norwich silt loam, 0 to 3 percent slopes
- Otisville gravelly loamy sand, 15 to 35 percent slopes
- Otisville gravelly loamy sand, 3 to 15 percent slopes
- Palmyra gravelly fine sandy loam, 0 to 3 percent slopes
- Palmyra gravelly fine sandy loam, 3 to 8 percent slopes
- Palmyra gravelly fine sandy loam, 8 to 25 percent slopes
- Pits, sand and gravel
- Pompton fine sandy loam, 0 to 3 percent slopes
- Pompton fine sandy loam
- Quarries
- Riverhead sandy loam, 3 to 8 percent slopes
- Riverhead sandy loam, 8 to 25 percent slopes
- Rock outcrop-Nassau association, very steep
- Rock outcrop-Rockaway association, steep
- Rockaway gravelly loam, 15 to 25 percent slopes
- Rockaway gravelly loam, 3 to 8 percent slopes
- Rockaway gravelly loam, 8 to 15 percent slopes
- Rockaway very stony loam, 25 to 40 percent slopes
- Rockaway very stony loam, 5 to 25 percent slopes
- Rockaway-Rock outcrop association, sloping and moderately steep
- Sloan and Wayland silt loams
- Swamp
- Valois shaly loam, 15 to 25 percent slopes
- Valois shaly loam, 3 to 8 percent slopes
- Washington loam, 15 to 25 percent slopes
- Washington loam, 3 to 8 percent slopes
- Washington loam, 8 to 15 percent slopes
- Washington very stony loam, 15 to 25 percent slopes
- Washington very stony loam, 3 to 15 percent slopes
- Washington-Wassaic complex, 15 to 25 percent slopes
- Washington-Wassaic complex, 3 to 15 percent slopes
- Wassaic silt loam, 3 to 15 percent slopes
- Wassaic-Rock outcrop association, moderately steep
- Whitman extremely stony sandy loam
- Ireton loam, 3 to 8 percent slopes



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F. X. Browne, Inc.
Geographic Information Systems

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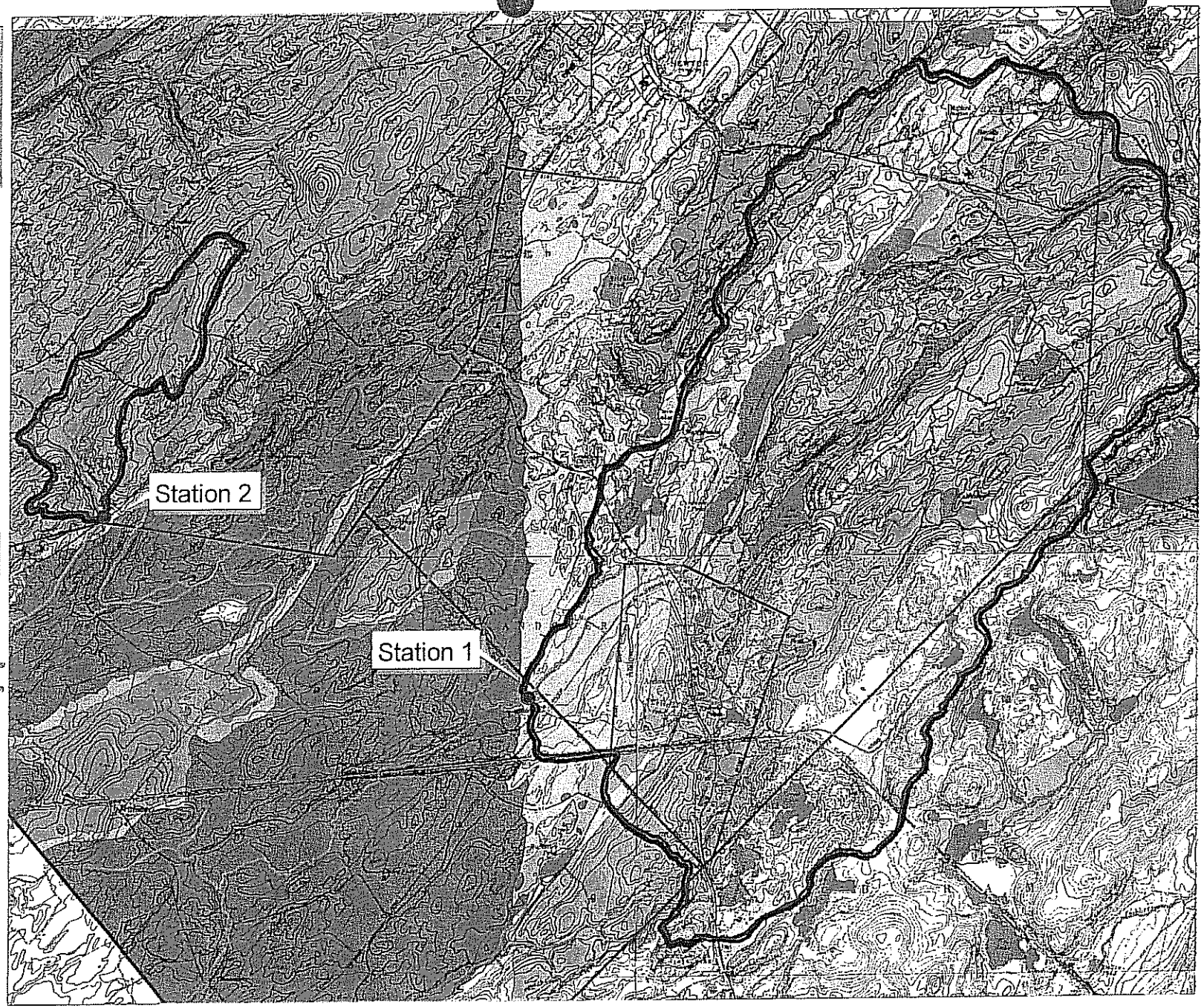
Evaluation of Two Streams Draining to Green Township

Bedrock Geology



Legend

- Sample Sites
- Watersheds
- Streams
- County Boundary
- Township Boundaries

Bedrock Geology

- ALKALIC DIKES
- ALLENTOWN FORMATION
- AMPHIBOLITE
- EPLER FORMATION
- HARDYSTON FORMATION/HARDYSTON QUARTZITE/HARDYSTON
- HORNBLENDE AND BIOTITE GNEISS
- HORNBLENDE GRANITE/MOSTLY HORNBLENDE GRANITE & GNEISS
- PINDICATES GRANODIORITE GNEISS
- JACKSONBURG FORMATION/JACKSONBURG LIMESTONE
- KITTATINNY GROUP/KITTATINNY FORMATION (UNDIFFERENTIATED)
- LEITHSVILLE FORMATION
- MARBLE AND SKARN
- MARTINSBURG FORMATION/MARTINSBURG SHALE
- MIXED GNEISS
- ONTELAUNEE FORMATION
- PYROXENE GNEISS
- QUARTZ MICROCLINE GNEISS
- QUARTZ-OLIGOCLASE GNEISS
- RICKENBACK FORMATION
- WATER

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Geographic Information Systems

2 0 2 4 Miles

SECTION 2

Environmental Committee

Macroinvertebrate Data Sheets

Save Our Streams

Stream Quality Survey

Name of reviewer: _____

Date reviewed: _____

Data sent to: NJDEP

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observations and data from your macroinvertebrate count, you can document changes in water quality. Refer to the SOS insect card and monitoring instructions to learn how to trap and identify stream macroinvertebrates and how to complete this form.

Stream PEQUEST RIVER. Station # 3-1 # of participants 15

County SUSSEX State NJ Group or individual GROUP

Location PEQUEST RIVER @ HUNTSVILLE (GREEN SITE #3)

Weather conditions (last 72 hours) SUNNY - WARM

Date 6/27/01 Average stream width _____ ft. Average stream depth _____ ft.

Start Time 530 End Time 630 Flow rate: High _____ Normal X Low _____ Negligible _____

If conducting rocky bottom sampling, select a riffle where the water is not running too fast, the water depth is between 3-12 inches, and the bed consists of cobble-sized stones or larger. Monitored riffle area (3' x 3' square) X Water depth 12 in., in riffle. Water temperature 76 F° ? C° ? Take 3 samples in the same general area. Count each separately and report the highest-scoring sample below. Sample 1 reported of 3.

If conducting muddy bottom sampling, take the required number of scoops from each habitat type: steep banks/vegetated margin (10 scoops), woody debris with organic matter (4 scoops), rock/gravel/sand substrates (3 scoops), and silty bottom with organic matter (3 scoops).

MACROINVERTEBRATE COUNT

Use the stream monitoring instructions to conduct a macroinvertebrate count. Use letter codes (A = 1-9, B = 10-99, C = 100 or more) to record the numbers of organisms found in a 3 foot by 3 foot area. Add up the number of letters in each column and multiply by the indicated index value. The following columns are divided based on the organism's sensitivity to pollution.

SENSITIVE		SOMEWHAT SENSITIVE		TOLERANT	
B	caddisfly larvae	A	beetle larvae	_____	aquatic worms
A	hellgrammite	A	clams	_____	blackfly larvae
C	mayfly nymphs	_____	crane fly larvae	_____	leeches
_____	gilled snails	A	crayfish	_____	midge larvae
A	riffle beetle adult	_____	damselfly nymphs	_____	pouch (and other) snails
A	stonefly nymphs	_____	dragonfly nymphs		
B	water penny larvae	A	scuds		
		_____	sowbugs		
		_____	fishfly larvae		
		_____	alderfly larvae		
		_____	atherix		
6	# letters times 3 =	4	# letters times 2 =	_____	# letters times 1 =
18	index value	8	index value	_____	index value

Now add together the three index values from each column for your total index value. Total index value = 26

Compare this total index value to the following ranges of numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample. Although the A, B, and C ratings do not contribute to the water quality rating, keep track of them to see how your macroinvertebrate populations change over time.

WATER QUALITY RATING

✓ Excellent (>22) _____ Good (17-22) _____ Fair (11-16) _____ Poor (<11)

Fish water quality indicators:
- [x] scattered individuals
- [ ] scattered schools
- [ ] trout (pollution sensitive)
- [ ] bass (somewhat sensitive)
- [ ] catfish (pollution tolerant)
- [ ] carp (pollution tolerant)

Barriers to fish movement:
- [ ] beaver dams
- [x] man-made dams
- [ ] waterfalls (>1 ft.)
- [ ] other
- [ ] none

Stream: PEQUEST RIVER
Station #: No. 3-1
Date: 6/27/01

Surface water appearance:
- [x] clear
- [x] clear, but tea-colored
- [ ] colored sheen (oily)
- [ ] foamy
- [ ] milky
- [ ] muddy
- [ ] black
- [ ] grey
- [ ] other _____

Stream bed deposit (bottom):
- [ ] grey
- [ ] orange/red
- [ ] yellow
- [ ] black
- [x] brown
- [ ] silt
- [x] sand
- [ ] other _____

Odor:
- [ ] rotten eggs
- [ ] musky
- [ ] oil
- [ ] sewage
- [ ] other _____
- [x] none

Stability of stream bed:
Bed sinks beneath your feet in:
- [x] no spots
- [ ] a few spots
- [ ] many spots

% bank covered by plants, rocks and logs (no exposed soil) is:

	Good >70%	Fair 30%-70%	Poor <30%
Stream banks (sides)	X		
Top bank (slope and floodplain)	X		

Algae color:
- [ ] light green
- [ ] dark green
- [x] brown coated
- [ ] matted on stream bed
- [ ] hairy

Algae located:
- [ ] everywhere
- [x] in spots

15 % of bed covered

Stream channel shade:
- [x] >80% excellent
- [ ] 50%-80% high
- [ ] 20%-49% moderate
- [ ] <20% almost none

Stream bank composition (=100%):
30 % trees
10 % shrubs
50 % grass
5 % bare soil
5 % rocks
____ % other _____

Stream bank erosion:
- [ ] >80% severe
- [ ] 50%-80% high
- [ ] 20%-49% moderate
- [x] <20% slight

Riffle composition (=100%):
____ % silt (mud)
10 % sand (1/16"-1/4"grains)
35 % gravel (1/4"-2" stones)
50 % cobbles (2"-10" stones)
5 % boulders (>10" stones)

~~MUDDY~~ BOTTOM ONLY: Record the number of scoops taken from each habitat type. Provide any details (mostly sand, little silt, etc.) to best describe the habitat.
- [ ] Steep bank/vegetated margin _____
- [ ] Woody debris with organic matter _____
- [ ] Rock/gravel/sand substrates _____
- [ ] Silty bottom with organic matter _____

Land uses in the watershed: Record all land uses observed in the watershed area upstream and surrounding your sampling site. Indicate whether the following land uses have a high **(H)**, moderate **(M)**, slight **(S)**, or none **(N)** potential to impact the quality of your stream. Refer to the SOS stream survey instructions to determine how to assess H, M, S, or N. If the land use is not present in your watershed, leave the space blank.
- [ ] Oil & gas drilling
- [ ] Housing developments
- [x] Forest
- [ ] Logging
- [ ] Urban uses (parking lots, highways, etc.)
- [ ] Sanitary landfill
- [ ] Active construction
- [ ] Mining (types) _____
- [x] Cropland (types) _____
- [ ] Trash dump
- [x] Fields
- [x] Livestock pasture
- [ ] Other _____

Are there any discharging pipes? [x] no [ ] yes If yes, how many? _____
What types of ~~pipes~~ are they?
- [x] runoff (field or stormwater) describe: ROADWAY
- [ ] sewage treatment _____
- [ ] industrial: type of industry _____

Did you test above and below the pipes to determine any change in water quality? Were changes noticed? NOTE: If you answer *Yes*, you must submit two different survey forms, one for above the pipe and one for below the pipe, to document your claim.
-NA-

Describe amount of litter in and around the stream as % of ground cover. Also describe the type of litter in and around the stream.
-0-

Comments Indicate what you think are the current and potential future threats to your stream's health. Feel free to attach additional pages or photographs to better describe the condition of your stream. COMPLETE REPORT ATTACHED

Save Our Streams Program
The Izaak Walton League of America • 707 Conservation Lane • Gaithersburg, MD 20878 • 301-548-0150
Please feel free to copy and distribute this survey form.

Save Our Streams

Stream Quality Survey

Name of reviewer: _____

Date reviewed: _____

Data sent to: NJDEP

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observations and data from your macroinvertebrate count, you can document changes in water quality. Refer to the SOS insect card and monitoring instructions to learn how to trap and identify stream macroinvertebrates and how to complete this form.

Stream PEQUEST RIVER Station # 3-2 # of participants 20

County SUSSEX State NJ Group or individual GROUP

Location PEQUEST RIVER @ HUNTSVILLE (GREEN SITE-3)

Weather conditions (last 72 hours) LIGHT RAIN

Date 6/27/00 Average stream width _____ ft. Average stream depth _____ ft.

Start Time 5:30 End Time 6:30 Flow rate: High _____ Normal X Low _____ Negligible _____

If conducting rocky bottom sampling, select a riffle where the water is not running too fast, the water depth is between 3-12 inches, and the bed consists of cobble-sized stones or larger. Monitored riffle area (3' x 3' square) X Water depth 12 in., in riffle. Water temperature 71 F° ? C° ? Take 3 samples in the same general area. Count each separately and report the highest-scoring sample below. Sample 2 reported of 3.

If conducting muddy bottom sampling, take the required number of scoops from each habitat type: steep banks/vegetated margin (10 scoops), woody debris with organic matter (4 scoops), rock/gravel/sand substrates (3 scoops), and silty bottom with organic matter (3 scoops).

MACROINVERTEBRATE COUNT

Use the stream monitoring instructions to conduct a macroinvertebrate count. Use letter codes (A = 1-9, B = 10-99, C = 100 or more) to record the numbers of organisms found in a 3 foot by 3 foot area. Add up the number of letters in each column and multiply by the indicated index value. The following columns are divided based on the organism's sensitivity to pollution.

SENSITIVE		SOMEWHAT SENSITIVE		TOLERANT	
B	caddisfly larvae	B	beetle larvae	A	aquatic worms
	hellgrammite	A	clams		blackfly larvae
A	mayfly nymphs		crane fly larvae		leeches
A	gilled snails	A	crayfish		midge larvae
B	riffle beetle adult		damselfly nymphs		pouch (and other) snails
	stonefly nymphs	A	dragonfly nymphs		
B	water penny larvae	B	scuds		
		A	sowbugs		
			fishfly larvae		
			alderfly larvae		
			atherix		
5 / 15	# letters times 3 = index value	6 / 12	# letters times 2 = index value	1 / 1	# letters times 1 = index value

Now add together the three index values from each column for your total index value. Total index value = 28

Compare this total index value to the following ranges of numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample. Although the A, B, and C ratings do not contribute to the water quality rating, keep track of them to see how your macroinvertebrate populations change over time.

WATER QUALITY RATING

✓ Excellent (>22) _____ Good (17-22) _____ Fair (11-16) _____ Poor (<11)

Fish water quality indicators:
- [x] scattered individuals
- [ ] scattered schools
- [ ] trout (pollution sensitive)
- [ ] bass (somewhat sensitive)
- [ ] catfish (pollution tolerant)
- [ ] carp (pollution tolerant)

Barriers to fish movement:
- [ ] beaver dams
- [x] man-made dams
- [ ] waterfalls (>1 ft.)
- [ ] other
- [ ] none

Stream: PEQUEST RIVER
Station #: 3-2
Date: 6/27/00

Surface water appearance:
- [x] clear
- [x] clear, but tea-colored
- [ ] colored sheen (oily)
- [ ] foamy
- [ ] milky
- [ ] muddy
- [ ] black
- [ ] grey
- [ ] other _____

Stream bed deposit (bottom):
- [ ] grey
- [ ] orange/red
- [ ] yellow
- [ ] black
- [x] brown
- [ ] silt
- [x] sand
- [ ] other _____

Odor:
- [ ] rotten eggs
- [ ] musky
- [ ] oil
- [ ] sewage
- [ ] other _____
- [x] none

Stability of stream bed:
Bed sinks beneath your feet in:
- [x] no spots
- [ ] a few spots
- [ ] many spots

% bank covered by plants, rocks and logs (no exposed soil) is:	Good >70%	Fair 30%-70%	Poor <30%
Stream banks (sides)	X		
Top bank (slope and floodplain)	X		

Algae color:
- [ ] light green
- [ ] dark green
- [ ] brown coated
- [ ] matted on stream bed
- [x] hairy

Algae located:
- [ ] everywhere
- [x] in spots

10 % of bed covered

Stream channel shade:
- [x] >80% excellent
- [ ] 50%-80% high
- [ ] 20%-49% moderate
- [ ] <20% almost none

Stream bank composition (=100%):
30 % trees
10 % shrubs
50 % grass
5 % bare soil
5 % rocks
____ % other _____

Stream bank erosion:
- [ ] >80% severe
- [ ] 50%-80% high
- [ ] 20%-49% moderate
- [x] <20% slight

Riffle composition (=100%):
____ % silt (mud)
10 % sand (1/16"-1/4"grains)
35 % gravel (1/4"-2" stones)
50 % cobbles (2"-10" stones)
5 % boulders (>10" stones)

MUDDY BOTTOM ONLY: Record the number of scoops taken from each habitat type. Provide any details (mostly sand, little silt, etc.) to best describe the habitat.
- [ ] Steep bank/vegetated margin _____
- [ ] Woody debris with organic matter _____
- [ ] Rock/gravel/sand substrates _____
- [ ] Silty bottom with organic matter _____

Land uses in the watershed: Record all land uses observed in the watershed area upstream and surrounding your sampling site. Indicate whether the following land uses have a high **(H)**, moderate **(M)**, slight **(S)**, or none **(N)** potential to impact the quality of your stream. Refer to the SOS stream survey instructions to determine how to assess H, M, S, or N. If the land use is not present in your watershed, leave the space blank. (< 2 MILES)
- [ ] Oil & gas drilling
- [ ] Housing developments
- [x] Forest
- [ ] Logging
- [ ] Urban uses (parking lots, highways, etc.)
- [ ] Sanitary landfill
- [ ] Active construction
- [ ] Mining (types) _____
- [x] Cropland (types) _____
- [ ] Trash dump
- [x] Fields
- [x] Livestock pasture
- [ ] Other _____

Are there any discharging pipes? [x] no [ ] yes If yes, how many? _____
What types of ~~pipes~~ are they?
- [x] runoff (field or stormwater) describe: ROAD WAYS
- [ ] sewage treatment _____
- [ ] industrial: type of industry _____

Did you test above and below the pipes to determine any change in water quality? Were changes noticed? NOTE: If you answer *Yes*, you must submit two different survey forms, one for above the pipe and one for below the pipe, to document your claim.
– NA –

Describe amount of litter in and around the stream as % of ground cover. Also describe the type of litter in and around the stream.
– 0 –

Comments Indicate what you think are the current and potential future threats to your stream's health. Feel free to attach additional pages or photographs to better describe the condition of your stream. PHOTOS ATTACHED AND USGS TOPO MAPS ATTACHED TO REPORT

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Please feel free to copy and distribute this survey form.

SECTION 3

Lab

Macroinvertebrate Data Sheets

Save Our Streams

Stream Quality Survey

Name of reviewer: _____

Date reviewed: _____

Data sent to: _____

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observations and data from your macroinvertebrate count, you can document changes in water quality. Refer to the SOS insect card and monitoring instructions to learn how to trap and identify stream macroinvertebrates and how to complete this form.

Stream PEQUEST RIVER Station # 1 # of participants 1

County SUSSEX State NJ Group or individual INDIVIDUAL

Location PEQUEST RIVER @ BRIGHTON (GREENTUP STATION - 1)

Weather conditions (last 72 hours) _____

Date 6/00 Average stream width _____ ft. Average stream depth _____ ft.

Start Time _____ End Time _____ Flow rate: High _____ Normal _____ Low _____ Negligible _____

If conducting rocky bottom sampling, select a riffle where the water is not running too fast, the water depth is between 3-12 inches, and the bed consists of cobble-sized stones or larger. Monitored riffle area (3' x 3' square) _____ Water depth _____ in., in riffle. Water temperature _____ F° ? C° ? Take 3 samples in the same general area. Count each separately and report the highest-scoring sample below. Sample _____ reported of 3.

If conducting muddy bottom sampling, take the required number of scoops from each habitat type: steep banks/vegetated margin (10 scoops), woody debris with organic matter (4 scoops), rock/gravel/sand substrates (3 scoops), and silty bottom with organic matter (3 scoops).

MACROINVERTEBRATE COUNT

Use the stream monitoring instructions to conduct a macroinvertebrate count. Use letter codes (A = 1-9, B = 10-99, C = 100 or more) to record the numbers of organisms found in a 3 foot by 3 foot area. Add up the number of letters in each column and multiply by the indicated index value. The following columns are divided based on the organism's sensitivity to pollution.

SENSITIVE		SOMEWHAT SENSITIVE		TOLERANT	
A	caddisfly larvae	_____	beetle larvae	B	aquatic worms
_____	hellgrammite	A	clams	A	blackfly larvae
_____	mayfly nymphs	A	crane fly larvae	_____	leeches
_____	gilled snails	_____	crayfish	B	midge larvae
B	riffle beetle adult	_____	damselfly nymphs	A	pouch (and other) snails
_____	stonefly nymphs	A	dragonfly nymphs		
_____	water penny larvae	B	scuds		
		A	sowbugs		
		_____	fishfly larvae		
		_____	alderfly larvae		
		_____	atherix		
2	# letters times 3 =	5	# letters times 2 =	4	# letters times 1 =
6	index value	10	index value	4	index value

Now add together the three index values from each column for your total index value. Total index value = 20

Compare this total index value to the following ranges of numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample. Although the A, B, and C ratings do not contribute to the water quality rating, keep track of them to see how your macroinvertebrate populations change over time.

WATER QUALITY RATING

_____ Excellent (>22) ✓ Good (17-22) _____ Fair (11-16) _____ Poor (<11)

Save Our Streams

Stream Quality Survey

Name of reviewer: _____

Date reviewed: _____

Data sent to: _____

The purpose of this form is to aid you in gathering and recording important data about the health of your stream. By keeping accurate and consistent records of your observations and data from your macroinvertebrate count, you can document changes in water quality. Refer to the SOS insect card and monitoring instructions to learn how to trap and identify stream macroinvertebrates and how to complete this form.

Stream DEAD END CREEK Station # 2 # of participants 1

County SUSSEX State NJ Group or individual INDIVIDUAL

Location DEAD END CREEK (GREEN TWP. STATION - 2)

Weather conditions (last 72 hours) _____

Date 6/00 Average stream width _____ ft. Average stream depth _____ ft.

Start Time _____ End Time _____ Flow rate: High _____ Normal _____ Low _____ Negligible _____

If conducting rocky bottom sampling, select a riffle where the water is not running too fast, the water depth is between 3-12 inches, and the bed consists of cobble-sized stones or larger. Monitored riffle area (3' x 3' square) _____ Water depth _____ in., in riffle. Water temperature _____ F° ? C° ? Take 3 samples in the same general area. Count each separately and report the highest-scoring sample below. Sample _____ reported of 3.

If conducting muddy bottom sampling, take the required number of scoops from each habitat type: steep banks/vegetated margin (10 scoops), woody debris with organic matter (4 scoops), rock/gravel/sand substrates (3 scoops), and silty bottom with organic matter (3 scoops).

MACROINVERTEBRATE COUNT

Use the stream monitoring instructions to conduct a macroinvertebrate count. Use letter codes (A = 1-9, B = 10-99, C = 100 or more) to record the numbers of organisms found in a 3 foot by 3 foot area. Add up the number of letters in each column and multiply by the indicated index value. The following columns are divided based on the organism's sensitivity to pollution.

SENSITIVE		SOMEWHAT SENSITIVE		TOLERANT	
A	caddisfly larvae	A	beetle larvae	B	aquatic worms
	hellgrammite		clams	A	blackfly larvae
B	mayfly nymphs		crane fly larvae		leeches
	gilled snails		crayfish	B	midge larvae
	riffle beetle adult		damselfly nymphs	B	pouch (and other) snails
A	stonefly nymphs		dragonfly nymphs		
	water penny larvae		scuds		
			sowbugs		
			fishfly larvae		
			alderfly larvae		
			atherix		
3	# letters times 3 =	1	# letters times 2 =	4	# letters times 1 =
9	index value	2	index value	4	index value

Now add together the three index values from each column for your total index value. Total index value = 15

Compare this total index value to the following ranges of numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample. Although the A, B, and C ratings do not contribute to the water quality rating, keep track of them to see how your macroinvertebrate populations change over time.

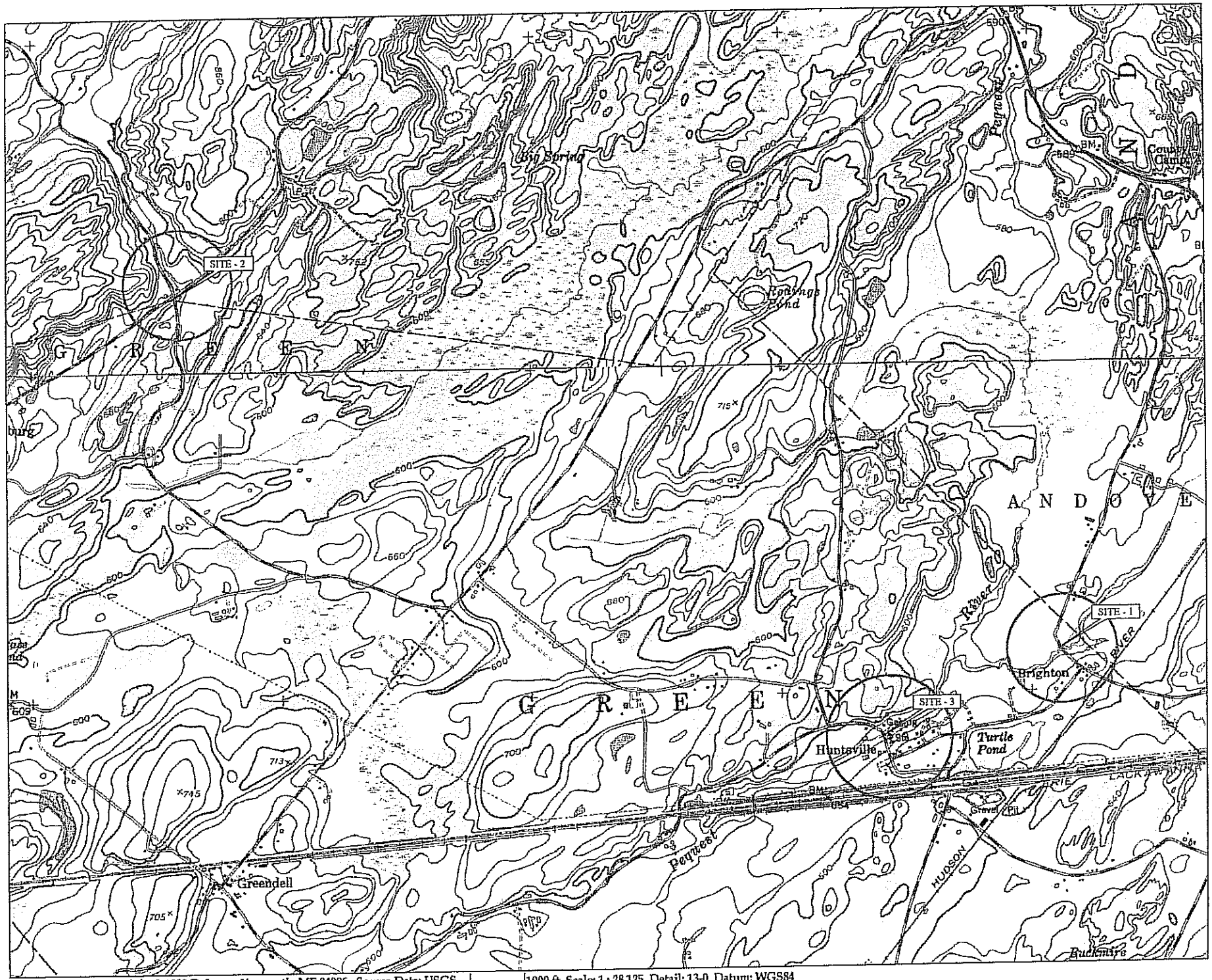
WATER QUALITY RATING

_____ Excellent (>22) _____ Good (17-22) ✓ Fair (11-16) _____ Poor (<11)

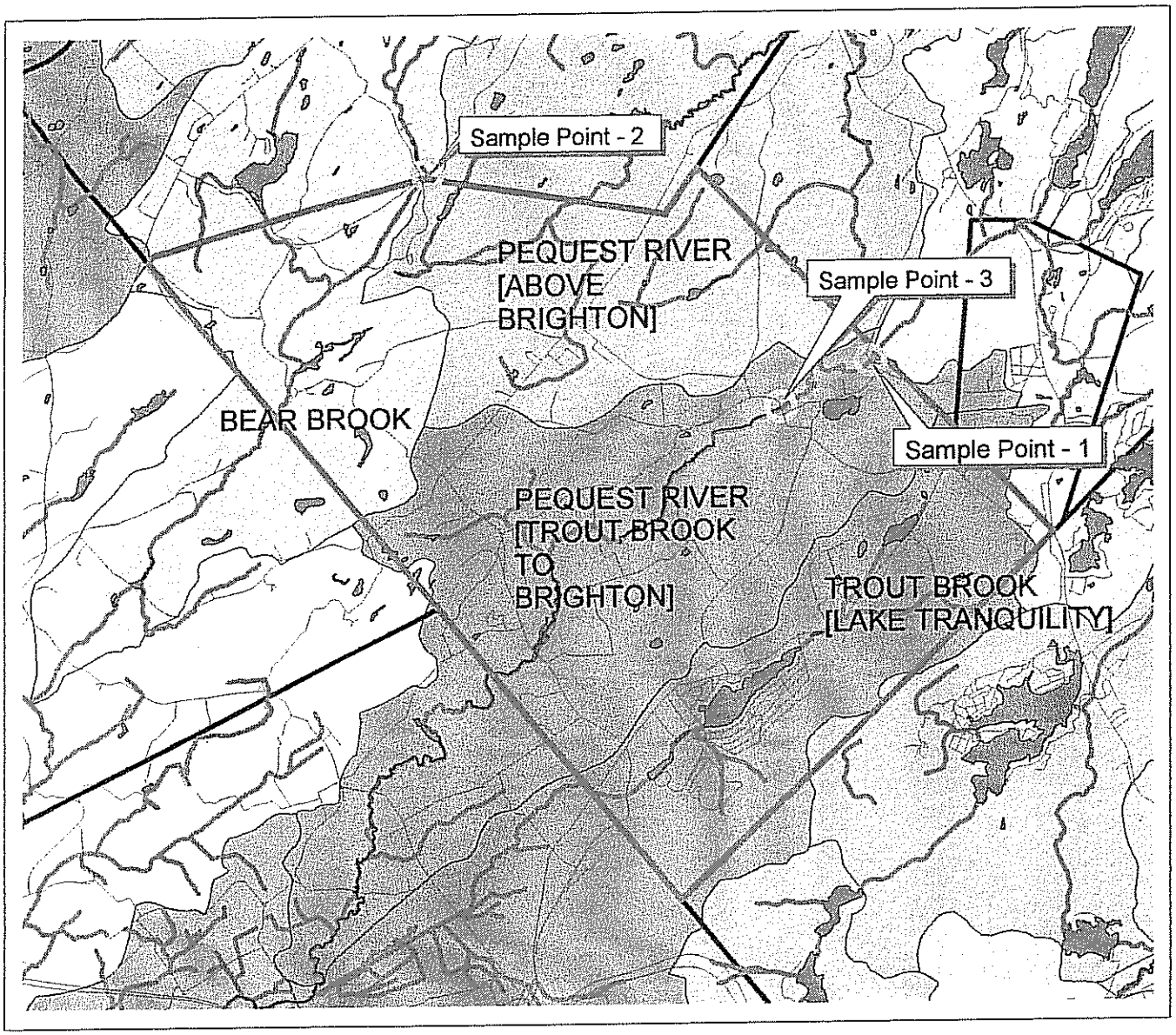
SECTION 4

GIS

Mapwork



 1000 ft Scale: 1 : 28,125 Detail: 13-0 Datum: WGS84



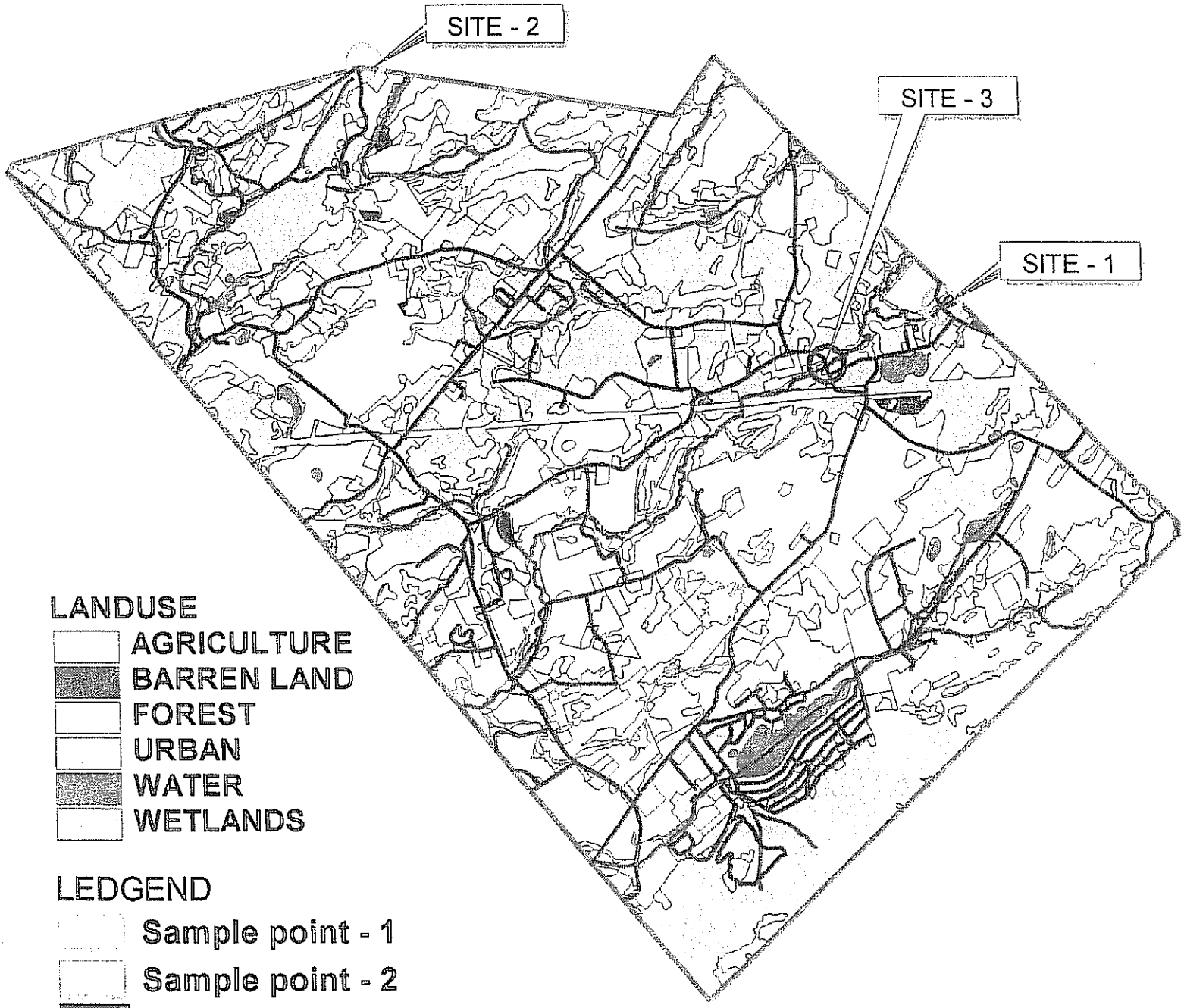
Green Township Macroinvertebrate Sampling Points

LEDGEND

- Sample point - 1 Pequest @ Brighton
- Sample point - 2 Dead End Creek
- Sample point - 3 Pequest @ Huntsville
- Green Township
- Surface Water
- Streams
- Township Lines

N
W E
S

GREEN TOWNSHIP SURFACEWATER SAMPLING SITES



LANDUSE

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS

LEDGEND

- Sample point - 1
- Sample point - 2
- Sample point - 3
- Roads
- Streams

0.3 0 0.3 0.6 0.9 1.2 1.5 Miles

N
W E
S

GREEN TOWNSHIP
STATION NO. - 1
LANDUSE ABOVE SAMPLING SITE

0.5 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 Miles

Pequest River Landuse

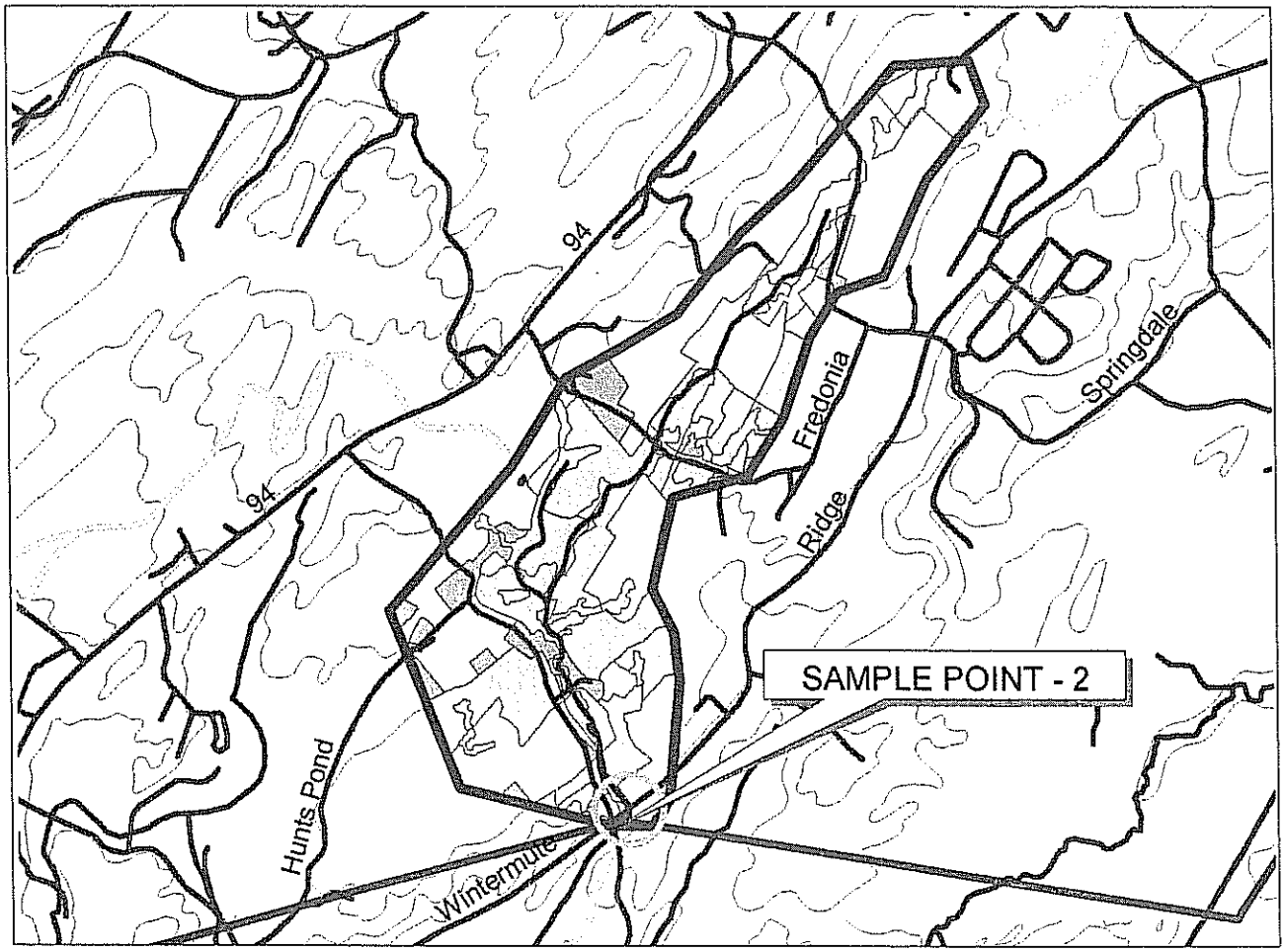
- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS

Ledgend

- WATERSHED
- GREEN TOWNSHIP
- SAMPLE POINT - 1
- DRAINAGE LINES
- STREAMS
- ROADS

N
W E
S

GREEN TOWNSHIP
STATION NO. - 2
LANDUSE ABOVE SAMPLING SITE



0.5 0 0.5 1 1.5 Miles

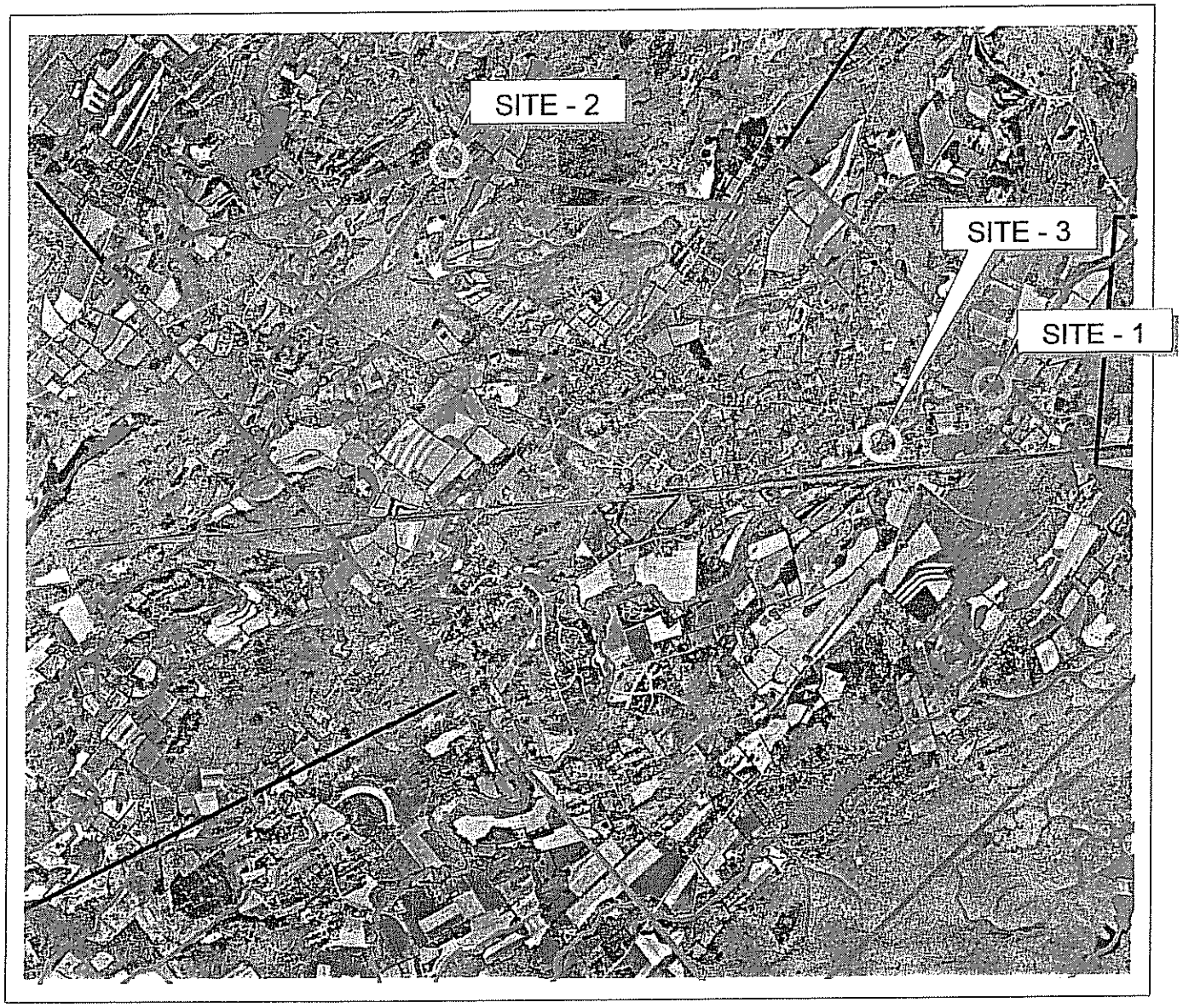
Dead End Creek Landuse

- AGRICULTURE
- FOREST
- URBAN
- WATER
- WETLANDS

Ledgend

- WATERSHED
- GREEN TOWNSHIP
- SAMPLE POINT - 2
- DRAINAGE LINES
- STREAMS
- ROADS

N
W E
S



Green Township Macroinvertebrate Sampling Points

- Sample point - 1
  Pequest @ Brighton
- Sample point - 2
  Dead End Creek
- Sample point - 3
  Pequest @ Huntsville
- Green Township
- Surfacewater
- Streams
- Township Lines

N
W E
S

2 0 2 4 Miles

CONCLUSIONS

This report includes the complete State Certified Lab report with all the data collected. This lab report was conducted by an independent lab to substantiate the Environmental Committees Macroinvertebrate Monitoring Program. Testing was completed by both the Lab and the Environmental Committee in June of 2000. The lab sampled the Pequest River at the township's sampling station No. 2 (Brighton). While the committee sampled the Pequest River at the township's sampling station No. 3 (Huntsville), less than 4,000 feet down stream.

Using the same Stream Quality Survey Sheets, the committee obtained a water quality rating of **excellent**, while the lab obtained a **good** water quality rating at their site. The improved water quality at sampling station No. 3 may be due to the fact that it receives additional water from predominantly forested areas in Green Township and Andover Township. (It should be noted that the water quality rating the committee obtained was developed from three sampling events while the lab's was generated from a single sampling event.)

In conclusion, the Environmental Committee found that the results of both it's June 2000 and June 2001 sampling rounds were **excellent** water quality ratings, in the Pequest River at sampling station No. 3 (see stream quality survey sheets attached).

The photographs attached to the report were taken during the committees June 2000 sampling event. They show the committee members dislodging "critters" from the gravelly bottom of the Pequest River into the nets held by the Green Township Girl Scout Troop. The nets being emptied into water filled examining trays, where the macroinvertebrates were separated and counted. Identification charts, tweezers, and fingers were all used to develop the final Stream Quality Survey Sheets.

The Green Township Environmental Committee realizes the importance of this biological monitoring aspect to the townships overall Stream Monitoring Program. The committee has conducted water chemistry baseline monitoring on the Pequest River since 1968 (see the township's "Watershed Monitoring Program Report") and will maintain the biological monitoring data as part of this important baseline. Having established the township's monitoring stations the committee will continue this Biological Monitoring Program in June of each year.

SECTION 5

Photographs