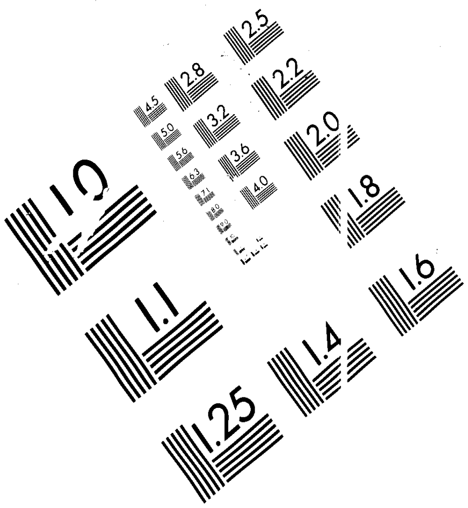

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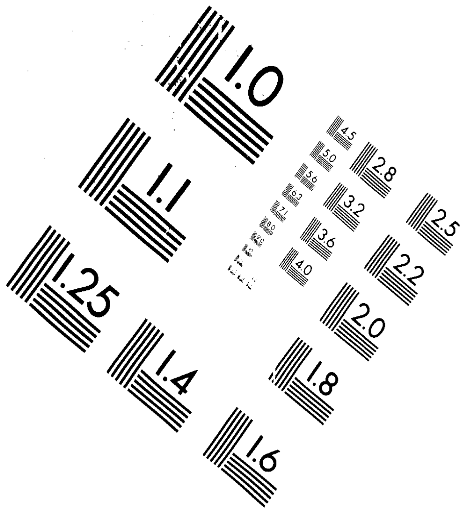

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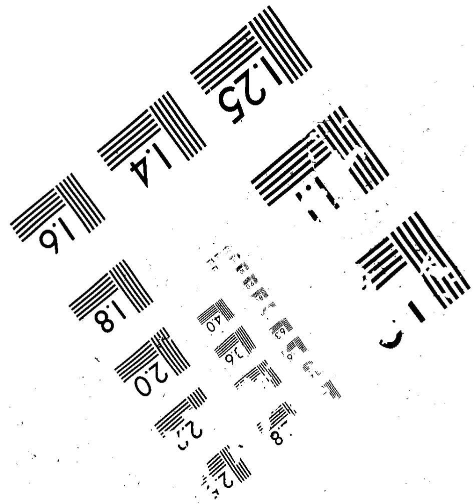

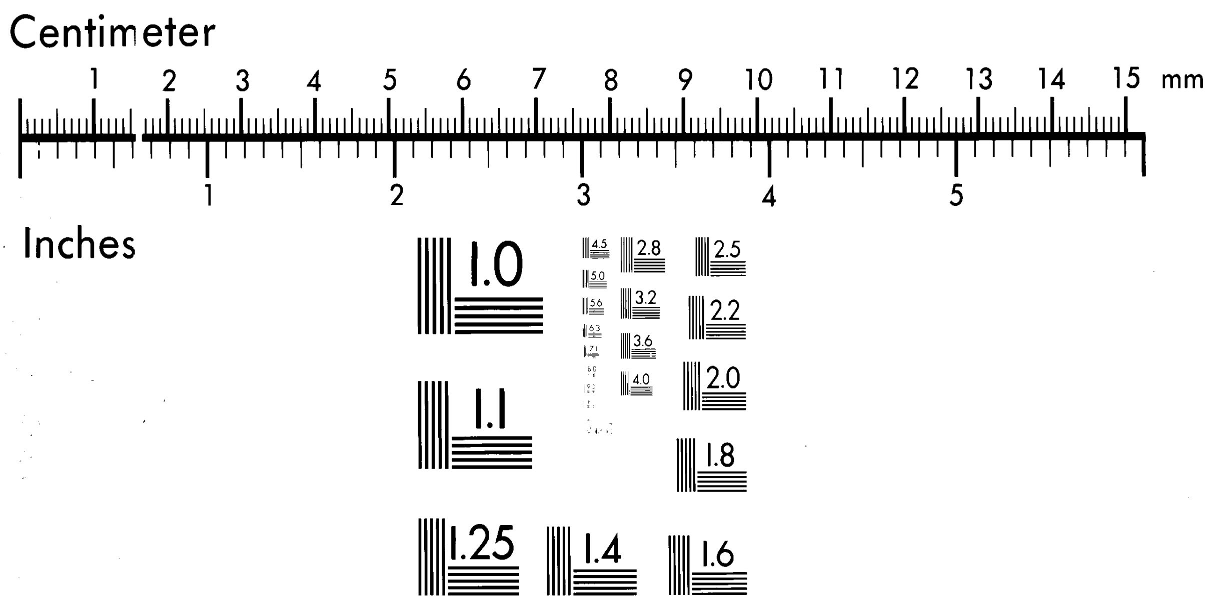

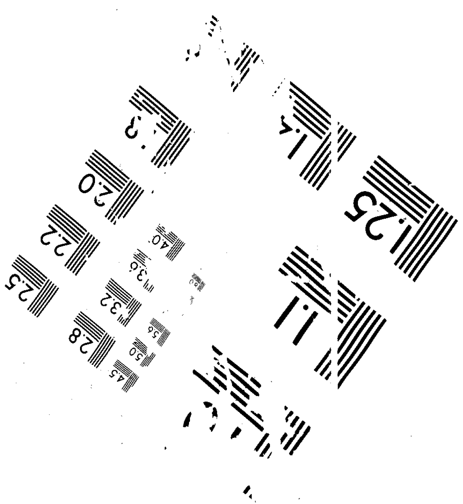

New York State
Department of Environmental Conservation

Division of Water

Ischua Creek

Biological Assessment

1998 Survey

GEORGE E. PATAKI, *Governor* JOHN P. CAHILL, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Ischua Creek
Cattaraugus County, New York

Survey date: September 2, 1998
Report date: May 5, 1999

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Margaret A. Novak
Lawrence E. Abele

Stream Biomonitoring Unit
Bureau of Watershed Assessment and Research
Division of Water
NYS Department of Environmental Conservation
Albany, New York

CONTENTS

Stream: Ischua Creek, Cattaraugus County, New York

Reach: above Franklinville to Hinsdale, New York

Background:

The Stream Biomonitoring Unit conducted biological sampling on Ischua Creek on September 2, 1998. The purpose of the sampling was to assess general water quality and compare results to previous studies. Regional DEC personnel had reported possible problems resulting from salt piles and junk piles in the drainage of Rock Spring Brook, a tributary of Ischua Creek. Traveling kick samples were taken in riffle areas at 7 sites, using methods described in the Quality Assurance document (Bode et al., 1996) 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. Water quality assessments were based on resident macroinvertebrates (aquatic insects, worms, mollusks, crustaceans). Community parameters used in the determination of water quality included species richness, biotic index, EPT value, and percent model affinity (see Appendices II and III). 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 site collection pages, which include the raw invertebrate data from each site and descriptions of each site. A previous macroinvertebrate study of Ischua Creek conducted by Preddice in 1975 was used for site selection and comparison of results.

The Stream Biomonitoring Unit acknowledges the help of the Region 9 personnel who assisted in this survey.

Results and Conclusions:

1. Water quality in Ischua Creek ranged from non-impacted to slightly impacted. Impacts appeared in the upstream reaches below the confluence of Rock Spring Brook, and displayed some attributes that could be consistent with leachate from salt piles and solid waste in the drainage, as reported by Regional personnel. These concerns could be further investigated with chemical sampling.

2. Nutrient runoff from the Ischua Valley Golf Course appears to be enriching Ischua Creek above Franklinville. Filter-feeding caddisflies were very numerous downstream of the golf course, indicating increased levels of plankton.

3. Water quality from Cadiz to the mouth at Hinsdale was assessed as non-impacted.

4. Compared to results from a DEC study conducted in 1975 (Preddice, 1977), improved water quality is documented downstream of Franklinville, likely due to the 1987 upgrade of the sewage treatment plant.

Discussion:

The purpose of this biological sampling of Ischua Creek was to assess general water quality, and compare to results of previous studies. A previous NYS DEC macroinvertebrate study of Ischua Creek was conducted in 1975 by Preddice (1977). Five of the sites sampled in the present survey were included in Preddice's study, and the site numbering is the same. The 1975 study found good overall water quality in Ischua Creek, with some degradation downstream of the Franklinville sewage treatment plant discharge, and slight degradation at all sites due to siltation. Station 2 at Cadiz appeared to show the most impact in the 1975 study, and Station 5 below Ischua showed the best water quality.

From upstream to downstream, the results of the present study show that water quality is non-impacted at the most upstream site above Franklinville (Station A). Although three metrics were depressed at this site, this is likely due to a combination of headwater effects, low gradient, and a gravel substrate. Metric values and dominant species closely fit the pattern described for headwater streams; even though this site is several miles below the source, most of the upstream reach is low gradient, contributing to a prolonged headwater effect. The assessment for this site was consequently upgraded from slightly impacted to non-impacted after applying the recommended correction factor (Appendix X).

Rock Spring Brook was one of the subjects of investigation in the present study. Regional DEC personnel reported possible problems resulting from salt piles and junk piles in its drainage. The stream enters Ischua Creek 0.5 miles upstream of Station 1A. Rock Spring Brook was sampled for invertebrates, but this sample was not considered to be representative of water quality, since the stream is believed to be intermittent and had poor habitat. The specific conductance of Rock Spring Brook was elevated, with a value of 658 µmhos, compared to 413 µmhos in Ischua Creek above the confluence. The invertebrate sample taken in Ischua Creek below the Rock Spring Brook confluence (Station 1A) showed slightly impacted water quality. Similar impacts were found 2.1 miles downstream at Station 1. Impact Source Determination (ISD) showed that the impacts above Franklinville (Station 1A) may include sources of toxic and complex origin, (see Table 1). Rock Spring Brook is thus considered a possible cause of these impacts. Although the faunal shift between Stations A and 1A is subtle, the appearance of high numbers of the tolerant black fly Simulium vittatum downstream of the Rock Spring Brook confluence is a strong indicator of probable impact. The impacts observed downstream of Rock Spring Brook could be consistent with leachate from salt piles and solid waste in the drainage, and these concerns should be further investigated with chemical sampling.

Ischua Creek runs through the Ischua Valley Golf Course between Stations 1A and 1 above Franklinville. Station 1 in Franklinville, just downstream of the golf course, exhibited a large increase in filter-feeding caddisflies compared to upstream Station 1A. These caddisflies filter planktonic particles and organisms from the water column, and their increase is usually a direct indicator of increased levels of plankton, often due to nutrient enrichment. This site carried the highest percentage of filter-feeding caddisflies of any Ischua Creek site, and appears to be an indicator of nutrient enrichment from the golf course.

Water quality improved at Cadiz (Station 2) and sites downstream. Nonpoint sources appear to be contributing some nutrients and silt, especially at Station 3 (Table 1), but all these sites are assessed as non-impacted. The invertebrate communities at these sites maintained diverse populations of clean-water mayflies, stoneflies, caddisflies, and beetles, and water quality was considered excellent.

Two sites on Ischua Creek were previously sampled by the NYS DEC Stream Biomonitoring Unit in 1990 (Bode et al., 1992). Station 2 in Cadiz was found to be non-impacted, representing an improvement from the 1975 conditions documented by Preddice (1977). This is likely related to the 1987 upgrade of the Franklinville sewage treatment plant. Station 3 below Cadiz was found to be slightly impacted in the 1990 sampling, probably by nonpoint source nutrients and other inputs. This site exhibited the best water quality found in the stream in the present study, and may represent a slight improvement from 1990.

Literature cited

Bode, R.W., M.A. Novak, and L.E. Abele. 1992. Rotating Intensive Basin Studies. Appendix B. Macroinvertebrate Data. New York State Department of Environmental Conservation, Albany, NY. NYS DEC Technical Report, 178 pages.

Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Albany, NY. NYS DEC Technical Report, 89 pages.

Preddice, T.L. 1977. Water quality and quantitative macroinvertebrate survey of segments of Ischua, Oil, and Olean Creeks, July, 1975. New York State Department of Environmental Conservation, Avon Pollution Investigations. NYS DEC Technical Report, 66 pages.

Overview of field data:

On the date of sampling, September 2, 1998, the sites sampled on Ischua Creek were 4-20 meters wide, 0.2-0.3 meters deep in riffles, and had current speeds of 83-100 cm/sec in riffles. Dissolved oxygen was 7.5-11.4 mg/l, specific conductance was 344-429 µmhos, pH was 7.8-8.6, and the temperature was 13.9-20.1 °C (57-68 °F). Measurements for each site are found on the field data summary sheets.

Figure 1. Biological Assessment Profile of index values, Ischua Creek, 1998. 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 explanat on.

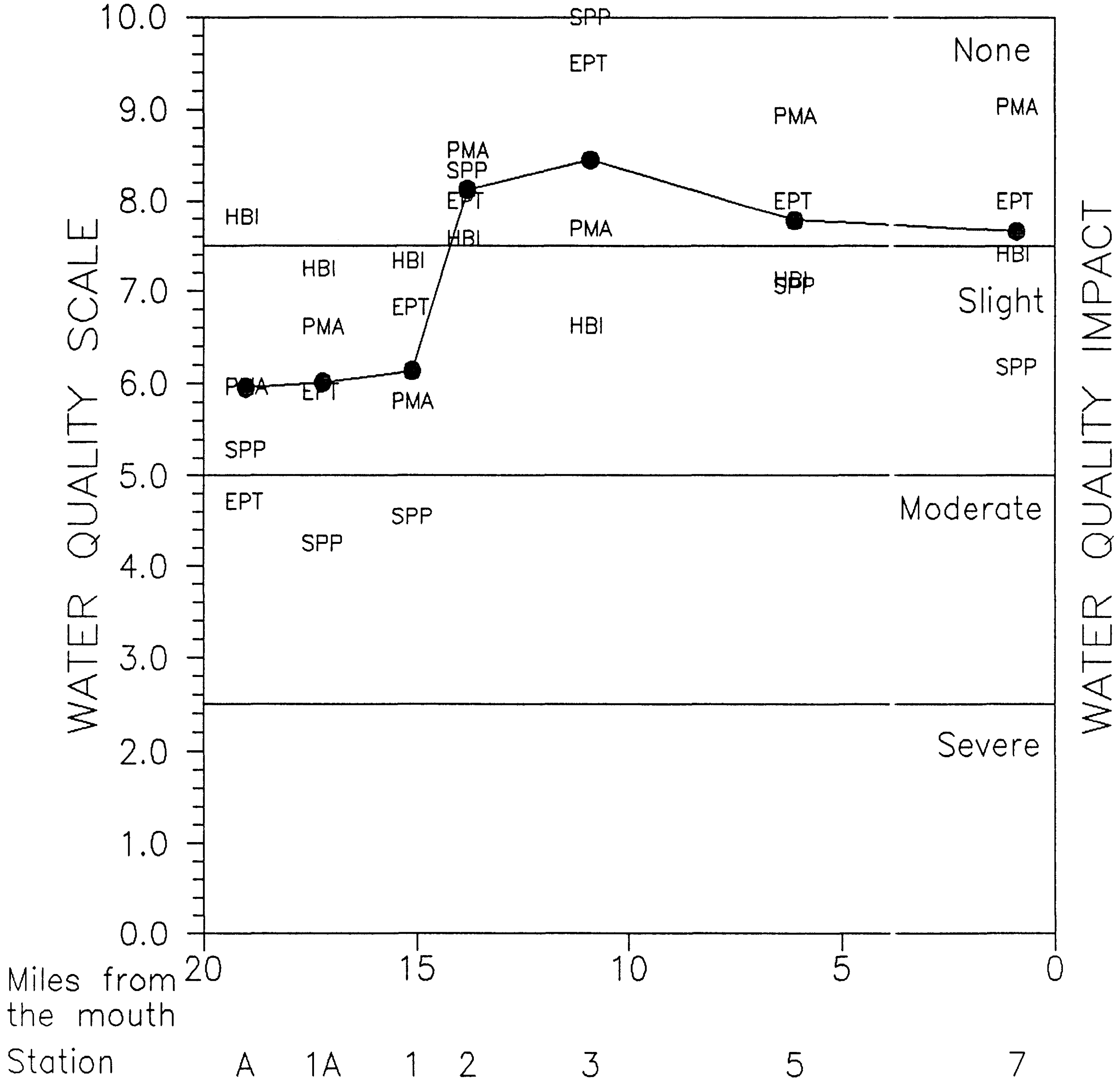


Table 1. Impact Source Determination, Ischua Creek, 1998. Numbers represent similarity to community type models for each impact category. The highest similarity at each station is highlighted. Similarities less than 50% are less conclusive.

	STATION						
Community Type	ISCH A	ISCH 01A	ISCH 01	ISCH 02	ISCH 03	ISCH 05	ISCH 07
Natural: minimal human impacts	54	50	51	48	52	62	64
Nutrient additions; mostly nonpoint runoff	53	48	58	45	64	57	57
Toxic: industrial, municipal, or urban run-off	27	46	40	34	51	54	51
Organic: sewage effluent, animal wastes	29	38	40	30	50	37	44
Complex: municipal/industrial	33	51	66	38	63	47	46
Siltation	40	42	45	43	64	50	54
Impoundment	41	39	56	36	60	47	49

Figure 2	Site Overview Map	Ischua Creek

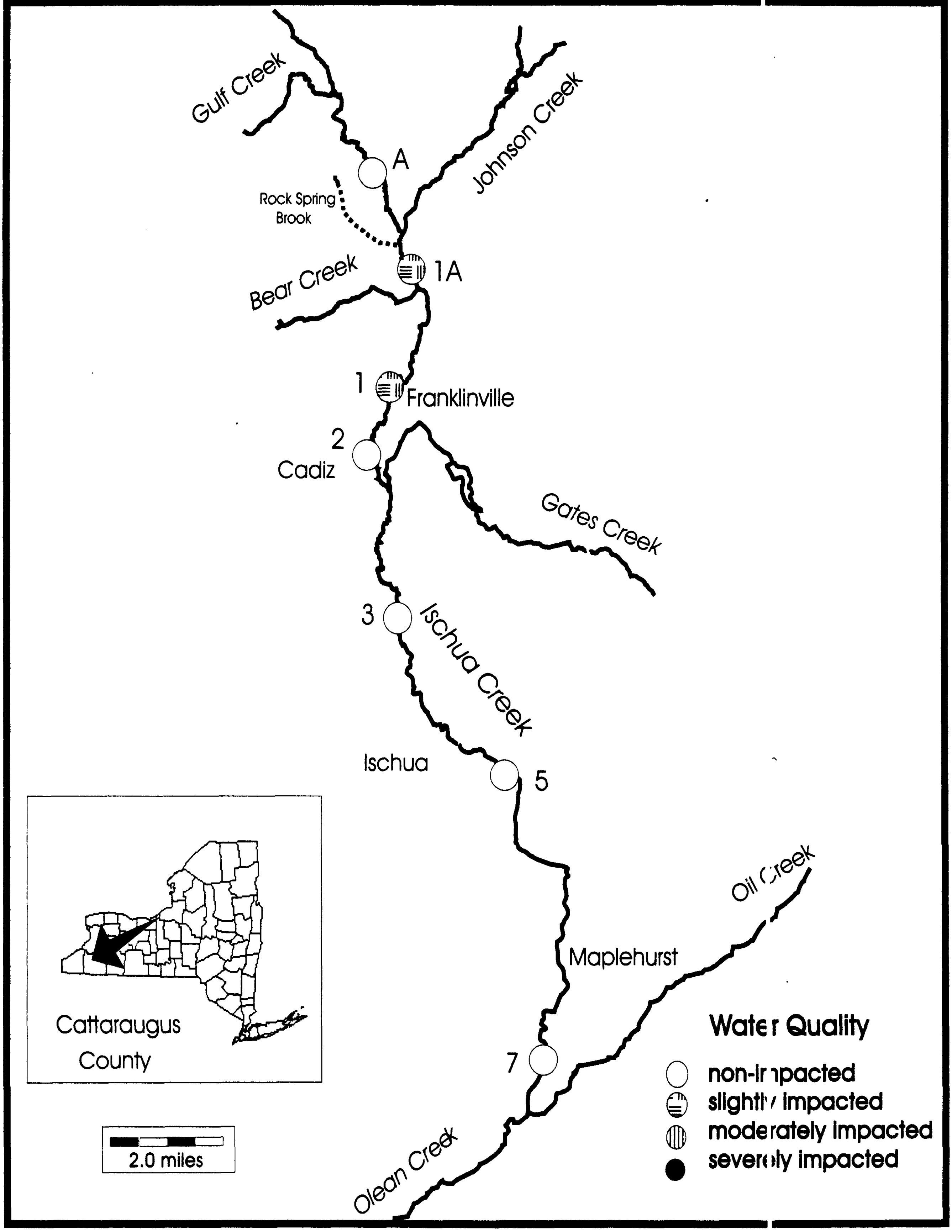


TABLE 2. STATION LOCATIONS FOR ISCHUA CREEK, CATTARAUGUS COUNTY, NEW YORK (see map).

STATION	LOCATION
A	above Franklinville 30 meters below Reynolds Rd. bridge 19.0 miles above mouth latitude/longitude: 42°22'54";78°27'53"
01A	above Franklinville opposite 6th tee, Ischua Valley golf course 17.2 miles above mouth latitude/longitude: 42°21'35"; 78°27'07"
01	Franklinville 50 meters below West Main St. bridge 15.1 miles above mouth latitude/longitude: 42°20'12"; 78°27'47"
02	Cadiz 50 meters above Rt. 98 bridge 13.8 miles above mouth latitude/longitude: 42°19'17"; 78°27'54"
03	below Cadiz 150 meters below Coal Chutes Rd. bridge 10.9 miles above mouth latitude/longitude: 42°17'12"; 78°27'25"
05	Ischua 5 meters below Old Dutch Hill Rd. bridge 6.1 miles above mouth latitude/longitude: 42°14'34"; 78°23'51"
07	Maplehurst 20 meters above Mill St. bridge (closed) 0.9 miles above mouth latitude/longitude: 42°10'51"; 78°23'05"

Figure 3a	Site Location Map	Ischua Creek

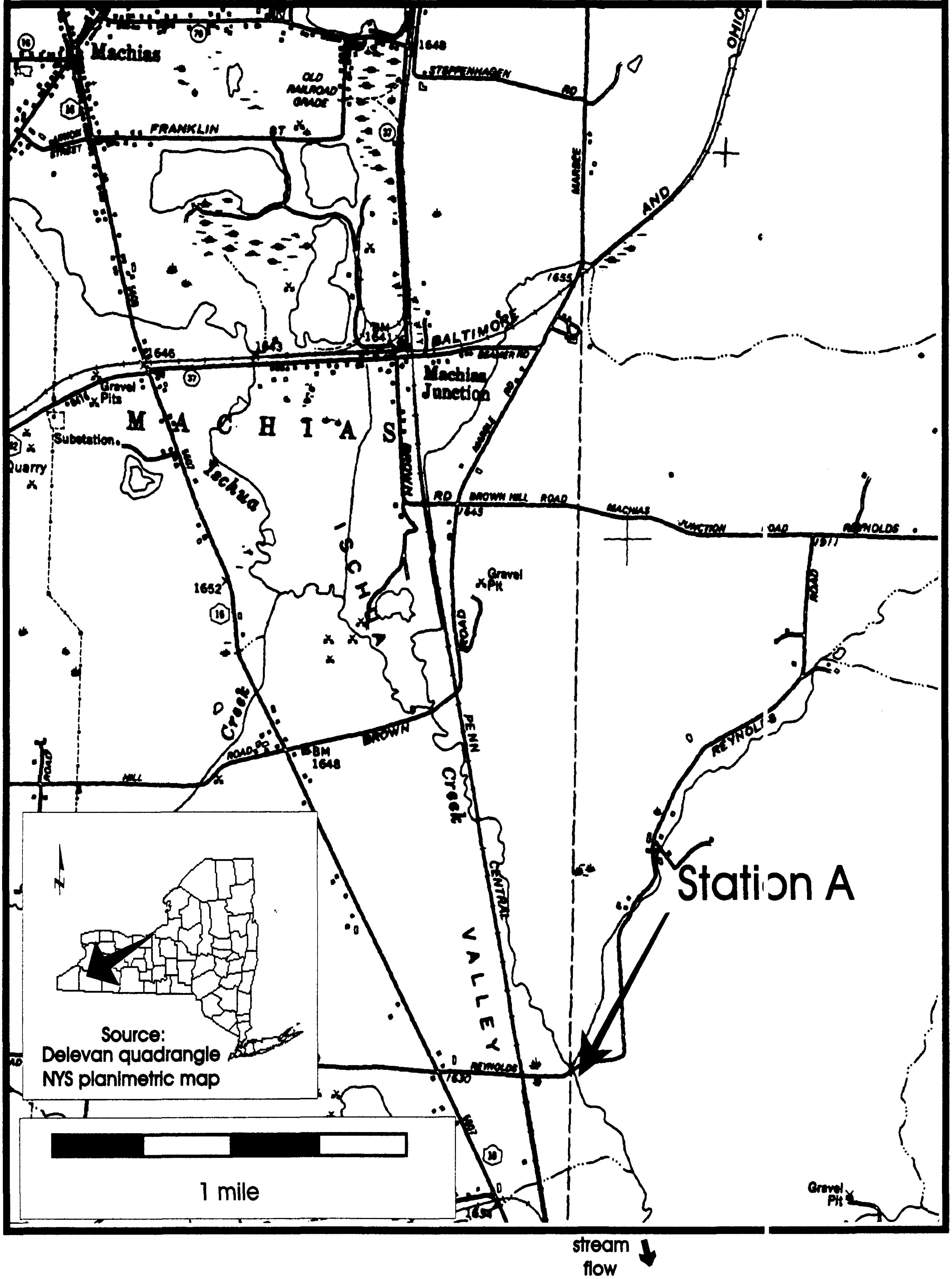


Figure 3b	Site Location Map	Ischua Creek

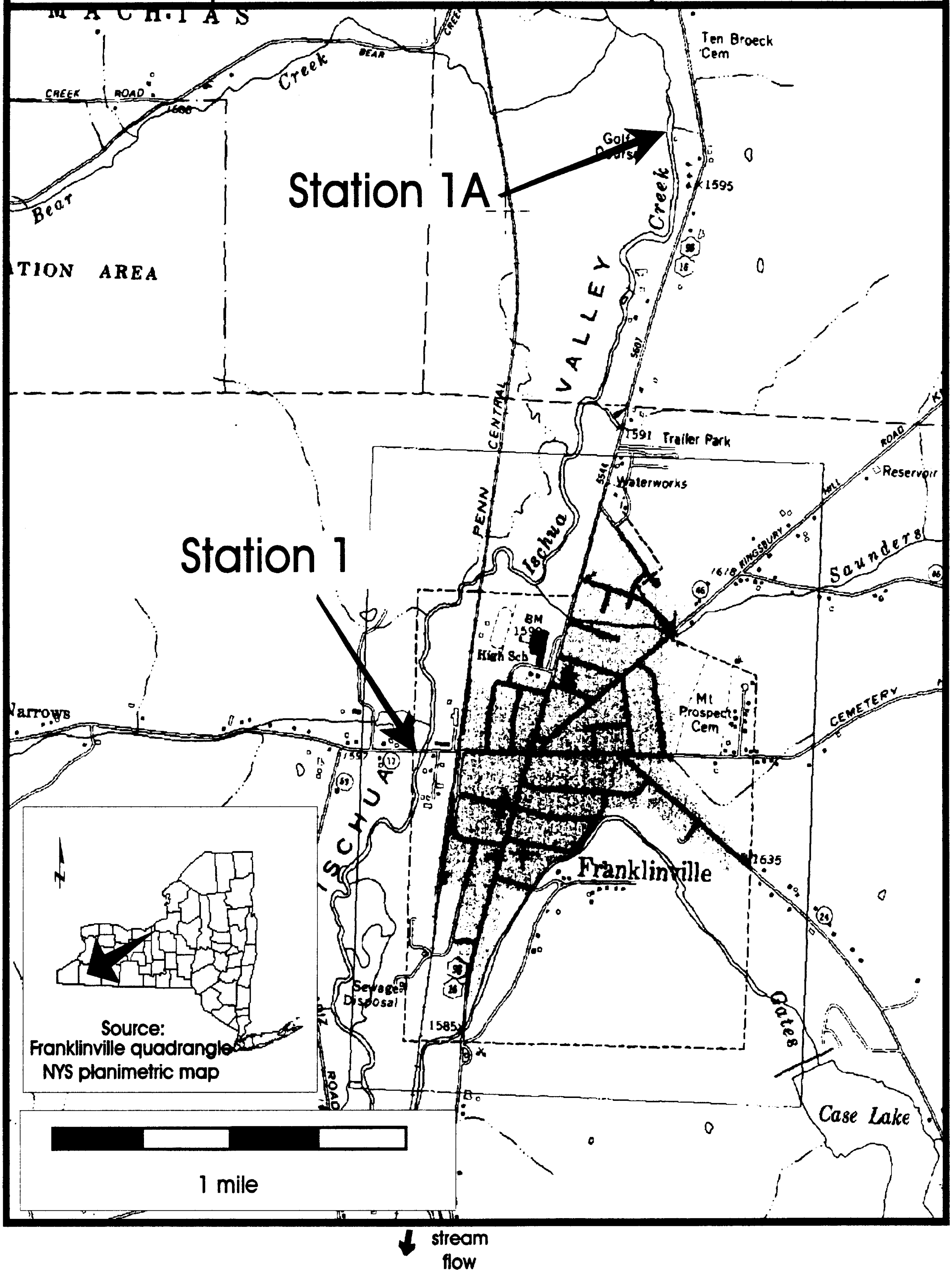


Figure 3c	Site Location Map	Ischua Creek

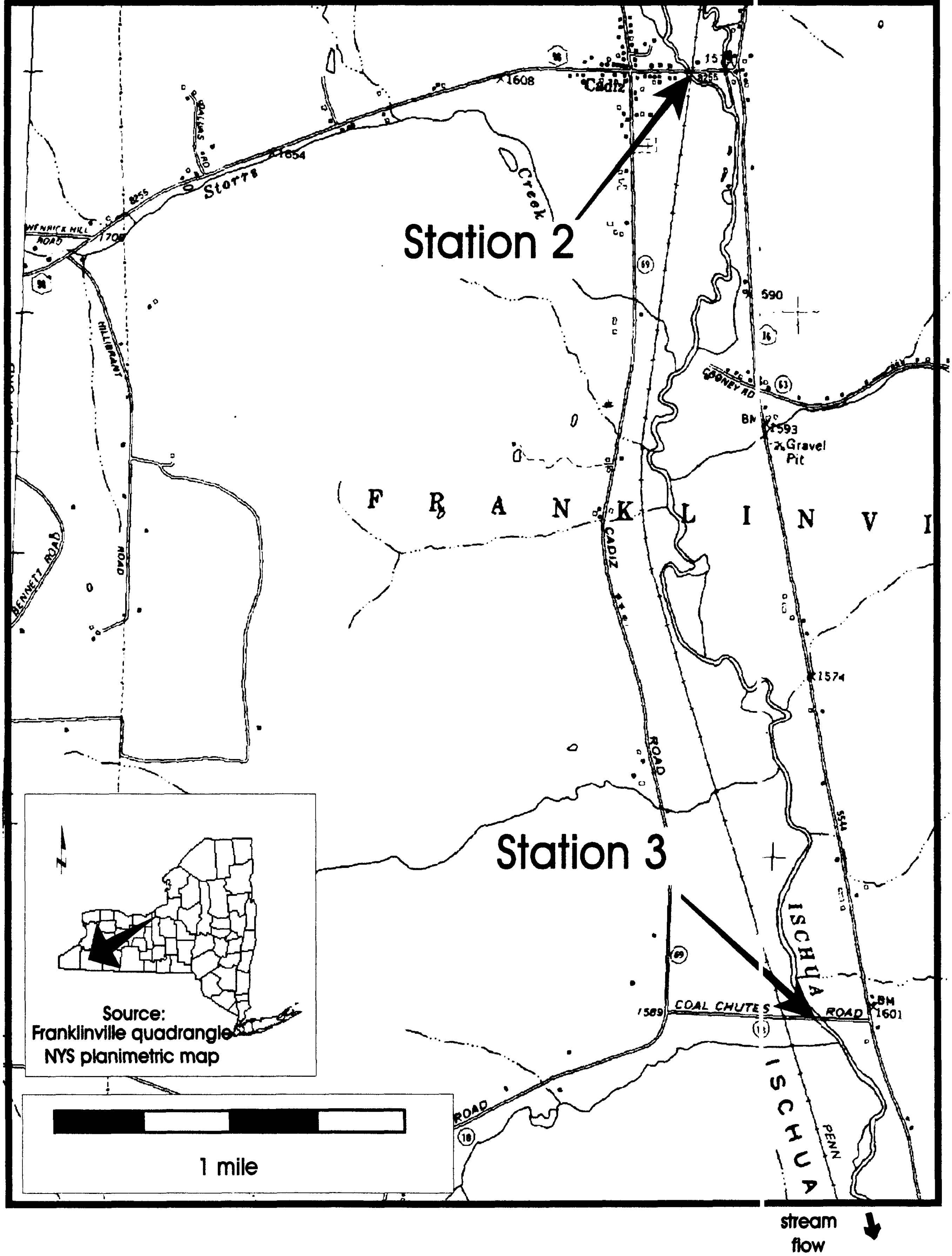


Figure 3d	Site Location Map	Ischua Creek

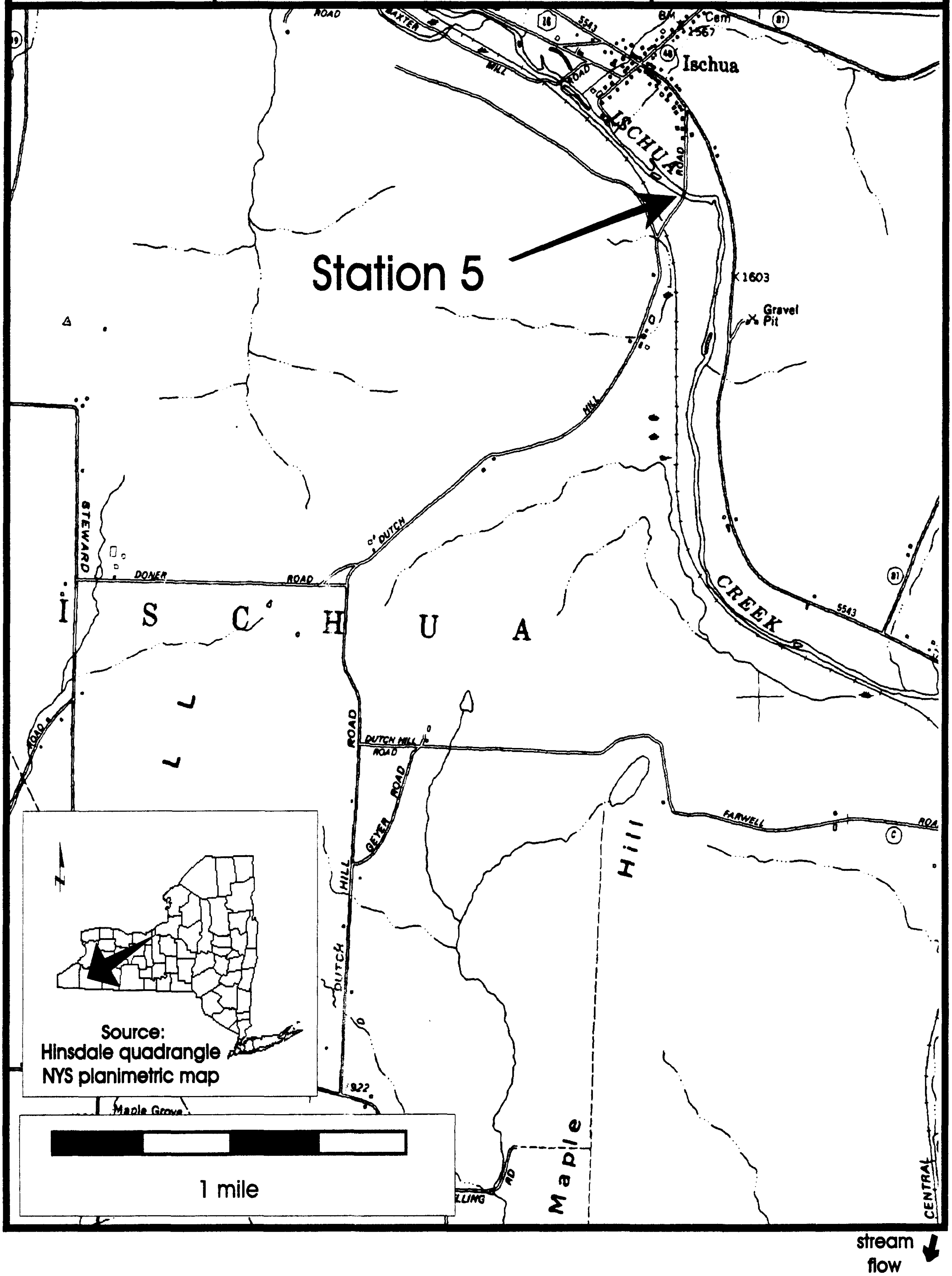


Figure 3e	Site Location Map	Ischua Creek

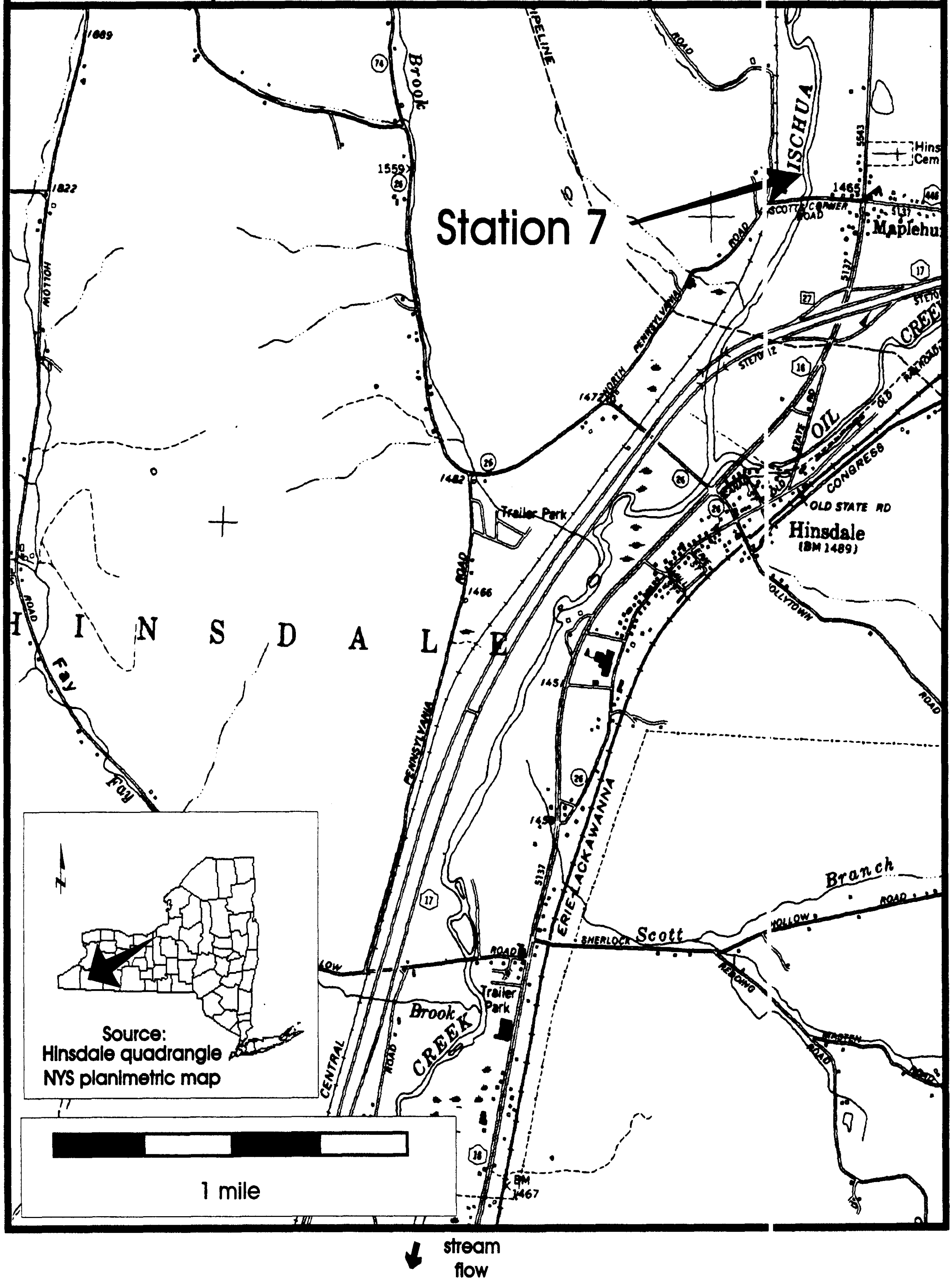


TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN ISCHUA CREEK, CATTARAUGUS COUNTY, NEW YORK, SEPTEMBER 2, 1998.

PLATYHELMINTHES
TURBELLARIA
Undetermined Turbellaria
OLIGOCHAETA
Undetermined Lumbricina
Lumbriculidae
Undetermined Lumbriculidae
MOLLUSCA
PELECYPODA
Sphaeriidae
Sphaerium sp.
ARTHROPODA
CRUSTACEA
ISOPODA
Asellidae
Caecidotea racovitzai
DECAPODA
Cambaridae
Cambarus sp.
INSECTA
EPHEMEROPTERA
Isonychiidae
Isonychia bicolor
Baetidae
Acentrella sp.
Baetis brunneicolor
Baetis flavistriga
Baetis intercalaris
Baetis sp.
Heptageniidae
Stenacron interpunctatum
Stenonema vicarium
Stenonema sp.
Ephemerellidae
Undetermined Ephemerellidae
Tricorythidae
Tricorythodes sp.
Caenidae
Caenis anceps
PLECOPTERA
Perlidae
Acroneuria carolinensis
Agnetina capitata
Paragnetina media
COLEOPTERA
Psephenidae
Psephenus herricki
Elmidae
Optioservus ovalis
Optioservus trivittatus
Optioservus sp.
Stenelmis sp.
Curculionidae
Undetermined Curculionidae
MEGALOPTERA
Corydalidae
Nigronia serricornis
TRICHOPTERA
Philopotamidae
Chimarra aterrima?
Chimarra obscura
Chimarra socia
Chimarra sp.
Hydropsychidae
Cheumatopsyche sp.
Hydropsyche betteni
Hydropsyche bronta
Hydropsyche morosa
Hydropsyche slossonae
Hydropsyche sparna
Rhyacophilidae
Rhyacophila sp.
Glossosomatidae
Glossosoma sp.
DIPTERA
Tipulidae
Antocha sp.
Hexatoma sp.
Ceratopogonidae
Undetermined Ceratopogonidae
Simuliidae
Simulium jenningsi
Simulium tuberosum
Simulium vittatum
Simulium sp.
Athericidae
Atherix sp.
Empididae
Hemerodromia sp.

TABLE 3 (continued). MACROINVERTEBRATE SPECIES COLLECTED IN ISCHUA CREEK, CATTARAUGUS COUNTY, NEW YORK, SEPTEMBER 2, 1998.

Chironomidae
Tanypodinae
Thienemannimyia gr. spp.
Podonominae
Pagastia sp. A
Orthocladiinae
Cardiocladius obscurus
Cricotopus bicinctus
Cricotopus trifascia gr.
Eukiefferiella claripennis gr.
Eukiefferiella devonica gr.
Parametriocnemus lundbecki
Tvetenia bavarica gr.
Tvetenia vitracies
Chironominae
Chironomini
Microtendipes pedellus gr.
Microtendipes rydalensis gr.
Polypedilum aviceps
Polypedilum convictum
Polypedilum illinoense
Tanytarsini
Micropsectra sp.
Paratanytarsus dimorphis
Rheotanytarsus distinctissimus gr.
Rheotanytarsus exiguus gr.
Sublettea coffmani
Tanytarsus guerlus gr.

STREAM SITE:	Ischua Creek Station A
LOCATION:	Above Franklinville
DATE:	September 2, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA		Undetermined Turbellaria	2
MOLLUSCA			
PELECYPODA	Sphaeriidae	Sphaerium sp.	8
ARTHROPODA			
DECAPODA	Cambaridae	Cambarus sp.	1
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis brunneicolor	5
		Baetis flavistriga	3
	Heptageniidae	Stenonema sp.	5
PLECOPTERA	Perlidae	Agnetina capitata	4
COLEOPTERA	Psephenidae	Psephenus herricki	1
	Elmidae	Optioservus ovalis	31
		Optioservus trivittatus	5
MEGALOPTERA	Corydalidae	Nigronia serricornis	1
TRICHOPTERA	Hydropsychidae	Hydropsyche slossonae	18
DIPTERA	Tipulidae	Hexatoma sp.	2
	Simuliidae	Simulium vittatum	1
	Athericidae	Atherix sp.	5
	Chironomidae	Pagastia sp. A	1
		Cricotopus trifascia gr.	1
		Polypedilum aviceps	1
		Micropsectra sp.	5

SPECIES RICHNESS	19 (good)
BIOTIC INDEX	4.18 (excellent)
EPT RICHNESS	5 (fair)
MODEL AFFINITY	55 (good)
ASSESSMENT	non-impacted (upgraded due to headwater effect)

DESCRIPTION The kick sample at this upstream site on Ischua Creek was taken 30 meters downstream of the Reynolds Road bridge. The riffle sampled was less than ideal as a macroinvertebrate habitat, being composed mostly of gravel and sand. The invertebrate fauna was dominated by clean-water riffle beetles. Although the indices were mostly in the range of slight impact, these were believed to result from headwater effect, prolonged by low gradient. Actual water quality is assessed as non-impacted. Impact Source Determination also showed highest similarities were to natural communities.

STREAM SITE:	Ischua Creek Station 01A
LOCATION:	above Franklinville, NY
DATE:	September 2, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	1
	Baetidae	Baetis flavistriga	10
	Ephemerellidae	Undetermined Ephemerellidae	1
COLEOPTERA	Elmidae	Optioservus sp.	30
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	2
		Hydropsyche bronta	2
		Hydropsyche morosa	2
		Hydropsyche slossonae	11
DIPTERA	Simuliidae	Simulium vittatum	23
	Athericidae	Atherix sp.	1
	Chironomidae	Thienemannimyia gr. spp.	2
		Pagastia sp. A	7
		Cricotopus bicinctus	2
		Cricotopus trifascia gr.	2
		Tvetenia vitracies	2
		Polypedilum aviceps	2

SPECIES RICHNESS	16 (fair)
BIOTIC INDEX	4.70 (good)
EPT RICHNESS	7 (good)
MODEL AFFINITY	59 (good)
ASSESSMENT	slightly impacted

DESCRIPTION This site above Franklinville was downstream of the confluence of Rock Spring Brook. Access to the site was through the Ischua Valley Golf Course; the riffle was at the upstream end of the golf course. The riffle was similar to that at Station A, with some rubble present but mostly gravel and sand. The invertebrate fauna contained many riffle beetles, as at Station A, but also had many tolerant black fly larvae. Indices were similar to those at Station A, but the presence of some tolerant species may indicate more than headwater effects. Impact Source Determination showed probable complex and toxic impacts, and these may be attributable to Rock Spring Brook.

STREAM SITE:	Ischua Creek Station 01
LOCATION:	Franklinville, NY
DATE:	September 23, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

INSECTA			
EPHEMEROPTERA	Baetidae	Acentrella sp.	3
		Baetis flavistriga	10
		Baetis sp.	1
	Heptageniidae	Stenonema sp.	1
	Tricorythidae	Tricorythodes sp.	1
COLEOPTERA	Elmidae	Optioservus ovalis	17
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	9
	Hydropsychidae	Cheumatopsyche sp.	7
		Hydropsyche bronta	1
		Hydropsyche slossonae	29
DIPTERA	Simuliidae	Simulium vittatum	12
	Empididae	Hemerodromia sp.	1
	Chironomidae	Cricotopus bicinctus	4
		Cricotopus trifascia gr.	1
		Eukiefferiella devonica gr.	1
		Sublettea coffmani	1
		Tanytarsus guerlus gr.	1

SPECIES RICHNESS	17 (fair)
BIOTIC INDEX	4.64 (good)
EPT RICHNESS	9 (good)
MODEL AFFINITY	54 (good)
ASSESSMENT	slightly impacted

DESCRIPTION The sample was taken 50 meters downstream of the West Main Street bridge in Franklinville. The riffle was considered a better invertebrate habitat than that at upstream sites, composed of rock, rubble, gravel, and sand. The invertebrate fauna was dominated by filter-feeding caddisflies, and metrics changed little from the upstream site. Water quality was assessed as slightly impacted, possibly by complex discharges.

STREAM SITE:	Ischua Creek Station 02
LOCATION:	Cadiz, NY
DATE:	September 2, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Lumbriculidae	Undetermined Lumbriculidae	1
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	15
	Baetidae	Baetis flavistriga	2
	Heptageniidae	Stenonema vicarium	2
	Caenidae	Caenis anceps	5
COLEOPTERA	Elmidae	Optioservus ovalis	11
		Optioservus trivittatus	9
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	6
		Hydropsyche bronta	3
		Hydropsyche morosa	1
		Hydropsyche slossonae	3
		Hydropsyche sparna	1
	Rhyacophilidae	Rhyacophila sp.	1
	Glossosomatidae	Glossosoma sp.	1
DIPTERA	Tipulidae	Antocha sp.	1
		Hexatoma sp.	1
	Simuliidae	Simulium vittatum	14
	Athericidae	Atherix sp.	2
	Chironomidae	Thienemannimyia gr. spp.	1
		Pagastia sp. A	4
		Cricotopus bicinctus	2
		Cricotopus trifascia gr.	4
		Eukiefferiella claripennis gr.	1
		Tvetenia vitracies	4
		Polypedilum aviceps	1
		Paratanytarsus dimorphis	1
		Rheotanytarsus distinctissimus gr.	1
		Rheotanytarsus exiguus gr.	1
		Sublettea coffmani	1

SPECIES RICHNESS	29 (excellent)
BIOTIC INDEX	4.42 (excellent)
EPT RICHNESS	11 (excellent)
MODEL AFFINITY	75 (excellent)
ASSESSMENT	non-impacted

DESCRIPTION The site was upstream of the Route 98 bridge in Cadiz. The riffle sampled was a good invertebrate habitat, and the resident fauna was improved from upstream sites. The metrics placed the water quality assessment as non-impacted, and Impact Source Determination showed highest similarities to natural communities.

STREAM SITE: Ischua Creek Station 03
LOCATION: Above Fitch, NY
DATE: September 2, 1998
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

PLATYHELMINTHES	TURBELLARIA	Undetermined Turbellaria	1
ANNELIDA			
OLIGOCHAETA		Undetermined Lumbricina	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	1
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	4
	Baetidae	Acentrella sp.	2
		Baetis flavistriga	6
		Baetis intercalaris	1
	Heptageniidae	Stenacron interpunctatum	1
		Stenonema sp.	2
	Caenidae	Caenis anceps	4
COLEOPTERA	Elmidae	Optioservus trivittatus	3
		Stenelmis sp.	1
	Curculionidae	Undetermined Curculionidae	1
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	2
		Chimarra obscura	1
	Hydropsychidae	Cheumatopsyche sp.	15
		Hydropsyche betteni	2
		Hydropsyche bronta	9
		Hydropsyche slossonae	3
	Rhyacophilidae	Rhyacophila sp.	1
DIPTERA	Tipulidae	Hexatoma sp.	2
	Ceratopogonidae	Undetermined Ceratopogonidae	1
	Simuliidae	Simulium tuberosum	1
		Simulium vittatum	4
	Chironomidae	Cardiocladius obscurus	2
		Cricotopus bicinctus	6
		Cricotopus trifascia gr.	1
		Parametriocnemus lundbecki	2
		Tvetenia bavarica gr.	1
		Microtendipes pedellus gr.	2
		Microtendipes rydalensis gr.	1
		Polypedilum aviceps	1
		Polypedilum convictum	8
		Polypedilum illinoense	2
		Micropsectra sp.	4
		Tanytarsus guerlus gr.	1

SPECIES RICHNESS 36 (excellent)
BIOTIC INDEX 5.20 (good)
EPT RICHNESS 14 (excellent)
MODEL AFFINITY 66 (excellent)
ASSESSMENT non-impacted
DESCRIPTION The kick sample was taken 150 meters upstream of the Coal Chutes Road bridge, downstream of Cadiz. The water was more turbid than at upstream sites, with a gray clay appearance. Indices placed the water quality assessment as non-impacted, although siltation, nutrient enrichment, and complex discharges were indicated by ISD to be possible impactors.

STREAM SITE:	Ischua Creek Station 05
LOCATION:	Ischua, NY
DATE:	September 2, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	5
	Baetidae	Baetis flavistriga	5
		Baetis intercalaris	17
	Heptageniidae	Stenonema sp.	2
	Caenidae	Caenis anceps	3
PLECOPTERA	Perlidae	Acroneuria carolinensis	1
COLEOPTERA	Psephenidae	Psephenus herricki	3
	Elmidae	Optioservus trivittatus	5
		Stenelmis sp.	2
TRICHOPTERA	Philopotamidae	Chimarra obscura	5
		Chimarra socia	1
	Hydropsychidae	Cheumatopsyche sp.	1
		Hydropsyche bronta	1
		Hydropsyche morosa	23
DIPTERA	Tipulidae	Antocha sp.	3
		Hexatoma sp.	2
	Simuliidae	Simulium sp.	1
	Athericidae	Atherix sp.	2
	Chironomidae	Cardiocladius obscurus	4
		Cricotopus bicinctus	5
		Cricotopus trifascia gr.	2
		Eukiefferiella devonica gr.	1
		Parametriocnemus lundbecki	1
		Polypedilum convictum	4
		Sublettea coffmani	1

SPECIES RICHNESS	25 (good)
BIOTIC INDEX	4.80 (good)
EPT RICHNESS	11 (excellent)
MODEL AFFINITY	79 (excellent)
ASSESSMENT	non-impacted

DESCRIPTION The sampling site was just below the Old Dutch Hill Road bridge downstream o 'Ischua. The riffle was considered adequate, and the resident invertebrate fauna yielded indices mostly in the non-impacted ran ;e. Impact Source Determination showed highest similarities to natural communities.

STREAM SITE:	Ischua Creek Station 07
LOCATION:	Maplehurst, NY
DATE:	September 2, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA			
CRUSTACEA			
DECAPODA	Cambaridae	Cambarus sp.	1
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	4
	Baetidae	Baetis flavistriga	3
		Baetis intercalaris	8
	Heptageniidae	Stenonema vicarium	10
	Ephemerellidae	Undetermined Ephemerellidae	1
	Caenidae	Caenis anceps	2
PLECOPTERA	Perlidae	Paragnetina media	3
COLEOPTERA	Psephenidae	Psephenus herricki	1
	Elmidae	Optioservus trivittatus	7
		Stenelmis sp.	1
TRICHOPTERA	Philopotamidae	Chimarra obscura	6
	Hydropsychidae	Cheumatopsyche sp.	3
		Hydropsyche bronta	3
		Hydropsyche morosa	17
DIPTERA	Tipulidae	Antocha sp.	2
		Hexatoma sp.	3
	Simuliidae	Simulium jenningsi	5
	Chironomidae	Cardiocladius obscurus	6
		Cricotopus trifascia gr.	6
		Microtendipes pedellus gr.	1
		Polypedilum convictum	7

SPECIES RICHNESS	22 (good)
BIOTIC INDEX	4.57 (good)
EPT RICHNESS	11 (excellent)
MODEL AFFINITY	80 (excellent)
ASSESSMENT	non-impacted

DESCRIPTION The kick sample was taken in a riffle 20 meters upstream of the Mill Street Bridge at Maplehurst, upstream of Hinsdale. The riffle was a good invertebrate habitat, and the invertebrate fauna was similar to that at upstream Station 5. Water quality was similarly assessed as non-impacted.

LABORATORY DATA SUMMARY				
STREAM NAME: Ischua Creek DATE SAMPLED: September 2, 1998 SAMPLING METHOD: Traveling kick		DRAINAGE: 02 COUNTY: Cattaraugus		
STATION LOCATION	A above Franklinville	01A opp. golf course	01 Franklinville	02 Cadiz
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Optioservus ovalis 31 intolerant beetle	Optioservus sp. 30 intolerant beetle	Hydropsyche slossonae 29 intolerant caddisfly	Isonychia bicolor 15 intolerant mayfly
2.	Hydropsyche slossonae 18 intolerant caddisfly	Simulium vittatum 23 facultative black fly	Optioservus ovalis 17 intolerant beetle	Simulium vittatum 14 facultative black fly
3.	Sphaerium sp. 8 facultative clam	Hydropsyche slossonae 11 intolerant caddisfly	Simulium vittatum 12 facultative black fly	Optioservus ovalis 11 intolerant beetle
4.	Atherix sp. 5 intolerant snipe fly	Baetis flavistriga 10 intolerant mayfly	Baetis flavistriga 10 intolerant mayfly	Optioservus trivittatus 9 intolerant beetle
5.	Baetis brunneicolor 5 intolerant mayfly	Pagastia sp. A 7 intolerant midge	Chimarra aterrima? 9 intolerant caddisfly	Cheumatopsyche sp. 6 facultative caddisfly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	8 (4)	17 (6)	8 (5)	21 (11)
Trichoptera (caddisflies)	18 (1)	17 (4)	46 (4)	16 (7)
Ephemeroptera (mayflies)	13 (3)	12 (3)	16 (5)	24 (4)
Plecoptera (stoneflies)	4 (1)	0 (0)	0 (0)	0 (0)
Coleoptera (beetles)	37 (3)	30 (1)	17 (1)	20 (2)
Oligochaeta (worms)	0 (0)	0 (0)	0 (0)	1 (1)
Other (**)	20 (7)	24 (2)	13 (2)	18 (4)
TOTAL	100 (19)	100 (16)	100 (17)	100 (29)
SPECIES RICHNESS	19	16	17	29
HILSENHOFF BIOTIC INDEX	4.18	4.70	4.64	4.42
EPT RICHNESS	5	7	9	11
PERCENT MODEL AFFINITY	55	59	54	75
FIELD ASSESSMENT	non-impacted	slightly impacted	slightly impacted	non-impacted
OVERALL ASSESSMENT	non-impacted	slightly impacted	slightly impacted	non-impacted

** black flies (Stations A, 1A, 1, 2), fingernail clams (Station A), crayfish (Station A), crane flies (Station 2)

LABORATORY DATA SUMMARY				
STREAM NAME: Ischua Creek DATE SAMPLED: September 2, 1998 SAMPLING METHOD: Traveling kick		DRAINAGE: 02 COUNTY: Cattaraugus		
STATION LOCATION	03 below Cadiz	05 below Ischua	07 Maplehurst	
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Cheumatopsyche sp. 15 facultative caddisfly	Hydropsyche morosa 23 facultative caddisfly	Hydropsyche morosa 17 facultative caddisfly	
2.	Hydropsyche bronta 9 facultative caddisfly	Baetis intercalaris 17 facultative mayfly	Stenonema vicarium 10 intolerant mayfly	
3.	Polypedilum convictum 8 facultative midge	Cricotopus bicinctus 5 tolerant midge	Baetis intercalaris 8 facultative mayfly	
4.	Cricotopus bicinctus 6 tolerant midge	Isonychia bicolor 5 intolerant mayfly	Optioservus trivittatus 7 intolerant beetle	
5.	Baetis flavistriga 6 intolerant mayfly	Baetis flavistriga 5 intolerant mayfly	Polypedilum convictum 7 facultative midge	
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	31 (12)	18 (7)	20 (4)	
Trichoptera (caddisflies)	33 (7)	31 (5)	29 (4)	
Ephemeroptera (mayflies)	20 (7)	32 (5)	28 (6)	
Plecoptera (stoneflies)	0 (0)	1 (1)	3 (1)	
Coleoptera (beetles)	5 (3)	10 (3)	9 (3)	
Oligochaeta (worms)	1 (1)	0 (0)	0 (0)	
Other (**)	10 (6)	8 (4)	11 (4)	
TOTAL	100 (36)	100 (25)	100 (22)	
SPECIES RICHNESS	36	25	22	
HILSENHOFF BIOTIC INDEX	5.20	4.80	4.57	
EPT RICHNESS	14	11	11	
PERCENT MODEL AFFINITY	66	79	80	
FIELD ASSESSMENT	non-impacted	non-impacted	non-impacted	
OVERALL ASSESSMENT	non-impacted	non-impacted	non-impacted	

** black flies (Stations 3, 5, 7)

FIELD DATA SUMMARY

STREAM NAME: Ischua Creek
REACH: above Franklinville to mouth **DATE SAMPLED 09/02/1998**
FIELD PERSONNEL INVOLVED: Abele, Novak

STATION	A	01A	01	02
ARRIVAL TIME AT STATION	8:30	10:10	11:05	11:45
LOCATION	above Franklinville	above Ischua Valley golf course	Franklinville - below golf course	Cadiz - Rt. 98 bridge
PHYSICAL CHARACTERISTICS				
Width (meters)	4	7	10	10
Depth (meters)	0.2	0.1	0.2	0.3
Current speed (cm per sec.)	100	-	100	80
Substrate (%)				
rock (> 10 in., or bedrock)			10	
rubble (2.5 - 10 in.)		10	20	40
gravel (0.08 - 2.5 in.)	40	40	30	30
sand (0.06 - 2.0 mm)	40	30	20	20
silt (0.004 - 0.06 mm)	20	20	20	10
clay (< 0.004 mm)				
Embeddedness (%)	50	30	30	20
CHEMICAL MEASUREMENTS				
temperature (° C)	13.9	13.3	14.8	15.8
specific conductance (μmhos)	413	426	420	429
D.O. (mg per l)	8.0	8.3	7.5	8.4
pH	7.8	7.9	7.9	8.0
BIOLOGICAL ATTRIBUTES				
canopy (%)	90	50	30	40
Aquatic Vegetation				
algae - suspended in water column				
algae - attached, filamentous		present		
algae - diatoms			present	present
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	
Trichoptera (caddisflies)		X	X	X
Coleoptera (beetles)	X	X	X	X
Megaloptera (dobsonflies, alderflies)	X	X	X	
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X	X	X	X
Simuliidae (black flies)	X	X	X	X
Decapoda (crayfish)	X		X	
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)			X	
Other				
FIELD ASSESSMENT	non	slt	slt	non

FIELD DATA SUMMARY				
STREAM NAME: Ischua Creek REACH: above Franklinville to mouth — DATE SAMPLED: 09/02/1998 FIELD PERSONNEL INVOLVED: Abele, Novak				
STATION	03	05	07	
ARRIVAL TIME AT STATION	12:05	12:45	1:10	
LOCATION	below Cadiz - Coal Chute Rd.	Ischua - Old Dutch Hill Rd.	Maplehurst - Mill St. bridge	
PHYSICAL CHARACTERISTICS				
Width (meters)	8	20	5	
Depth (meters)	0.2	0.2	0.2	
Current speed (cm per sec.)	83	100	100	
Substrate (%)				
rock (> 10 in., or bedrock)				
rubble (2.5 - 10 in.)	30	30	20	
gravel (0.08 - 2.5 in.)	40	30	30	
sand (0.06 - 2.0 mm)	10	20	30	
silt (0.004 - 0.06 mm)	20	20	20	
clay (< 0.004 mm)				
Embeddedness (%)	30	40	30	
CHEMICAL MEASUREMENTS				
temperature (° C)	16.9	18.7	20.1	
specific conductance (μmhos)	408	375	344	
D.O. (mg per l)	8.1	9.4	11.4	
pH	7.9	8.1	8.6	
BIOLOGICAL ATTRIBUTES				
canopy (%)	30	40	0	
Aquatic Vegetation				
algae - suspended in water column				
algae - attached, filamentous	present		present	
algae - diatoms	present	present	present	
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	
Plecoptera (stoneflies)	X	X	X	
Trichoptera (caddisflies)	X	X	X	
Coleoptera (beetles)		X	X	
Megaloptera (dobsonflies, alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)		X	X	
Simuliidae (black flies)	X		X	
Decapoda (crayfish)			X	
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other	X			
FIELD ASSESSMENT	non	non	non	

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 to which rose bengal stain has been added.

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 and placed in a petri dish with alcohol. This portion is examined under a dissecting stereomicroscope and 100 organisms are removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. 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.

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 sample is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol.

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 excellent 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

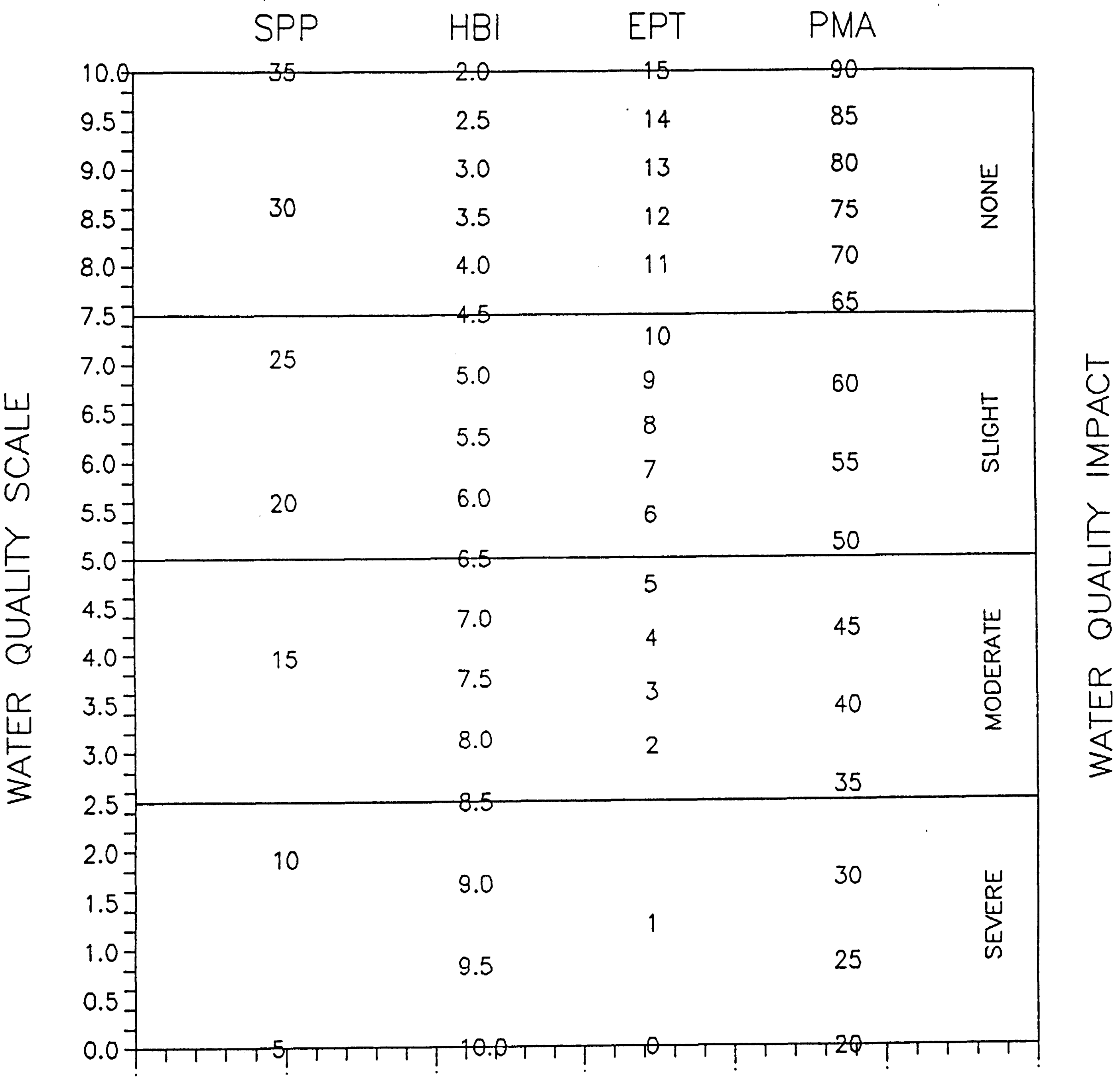
Indices reflect fair water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50. 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 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 is represented by a circle; this value is used for graphing trends between sites, and 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.

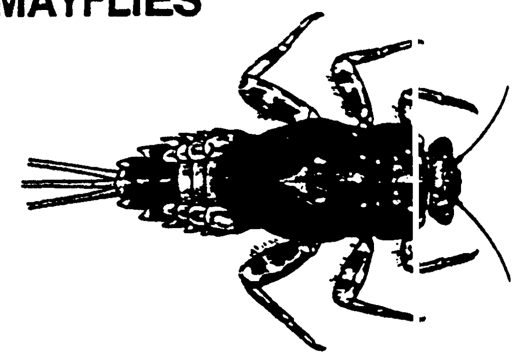
THE TRAVELING KICK SAMPLE

← CURRENT ——

Rocks and sediment in the stream riffle are dislodged by foot upstream of a net; dislodged organisms are carried by the current in the net. Sampling is continued for a specified time, gradually moving downstream to cover a specified distance.

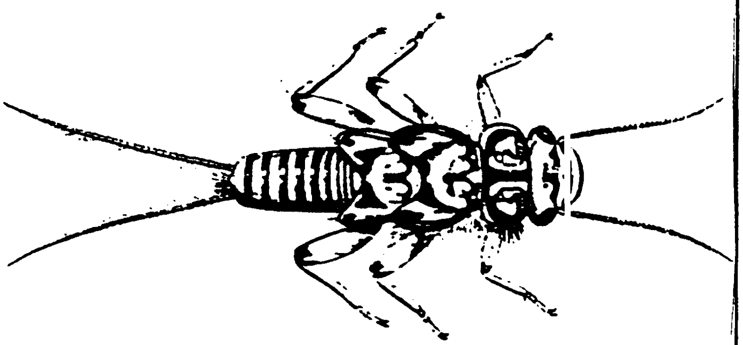
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

MAYFLIES



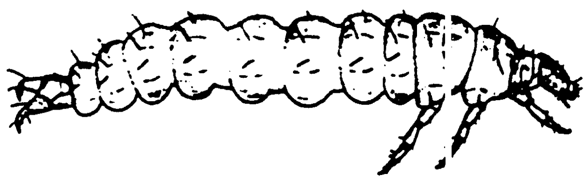
Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.

STONEFLIES



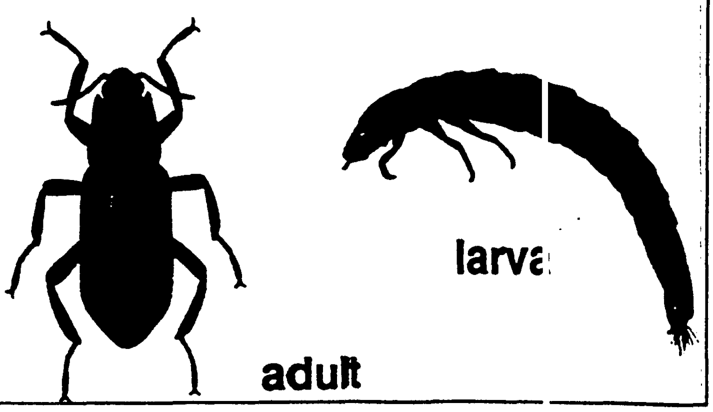
Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained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

CADDISFLIES



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 recovery zones below sewage discharges.

BEETLES



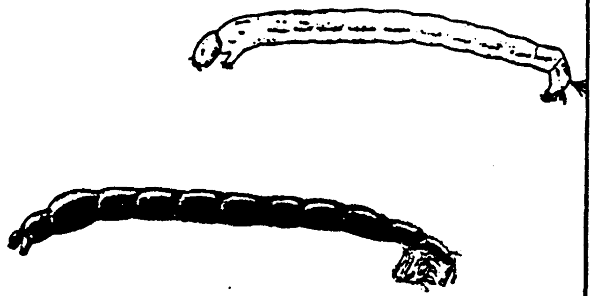
The most common beetles in streams are riffle beetles and water pennies. Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.

Illustrations by Arwin Provonsha
In McCafferty: Aquatic Entomology

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

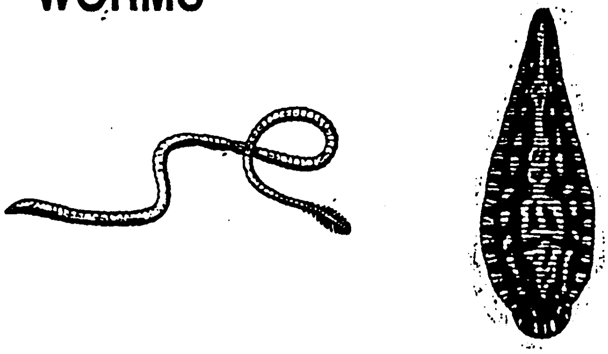
MIDGES

Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution; most of these are red and are called "bloodworms". Other species filter suspended food particles, and are numerous in sewage recovery zones.



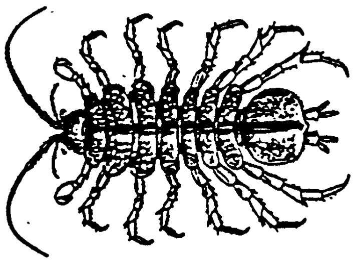
WORMS

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.



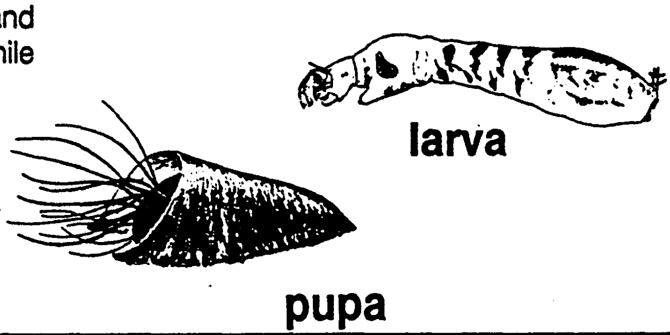
SOWBUGS

Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. When numerous they can indicate a stream segment in the recovery stage of sewage pollution.



BLACK FLIES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are numerous in the decomposition and recovery zones of sewage pollution, while others are intolerant of pollutants.



Illustrations by Arwin Provonsha
In McCafferty: Aquatic Entomology

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

multiplate: multiple-plate sampler, a type of artificial substrate sampler of aquatic macroinvertebrates

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. CHARACTERISTICS OF HEADWATER STREAM SITES

Headwater stream sites are defined as first-order or second-order stream locations close to the stream source, usually less than three miles. The natural characteristics of headwaters may sometimes result in an erroneous assessment of impacted water quality.

1) Headwater sites have reduced upstream recruitment resource populations to provide colonization by drift, and may have reduced species richness.

2) Headwater sites usually are nutrient-poor, lower in food resources, and less productive.

3) The reduced, simplified fauna of headwater sites may result in a community in which a few intolerant species may be very abundant. For 100-organism subsamples, this can affect many community indices: species richness, EPT richness, and percent model affinity. The dominant species averages 37% of the total fauna, and is an intolerant mayfly (e.g., Epeorus, Paraleptophlebia, or Stenonema), stonefly (e.g., Leuctridae or Capniidae), caddisfly (e.g., Brachycentrus, Dolophilodes, or Chimarra), or riffle beetle (e.g., Optioservus or Promoresia).

4) Although headwater stream invertebrate communities are dominated by intolerant species, many community indices are low. Average index values are: species richness - 19, EPT richness - 8, Hilsenhoff biotic index - 3.05, and percent model affinity - 57. These indices are based on headwaters of a number of streams across New York State.

5) Recommended corrective action for non-representative indices from headwater sites a correction factor of 1.5 may be applied to species richness, EPT richness, and percent model affinity. Criteria for the use of the correction factor are: the headwater location is as described above, the community is dominated by intolerant species, and the above indices (species richness, EPT richness, and percent model affinity) are judged to be non-representative of actual water quality. Alternatively, index values may be maintained, and the overall assessment may be adjusted up to non-impacted if the above criteria are met.

APPENDIX XI. 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 mostly 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: nonpoint nutrient additions, toxics, sewage effluent or animal wastes, municipal/industrial, siltation, impoundment, and natural. Cluster analysis was then performed within each group, using percent similarity, mostly at the family or genus level. Within each group different 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, the highest similarity of each source type is identified, and similarities that are within 5% of the highest. Similarities less than 50% are considered less conclusive. 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	-	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia	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
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
Psephenus	5	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	5	-	20	5	5	-	5	5	5	5	-	-	-
Promoresia	5	-	-	-	-	-	25	-	-	-	-	-	-
Stenelmis	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		-	-
Simulium vittatum	-	-	-	-	-	-	-	-	-	-		-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-		-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-		-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-		-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-		-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-		-	-
Cricotopus/ Orthocladius	5	5	-	-	10	-	-	5	-	-	5	5	5
Eukiefferiella/ Tvetenia	5	5	10	-	-	5	5	5	-	5	-	5	5
Parametriocnemus	-	-	-	-	-	-	-	5	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	20	-	-	10	20	20	5	-
Polypedilum (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									TOXIC				
	A	B	C	D	E	F	G	H	I	A	B	C	D	E
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-	5
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	-	10	20	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	5	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	10	10	-	20	10
GAMMARIDAE	-	-	-	5	-	-	-	-	-	5	-	-	-	5
Isonychia	-	-	-	-	-	-	-	5	-	-	-	-	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	15	10	20	-	-
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	5	-	-	5	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	5	-	-	5	-	5	5	-	-	-	-	-	-	-
Optioservus	10	-	10	5	-	-	15	5	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	15	-	10	15	5	25	5	10	10	15	-	40	35
PHILOPOTAMIDAE	15	5	-	5	-	25	5	-	-	10	-	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	20	10	15	10	35
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	5	-	20	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	-	-	-	-	-	5	-	-	5	10	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	10	15	10	5	-	-	-	-	5	15	10	25	10	5
Eukiefferiella/ Tvetenia	-	15	10	5	-	-	-	-	5	-	-	20	10	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	-	5	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	20	10	5	10	5	10	-	-	-	-
Tanytarsini	10	10	10	5	20	5	5	10	-	-	-	-	-	-
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100

	SEWAGE EFFLUENT, ANIMAL WASTES									MUNICIPAL/INDUSTRIAL					
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	40	-	-	-	5
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	20	20	70	10	-	20
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-	5	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	10	5	10	10	15	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	40	-	-	-	15	-
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	10	5	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	5	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Stenelmis	15	-	10	10	-	-	-	-	-	5	-	-	10	5	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	10	10	-	-	50	20	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	25	10	35	-	-	5	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	5	-	-	-	-	-	-	-	-	10	-	-	5	15
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5	10	20	-	5	10
Eukiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	60	-	30	10	10	-	-	-	10	20	40
Tanytarsini	10	10	10	10	-	-	-	10	20	-	-	-	10	10	-
TOTAL	100	100	100	100	100	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