New York State
Department of Environmental Conservation

Division of Water

Oil Creek

Biological Assessment

2002 Survey

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OIL CREEK

BIOLOGICAL ASSESSMENT

Allegheny River Basin
Cattaraugus County, New York

Survey date: August 6, 2002
Report date: October 20, 2003

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CONTENTS

Stream: Oil Creek, New York

Reach: Hinsdale to Cuba, New York

NYS Drainage Basin: Allegheny River

Background:

The Stream Biomonitoring Unit sampled at four stations on Oil Creek in the reach between Hinsdale and Cuba, New York on August 6, 2002. The purpose of the sampling was to assess general water quality, and compare to previous findings. In the present survey, traveling kick samples for macroinvertebrates were taken in riffle areas using methods described in the Quality Assurance document (Bode et al., 2002) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT value, Percent Model Affinity, and NCO richness (see Appendices II III, and XI). Table 2 provides a listing of sampling sites, and Table 3 provides a listing of all macroinvertebrate species collected in the present survey. This is followed by macroinvertebrate data reports, including individual site descriptions and raw invertebrate data from each site.

Results and Conclusions:

1. All sites on Oil Creek were assessed as slightly impacted. Nonpoint source nutrient enrichment was the primary source of impact.

2. The site downstream of Cuba (Station 2) displayed a slightly poorer fauna than in 1990. Further monitoring is required to determine if the trend is valid.

3. Improvement is seen at the Maplehurst/Hinsdale site (Station 4) compared to 1975 results. The assessment for this site has improved from moderately impacted to slightly impacted. The improvement trend at this site appears genuine, but continued monitoring is recommended to confirm this.

Discussion

Previous sampling of Oil Creek by the Stream Biomonitoring Unit includes only 2 sampling visits. The Cuba Lake Road site (Station 2) was assessed as non-impacted in 1990. The Hinsdale site (Station 4) was assessed as slightly impacted in 2001.

Macroinvertebrates were sampled at four sites on Oil Creek from Cuba to Maplehurst in 1975 by the DEC Avon Pollution Investigations Unit (Preddice, 1977). The four site locations served as the basis for those of the present survey. Based on the 1975 macroinvertebrate samples, water quality in Oil Creek ranged from slightly impacted at the 3 upstream sites to moderately impacted at the most downstream site. The primary causes of impact were siltation, nutrient enrichment, and organic inputs.

In the present survey all four sites sampled on Oil Creek were assessed as slightly impacted (Figure 1). The habitat at the first site, just upstream of Cuba, was different from all downstream sites, with a slower current speed and a gravel-sand substrate. Sandy stream criteria were used to evaluate macroinvertebrate data from this site (see Appendix XI). The 3 downstream sites had adequate riffles, and data from these sites were evaluated with riffle criteria. All these sites were assessed as slightly impacted. Nonpoint nutrient enrichment appears to be a primary factor affecting water quality in the stream (Table 1).

The site downstream of Cuba (Station 2) displayed a slightly poorer fauna than in 1990. The differences in the metrics were not great, but sufficient for the site to be assessed as non-impacted in 1990 and slightly impacted in 2002. Further monitoring is required to determine if the trend is genuine. This site is 1.5 miles downstream of the Cuba (V) Wastewater Treatment Facility, which was upgraded in 1989.

Improvement was indicated at the Maplehurst/Hinsdale site (Station 4) compared to 1975 results. In 1975 the fauna was described as unbalanced, with facultative Hydropsychidae caddisflies comprising 61% of the organisms, and with high numbers of planarians (flatworms) and tolerant tubificid worms present. In the present survey, Hydropsychidae comprised only 21% of the fauna, with clean-water mayflies comprising 24%; planarians comprised 3%, and tubificid worms were not found. An organic input was suspected in the 1975 study, while there was no evidence for such an input in the present study. The improvement trend at this site appears genuine, but continued monitoring is recommended to confirm this.

Literature Cited:

Bode, R. W., M. A. Novak, L. E. Abele, D. L. Heitzman, and A. J. Smith. 2002. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Technical Report, 115 pages.

Preddice, T. L. 1977. Water quality and quantitative macroinvertebrate survey of segments of Ischua, Oil, and Oil Creeks. New York State Department of Environmental Conservation, Avon Pollution Investigations Unit, Division of Fish and Wildlife, NYS DEC Technical Memorandum, 66 pages.

Overview of field data

On the date of sampling, August 6, 2002, Oil Creek at the sites sampled was 4-15 meters wide, 0.1-0.2 meters deep, and had current speeds of 50-100 cm/sec in riffles. Dissolved oxygen was 5.5-7.8 mg/l, specific conductance was 377-575 μmhos, pH was 7.4-7.8 and the temperature was 17.5-21.6 °C. Measurements for each site are found on the field data summary sheets.

Figure 1. Biological Assessment Profile of index values, Oil Creek, 2002. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for more complete explanation. For Station 1, NCO was used in place of PMA, as specified for sandy stream criteria (Appendix XI).

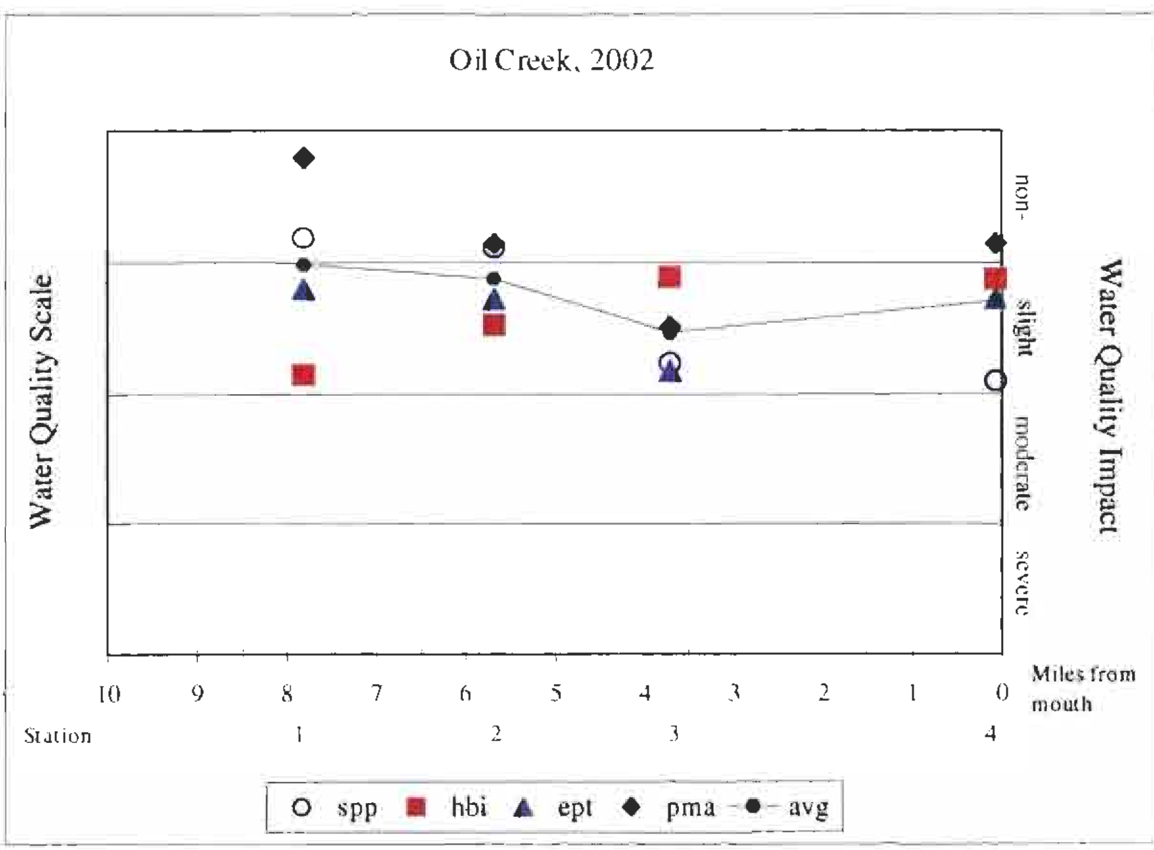


Table 1. Impact Source Determination, Oil Creek, 2002 Numbers represent similarity to community type models for each impact category. The highest similarities at each station are highlighted. Similarities less than 50% are less conclusive. Highest numbers represent probable type of impact. See Appendix X for further explanation.

	STATION			
Community Type	OIL-01	OIL-02	OIL-03	OIL-04
Natural: minimal human impacts	17	53	59	60
Nutrient additions; mostly nonpoint, agricultural	26	65	55	65
Toxic: industrial, municipal, or urban run-off	31	62	45	66
Organic: sewage effluent, animal wastes	36	50	32	42
Complex: municipal/industrial	32	60	38	49
Siltation	20	56	42	50
Impoundment	42	53	35	60

STATION	COMMUNITY TYPE
OIL-01	Impoundment
OIL-02	Nonpoint nutrient, toxic, complex
OIL-03	Natural, nonpoint nutrient
OIL-04	Toxic, nonpoint nutrient

TABLE 2. STATION LOCATIONS FOR OIL CREEK, CATTARAUGUS COUNTY, NY

STATION	LOCATION
01	Cuba, New York 10 meters below Rte. 305 bridge Latitude/Longitude 42° 13' 35"; 78° 16' 39" 7.83 stream miles above mouth
02	Below Cuba, New York Opposite Cuba Lake Road Latitude/Longitude 42° 13' 00"; 78° 18' 38" 5.68 stream miles above mouth
03	Below Cuba, New York Off Rte. 446 Latitude/Longitude 42° 11' 50"; 78° 20' 03" 3.72 stream miles above mouth
04	Hinsdale, New York 30 meters above Rte. 16 bridge Latitude/Longitude 42° 10' 12"; 78° 23' 15" 0.07 stream miles above mouth

Figure 2.	Site Overview Map	Oil Creek

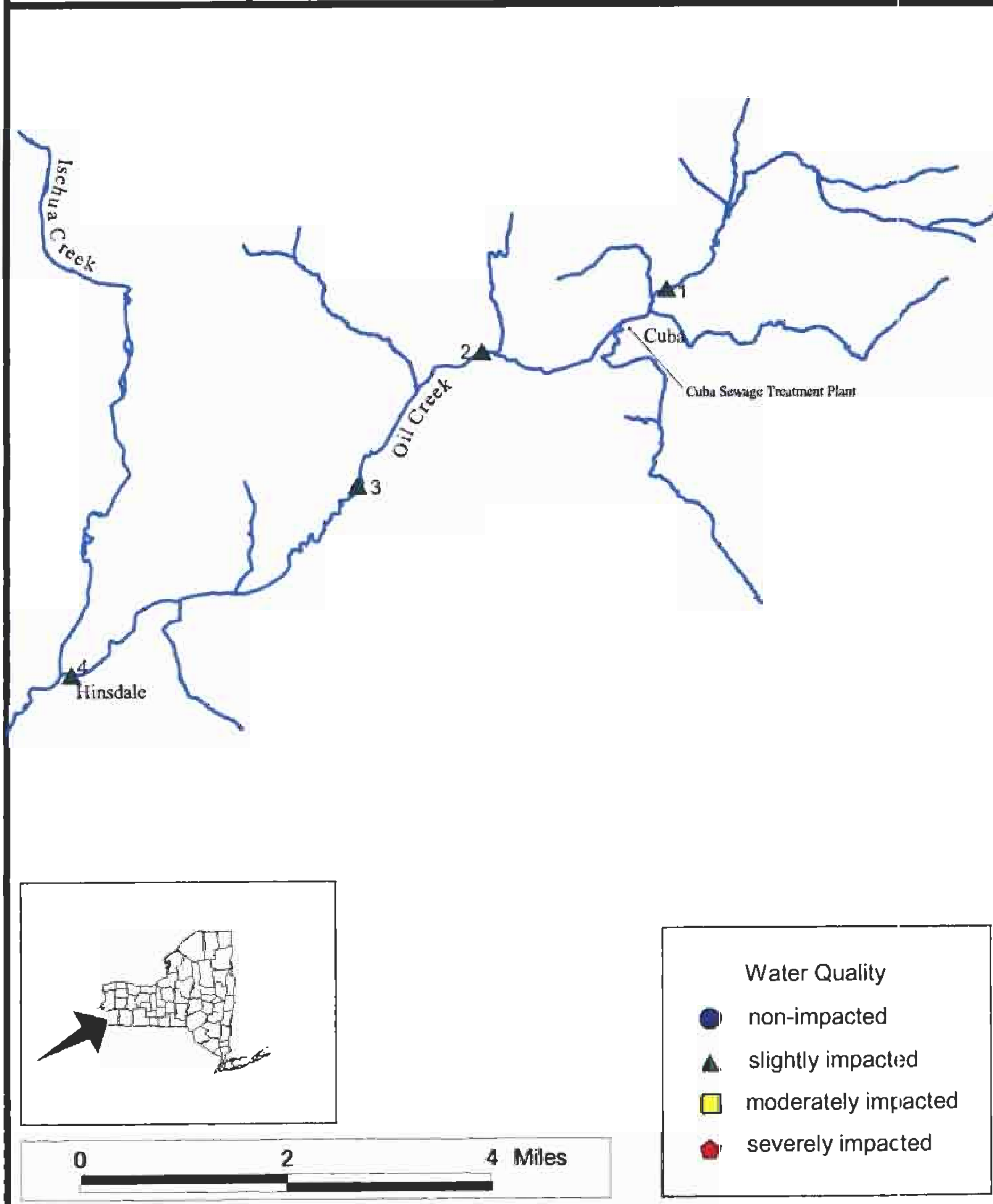


Figure 3a.	Site Location Map	Oil Creek

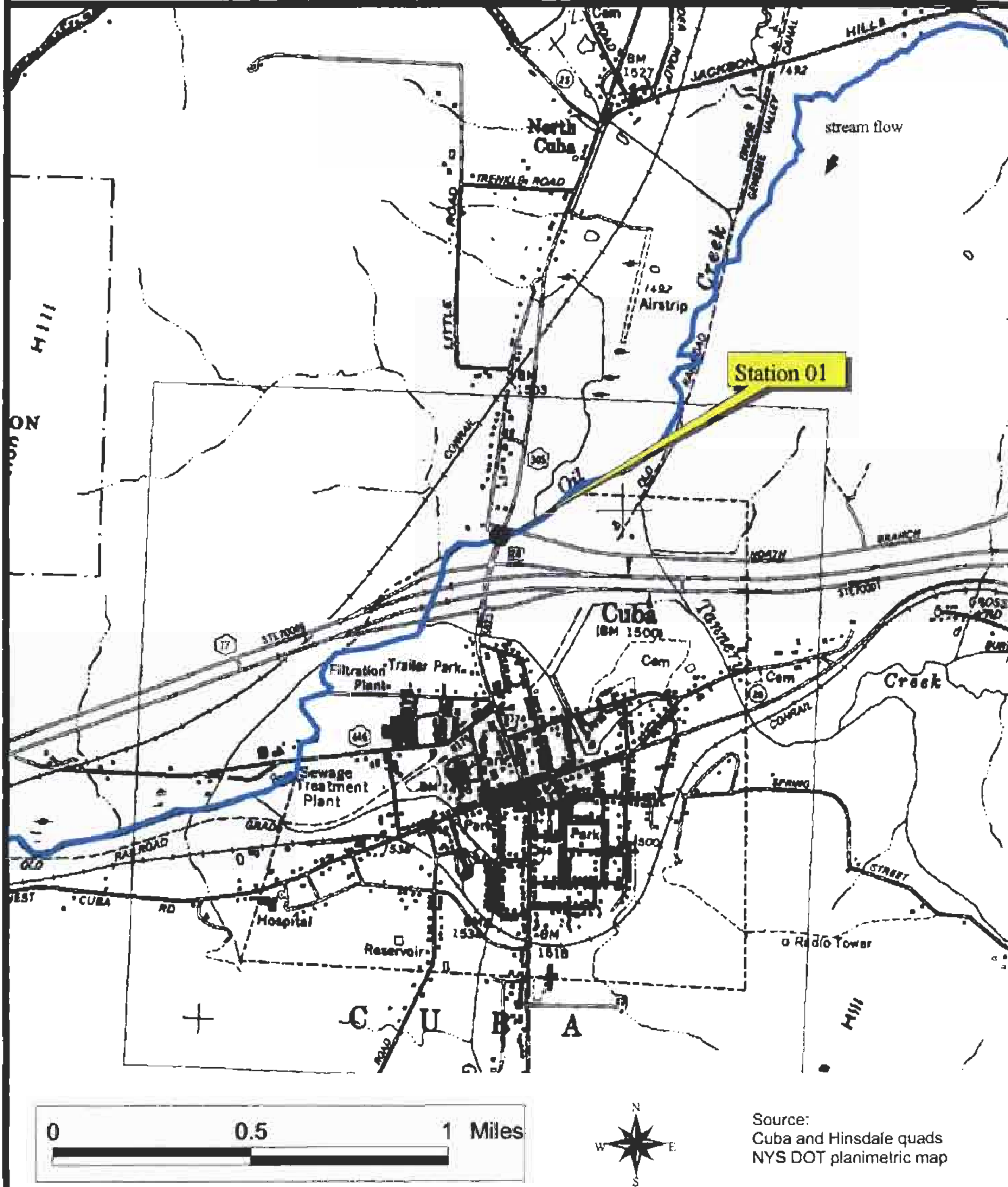


Figure 3b.	Site Location Map	Oil Creek

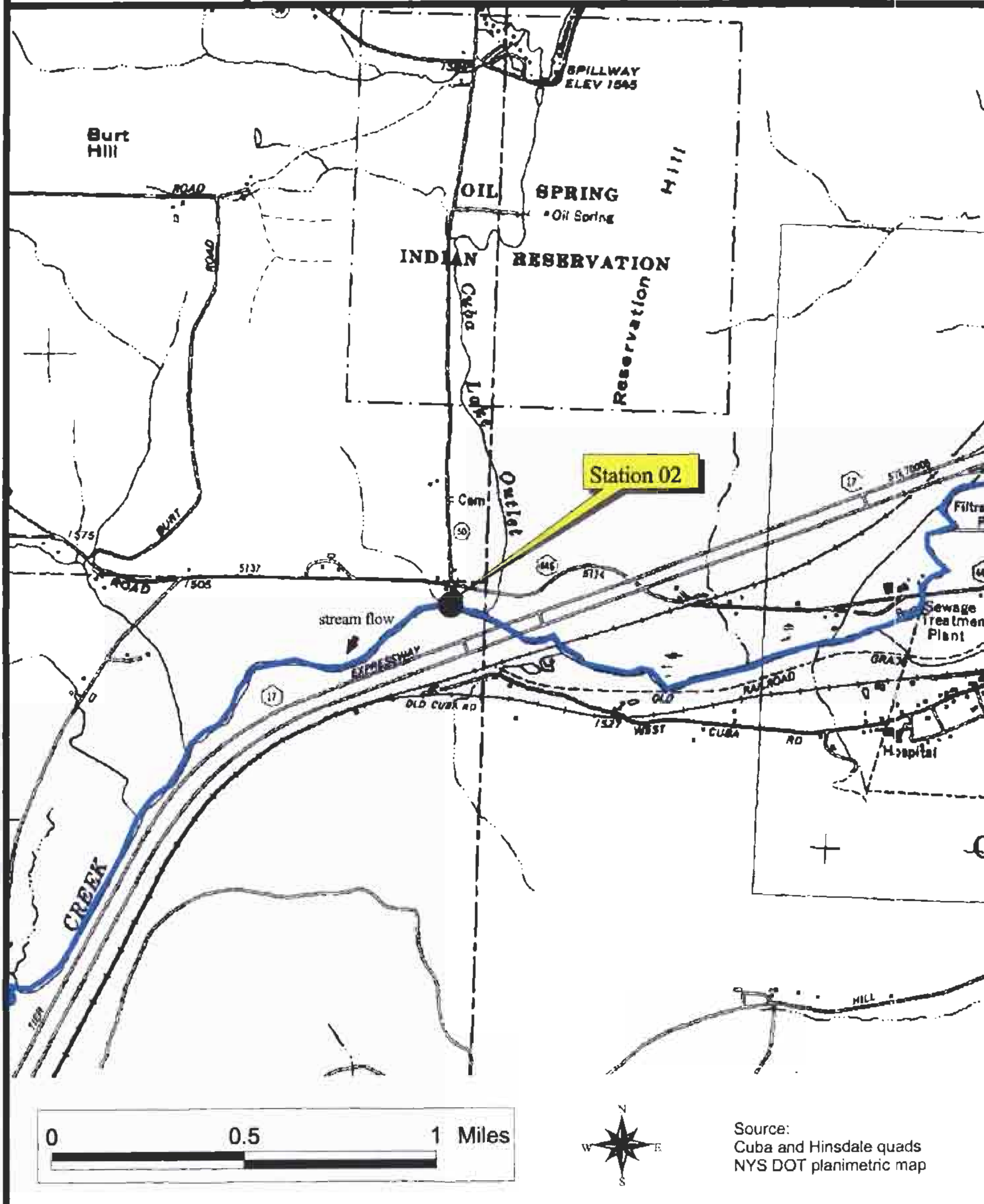


Figure 3c.	Site Location Map	Oil Creek

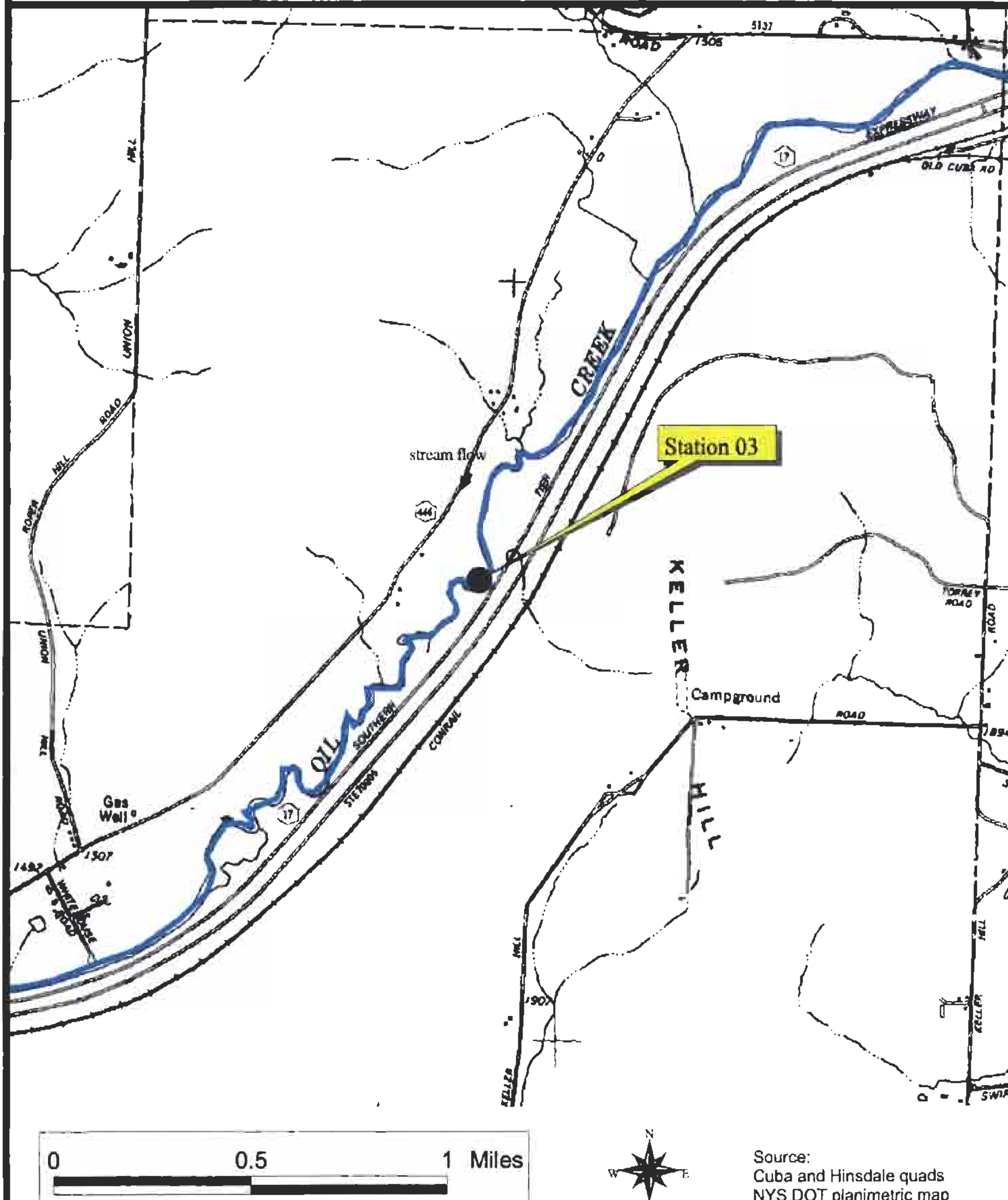
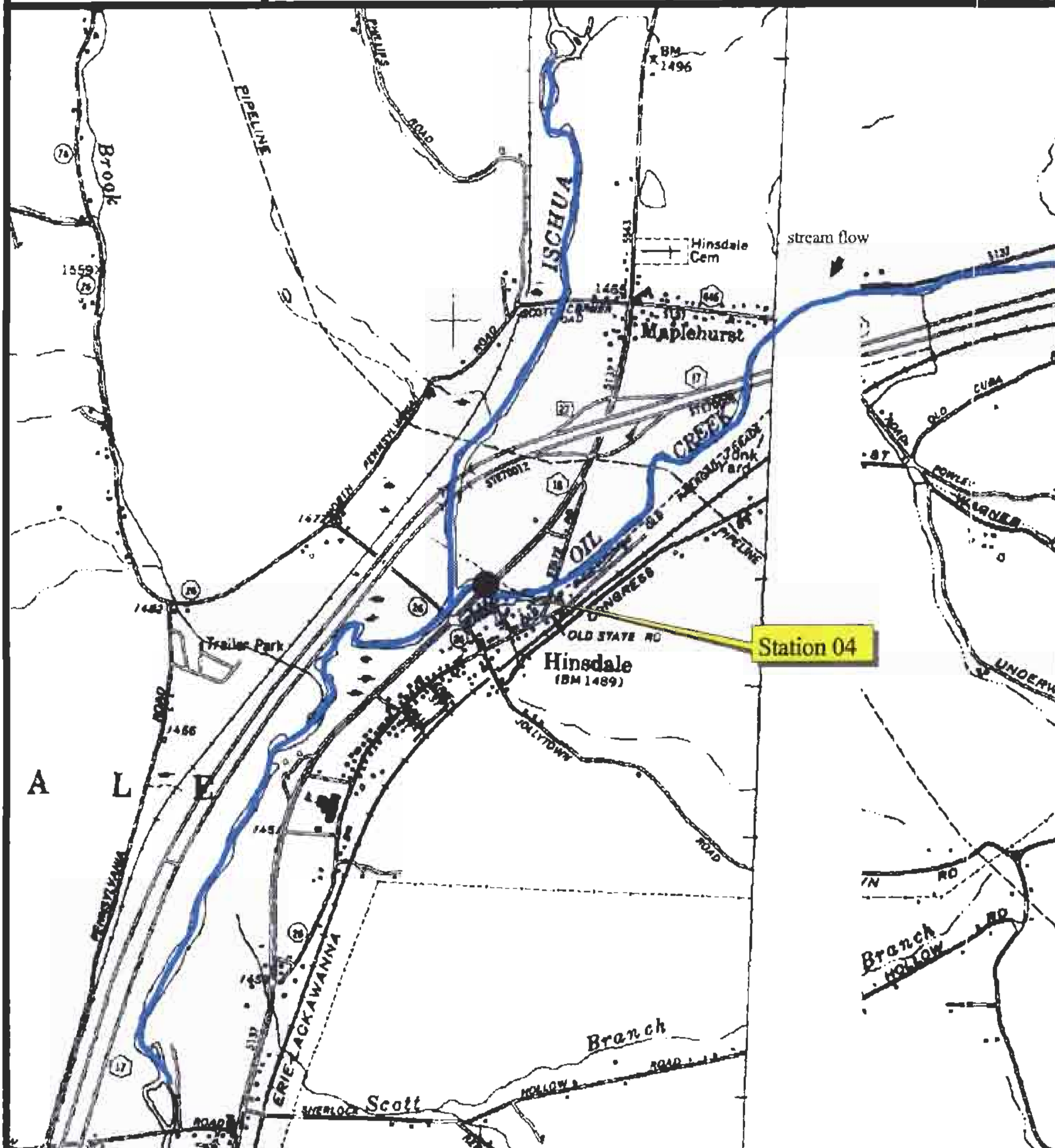
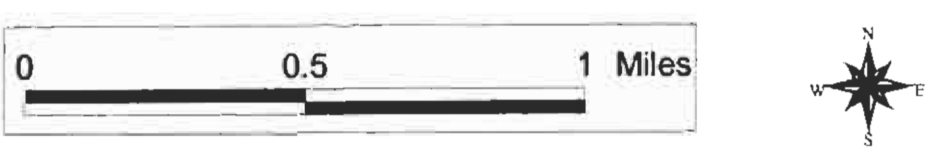


Figure 3d.	Site Location Map	Oil Creek





Source:
Cuba and Hinsdale quads
NYS DOT planimetric map

TABLE 3. MACROINVERTEBRATES COLLECTED IN OIL CREEK, CATTARAUGUS COUNTY, NY, 2002

PLATYHELMINTHES
TURBELLARIA
Planariidae
Undetermined Turbellaria
ANNELIDA
OLIGOCHAETA
LUMBRICIDA
Undetermined Lumbricina
HIRUDINEA
Glossiphoniidae
Undetermined Hirudinea
MOLLUSCA
GASTROPODA
Physidae
Physella sp.
PELECYPODA
Sphaeriidae
Sphaerium sp.
Undetermined Sphaeriidae
ARTHROPODA
CRUSTACEA
ISOPODA
Asellidae
Caecidotea racovitzai
INSECTA
EPHEMEROPTERA
Isonychiidae
Isonychia bicolor
Baetidae
Acentrella sp.
Baetis flavistriga
Baetis intercalaris
Heptageniidae
Stenonema sp.
Ephemerellidae
Serratella deficiens
Leptohyphidae
Tricorythodes sp.
ODONATA
Gomphidae
Undetermined Gomphidae
COLEOPTERA
Psephenidae
Psephenus herricki
Elmidae
Dubiraphia sp.
Optioservus trivittatus
Optioservus sp.
Promoresia elegans
Stenelmis crenata
Stenelmis sp.
TRICHOPTERA
Philopotamidae
Chimarra obscura
Hydropsychidae
Cheumatopsyche sp.
Hydropsyche betteni
Hydropsyche bronta
Hydropsyche morosa
Hydroptilidae
Hydroptila consimilis
Limnephilidae
Undetermined Limnephilidae
Leptoceridae
Undetermined Leptoceridae
DIPTERA
Tipulidae
Antocha sp.
Simuliidae
Simulium vittatum
Athericidae
Atherix sp.
Empididae
Hemerodromia sp.
Chironomidae
Thienemannimyia gr. spp.
Diamesa sp.
Cardiocladius obscurus
Cricotopus bicinctus
Cricotopus vierriensis
Nanocladius sp.
Orthocladius obumbratus
Parametriocnemus lundbecki
Tvetenia vitracies
Cryptochironomus fulvus gr.
Polypedilum aviceps
Polypedilum flavum
Polypedilum scalaenum gr.
Micropsectra sp.
Rheotanytarsus exiguus gr.
Tanytarsus guerlus gr.

STREAM SITE:	Oil Creek - Station 01
LOCATION:	Cuba, NY, 10 meters below oute 305
DATE:	06 August 2002
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA	Planariidae	Undetermined Turbellaria	11
HIRUDINEA			
	Glossiphoniidae	Undetermined Hirudinea	1
MOLLUSCA			
GASTROPODA	Physidae	Physella sp.	1
PELECYPODA	Sphaeriidae	Sphaerium sp.	10
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	26
INSECTA			
COLEOPTERA	Elmidae	Dubiraphia sp.	3
		Stenelmis sp.	3
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	2
		Hydropsyche betteni	2
	Hydroptilidae	Hydroptila consimilis	1
	Uenoidae	Undetermined Limnephilidae	1
	Leptoceridae	Undetermined Leptoceridae	1
DIPTERA	Simuliidae	Simulium vittatum	22
	Empididae	Hemerodromia sp.	1
	Chironomidae	Thienemannimyia gr. spp.	3
		Cricotopus vierriensis	3
		Orthocladius obumbratus	1
		Cryptochironomus fulvus gr.	1
		Polypedilum flavum	3
		Micropsectra sp.	1
		Rheotanytarsus exiguus gr.	2
		Tanytarsus guerlus gr.	1

SPECIES RICHNESS:	22 (very good)
BIOTIC INDEX:	6.77 (good)
EPT RICHNESS:	5 (good)
NCO RICHNESS:	14 (very good)
ASSESSMENT:	slightly impacted

DESCRIPTION: The habitat at this site, just upstream of Cuba, was different from all downstream sites, with a slower current speed and a gravel-sand substrate. Using sandy stream criteria to evaluate the macroinvertebrate data, water quality was assessed as slightly impacted. The fauna was dominated by sowbugs and black fly larvae, with no mayflies or stoneflies. Due to the strong habitat influence at this site, it is difficult to make definitive water quality conclusions.

STREAM SITE:	Oil Creek - Station 02
LOCATION:	Below Cuba, NY, opposite Cuba Lake Road
DATE:	06 August 2002
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA	Planariidae	Undetermined Turbellaria	4
ANNELIDA			
OLIGOCHAETA			
LUMBRICIDA		Undetermined Lumbricina	1
MOLLUSCA			
PELECYPODA	Sphaeriidae	Undetermined Sphaeriidae	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	Acentrella sp.	4
		Baetis flavistriga	11
		Baetis intercalaris	1
	Leptohyphidae	Tricorythodes sp.	1
COLEOPTERA	Elmidae	Optioservus sp.	5
		Stenelmis crenata	10
TRICHOPTERA	Philopotamidae	Chimarra obscura	2
	Hydropsychidae	Cheumatopsyche sp.	14
		Hydropsyche betteni	1
		Hydropsyche bronta	1
		Hydropsyche morosa	1
DIPTERA	Tipulidae	Antocha sp.	1
	Simuliidae	Simulium vittatum	14
	Athericidae	Atherix sp.	1
	Empididae	Hemerodromia sp.	3
	Chironomidae	Thienemannimyia gr. spp.	1
		Cardiocladius obscurus	2
		Cricotopus bicinctus	6
		Cricotopus vierriensis	2
		Nanocladius sp.	1
		Parametriocnemus lundbecki	1
SPECIES RICHNESS:	27 (very good)	Cryptochironomus fulvus gr.	1
BIOTIC INDEX:	5.45 (good)	Polypedilum aviceps	1
EPT RICHNESS:	9 (good)	Polypedilum flavum	9
MODEL AFFINITY:	68 (very good)		
ASSESSMENT:	slightly impacted		

DESCRIPTION: This site had a greater current speed than Station 1, but the substrate was more gravel than rubble, possibly limiting the fauna somewhat. Nevertheless, the community included clean-water mayflies, stoneflies, caddisflies, hellgrammites, and riffle beetles. Based on the metrics, water quality was assessed as slightly impacted. Riffle criteria were used to evaluate the metric values from this site.

STREAM SITE:	Oil Creek - Station 03
LOCATION:	Below Cuba, NY, off Route 446, access through field
DATE:	06 August 2002
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA	Planariidae	Undetermined Turbellaria	1
MOLLUSCA			
PELECYPODA	Sphaeriidae	Undetermined Sphaeriidae	5
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis flavistriga	8
		Baetis intercalaris	6
ODONATA	Gomphidae	Undetermined Gomphidae	1
COLEOPTERA	Psephenidae	Psephenus herricki	1
	Elmidae	Optioservus trivittatus	39
		Stenelmis crenata	4
TRICHOPTERA	Philopotamidae	Chimarra obscura	3
	Hydropsychidae	Cheumatopsyche sp.	12
		Hydropsyche betteni	2
		Hydropsyche bronta	2
DIPTERA	Simuliidae	Simulium vittatum	1
	Chironomidae	Thienemannimyia gr. spp.	1
		Diamesa sp.	1
		Cardiocladius obscurus	2
		Parametriocnemus lundbecki	1
		Tvetenia vitracies	2
		Polypedilum flavum	7
		Rheotanytarsus exiguus gr.	1

SPECIES RICHNESS:	20 (good)
BIOTIC INDEX:	4.71 (good)
EPT RICHNESS:	6 (good)
MODEL AFFINITY:	57 (good)
ASSESSMENT:	slightly impacted

DESCRIPTION: This site was accessed through a farm field off Route 446. The substrate contained equal portions of rubble and gravel, the streambanks were clay, and the water was turbid with silt. The macroinvertebrate fauna was dominated by algal-scraping riffle beetles and filter-feeding caddisflies, indicators of nutrient enrichment. All metrics were within the range of slight impact.

STREAM SITE:	Oil Creek - Station 04
LOCATION:	Hinsdale, NY, 30 meters upstream of Route 16 bridge
DATE:	06 August 2002
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA	Planariidae	Undetermined Turbellaria	3
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	2
	Baetidae	Baetis flavistriga	11
		Baetis intercalaris	7
	Heptageniidae	Stenonema sp.	3
	Ephemerellidae	Serratella deficiens	1
COLEOPTERA	Elmidae	Promoresia elegans	1
		Optioservus trivittatus	6
		Stenelmis crenata	8
TRICHOPTERA	Philopotamidae	Chimarra obscura	16
	Hydropsychidae	Cheumatopsyche sp.	19
		Hydropsyche betteni	1
		Hydropsyche morosa	1
DIPTERA	Simuliidae	Simulium vittatum	3
	Chironomidae	Thienemannimyia gr. spp.	3
		Cardiocladius obscurus	1
		Tvetenia vitracies	2
		Polypedilum flavum	11
		Polypedilum scalaenum gr.	1

SPECIES RICHNESS:	19 (good)
BIOTIC INDEX:	4.76 (good)
EPT RICHNESS:	9 (good)
MODEL AFFINITY:	68 (very good)
ASSESSMENT:	slightly impacted

DESCRIPTION: The kick sample was taken in a riffle that was somewhat gravelly, but judged to be adequate. The macroinvertebrate community was dominated by caddisflies and mayflies, indicative of nonpoint source nutrient enrichment. Based on the metrics, water quality was assessed as slightly impacted.

FIELD DATA SUMMARY

STREAM NAME: Oil Creek		**DATE SAMPLED: 8/6/2002**		
REACH: Cuba to Hinsdale				
FIELD PERSONNEL INVOLVED: Abele, Bode				
STATION	01	02	03	04
ARRIVAL TIME AT STATION	9:20	10:10	11:00	11:25
LOCATION	Cuba	Cuba Lake Rd	Off Rte 446, Cuba	Hinsdale
PHYSICAL CHARACTERISTICS				
Width (meters)	4	5	10	15
Depth (meters)	0.2	0.2	0.2	0.1
Current speed (cm per sec.)	50	80	100	100
Substrate (%)				
Rock (>25.4 cm, or bedrock)	0	0	0	0
Rubble (6.35 - 25.4 cm)	30	20	30	30
Gravel (0.2 – 6.35 cm)	20	40	30	30
Sand (0.06 – 2.0 mm)	20	20	20	20
Silt (0.004 – 0.06 mm)	30	20	20	20
Embeddedness (%)	20	20	30	20
CHEMICAL MEASUREMENTS				
Temperature (° C)	17.5	20.4	20.6	21.6
Specific Conductance (umhos)	421	377	442	575
Dissolved Oxygen (mg/l)	5.5	7.3	7.5	7.8
pH	7.4	7.6	7.7	7.8
BIOLOGICAL ATTRIBUTES				
Canopy (%)	10	20	50	40
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous				
algae - diatoms				
macrophytes or moss	X	X		
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)		X	X	X
Plecoptera (stoneflies)		X		
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)	X	X	X	X
Megaloptera(dobsonflies,alderflies)		X	X	
Odonata (dragonflies, damselflies)		X		
Chironomidae (midges)				
Simuliidae (black flies)	X	X	X	
Decapoda (crayfish)	X		X	
Gammaridae (scuds)	X			
Mollusca (snails, clams)	X			
Oligochaeta (worms)				
Other	X			
FAUNAL CONDITION	poor	very good	good	good

APPENDIX I. BIOLOGICAL METHODS FOR KICK SAMPLING

A. Rationale. The use of the standardized kick sampling method provides a biological assessment technique that lends itself to rapid assessments of stream water quality.

B. Site Selection. Sampling sites are selected based on these criteria: (1) The sampling location should be a riffle with a substrate of rubble, gravel, and sand. Depth should be one meter or less, and current speed should be at least 0.4 meters per second. (2) The site should have comparable current speed, substrate type, embeddedness, and canopy cover to both upstream and downstream sites to the degree possible. (3) Sites are chosen to have a safe and convenient access.

C. Sampling. Macroinvertebrates are sampled using the standardized traveling kick method. An aquatic net is positioned in the water at arms' length downstream and the stream bottom is disturbed by foot, so that the dislodged organisms are carried into the net. Sampling is continued for a specified time and for a specified distance in the stream. Rapid assessment sampling specifies sampling 5 minutes for a distance of 5 meters. The net contents are emptied into a pan of stream water. The contents are then examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol.

D. Sample Sorting and Subsampling. In the laboratory the sample is rinsed with tap water in a U.S. No. 40 standard sieve to remove any fine particles left in the residues from field sieving. The sample is transferred to an enamel pan and distributed homogeneously over the bottom of the pan. A small amount of the sample is randomly removed with a spatula, rinsed with water, and placed in a petri dish. This portion is examined under a dissecting stereomicroscope and 100 organisms are randomly removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. The total number of organisms in the sample is estimated by weighing the residue from the picked subsample and determining its proportion of the total sample weight.

E. Organism Identification. All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species, and the total number of individuals in the subsample is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol. Following identification of a subsample, if the results are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment, additional subsampling may be required.

APPENDIX II. MACROINVERTEBRATE COMMUNITY PARAMETERS

1. Species richness. This is the total number of species or taxa found in the sample. Expected ranges for 100-specimen subsamples of kick samples in most streams in New York State are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted; less than 11, severely impacted.

2. EPT value. EPT denotes the total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in an average 100-organism subsample. These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). Expected ranges from most streams in New York State are: greater than 10, non-impacted; 6-10, slightly impacted; 2-5, moderately impacted; and 0-1, severely impacted.

3. Biotic index. The Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage effluent, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each species by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). For purposes of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. Values are listed in Hilsenhoff (1987); additional values are assigned by the NYS Stream Biomonitoring Unit. The most recent values for each species are listed in the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, non-impacted; 4.51-6.50, slightly impacted; 6.51-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. Percent Model Affinity is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. NYS DEC technical report, 89 pp.

Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist 20(1): 31-39.

Lenat, D. R. 1987. Water quality assessment using a new qualitative collection method for freshwater benthic macroinvertebrates. North Carolina DEM Tech. Report. 12 pp.

Novak, M.A., and R.W. Bode. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. J. N. Am. Benthol. Soc. 11(1):80-85.

APPENDIX III. LEVELS OF WATER QUALITY IMPACT IN STREAMS.

The description of overall stream water quality based on biological parameters uses a four-tiered system of classification. Level of impact is assessed for each individual parameter, and then combined for all parameters to form a consensus determination. Four parameters are used: species richness, EPT value, biotic index, and percent model affinity. The consensus is based on the determination of the majority of the parameters; since parameters measure different aspects of the community, they cannot be expected to always form unanimous assessments. The ranges given for each parameter are based on 100-organism subsamples of macroinvertebrate riffle kick samples, and also apply to most multiplate samples, with the exception of percent model affinity.

1. Non-impacted

Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 27 species in riffle habitats. Mayflies, stoneflies, and caddisflies are well-represented; the EPT value is greater than 10. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

2. Slightly impacted

Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

3. Moderately impacted

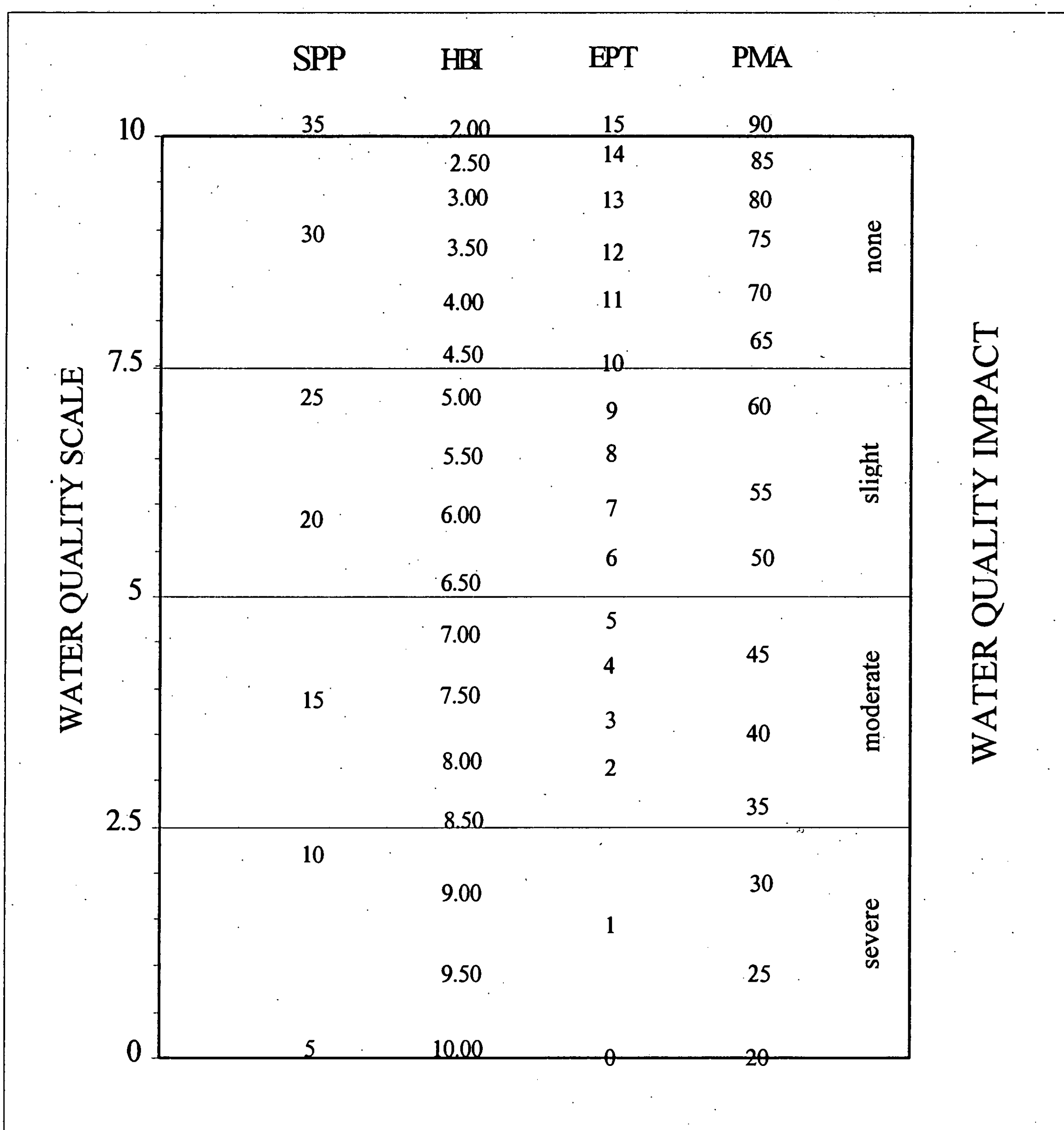
Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50. The percent model affinity value is 35-49. Water quality often is limiting to fish propagation, but usually not to fish survival.

4. Severely impacted

Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or less. Mayflies, stoneflies, and caddisflies are rare or absent; EPT value is 0-1. The biotic index value is greater than 8.50. Percent model affinity is less than 35. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

APPENDIX IV. BIOLOGICAL ASSESSMENT PROFILE OF INDEX VALUES

The Biological Assessment Profile of index values, developed by Mr. Phil O'Brien, Division of Water, NYS DEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the four indices defined in Appendix II are converted to a common 0-10 scale as shown in the figure below. To plot survey data, each site is positioned on the x-axis according to river miles from the mouth, and the scaled values for the four indices are plotted on the common scale. The mean scale value of the four indices represents the assessed impact for each site.



APPENDIX V.
WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity#	Diversity*
Non-Impacted	>26	0.00-4.50	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	0-1	<35	0.00-2.00

Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.

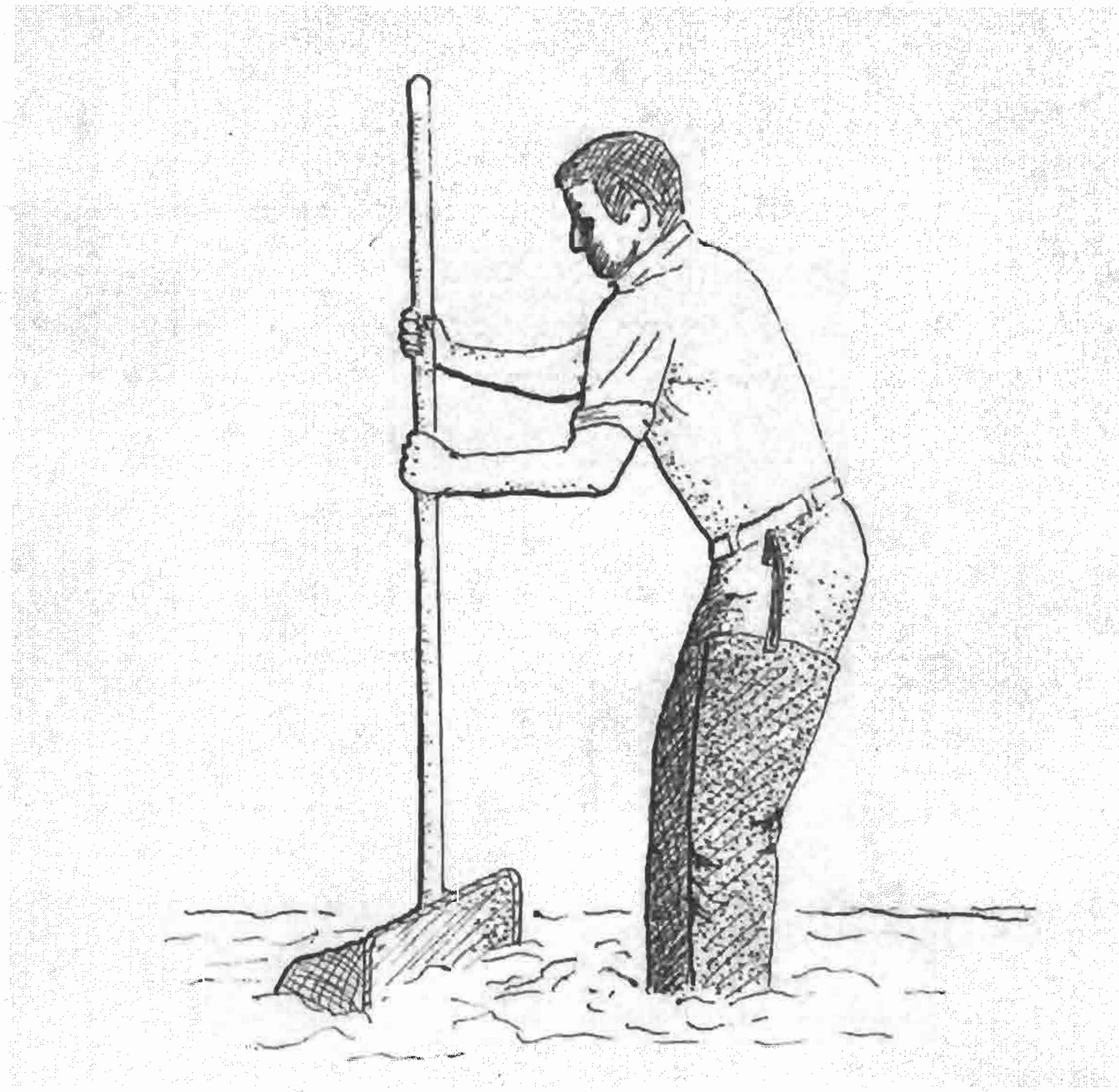
* Diversity criteria are used for multiplate samples but not for traveling kick samples.

WATER QUALITY ASSESSMENT CRITERIA
for navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Diversity
Non-Impacted	>21	0.00-7.00	>5	>3.00
Slightly Impacted	17-21	7.01-8.00	4-5	2.51-3.00
Moderately Impacted	12-16	8.01-9.00	2-3	2.01-2.50
Severely Impacted	0-11	9.01-10.00	0-1	0.00-2.00

APPENDIX VI.

THE TRAVELING KICK SAMPLE



current ➡

Rocks and sediment in the riffle are dislodged by foot upstream of a net; organisms dislodged are carried by the current into the net. Sampling is continued for five minutes, as the sampler gradually moves downstream to cover a distance of five meters.

APPENDIX VII. A.
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.

MAYFLIES

Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies, except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained for several months.

STONEFLIES

Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are tolerant. One family spins nets to catch drifting plankton, and is often numerous in nutrient-enriched stream segments.

CADDISFLIES

The most common beetles in streams are riffle beetles and water pennies. Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.

BEETLES

APPENDIX VII. B.

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution. Large, red midge larvae called "bloodworms" indicate organic enrichment. Other midge larvae filter plankton, indicating nutrient enrichment when numerous.

MIDGES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are tolerant of organic enrichment and toxic contaminants, while others are intolerant of pollutants.

BLACK FLIES

The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution indicators. Many leeches are also tolerant of poor water quality.

WORMS

Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. They are classic indicators of sewage pollution, and can also thrive in toxic situations.

SOWBUGS

Digital images by Larry Abele, New York State Department of Environmental Conservation, Stream Biomonitoring Unit.

APPENDIX VIII. THE RATIONALE OF BIOLOGICAL MONITORING

Biological monitoring as applied here refers to the use of resident benthic macroinvertebrate communities as indicators of water quality. Macroinvertebrates are larger-than-microscopic invertebrate animals that inhabit aquatic habitats; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans.

Concept

Nearly all streams are inhabited by a community of benthic macroinvertebrates. The species comprising the community each occupy a distinct niche defined and limited by a set of environmental requirements. The composition of the macroinvertebrate community is thus determined by many factors, including habitat, food source, flow regime, temperature, and water quality. The community is presumed to be controlled primarily by water quality if the other factors are determined to be constant or optimal. Community components which can change with water quality include species richness, diversity, balance, abundance, and presence/absence of tolerant or intolerant species. Various indices or metrics are used to measure these community changes. Assessments of water quality are based on metric values of the community, compared to expected metric values.

Advantages

The primary advantages to using macroinvertebrates as water quality indicators are:

1) they are sensitive to environmental impacts
2) they are less mobile than fish, and thus cannot avoid discharges
3) they can indicate effects of spills, intermittent discharges, and lapses in treatment
4) they are indicators of overall, integrated water quality, including synergistic effects and substances lower than detectable limits
5) they are abundant in most streams and are relatively easy and inexpensive to sample
6) they are able to detect non-chemical impacts to the habitat, such as siltation or thermal changes
7) they are vital components of the aquatic ecosystem and important as a food source for fish
8) they are more readily perceived by the public as tangible indicators of water quality
9) they can often provide an on-site estimate of water quality
10) they can often be used to identify specific stresses or sources of impairment
11) they can be preserved and archived for decades, allowing for direct comparison of specimens
12) they bioaccumulate many contaminants, so that analysis of their tissues is a good monitor of toxic substances in the aquatic food chain

Limitations

Biological monitoring is not intended to replace chemical sampling, toxicity testing, or fish surveys. Each of these measurements provides information not contained in the others. Similarly, assessments based on biological sampling should not be taken as being representative of chemical sampling. Some substances may be present in levels exceeding ambient water quality criteria, yet have no apparent adverse community impact.

APPENDIX IX. GLOSSARY

assessment: a diagnosis or evaluation of water quality

benthos: organisms occurring on or in the bottom substrate of a waterbody

biomonitoring: the use of biological indicators to measure water quality

community: a group of populations of organisms interacting in a habitat

drainage basin: an area in which all water drains to a particular waterbody; watershed

EPT value: the number of species of mayflies, stoneflies, and caddisflies in a sample

facultative: occurring over a wide range of water quality; neither tolerant nor intolerant of poor water quality

fauna: the animal life of a particular habitat

impact: a change in the physical, chemical, or biological condition of a waterbody

impairment: a detrimental effect caused by an impact

index: a number, metric, or parameter derived from sample data used as a measure of water quality

intolerant: unable to survive poor water quality

macroinvertebrate: a larger-than-microscopic invertebrate animal that lives at least part of its life in aquatic habitats

organism: a living individual

rapid bioassessment: a biological diagnosis of water quality using field and laboratory analysis designed to allow assessment of water quality in a short turn-around time; usually involves kick sampling and laboratory subsampling of the sample

riffle: wadeable stretch of stream usually with a rubble bottom and sufficient current to have the water surface broken by the flow; rapids

species richness: the number of macroinvertebrate species in a sample or subsample

station: a sampling site on a waterbody

survey: a set of samplings conducted in succession along a stretch of stream

tolerant: able to survive poor water quality

APPENDIX X. METHODS FOR IMPACT SOURCE DETERMINATION

Definition Impact Source Determination (ISD) is the procedure for identifying types of impacts that exert deleterious effects on a waterbody. While the analysis of benthic macroinvertebrate communities has been shown to be an effective means of determining severity of water quality impacts, it has been less effective in determining what kind of pollution is causing the impact. Impact Source Determination uses community types or models to ascertain the primary factor influencing the fauna.

Development of methods The method found to be most useful in differentiating impacts in New York State streams was the use of community types, based on composition by family and genus. It may be seen as an elaboration of Percent Model Affinity (Novak and Bode, 1992), which is based on class and order. A large database of macroinvertebrate data was required to develop ISD methods. The database included several sites known or presumed to be impacted by specific impact types. The impact types were mostly known by chemical data or land use. These sites were grouped into the following general categories: agricultural nonpoint, toxic-stressed, sewage (domestic municipal), sewage/toxic, siltation, impoundment, and natural. Each group initially contained 20 sites. Cluster analysis was then performed within each group, using percent similarity at the family or genus level. Within each group four clusters were identified, each cluster usually composed of 4-5 sites with high biological similarity. From each cluster a hypothetical model was then formed to represent a model cluster community type; sites within the cluster had at least 50 percent similarity to this model. These community type models formed the basis for Impact Source Determination (see tables following). The method was tested by calculating percent similarity to all the models, and determining which model was the most similar to the test site. Some models were initially adjusted to achieve maximum representation of the impact type. New models are developed when similar communities are recognized from several streams.

Use of the ISD methods Impact Source Determination is based on similarity to existing models of community types (see tables following). The model that exhibits the highest similarity to the test data denotes the likely impact source type, or may indicate "natural", lacking an impact. In the graphic representation of ISD, only the highest similarity of each source type is identified. If no model exhibits a similarity to the test data of greater than 50%, the determination is inconclusive. The determination of impact source type is used in conjunction with assessment of severity of water quality impact to provide an overall assessment of water quality.

Limitations These methods were developed for data derived from 100-organism subsamples of traveling kick samples from riffles of New York State streams. Application of the methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the models.

NATURAL

	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Isonychia</u>	5	5	-	5	20	-	-	-	-	-	-	-	-
BAETIDAE	20	10	10	10	10	5	10	10	10	10	5	15	40
HEPTAGENIIDAE	5	10	5	20	10	5	5	5	5	10	10	5	5
LEPTOPHLEBIIDAE	5	5	-	-	-	-	-	-	5	-	-	25	5
EPHEMERELLIDAE	5	5	5	10	-	10	10	30	-	5	-	10	5
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
<u>Psephenus</u>	5	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	5	-	20	5	5	-	5	5	5	5	-	-	-
<u>Promoresia</u>	5	-	-	-	-	-	25	-	-	-	-	-	-
<u>Stenelmis</u>	10	5	10	10	5	-	-	-	10	-	-	-	5
PHILOPOTAMIDAE	5	20	5	5	5	5	5	-	5	5	5	5	5
HYDROPSYCHIDAE	10	5	15	15	10	10	5	5	10	15	5	5	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	5	5	-	-	-	20	-	5	5	5	5	5	-
SIMULIIDAE	-	-	-	5	5	-	-	-	-	5	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
<u>Cardiocladius</u>	-	5	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/ Orthocladius</u>	5	5	-	-	10	-	-	5	-	-	5	5	5
<u>Eukiefferiella/ Tvetenia</u>	5	5	10	-	-	5	5	5	-	5	-	5	5
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	5	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	20	-	-	10	20	20	5	-
<u>Polypedilum</u> (all others)	5	5	5	5	5	-	5	5	-	-	-	-	-
Tanytarsini	-	5	10	5	5	20	10	10	10	10	40	5	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

NONPOINT NUTRIENTS, PESTICIDES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
<u>Isonychia</u>	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	5	-	-	5	-	5
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	5	-	-	5	-	5	5	-	-	-
<u>Optioservus</u>	10	-	-	5	-	-	15	5	-	5
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	15	-	10	15	5	25	5	10	5
PHILOPOTAMIDAE	15	5	10	5	-	25	5	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/ Orthocladius</u>	10	15	10	5	-	-	-	-	5	5
<u>Eukiefferiella/ Tvetenia</u>	-	15	10	5	-	-	-	-	5	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-
<u>Microtendipes</u>	-	-	-	-	-	-	-	-	-	20
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	10	20	10	5	10	5	5
Tanytarsini	10	10	10	5	20	5	5	10	-	10
TOTAL	100	100	100	100	100	100	100	100	100	100

	MUNICIPAL/INDUSTRIAL								TOXIC					
	A	B	C	D	E	F	G	H	A	B	C	D	E	F
PLATYHELMINTHES	-	40	-	-	-	5	-	-	-	-	-	-	5	-
OLIGOCHAETA	20	20	70	10	-	20	-	-	-	10	20	5	5	15
HIRUDINEA	-	5	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	5	-	-	-	5	-	-	-	5
SPHAERIIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	10	5	10	10	15	5	-	-	10	10	-	20	10	5
GAMMARIDAE	40	-	-	-	15	-	5	5	5	-	-	-	5	5
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	5	-	-	10	5	-	5	5	10	15	-	40	35	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	40	10	-	-	-	-	-
HYDROPSYCHIDAE	10	-	-	50	20	-	40	20	20	10	15	10	35	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	10	20	-	5	10	5	5	15	10	25	10	5	10
Eukiefferiella/ Tvetenia	-	-	-	-	-	-	-	-	-	-	20	10	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	-	-	-	10	20	40	10	5	10	-	-	-	-	5
Tanytarsini	-	-	-	10	10	-	5	-	-	-	-	-	-	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100

SEWAGE EFFLUENT, ANIMAL WASTES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	-
Isonychia	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE										
Tanypodinae	-	5	-	-	-	-	-	-	5	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5
Eukiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	10	-	-	60
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	60	-	30	10	5	5
Tanytarsini	10	10	10	10	-	-	-	10	40	-
TOTAL	100	100	100	100	100	100	100	100	100	100

	SILTATION					IMPOUNDMENT									
	A	B	C	D	E	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	-
OLIGOCHAETA	5	-	20	10	5	5	--	40	5	10	5	10	5	5	-
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	-
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	-
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	-
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Optioservus	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	5	10	10	5	20	5	5	10	10	-	5	35	-	5	10
PHILOPOTAMIDAE	-	-	-	-	-	5	-	-	5	-	-	-	-	-	30
HYDROPSYCHIDAE	25	10	-	20	30	50	15	10	10	10	10	20	5	15	20
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
SIMULIIDAE	5	10	-	-	5	5	-	5	-	35	10	5	-	-	15
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	25	-	10	5	5	5	25	5	-	10	-	5	10	-	-
Eukiefferiella/ Tvetenia	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	5	5	5	-	-	20	-	-	5	5	5	5
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

APPENDIX XI. MACROINVERTEBRATE COMMUNITY PARAMETERS FOR SANDY STREAMS

Stream habitats dominated by slow current speeds and smaller overall sediment particle size, mostly gravel, sand, and silt, require different methods of data analysis compared to streams with rubble/gravel riffles. The criteria used to interpret the invertebrate data and assess water quality were selected to account for habitat influences in order to separate water quality influences. The following indices and scales were used:

1. Species richness. This is the total number of species or taxa found in the sample. Expected ranges for 100-specimen subsamples of kick samples are: greater than 21, non-impacted; 17-21, slightly impacted; 12-16, moderately impacted; less than 12, severely impacted.

2. EPT richness. EPT denotes the total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in an average 100-organism subsample. The scale for navigable waters was also used for this index. Expected ranges are: greater than 5, non-impacted; 4-5, slightly impacted; 2-3, moderately impacted; and 0-1, severely impacted.

3. Biotic index. The Hilsenhoff Biotic Index, the average tolerance value for all the organisms in the sample, ranges from intolerant (0) to tolerant (10). The scale of expected values set for slow sandy streams is: 0-5.50, non-impacted; 5.51-7.00, slightly impacted; 7.01-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. NCO richness. NCO denotes the total number of species of organisms other than those in the groups Chironomidae and Oligochaeta. Since Chironomidae and Oligochaeta are generally the most abundant groups in impacted communities, NCO taxa are considered to be less pollution tolerant, and their presence would be expected to be more indicative of good water quality. The scale used for slow sandy streams is: greater than 10, non-impacted; 6-10, slightly impacted; 2-5, moderately impacted; and 0-1, severely impacted.

These scales were developed using Long Island data in addition to data from several statewide sites with habitats similar to the Long Island streams. The scales were adjusted to make the indices corroborative, leading to accurate water quality assessments. Overall water quality is assigned by normalizing the four index values on a common ten-scale, and calculating the average of the four indices. Percent model affinity was not selected as an index, because there was no single prevailing community composition among the sites.