New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

Sconondoa Creek

Biological Assessment

2007 Survey

New York State
Department of Environmental Conservation

BIOLOGICAL STREAM ASSESSMENT

Sconondoa Creek
Oneida County, New York
Seneca-Oswego-Oneida River Basins

Survey date: September 05, 2007
Report date: August 30, 2008

Alexander J. Smith
Robert W. Bode
Margaret A. Novak
Lawrence E. Abele
Diana L. Heitzman
Brian T. Duffy

Statewide Biomonitoring Unit
Bureau of Water Assessment and Management
Division of Water
NYS Department of Environmental Conservation
Albany, New York

Table of Contents

Stream: Sconondoa Creek

Reach: Vernon to Sconondoa, NY

River Basin: Seneca-Oswego-Oneida River Basins

Background

The Stream Biomonitoring Unit sampled six stations on Sconondoa Creek, Oneida County, New York, on September 5, 2007. Sampling was conducted to collect current information on water quality and compare results to a 1986 investigation. To characterize water quality based on benthic macroinvertebrate communities, a traveling kick sample was collected from riffle areas at each of the six sites. Methods used are 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 100-specimen subsamples from each site. Macroinvertebrate community parameters used in the determination of water quality included: species richness, biotic index, EPT richness, and percent model affinity (see Appendices II and III). The amount of expected variability of results is stated in Smith and Bode (2004). Table 1 provides a listing of sampling sites, and Table 4 provides a listing of all species collected in the present survey. This is followed by macroinvertebrate data reports, including raw data from each site.

Results and Conclusions

1. Sconondoa Creek is assessed as slightly impacted due to nonpoint source nutrient enrichment and naturally occurring elevated levels of specific conductance at all stations.

2. Water quality downstream of the Vernon Sewage Treatment Plant improved from moderately impaired in 1986 to slightly impacted in 2007.

3. As was the case in 1986, water quality did not appear affected by the Oneida Ltd. silver smith operation discharge.

4. Impact Source Determination and the Nutrient Biotic Indices indicated enrichment from non-point source nutrients in the watershed.

Discussion

Sconondoa Creek is a small tributary to Oneida Creek in Central NY, Oneida County, with a drainage area of approximately 38 square miles. From its confluence with Oneida Creek in Oneida, NY, to its source in the area of Lloyds Corners, the stream is classified as C(T) (See Appendix XII).

On September 5, 2007, the Stream Biomonitoring Unit (SBU) sampled benthic macroinvertebrate communities at six different locations on Sconondoa Creek (Figures 1-7) to assess current water quality and compare results to a 1986 investigation. In 1986, the SBU conducted a study to gather baseline water-quality information on the stream and determine the effects, if any, from the Vernon (V) sewage treatment plant (STP) and the Oneida Ltd. STP. The current survey used the same locations as in the 1986 study.

The 1986 study found moderate impact to Sconondoa Creek downstream of the Vernon STP (Station 03) (Figure 8). Upstream of the STP, water quality was considered slightly impacted. Some recovery was noted further downstream at Station 04 where water quality was considered slightly impacted again. No water quality impacts were found downstream of the Oneida Ltd. STP (Stations 05 and 06). Specific conductance was significantly elevated at all sites in 1986 and ranged from 1125 - 1210 μmhos/cm. This high conductivity was attributed to "natural geologic formations of evaporite deposits and carbonate rocks (R. Rogers, USGS District Office, Albany, NY; pers. comm.)."

Results of the 2007 SBU sampling found slightly impacted water quality at all stations including downstream of the Vernon STP (Station 03) (Figure 8). However, Station 03 did have the poorest water quality scores of all the sites. Downstream of Station 03 improvement in water quality scores occurs from Stations 04 to 06. No measurable changes in water quality were observed downstream of the Oneida Ltd. STP. Specific conductance was again recorded at elevated levels ranging from 1,507-1,900 μmhos/cm.

Compared to the 1986 survey, it appears the degree of water-quality degradation from the Vernon STP has improved. Water quality is now only slightly impacted at sites downstream of the discharge. This improvement in water quality from 1986 may in part be attributed to an extensive $1.4 million upgrade to the plant, which included a hydraulic expansion, more aeration tanks, a new final clarifier, and an aerobic digester. These upgrades have substantially improved the quality of the effluent entering Sconondoa Creek (D. Marcisofsky, NYSDEC Region 6, Utica Sub-office; pers. comm.).

As was the case in 1986, the Oneida Ltd. STP did not appear to have any detrimental affect on water quality and benthic biota in Sconondoa Creek in 2007. According to R. Coriale (NYSDEC Region 6, Utica Sub-office; pers. comm.) significant reductions in the operating capacity of the Oneida Silversmith Division (Oneida Ltd.) occurred since previous sampling events. The current discharge is so small (1/4 of capacity) that it is not expected to have any notable affect on the stream. This is evident in the results of the current survey.

Excess nutrients from nonpoint source runoff appear to be one of the major factors in determining water quality in the stream. The Nutrient Biotic Index (NBI) (Smith et al. 2007) suggests eutrophic conditions resulting from excess phosphorus (NBI-P) and nitrogen (NBI-N) (Figure 9) at all sites except for station 01. Impact Source Determination (ISD) identified nutrient enrichment, as well as sewage and municipal/industrial inputs, as the source of water-quality impacts (Table 3). A highly agricultural watershed, two animal operations are of concern and should be investigated further to determine how much they influence water quality in Sconondoa Creek: the Vernon Downs concentrated animal feed operation (CAFO), and an adjacent animal auction house. Both are located between sampling Stations 02 and 03. Therefore, some of the apparent reduction in water quality scores downstream of Station 02 may be the result of these and other operations in the area.

The naturally high specific conductance of Sconondoa Creek due to geologic formations in its watershed is an important consideration in assessing its water quality. Specific conductance is a measure of the ability of surface waters to conduct electrical currents. It is determined by measuring the concentration of charged-ion particles dissolved in the water; the greater the concentration, the higher the specific conductance.

Sources of charged particles in surface waters may come from many places, including weathering of carbonate geologic formations such as limestones, and evaporites, as well as man-made influences, including chlorides from road salt and runoff (Drever 1988; Hem 1989). In the Sconondoa Creek watershed, there are significant geologic formations in the Salina Group of bedrocks, including the Vernon, Cobleskill Limestone, Syracuse and Camillus Formations.

The Salina Group is unique in that it is composed of dolostones, shales and evaporates, including substantial layers of halite (salt) (Isachsen et al 2000). These formations make up a considerable part of the watershed area of Stations 01 and 02 (Figure 11), which explains the high specific conductance found throughout Sconondoa Creek (Table 2).

With elevated specific conductance above 1,500 μmhos/cm for all sites (Table 2), benthic macroinvertebrates may naturally be reduced to a limited community of facultative groups, such as species in the beetle family Elmidae, caddisfly family Hydropsychidae, and the midge family Chironomidae. These families are typical in water of slightly impacted quality.

Based on historical benthic macroinvertebrate sampling, the SBU has set a level of concern for specific conductance at 800 μmhos/cm, which corresponds to sites with median assessments of moderate impact (Appendix XIII). Therefore, non-impacted water quality in Sconondoa Creek may not be feasible in light of the naturally elevated specific conductance values. To determine a feasible level of water quality to strive for in the watershed, reference communities of streams with high conductance should be identified for comparison.

In summary, the Sconondoa Creek watershed has always been highly agricultural and the water quality of the stream has always reflected this. In addition, natural bedrock formations have contributed to elevated specific conductance in the stream, potentially reducing the benthic community. In the past, the Vernon STP also played a major role in determining water quality in the stream. Based on the current study, it appears that the influence of the Vernon STP has been reduced substantially. Nonpoint source nutrient enrichment is now the major anthropogenic source impacting water-quality and degrading benthic communities from their natural state. Investigation into the specific influences from agricultural operations in the watershed is warranted to improve water quality in Sconondoa Creek further.

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.

Drever, J. I. 1988. The Geochemistry of Natural Waters, 2nd Edition. Prentice Hall, Inc. Englewood Cliffs, N.J. 437 pages.

Hem, J. D. 1989. Study and Interpretation of the Chemical Characteristics of Natural Water, 3rd Edition. United States Geological Survey, Washington, D.C. Water-Supply Paper #2254.

Isachsen, Y. W., E. Landing, J. M. Lauber, L. V. Rickard, W. B. Rogers. 2000. Geology of New York, a Simplified Account, 2nd Edition. New York State Museum, Albany, NY. Educational Leaflet #28.

Smith, A. J., and R. W. Bode. 2004. *Analysis of Variability in New York State Benthic Macroinvertebrate Samples*. New York State Department of Environmental Conservation, Technical Report, 43 pages.

Smith, A. J., R. W. Bode, and G. S. Kleppel. 2007. *A nutrient biotic index (NBI) for use with benthic macroinvertebrate communities*. Ecological Indicators 7:371-386.

Table 1. Station locations for Sconondoa Creek, Oneida County, New York, 2007.

Station	Location
SCON-01	Vernon, NY Off Simmons Rd. 11.25 river miles above the mouth Latitude: 43.0300 Longitude: -75.5089
SCON -02	Vernon, NY Above Stuhlman Rd. bridge 7.61 river miles above the mouth Latitude: 43.0725 Longitude: -75.5269
SCON -03	Vernon, NY 1 km below Vernon STP discharge 5.54 river miles above the mouth Latitude: 43.0800 Longitude: -75.5589

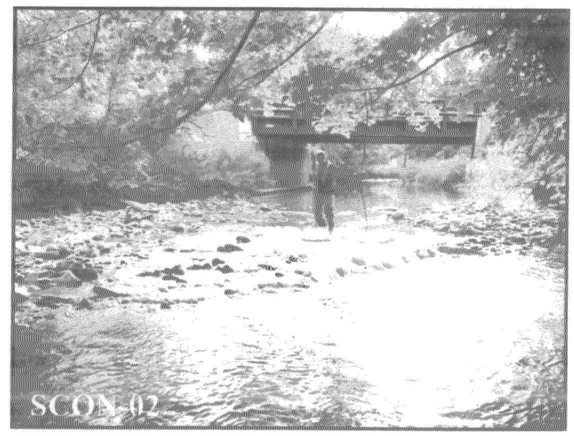
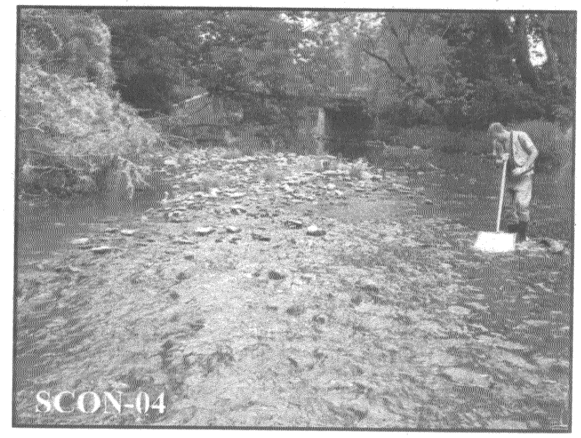
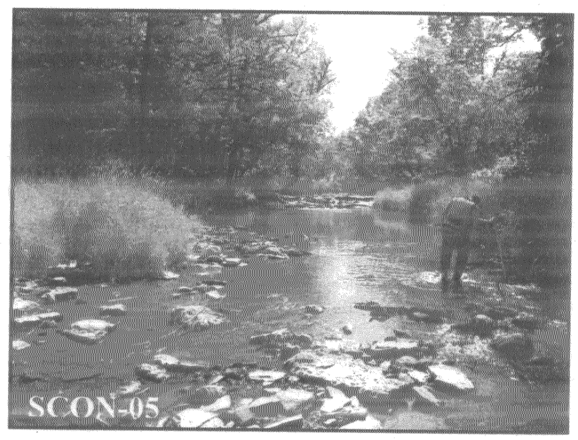
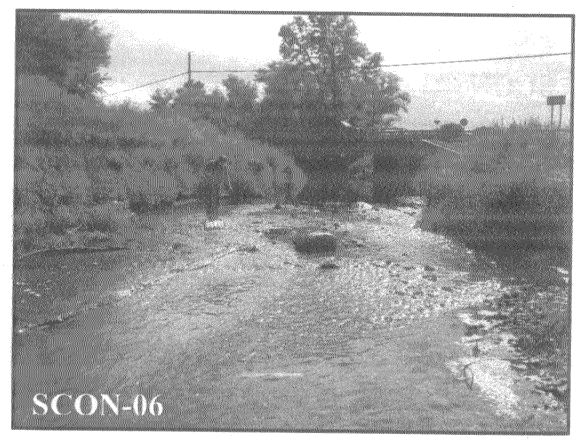


Table 1 cont'd. Station locations for Sconondoa Creek, Oneida County, New York, 2007.

Station	Location	
SCON-04	Vernon, NY Above Williams St. bridge 3.64 river miles above the mouth Latitude: 43.0797 Longitude: -75.5894	
SCON -05	Vernon, NY At Second St. bridge 1.83 river miles above the mouth Latitude: 43.0828 Longitude: -75.6219	
SCON -06	Vernon, NY 10 m below Rt. 365 bridge 0.92 river mile above the mouth Latitude: 43.0953 Longitude: -75.6250	

SCON-04

SCON-05

SCON-06

Figure 1. Watershed overview map, Sconondoa Creek, Oneida County, NY.

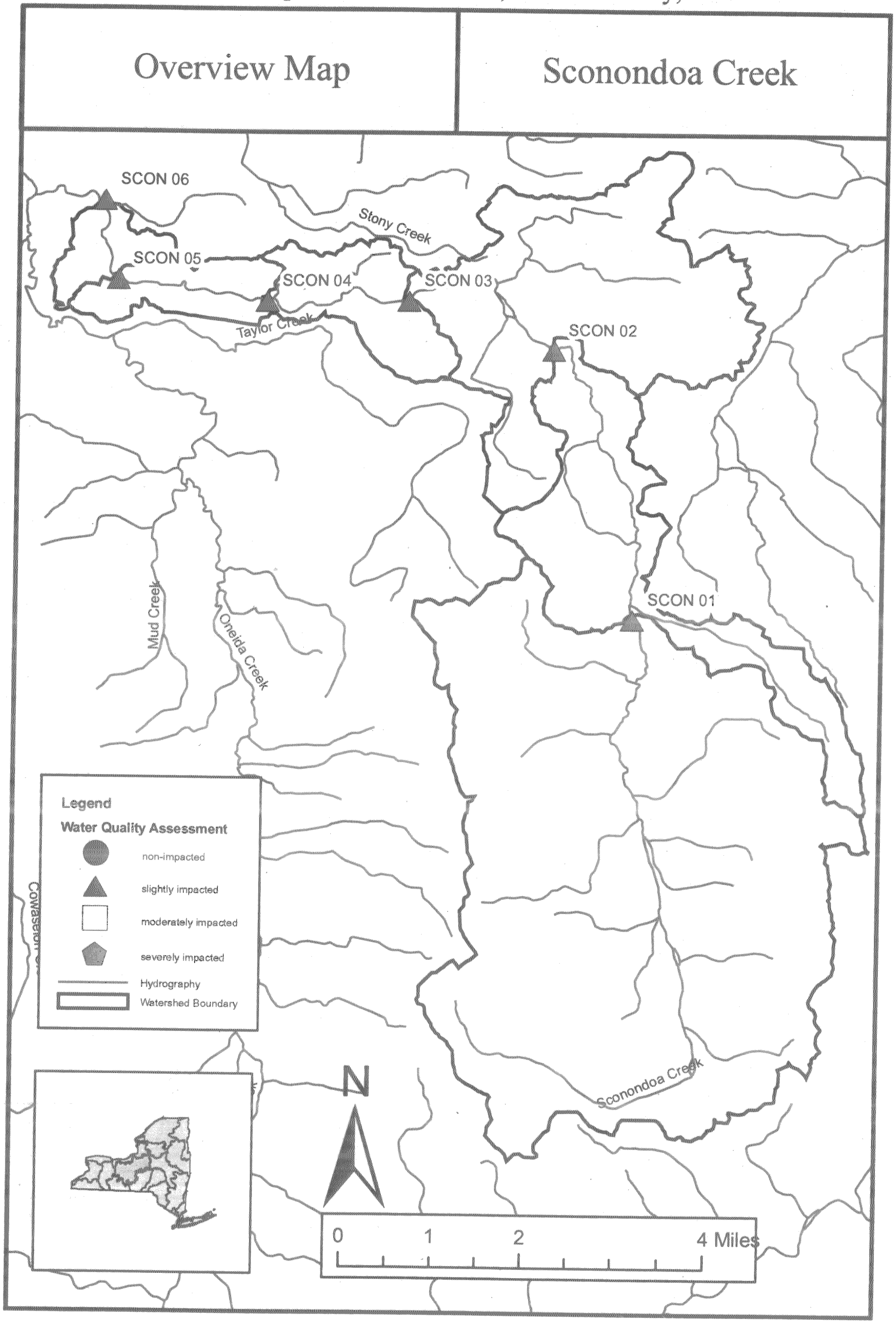


Figure 2. Map of Station 01.

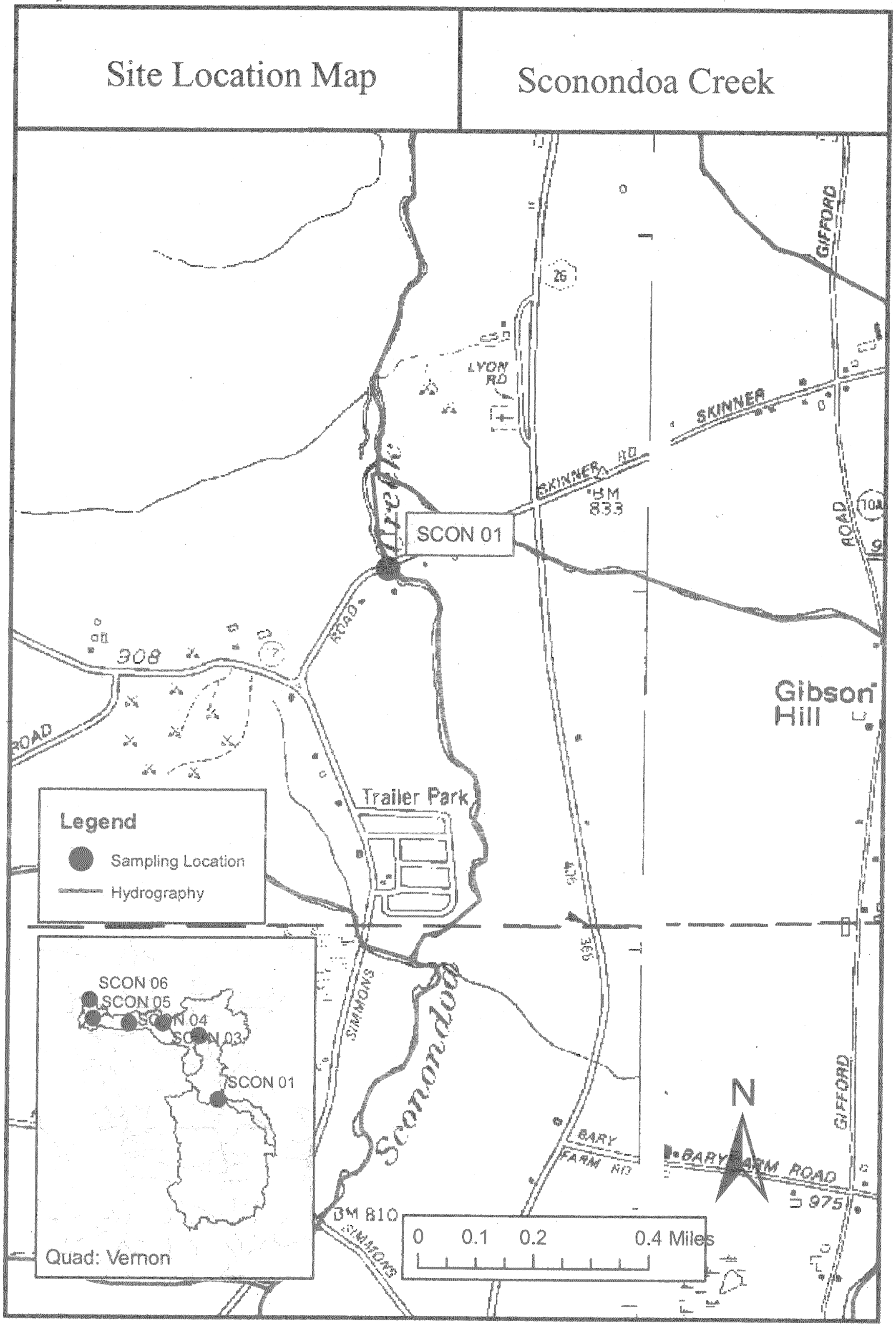


Figure 3. Map of Station 02.

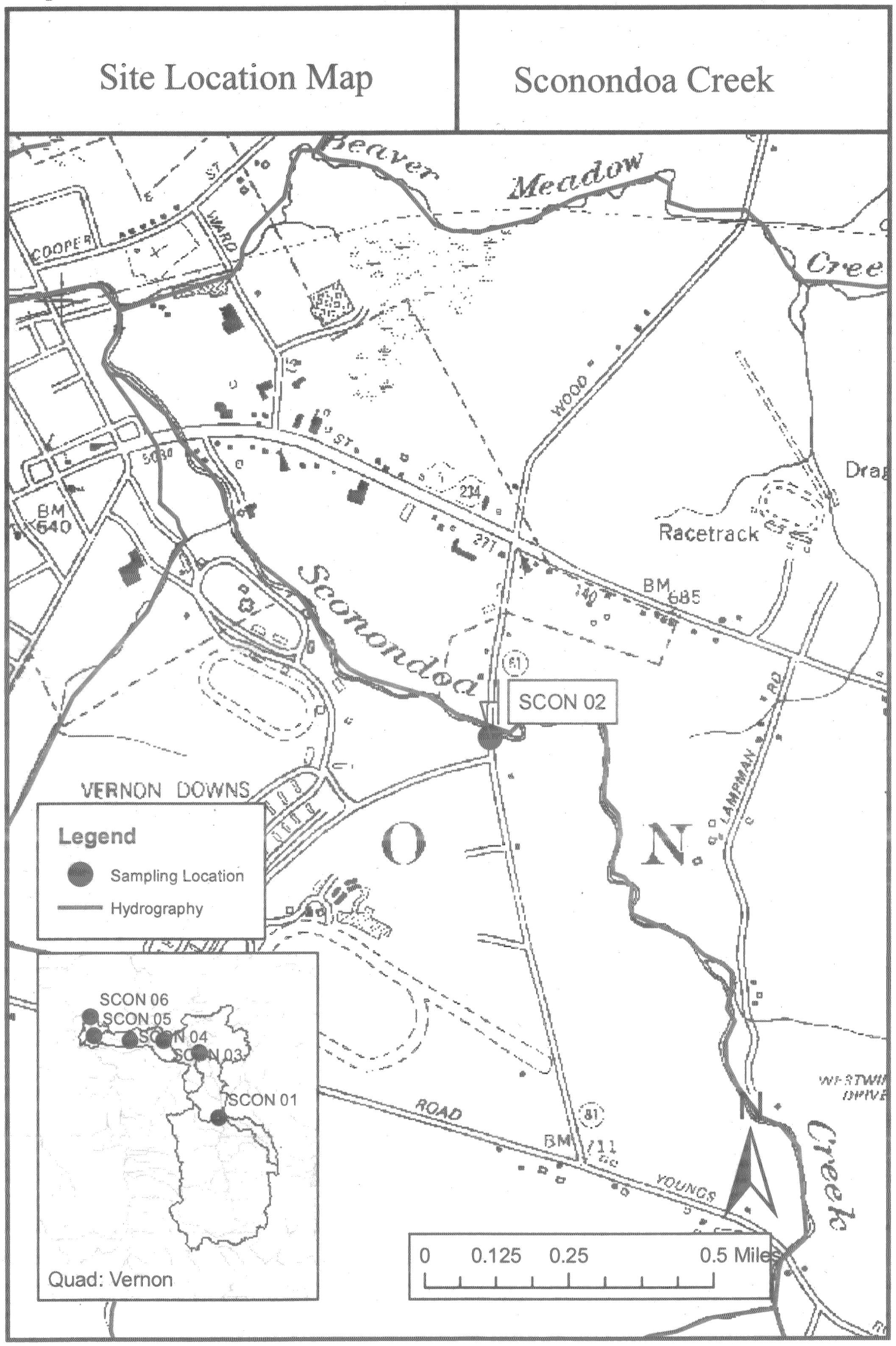


Figure 4. Map of Station 03

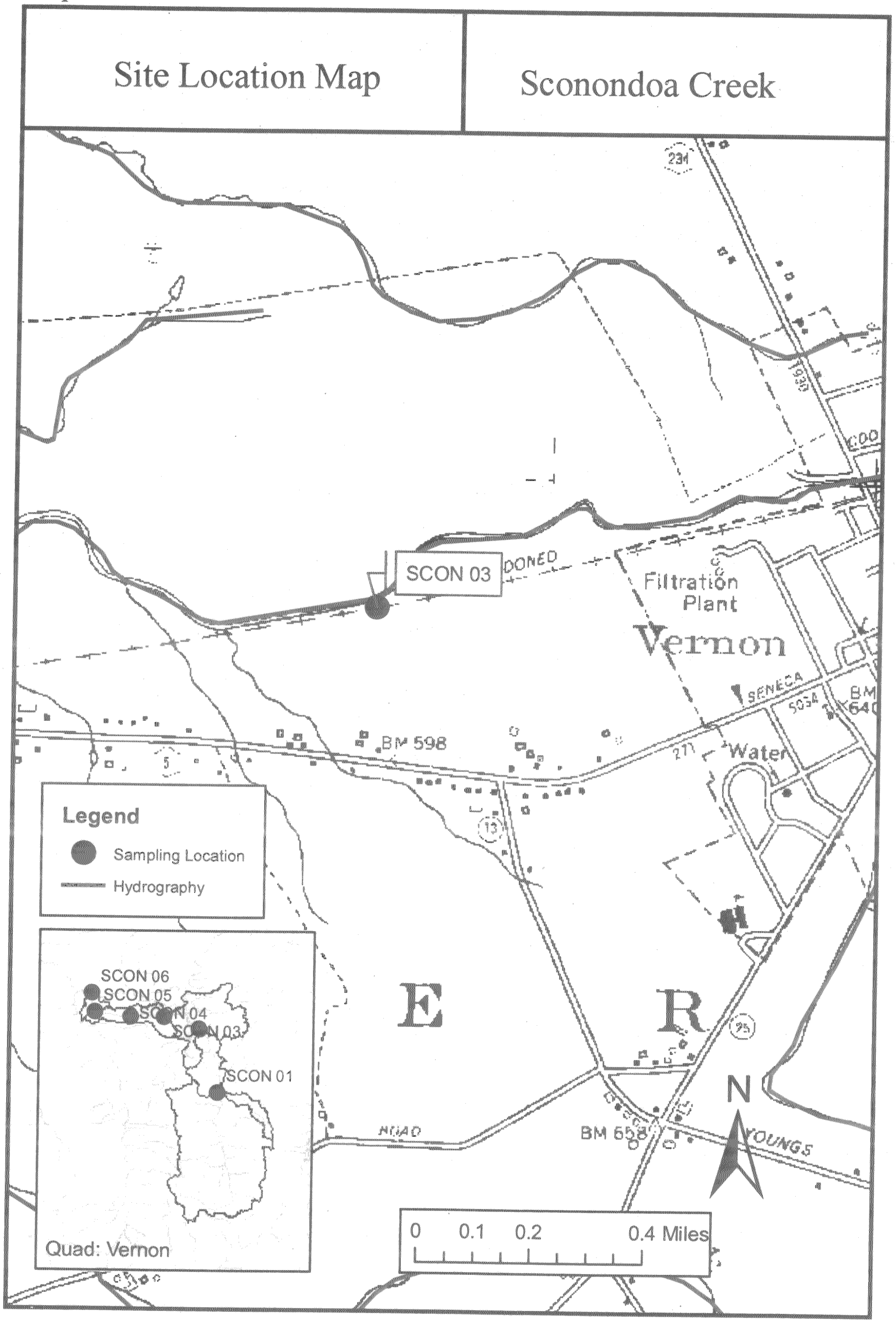


Figure 5. Map of Station 04.

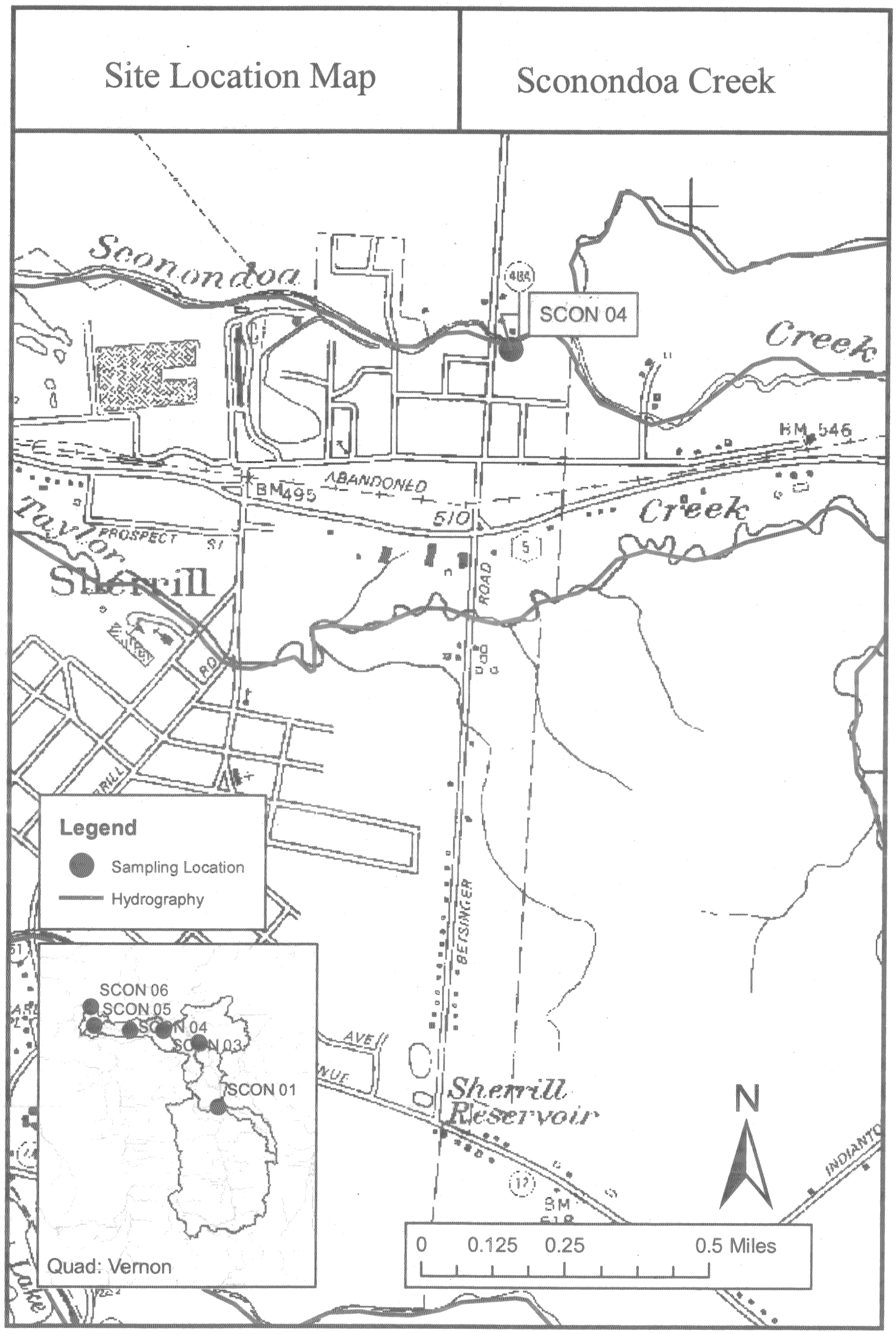


Figure 6. Map of Station 05.

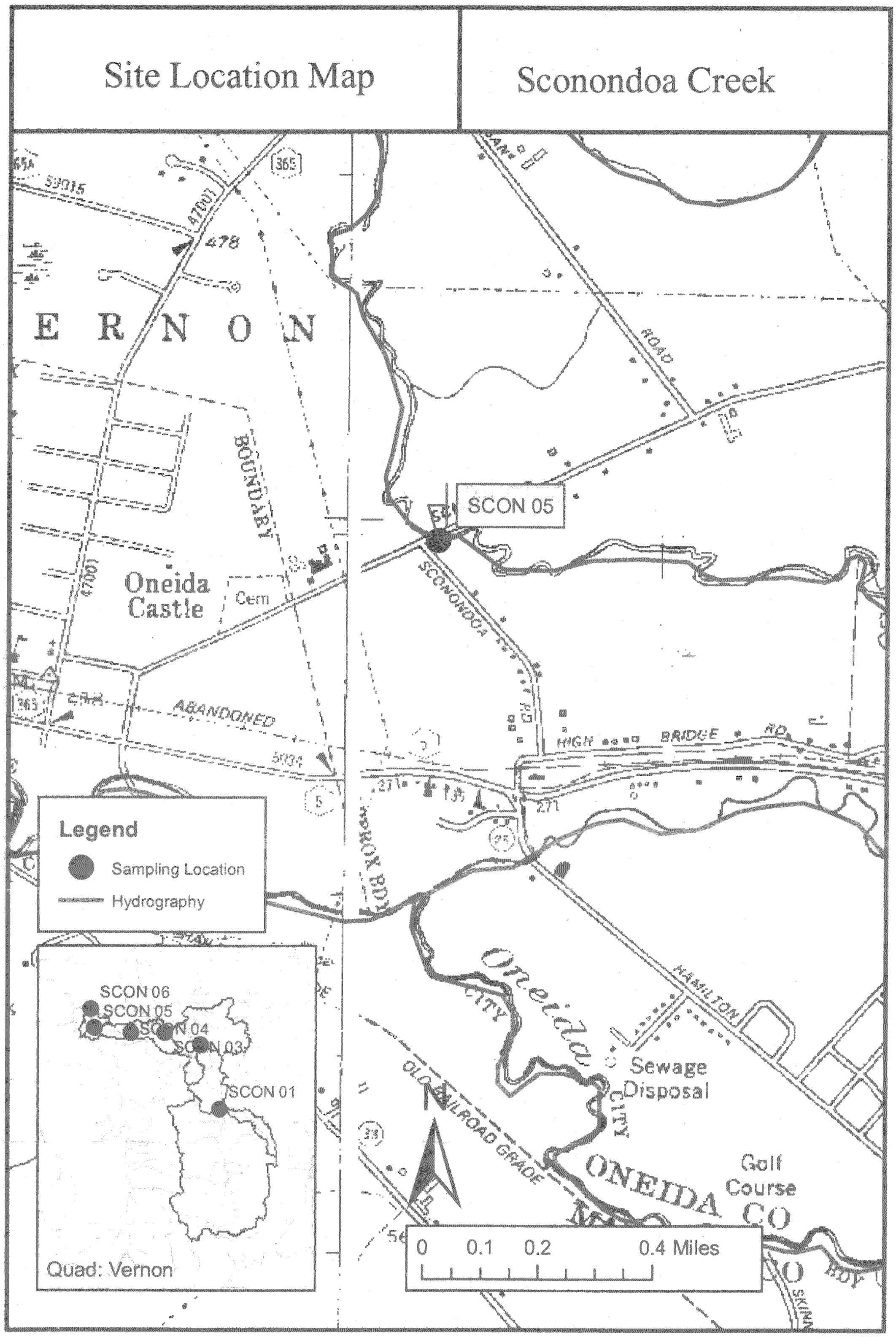


Figure 7. Map of Station 06.

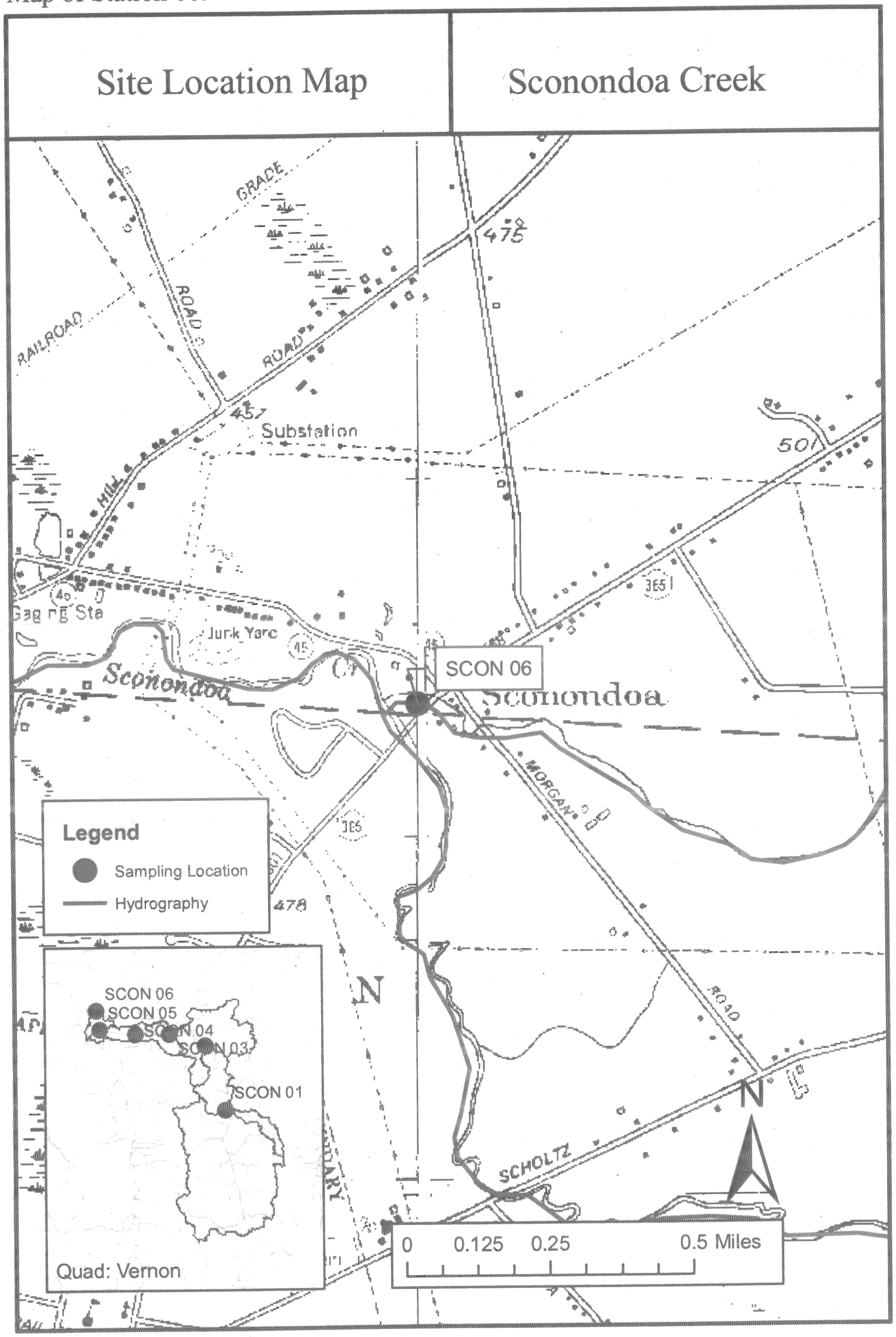


Figure 8. Biological Assessment Profile of index values, Sconondoa Creek, 2007 and 1986. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for a more complete explanation.

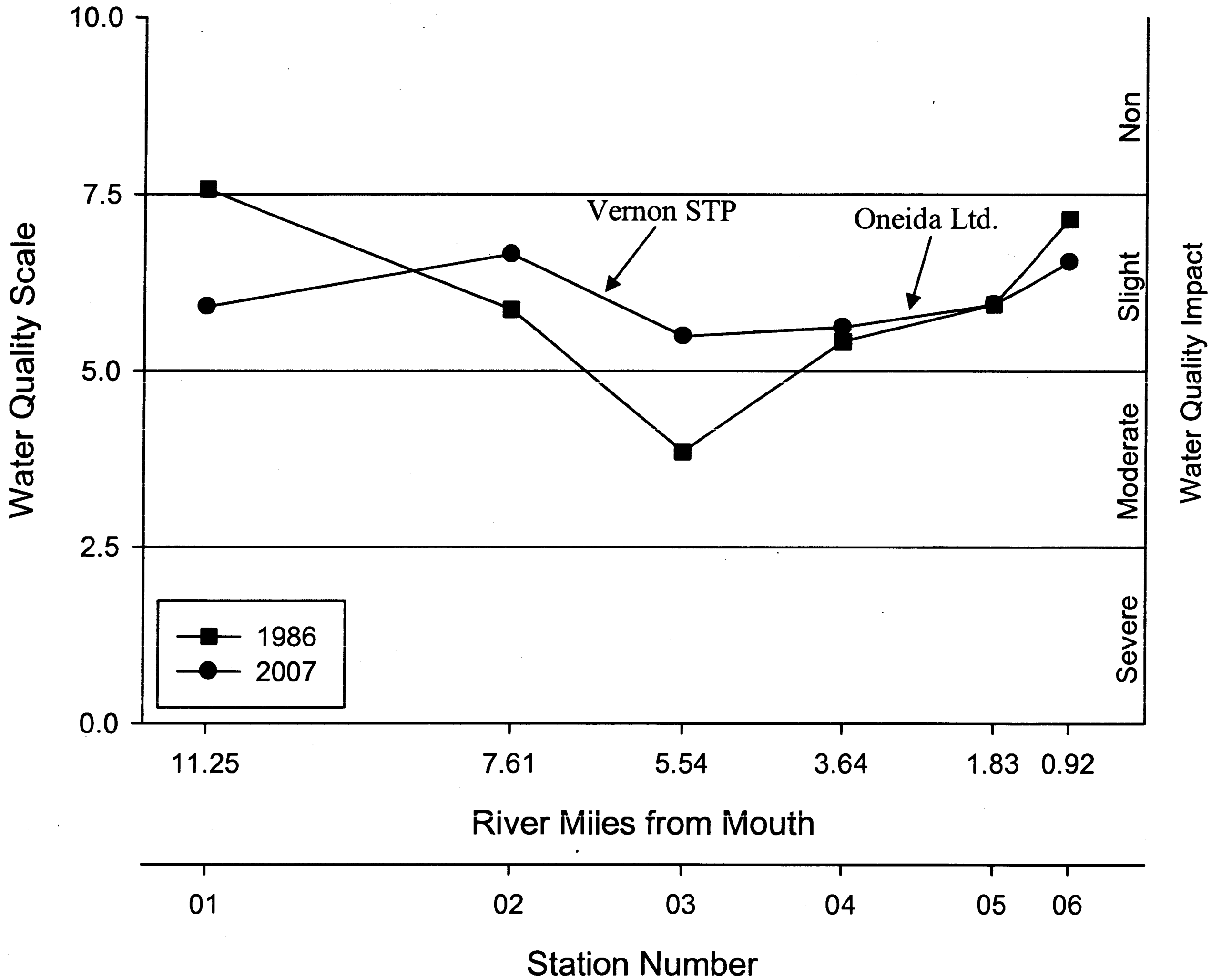


Table 2. Overview of field data

Location	Station	Depth	Width	Current	Canopy	Embed.	Temp.	Cond.	pH	DO	%Sat.
SCON	01	0.2	5	100	50	60	15.4	1722	7.5	8.6	91
SCON	02	0.2	10	75	20	60	16.3	1608	7.7	9.9	107
SCON	03	0.2	10	75	20	60	16.5	1647	7.9	10.0	118
SCON	04	0.1	8	80	0	50	18.3	1507	7.8	9.0	102
SCON	05	0.1	5	60	0	10	19.3	1639	7.8	9.4	100
SCON	06	0.2	10	80	80	60	13.6	1900	7.4	9.7	99

Figure 9. Nutrient Biotic Index values for Phosphorus (NBI-P) and Nitrogen (NBI-N). NBI values are plotted on a scale of eutrophication from oligotrophic to eutrophic. See Appendix X for a detailed explanation of the index.

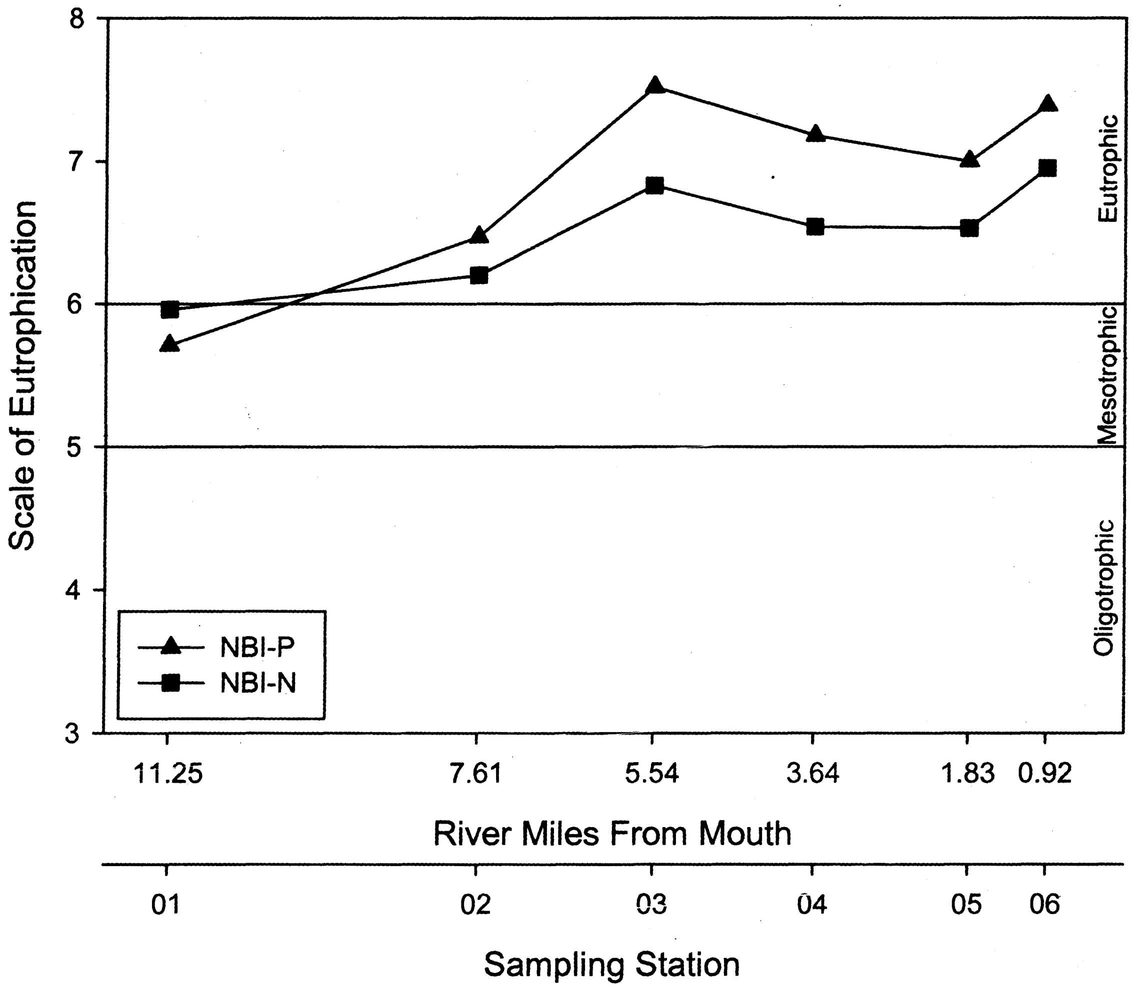


Table 3. Impact Source Determintation (ISD), Sconondoa Creek, 2007. Numbers represent percent similarity to community type models for each impact category. Highest similarities at each station are shaded. Similarities less than 50% are less conclusive. Highest numbers represent probable type of impact. See Appendix XI for further explanation.

Community Type	Station Number					
	01	02	03	04	05	06
Natural: minimal human disturbance	44	49	29	34	48	43
Nutrient Enrichment: mostly nonpoint, agricultural	53	48	59	65	66	61
Toxic: industrial, municipal, or urban run-off	41	56	54	57	52	49
Organic: sewage effluent, animal wastes	48	58	64	68	65	62
Complex: municipal/industrial	48	56	62	65	61	57
Siltation	40	55	55	56	50	57
Impoundment	53	59	58	63	60	52

Summary of ISD results

Station	Community Type
SCON-01	Nutrient Enrichment *
SCON-02	Organic / Toxic / Complex / Siltation *
SCON-03	Organic / Complex / Nutrient Enrichment
SCON-04	Organic / Nutrient Enrichment / Complex *
SCON-05	Nutrient Enrichment / Organic / Complex
SCON-06	Organic / Nutrient Enrichment / Complex / Siltation

* ISD results that identify impoundment effects are considered spurious in this dataset because no impoundments are known upstream of these locations. In situations where there are multiple stressors acting on the community simultaneously, as is the case in Sconondoa Creek, ISD will identify impoundments as a possible impact source.

Figure 10. Percent land cover for major landuse types within the Sconondoa Creek sampling point watersheds. Land cover data was generated using the 2006 National Land Cover Dataset.

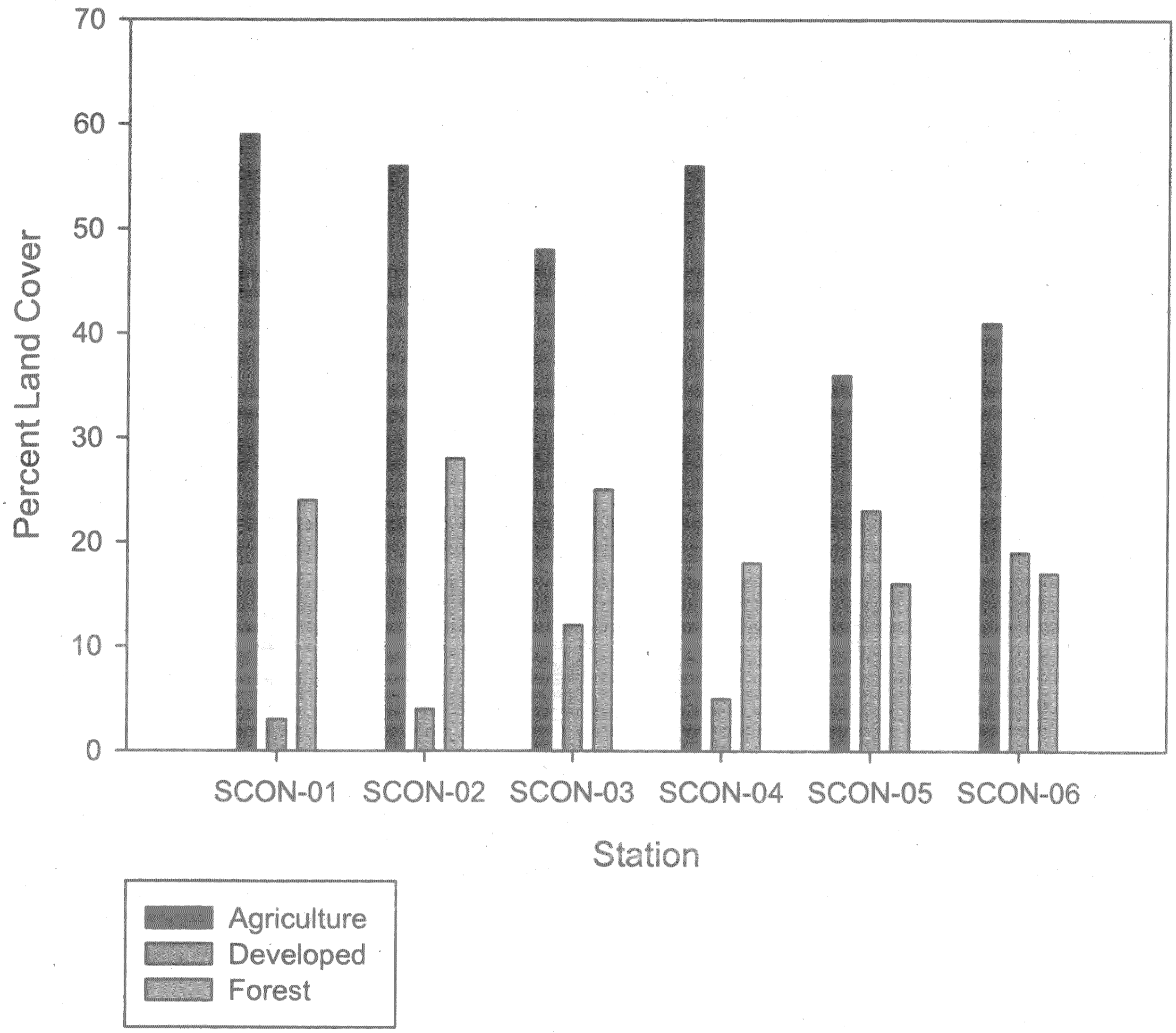


Figure 11. Percent of bedrock geologic formations in Sconondoa Creek watersheds. Vernon, Cobleskill Limestone, Syracuse and Camillus formations are all within the Salina Group of underlying bedrock, which is known to have significant layers of halite sometimes up to several meters thick. Many of these encompass large areas of the Sconondoa Creek watershed, especially in its upper reaches.

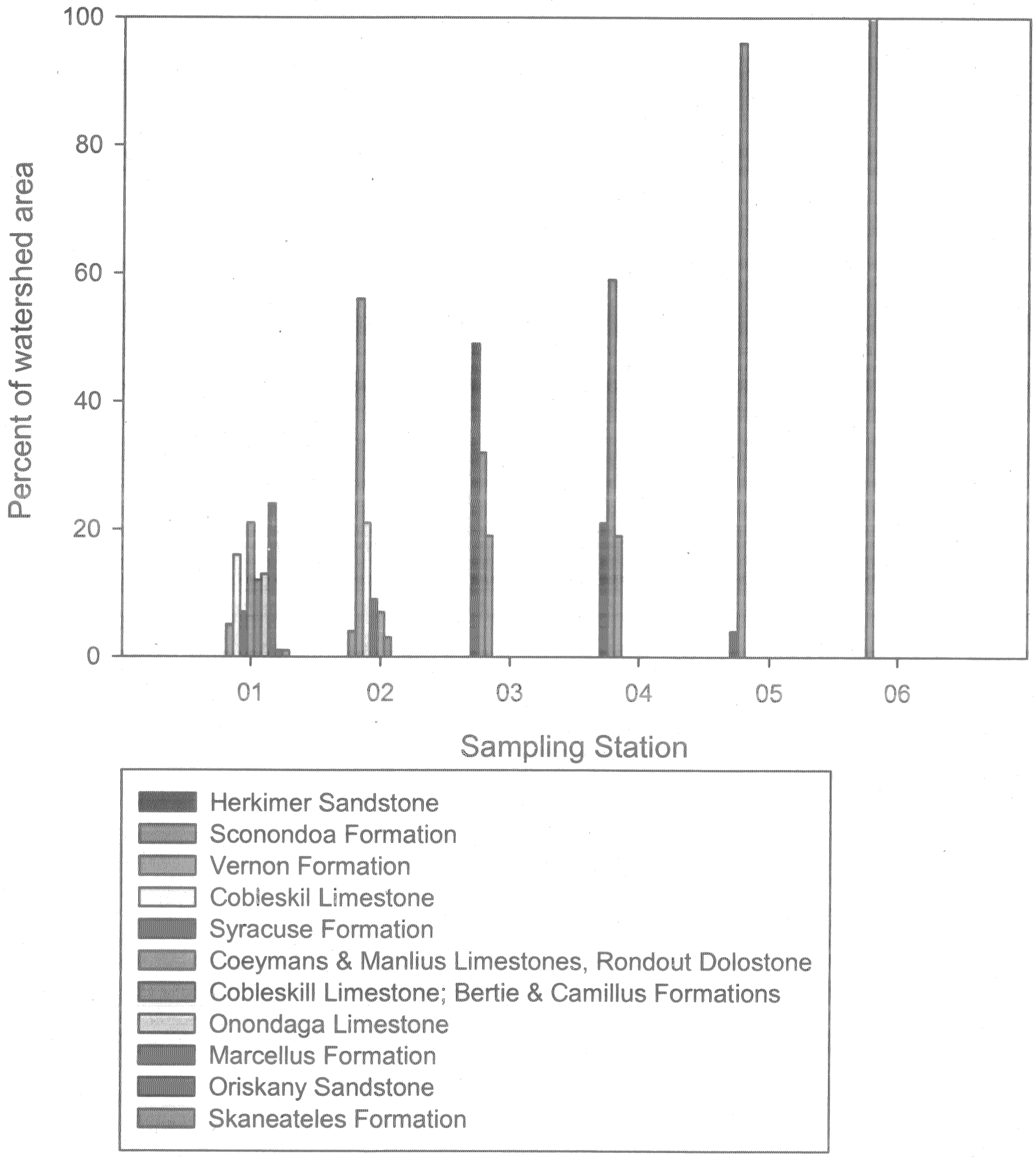


Table 4. Macroinvertebrate species collected in Sconondoa Creek, Oneida County, NY, 2007.

PLATYHELMINTHES
TURBELLARIA
TRICLADIDA
Undetermined Turbellaria

ANNELIDA
OLIGOCHAETA
LUMBRICIDA
Undetermined Lumbricina

TUBIFICIDA
Tubificidae
Undet. Tubificidae w/o cap. setae
Undetermined Oligochaeta

MOLLUSCA
PELECYPODA
VENEROIDEA
Sphaeriidae
Pisidium sp.
Undetermined Sphaeriidae

ARTHROPODA
DIPLOPODA
POLYDESMIDA
Undetermined Polydesmida

INSECTA
EPHEMEROPTERA
Baetidae
Acentrella sp.
Baetis flavistriga
Baetis intercalaris
Heptageniidae
Stenacron interpunctatum
Stenonema terminatum
Stenonema vicarium
Stenonema sp.
Ephemerellidae
Serratella sp.

PLECOPTERA
Perlidae
Agnetina capitata

COLEOPTERA
Psephenidae
Ectopria nervosa
Psephenus herricki
Elmidae
Optioservus fastiditus
Optioservus trivittatus
Optioservus sp.
Promoresia elegans
Promoresia tardella
Stenelmis crenata

MEGALOPTERA
Nigronia serricornis

TRICHOPTERA
Philopotamidae
Chimarra aterrima?
Chimarra obscura
Hydropsychidae
Arctopsyche sp.
Cheumatopsyche sp.
Hydropsyche betteni
Hydropsyche bronta
Hydropsyche scalaris
Hydropsyche slossonae
Hydropsyche sparna
Rhyacophilidae
Rhyacophila mainensis
Helicopsychidae
Helicopsyche borealis

DIPTERA
Tipulidae
Antocha sp.
~~Athericidae~~
Atherix sp.
Empididae
Hemerodromia sp.
Chironomidae
Thienemannimyia gr. spp.
Diamesa sp.
Pagastia orthogonia
Cricotopus bicinctus
Cricotopus trifascia gr.
Eukiefferiella brehmi gr.
Tvetenia vitracies
Dicrotendipes neomodestus
Polypedilum flavum
Paratanytarsus sp.
Rheotanytarsus exiguus gr.
Sublettea coffmani
Tanytarsus glabrescens gr.
Tanytarsus guerlus gr.

Table 5. Macroinvertebrate Data Report (MDR), Station 01

STREAM SITE:	Sconondoa Creek, Station 01
LOCATION:	Vernon, NY
DATE:	9/5/2007
SAMPLE TYPE:	Kick
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	3
ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Undet. Tubificidae w/o cap. setae	3
MOLLUSCA			
PELECYPODA			
VENEROIDEA	Sphaeriidae	Undetermined Sphaeriidae	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Ephemerellidae	*Serratella* sp.	9
COLEOPTERA	Elmidae	*Optioservus fastiditus*	7
		Promoresia tardella	14
TRICHOPTERA	Hydropsychidae	*Cheumatopsyche* sp.	22
		Hydropsyche betteni	1
		Hydropsyche bronta	5
		Hydropsyche slossonae	4
		Hydropsyche sparna	11
DIPTERA	Empididae	*Hemerodromia* sp.	2
	Chironomidae	*Pagastia orthogonia*	1
		Eukiefferiella brehmi gr.	5
		Tvetenia vitracies	10
		Rheotanytarsus exiguus gr.	1
		Sublettea coffmani	1
		SPECIES RICHNESS:	17
		BIOTIC INDEX:	4.5
		EPT RICHNESS:	6
		MODEL AFFINITY:	56
		ASSESSMENT:	slight

Description: The sample for station 01 was collected from a riffle immediately downstream of the Simmons Road bridge. An abundant amount of algae was noted on the stream substrate. The invertebrate community had low biomass and was made up mostly of caddisflies and beetles. This site was assessed as slightly impacted.

Table 6. Macroinvertebrate Data Report (MDR), Station 02

STREAM SITE:	Sconondoa Creek, Station 02
LOCATION:	Vernon, NY
DATE:	9/5/2007
SAMPLE TYPE:	Kick
SUBSAMPLE:	100 organisms

ANNELIDA			
OLIGOCHAETA			
LUMBRICIDA			
		Undetermined Lumbricina	1
ARTHROPODA			
DIPLOPODA			
POLYDESMIDA		Undetermined Polydesmida	4
INSECTA			
EPHEMEROPTERA	Baetidae	*Acentrella* sp.	6
		Baetis flavistriga	1
		Baetis intercalaris	3
	Ephemerellidae	*Serratella* sp.	1
COLEOPTERA	Elmidae	*Promoresia tardella*	4
		Stenelmis crenata	8
TRICHOPTERA	Hydropsychidae	*Cheumatopsyche* sp.	9
		Hydropsyche bronta	7
		Hydropsyche scalaris	1
		Hydropsyche sparna	14
	Rhyacophilidae	*Rhyacophila mainensis*	3
DIPTERA	Athericidae	*Atherix* sp.	2
	Empididae	*Hemerodromia* sp.	2
	Chironomidae	*Thienemannimyia* gr. spp.	3
		Cricotopus bicinctus	13
		Cricotopus trifascia gr.	4
		Eukiefferiella brehmi gr.	1
		Tvetenia vitracies	6
		Rheotanytarsus exiguus gr.	5
		Tanytarsus glabrescens gr.	1
		Tanytarsus guerlus gr.	1
		SPECIES RICHNESS:	23
		BIOTIC INDEX:	5.2
		EPT RICHNESS:	9
		MODEL AFFINITY:	60
		ASSESSMENT:	slight

Description: Station 02 was sampled upstream of Stuhlman Road. A single small trout was caught in the net at this site. However, only a single mayfly was noted in the pan. This site also appeared to have very low biomass. Net spinning caddisflies, and facultative chironomid taxa dominated the sample. This site was assessed as slightly impacted.

Table 7. Macroinvertebrate Data Report (MDR), Station 03

STREAM SITE: Sconondoa Creek, Station 03
LOCATION: Vernon, NY
DATE: 9/5/2007
SAMPLE TYPE: Kick
SUBSAMPLE: 100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	1
	Heptageniidae	*Stenacron interpunctatum*	1
COLEOPTERA	Psephenidae	*Psephenus herricki*	1
	Elmidae	*Optioservus* sp.	1
		Stenelmis crenata	11
TRICHOPTERA	Hydropsychidae	*Cheumatopsyche* sp.	10
		Hydropsyche betteni	4
		Hydropsyche bronta	18
		Hydropsyche slossonae	2
		Hydropsyche sparna	7
DIPTERA	Athericidae	*Atherix* sp.	5
	Chironomidae	*Thienemannimyia* gr. spp.	1
		Diamesa sp.	1
		Cricotopus bicinctus	6
		Cricotopus trifascia gr.	6
		Dicrotendipes neomodestus	1
		Polypedilum flavum	22
		Rheotanytarsus exiguus gr.	1
		SPECIES RICHNESS:	19
		BIOTIC INDEX:	5.71
		EPT RICHNESS:	7
		MODEL AFFINITY:	48
		ASSESSMENT:	slight

Description: Station 03 was sampled 1km below the discharge of the Vernon STP. Biomass at this site appeared to increase substantially. The community continued to look similar to those upstream. This site was assessed as slightly impacted.

Table 8. Macroinvertebrate Data Report (MDR), Station 04

STREAM SITE:	Sconondoa Creek, Station 04
LOCATION:	Vernon, NY
DATE:	9/5/2007
SAMPLE TYPE:	Kick
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	2
	Heptageniidae	*Stenonema vicarium*	1
COLEOPTERA	Psephenidae	*Ectopria nervosa*	1
		Psephenus herricki	1
	Elmidae	*Optioservus trivittatus*	2
		Promoresia elegans	1
		Stenelmis crenata	12
MEGALOPTERA	Corydalidae	*Nigronia serricornis*	1
TRICHOPTERA	Philopotamidae	*Chimarra obscura*	1
	Hydropsychidae	*Cheumatopsyche* sp.	31
		Hydropsyche betteni	1
		Hydropsyche bronta	12
		Hydropsyche sparna	1
DIPTERA	Athericidae	*Atherix* sp.	2
	Chironomidac	*Thienemannimyia* gr. spp.	1
		Cricotopus bicinctus	10
		Cricotopus trifascia gr.	3
		Eukiefferiella brehmi gr.	1
		Polypedilum flavum	15
		SPECIES RICHNESS:	20
		BIOTIC INDEX:	5.39
		EPT RICHNESS:	7
		MODEL AFFINITY:	47
		ASSESSMENT:	slight

Description: The sample at station 04 was collected upstream of the Williams Street bridge. Higher biomass was noted along with an abundance of long bright green filamentous algae. Fewer mayflies were present at this site with high numbers of riffle beetles, net spinning caddisflies, and chironomids. This site was assessed as slightly impacted.

Table 9. Macroinvertebrate Data Report (MDR), Station 05

STREAM SITE:	Sconondoa Creek, Station 05
LOCATION:	Vernon, NY
DATE:	9/5/2007
SAMPLE TYPE:	Kick
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	3
ANNELIDA			
OLIGOCHAETA			
		Undetermined Oligochaeta	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	5
		Baetis intercalaris	3
	Heptageniidae	*Stenonema* sp.	1
PLECOPTERA	Perlidae	*Agnetina capitata*	1
COLEOPTERA	Psephenidae	*Ectopria nervosa*	1
	Elmidae	*Optioservus trivittatus*	8
		Stenelmis crenata	13
TRICHOPTERA	Philopotamidae	*Chimarra aterrima*?	1
		Chimarra obscura	5
	Hydropsychidae	*Cheumatopsyche* sp.	4
		Hydropsyche betteni	15
		Hydropsyche bronta	22
		Hydropsyche sparna	2
DIPTERA	Tipulidae	*Antocha* sp.	1
	Athericidae	*Atherix* sp.	6
	Empididae	*Hemerodromia* sp.	1
	Chironomidae	*Polypedilum flavum*	7
		SPECIES RICHNESS:	19
		BIOTIC INDEX:	5.36
		EPT RICHNESS:	10
		MODEL AFFINITY:	48
		ASSESSMENT:	slight

Description: Station 05 was sampled at the riffle at the Second Street bridge. This site was assessed as slightly impacted. Many caddisflies were noted in the field, "more caddis than detritus."

Table 10. Macroinvertebrate Data Report (MDR), Station 06

STREAM SITE:	Sconondoa Creek, Station 06
LOCATION:	Vernon, NY
DATE:	9/5/2007
SAMPLE TYPE:	Kick
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	2
MOLLUSCA			
PELECYPODA			
VENEROIDEA	Sphaeriidae	*Pisidium* sp.	1
ARTHROPODA			
DIPLOPODA			
POLYDESMIDA		Undetermined Polydesmida	1
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	2
		Baetis intercalaris	3
	Heptageniidae	*Stenonema terminatum*	1
		Stenonema vicarium	3
COLEOPTERA	Psephenidae	*Psephenus herricki*	4
	Elmidae	*Optioservus trivittatus*	6
		Promoresia elegans	2
		Stenelmis crenata	13
MEGALOPTERA	Corydalidae	*Nigronia serricornis*	1
TRICHOPTERA	Hydropsychidae	*Arctopsyche* sp.	3
		Hydropsyche betteni	13
		Hydropsyche bronta	10
		Hydropsyche sparna	6
	Helicopsychidae	*Helicopsyche borealis*	1
DIPTERA	Tipulidae	*Antocha* sp.	1
	Athericidae	*Atherix* sp.	9
	Empididae	*Hemerodromia* sp.	1
	Chironomidae	*Cricotopus trifascia* gr.	2
		Polypedilum flavum	12
		Paratanytarsus sp.	3
		SPECIES RICHNESS:	23
		BIOTIC INDEX:	5.1
		EPT RICHNESS:	9
		MODEL AFFINITY:	56
		ASSESSMENT:	slight

Description: Station 06 was sampled at the riffle just upstream of the Route 365 bridge. The site was dominated by facultative caddisflies, chironomids, and riffle beetles, and was assessed as slightly impacted.

Table 11. Laboratory data summary, Sconondoa Creek, Oneida county, NY, 2007.

LABORATORY DATA SUMMARY				
STREAM NAME: Sconondoa Creek				
DATE SAMPLED: 9/5/2007				
SAMPLING METHOD: Kick				
LOCATION	SCON	SCON	SCON	SCON
STATION	01	02	03	04
DOMINANT SPECIES / %CONTRIBUTION / TOLERACE / COMMON NAME				
1.	Cheumatopsyche sp. 22 % facultative caddisfly	Hydropsyche sparna 14 % facultative caddisfly	Polypedilum flavum 22 % facultative midge	Cheumatopsyche sp. 31 % facultative caddisfly
2. Intolerant = not tolerant of poor water quality	Promoresia tardella 14 % intolerant beetle	Cricotopus bicinctus 13 % tolerant midge	Hydropsyche bronta 18 % facultative caddisfly	Polypedilum flavum 15 % facultative midge
3. Facultative = occurring over a wide range of water quality	Hydropsyche sparna 11 % . facultative caddisfly	Cheumatopsyche sp. 9 % facultative caddisfly	Stenelmis crenata 11 % facultative beetle	Hydropsyche bronta 12 % facultative caddisfly
4. Tolerant = tolerant of poor water quality	Tvetenia vitracies 10 % facultative midge	Stenelmis crenata 8 % facultative beetle	Cheumatopsyche sp. 10 % facultative caddisfly	Stenelmis crenata 12 % facultative beetle
5.	Serratella sp. 9 % intolerant mayfly	Hydropsyche bronta 7 % facultative caddisfly	Hydropsyche sparna 7 % facultative caddisfly	Cricotopus bicinctus 10 % tolerant midge
%CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESIS)				
Chironomidae (midges)	18 (5.0)	34 (8.0)	38 (7.0)	30 (5.0)
Trichoptera (caddisflies)	43 (5.0)	34 (5.0)	41 (5.0)	46 (5.0)
Ephemeroptera (mayflies)	9 (1.0)	11 (4.0)	2 (2.0)	3 (2.0)
Plecoptera (stoneflies)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Coleoptera (beetles)	21 (2.0)	12 (2.0)	13 (3.0)	17 (5.0)
Oligochaeta (worms)	3 (1.0)	1 (1.0)	0 (0.0)	0 (0.0)
Mollusca (clams and snails)	1 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)
Crustacea (crayfish, scuds, sowbugs)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Other insects (odonates, diptera)	2 (1.0)	4 (2.0)	5 (1.0)	3 (2.0)
Other (Nemertea, Platyhelminthes)	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)
SPECIES RICHNESS	17	23	19	20
BIOTIC INDEX	4.5	5.28	5.71	5.39
EPT RICHNESS	6	9	7	7
PERCENT MODEL AFFINITY	56	60	48	47
FIELD ASSESSMENT	P	P	P	P
OVERALL ASSESSMENT	slightly impacted	slightly impacted	slightly impacted	slightly impacted

Table 11 cont. Laboratory data summary, Sconondoa Creek, Oneida county, NY, 2007.

LABORATORY DATA SUMMARY				
STREAM NAME: Sconondoa Creek				
DATE SAMPLED: 9/5/2007				
SAMPLING METHOD: Kick				
LOCATION	SCON	SCON		
STATION	05	06		
DOMINANT SPECIES / %CONTRIBUTION / TOLERACE / COMMON NAME				
1.	Hydropsyche bronta 22 % facultative caddisfly	Hydropsyche betteni 13 % facultative caddisfly		
2. Intolerant = not tolerant of poor water quality	Hydropsyche betteni 15 % facultative caddisfly	Stenelmis crenata 13 % facultative beetle		
3. Facultative = occurring over a wide range of water quality	Stenelmis crenata 13 % facultative beetle	Polypedilum flavum 12 % facultative midge		
4. Tolerant = tolerant of poor water quality	Optioservus trivittatus 8 % intolerant beetle	Hydropsyche bronta 10 % facultative caddisfly		
5.	Polypedilum flavum 7 % facultative midge	Atherix sp. 9 % intolerant snipe fly		
%CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESIS)				
Chironomidae (midges)	7 (1.0)	17 (3.0)		
Trichoptera (caddisflies)	49 (6.0)	33 (5.0)		
Ephemeroptera (mayflies)	9 (3.0)	9 (4.0)		
Plecoptera (stoneflies)	1 (1.0)	0 (0.0)		
Coleoptera (beetles)	22 (3.0)	25 (4.0)		
Oligochaeta (worms)	1 (1.0)	0 (0.0)		
Mollusca (clams and snails)	0 (0.0)	1 (1.0)		
Crustacea (crayfish, scuds, sowbugs)	0 (0.0)	0 (0.0)		
Other insects (odonates, diptera)	8 (3.0)	12 (4.0)		
Other (Nemertea, Platyhelminthes)	1 (0.0)	2 (0.0)		
SPECIES RICHNESS	19	23		
BIOTIC INDEX	5.36	5.1		
EPT RICHNESS	10	9		
PERCENT MODEL AFFINITY	48	56		
FIELD ASSESSMENT	P	P		
OVERALL ASSESSMENT	slightly impacted	slightly impacted		

Table 12. Field data summary, Sconondoa Creek, Oneida County, NY, 2007.

FIELD DATA SUMMARY				
STREAM NAME: Sconondoa Creek	**DATE SAMPLED:** 9/5/2007			
REACH:				
FIELD PERSONNEL INVOLVED: Smith/Abele				
STATION	01	02	03	04
ARRIVAL TIME AT STATION	8:40	9:15	9:39	11:11
LOCATION	SCON	SCON	SCON	SCON
PHYSICAL CHARACTERISTICS				
Width (meters)	10	5	10	10
Depth (meters)	0.2	0.2	0.2	0.2
Current speed (cm per sec.)	80	100	75	75
Substrate (%)				
Rock (>25.4 cm, or bedrock)		10	10	10
Rubble (6.35 - 25.4 cm)	30	30	30	20
Gravel (0.2 - 6.35 cm)	30	30	30	20
Sand (0.06 - 2.0 mm)	20	20	20	30
Silt (0.004 - 0.06 mm)	20	10	10	20
Embeddedness (%)	60	60	60	60
CHEMICAL MEASUREMENTS				
Temperature (°C)	13.6	15.4	16.3	16.5
Specific Conductance (umhos)	1900	1722	1608	1647
Dissolved Oxygen (mg/l)	9.7	8.6	9.9	10
pH	7.4	7.5	7.7	7.9
BIOLOGICAL ATTRIBUTES				
Canopy (%)	80	50	20	20
Aquatic Vegetation				
Algae - suspended				
Algae - attached, filamentous				X
Algae - diatoms	X	X	X	X
Macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)		X		
Plecoptera (stoneflies)	X	X	X	X
Trichoptera (caddisflies)	X	X		X
Coleoptera (beetles)	X	X	X	X
Megaloptera (dobsonflies, damselflies)		X		X
Odonata (dragonflies, damselflies)			X	
Chironomidae (midges)		X	X	X
Simuliidae (black flies)				
Decapoda (crayfish)		X	X	X
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other	X		X	X
FAUNAL CONDITION	P	P	P	P

Table 12 cont. Field data summary, Sconondoa Creek, Oneida County, NY, 2007.

FIELD DATA SUMMARY				
STREAM NAME: Sconondoa Creek	**DATE SAMPLED:** 9/5/2007			
REACH:				
FIELD PERSONNEL INVOLVED: Smith/Abele				
STATION	05	06		
ARRIVAL TIME AT STATION	11:36	11:54		
LOCATION	SCON	SCON		
PHYSICAL CHARACTERISTICS				
Width (meters)	8	5		
Depth (meters)	0.1	0.1		
Current speed (cm per sec.)	80	60		
Substrate (%)				
Rock (>25.4 cm, or bedrock)		10		
Rubble (6.35 - 25.4 cm)	20	30		
Gravel (0.2 - 6.35 cm)	40	20		
Sand (0.06 - 2.0 mm)	30	30		
Silt (0.004 - 0.06 mm)	10	10		
Embeddedness (%)	50	10		
CHEMICAL MEASUREMENTS				
Temperature (°C)	18.3	19.3		
Specific Conductance (umhos)	1507	1639		
Dissolved Oxygen (mg/l)	9	9.4		
pH	7.8	7.8		
BIOLOGICAL ATTRIBUTES				
Canopy (%)	0	0		
Aquatic Vegetation				
Algae - suspended				
Algae - attached filamentous				
Algae - diatoms	X			
Macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X		
Plecoptera (stoneflies)	X			
Trichoptera (caddisflies)	X	X		
Coleoptera (beetles)		X		
Megaloptera (dobsonflies, damselflies)	X			
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X			
Simuliidae (black flies)				
Decapoda (crayfish)	X	X		
Gammaridae (scuds)	X			
Mollusca (snails, clams)				
Oligochaeta (worms)	X			
Other	X			
FAUNAL CONDITION	P	P		

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 meter 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 organisms are dislodged and carried into the net. Sampling is continued for a specified time and distance in the stream. Rapid assessment sampling specifies sampling for five minutes over a distance of five meters. The contents of the net 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 are recorded on a data sheet. All organisms from the subsample are archived (either slide-mounted or preserved in alcohol). If the results of the identification process 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: the total number of species or taxa found in a sample. For subsamples of 100-organisms each that are taken from kick samples, expected ranges in most New York State streams are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted, and less than 11, severely impacted.

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

3. Hilsenhoff Biotic Index: a measure of the tolerance of organisms in a 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 the purpose of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. Tolerance 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 Quality Assurance document, Bode et al. (2002). Impact ranges 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: a measure of similarity to a model, non-impacted community based on percent abundance in seven major macroinvertebrate groups (Novak and Bode, 1992). Percentage abundances in the model community are: 40% Ephemeroptera; 5% Plecoptera; 10% Trichoptera; 10% Coleoptera; 20% Chironomidae; 5% Oligochaeta; and 10% Other. Impact ranges are: greater than 64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted, and less than 35, severely impacted.

5. Nutrient Biotic Index: a measure of stream nutrient enrichment identified by macroinvertebrate taxa. 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 with assigned tolerance values. Tolerance values ranging from intolerant (0) to tolerant (10) are based on nutrient optima for Total Phosphorus (listed in Smith, 2005). Impact ranges are: 0-5.00, non-impacted; 5.01-6.00, slightly impacted; 6.01-7.00, moderately impacted, and 7.01-10.00, severely impacted.

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 richness, biotic index, and percent model affinity (see Appendix II). The consensus is based on the determination of the majority of the parameters. Since parameters measure different aspects of the macroinvertebrate community, they cannot be expected to always form unanimous assessments. The assessment ranges given for each parameter are based on subsamples of 100-organisms each that are taken from macroinvertebrate riffle kick samples. These assessments 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; EPT richness is greater than 10. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Nutrient Biotic Index is 5.00 or less. 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.

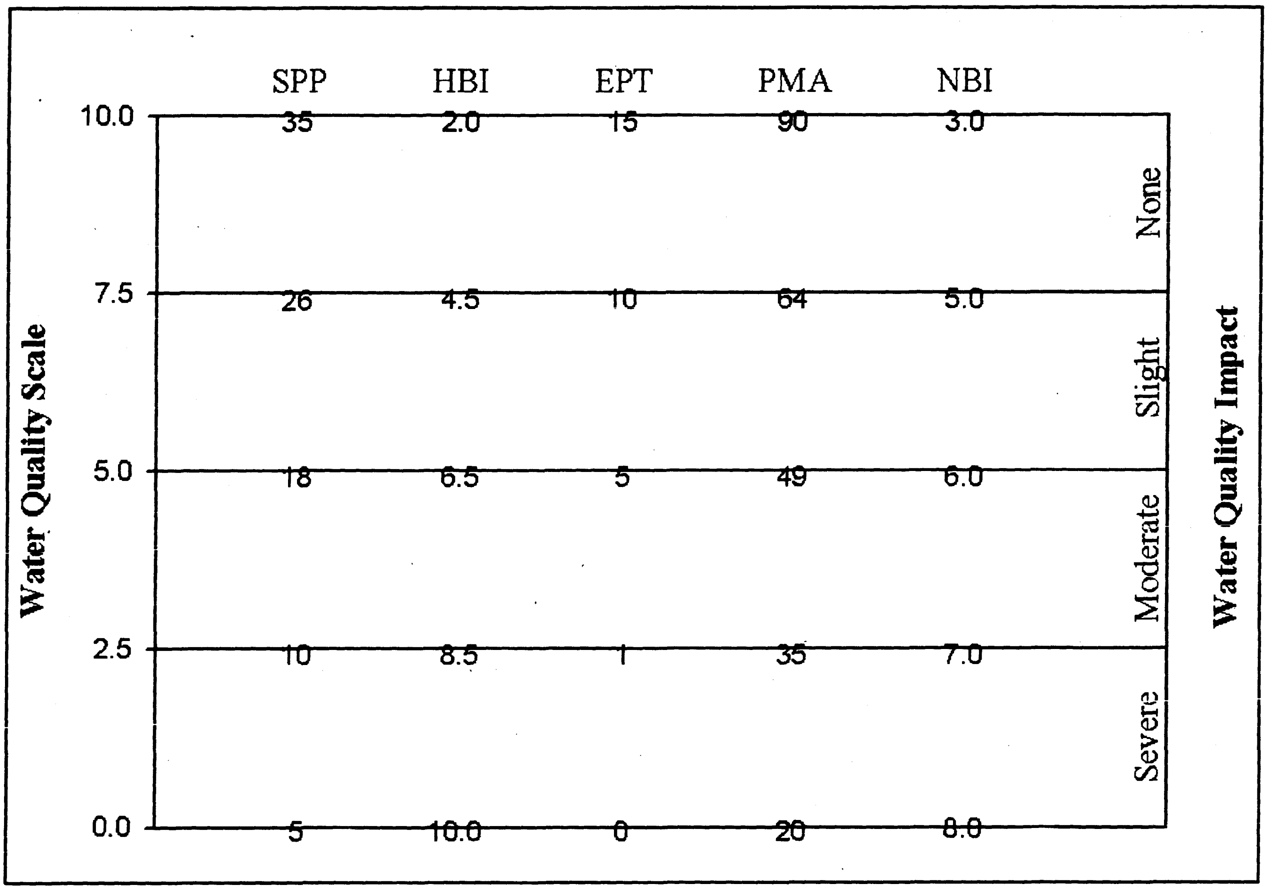
2. *Slightly impacted*: Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness is usually 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Nutrient Biotic Index is 5.01-6.00. 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 is usually 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT richness is 2-5. The biotic index value is 6.51-8.50. Percent model affinity is 35-49. Nutrient Biotic Index is 6.01-7.00. 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 fewer. Mayflies, stoneflies and caddisflies are rare or absent; EPT richness is 0-1. The biotic index value is greater than 8.50. Percent model affinity is less than 35. Nutrient Biotic Index is greater than 7.00. 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-A. Biological Assessment Profile: Conversion of Index Values to a Common 10-Scale

The Biological Assessment Profile (BAP) of index values, developed by Phil O'Brien, Division of Water, NYSDEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the five indices -- species richness (SPP), EPT richness (EPT), Hilsenhoff Biotic Index (HBI), Percent Model Affinity (PMA), and Nutrient Biotic Index (NBI)-- defined in Appendix II are converted to a common 0-10 scale using the formulae in the Quality Assurance document (Bode, et al., 2002), and as shown in the figure below.



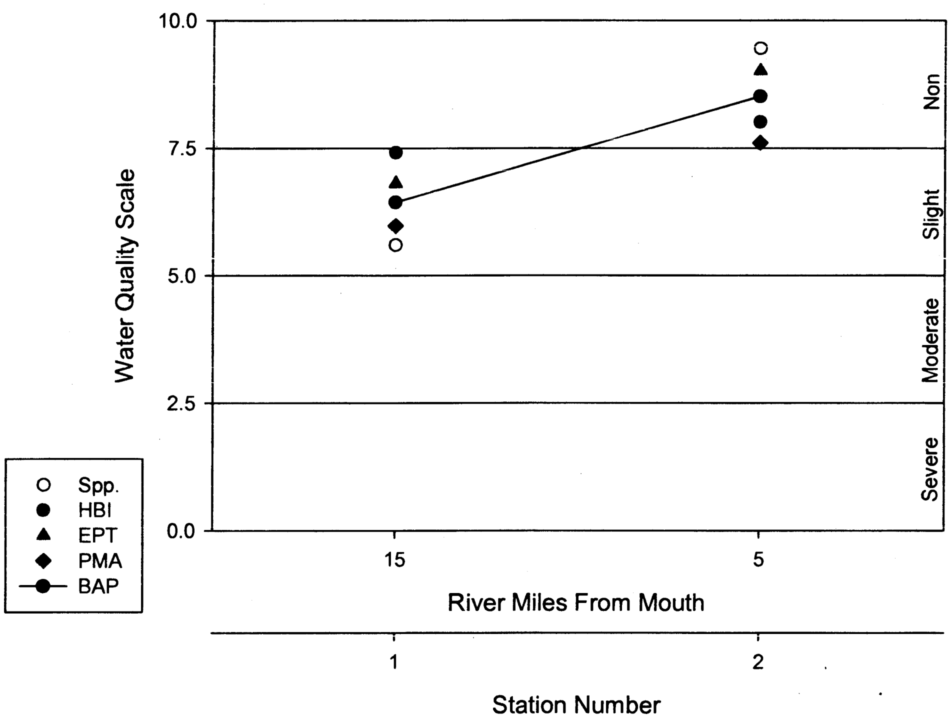
Appendix IV-B. Biological Assessment Profile: Plotting Values

To plot survey data:
1. Position each site on the x-axis according to miles or tenths of a mile upstream of the mouth.
2. Plot the values of the four indices for each site as indicated by the common scale.
3. Calculate the mean of the four values and plot the result. This represents the assessed impact for each site.

Example data:

	Station 1		Station 2	
	metric value	10-scale value	metric value	10-scale value
Species richness	20	5.59	33	9.44
Hilsenhoff Biotic Index	5.00	7.40	4.00	8.00
EPT richness	9	6.80	13	9.00
Percent Model Affinity	55	5.97	65	7.60
Average		6.44 (slight)		8.51 (non-)

Sample BAP plot:



Appendix V. Water Quality Assessment Criteria

Non-Navigable Flowing Waters

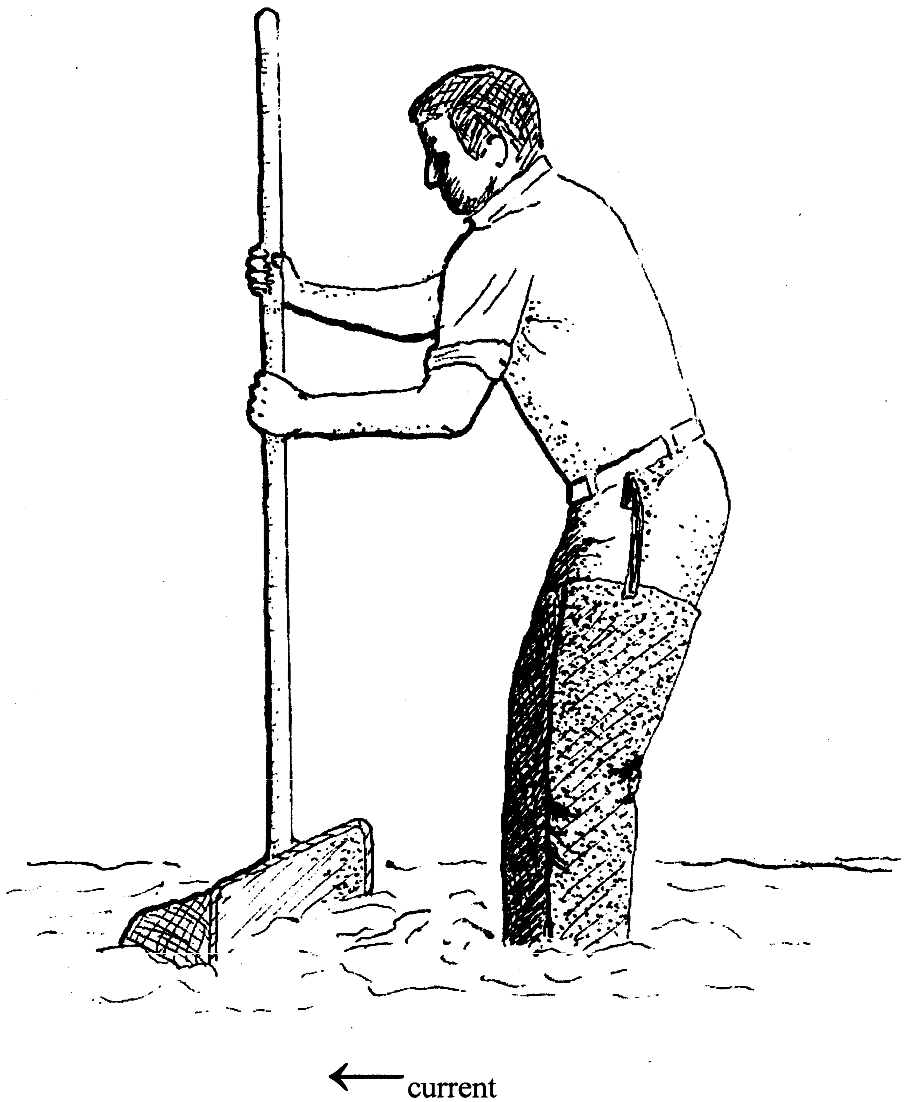
	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity*	Diversity **
Non-Impacted	>26	0.00-4.50	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	0-1	<35	0.00-2.00

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

Navigable Flowing Waters

	Species Richness	Hilsenhoff Biotic Index	EPT Richness	Species 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

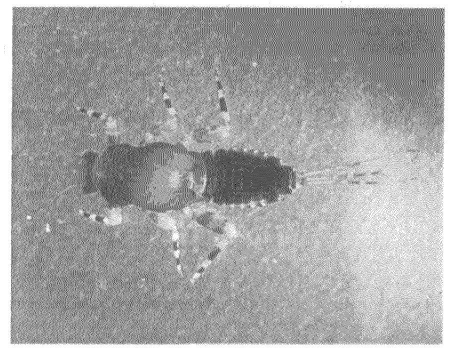
Appendix VI. The Traveling Kick Sample



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

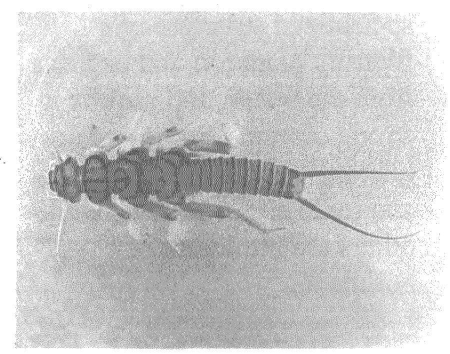
Appendix VII-A. Aquatic Macroinvertebrates Indicative of Good Water Quality

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.



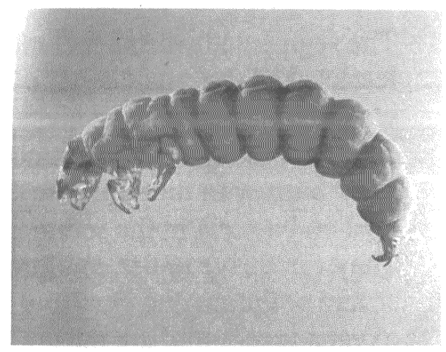
MAYFLIES

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.



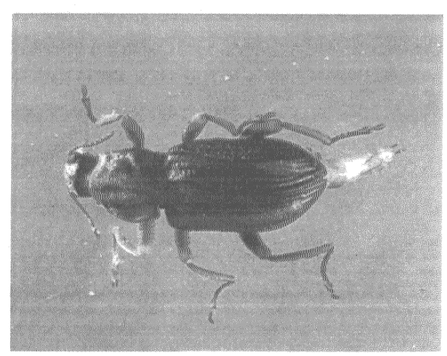
STONEFLIES

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

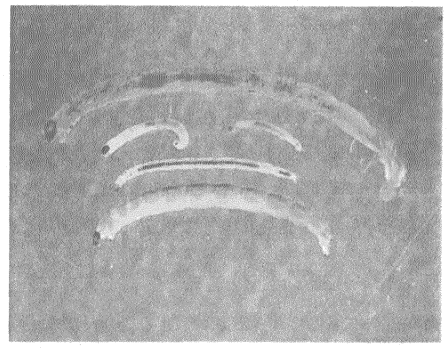
The most common beetles in streams are riffle beetles (adult and larva pictured) and water pennies (not shown). Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.



BEETLES

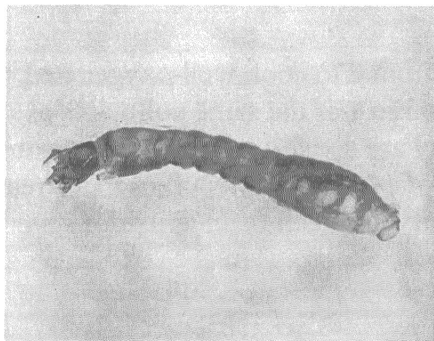
Appendix VII-B. Aquatic Macroinvertebrates Indicative of Poor Water Quality

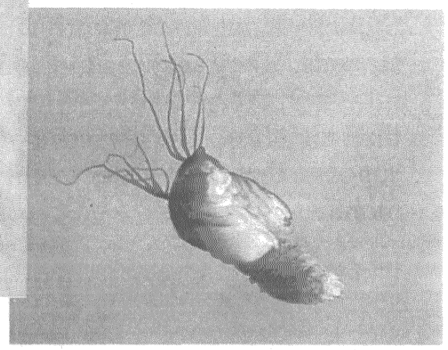
Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution. Large, red midge larvae called "bloodworms" indicate organic enrichment. Other midge larvae filter plankton, indicating nutrient enrichment when numerous.



MIDGES

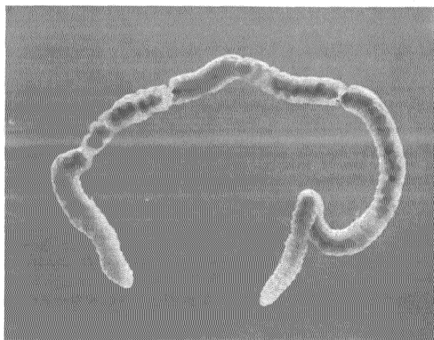
Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are tolerant of organic enrichment and toxic contaminants, while others are intolerant of pollutants.

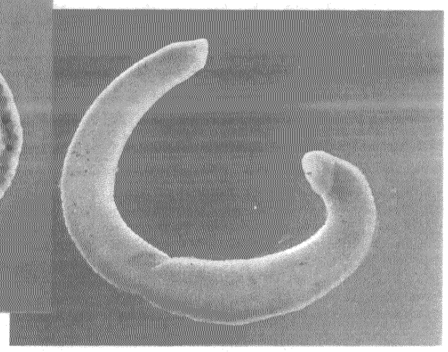




BLACK FLIES

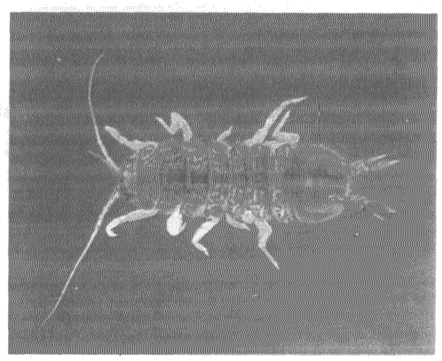
The segmented worms include the leeches and the small aquatic worms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution 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 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 that they:

- are sensitive to environmental impacts
- are less mobile than fish, and thus cannot avoid discharges
- can indicate effects of spills, intermittent discharges, and lapses in treatment
- are indicators of overall, integrated water quality, including synergistic effects
- are abundant in most streams and are relatively easy and inexpensive to sample
- are able to detect non-chemical impacts to the habitat, e.g. siltation or thermal changes
- are vital components of the aquatic ecosystem and important as a food source for fish
- are more readily perceived by the public as tangible indicators of water quality
- can often provide an on-site estimate of water quality
- can often be used to identify specific stresses or sources of impairment
- can be preserved and archived for decades, allowing for direct comparison of specimens
- 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

Anthropogenic: caused by human actions

Assessment: a diagnosis or evaluation of water quality

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

Bioaccumulate: accumulate contaminants in the tissues of an organism

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

Electrofishing: sampling fish by using electric currents to temporarily immobilize them, allowing capture

EPT richness: the number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) in a sample or subsample

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

Longitudinal trends: upstream-downstream changes in water quality in a river or stream

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

PAHs: Polycyclic Aromatic Hydrocarbons, a class of organic compounds that are often toxic or carcinogenic.

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

Synergistic effect: an effect produced by the combination of two factors that is greater than the sum of the two factors

Tolerant: able to survive poor water quality

Trophic State: ecosystem productivity

Appendix X. Methods for Calculation of the Nutrient Biotic Index

Definition: The Nutrient Biotic Index (Smith et al., 2007) is a diagnostic measure of stream nutrient enrichment identified by macroinvertebrate taxa. The frequency of occurrences of taxa at varying nutrient concentrations allowed the identification of taxon-specific nutrient optima using a method of weighted averaging. The establishment of nutrient optima is possible based on the observation that most species exhibit unimodal response curves in relation to environmental variables (Jongman et al., 1987). The assignment of tolerance values to taxa based on their nutrient optimum provided the ability to reduce macroinvertebrate community data to a linear scale of eutrophication from oligotrophic to eutrophic. Two tolerance values were assigned to each taxon, one for total phosphorus, and one for nitrate (listed in Smith, 2005). This provides the ability to calculate two different nutrient biotic indices, one for total phosphorus (NBI-P), and one for nitrate (NBI-N). Study of the indices indicate better performance by the NBI-P, with strong correlations to stream nutrient status assessment based on diatom information.

Calculation of the NBI-P and NBI-N: Calculation of the indices [2] follows the approach of Hilsenhoff (1987).

$$\text{NBI Score}_{(\text{TP or NO3}^-)} = \sum (a \text{ x } b) / c$$

Where ***a*** is equal to the number of individuals for each taxon, ***b*** is the taxon's tolerance value, and ***c*** is the total number of individuals in the sample for which tolerance values have been assigned.

Classification of NBI Scores: NBI scores have been placed on a scale of eutrophication with provisional boundaries between stream trophic status.

Index	Oligotrophic	Mesotrophic	Eutrophic
NBI-P	< 5.0	> 5.0 - 6.0	> 6.0
NBI-N	< 4.5	> 4.5 - 6.0	> 6.0

References:

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

Jongman, R. H. G., C. J. F. ter Braak and O. F. R. van Tongeren, 1987, Data analysis in community and landscape ecology. Pudoc Wageningen, Netherlands, 299 pages.

Smith, A.J., R. W. Bode, and G. S. Kleppel, 2007, A nutrient biotic index for use with benthic macroinvertebrate communities. Ecological Indicators 7(200):371-386.

Tolerance values assigned to taxa for calculation of the Nutrient Biotic Indices

TAXON	TP T-Value	NO3 T-Value	TAXON	TP T-Value	NO3 T-Value
Acentrella sp.	5	5	*Hexatoma sp.*	0	1
Acerpenna pygmaea	0	4	*Hydropsyche betteni*	7	9
Acroneuria abnormis	0	0	*Hydropsyche bronta*	7	6
Acroneuria sp.	0	0	*Hydropsyche morosa*	5	1
Agnetina capitata	3	6	*Hydropsyche scalaris*	3	3
Anthopotamus sp.	4	5	*Hydropsyche slossonae*	6	10
Antocha sp.	8	6	*Hydropsyche sp.*	5	4
Apatania sp.	3	4	*Hydropsyche sparna*	6	7
Atherix sp.	8	5	*Hydroptila consimilis*	9	10
Baetis brunneicolor	1	5	*Hydroptila sp.*	6	6
Baetis flavistriga	7	7	*Hydroptila spatulata*	9	8
Baetis intercalaris	6	5	*Isonychia bicolor*	5	2
Baetis sp.	6	3	*Lepidostoma sp.*	2	0
Baetis tricaudatus	8	9	*Leucotrichia sp.*	6	2
Brachycentrus appalachia	3	4	*Leucrocuta sp.*	1	3
Caecidotea racovitzai	6	2	*Macrostemum carolina*	7	2
Caecidotea sp.	7	9	*Macrostemum sp.*	4	2
Caenis sp.	3	3	*Micrasema sp. 1*	1	0
Cardiocladius obscurus	8	6	*Micropsectra dives gr.*	6	9
Cheumatopsyche sp.	6	6	*Micropsectra polita*	0	7
Chimarra aterrima?	2	3	*Micropsectra sp.*	3	1
Chimarra obscura	6	4	*Microtendipes pedellus gr.*	7	7
Chimarra socia	4	1	*Microtendipes rydalensis gr.*	2	1
Chimarra sp.	2	0	*Nais variabilis*	5	0
Chironomus sp.	9	6	*Neoperla sp.*	5	5
Cladotanytarsus sp.	6	4	*Neureclipsis sp.*	3	1
Corydalus cornutus	2	2	*Nigronia serricornis*	10	8
Cricotopus bicinctus	7	6	*Nixe (Nixe) sp.*	1	5
Cricotopus tremulus gr.	8	9	*Ophiogomphus sp.*	1	3
Cricotopus trifascia gr.	9	9	*Optioservus fastiditus*	6	7
Cricotopus vierriensis	6	5	*Optioservus ovalis*	9	4
Cryptochironomus fulvus gr.	5	6	*Optioservus sp.*	7	8
Diamesa sp.	10	10	*Optioservus trivittatus*	7	6
Dicranota sp.	5	10	*Orthocladius nr. dentifer*	3	7
Dicrotendipes neomodestus	10	4	*Pagastia orthogonia*	4	8
Dolophilodes sp.	4	3	*Paragnetina immarginata*	1	2
Drunella cornutella	4	4	*Paragnetina media*	6	3
Ectopria nervosa	10	9	*Paragnetina sp.*	1	6
Epeorus (Iron) sp.	0	0	*Paraleptophlebia mollis*	2	1
Ephemerella sp.	4	4	*Paraleptophlebia sp.*	2	3
Ephemerella subvaria	4	1	*Parametriocnemus lundbecki*	8	10
Ephoron leukon?	1	1			
Eukiefferiella devonica gr.	9	9	*Paratanytarsus confusus*	5	8
Ferrissia sp.	9	5	*Pentaneura sp.*	0	1
Gammarus sp.	8	9	*Petrophila sp.*	5	3
Glossosoma sp.	6	0	*Phaenopsectra dyari?*	4	5
Goniobasis livescens	10	10	*Physella sp.*	8	7
Helicopsyche borealis	1	2	*Pisidium sp.*	8	10
Hemerodromia sp.	5	6	*Plauditus sp.*	2	6
Heptagenia sp.	0	0	*Polycentropus sp.*	4	2

TAXON	TP T-Value	NO3 T-Value
Polypedilum aviceps	5	7
Polypedilum flavum	9	7
Polypedilum illinoense	10	7
Polypedilum laetum	7	6
Polypedilum scalaenum gr.	10	6
Potthastia gaedii gr.	9	10
Promoresia elegans	10	10
Prostoma graecense	2	7
Psephenus herricki	10	9
Psephenus sp.	3	4
Psychomyia flavida	1	0
Rheocricotopus robacki	4	4
Rheotanytarsus exiguus gr.	6	5
Rheotanytarsus pellucidus	3	2
Rhithrogena sp.	0	1
Rhyacophila fuscula	2	5
Rhyacophila sp.	0	1
Serratella deficiens	5	2
Serratella serrata	1	0
Serratella serratoides	0	1
Serratella sp.	1	1
Sialis sp.	5	6
Simulium jenningsi	6	2
Simulium sp.	7	6
Simulium tuberosum	1	0
Simulium vittatum	7	10
Sphaerium sp.	9	4
Stenacron interpunctatum	7	7
Stenelmis concinna	5	0
Stenelmis crenata	7	7
Stenelmis sp.	7	7
Stenochironomus sp.	4	3
Stenonema mediopunctatum	3	3
Stenonema modestum	2	5
Stenonema sp.	5	5

TAXON	TP T-Value	NO3 T-Value
Stenonema terminatum	2	3
Stenonema vicarium	6	7
Stylaria lacustris	5	2
Sublettea coffmani	3	5
Synorthocladius nr. semivirens	6	9
Tanytarsus glabrescens gr.	5	6
Tanytarsus guerlus gr.	5	5
Thienemannimyia gr. spp.	8	8
Tipula sp.	10	10
Tricorythodes sp.	4	9
Tvetenia bavarica gr.	9	10
Tvetenia vitracies	7	6
Undet. Tubificidae w/ cap. setae	10	8
Undet. Tubificidae w/o cap. setae	7	7
Undetermined Cambaridae	6	5
Undet. Ceratopogonidae	8	9
Undet. Enchytraeidae	7	8
Undet. Ephemerellidae	3	6
Undetermined Gomphidae	2	0
Undet. Heptageniidae	5	2
Undetermined Hirudinea	9	10
Undetermined Hydrobiidae	6	7
Undetermined Hydroptilidae	5	2
Undet. Limnephilidae	3	4
Undet. Lumbricina	8	8
Undet. Lumbriculidae	5	6
Undetermined Perlidae	5	7
Undetermined Sphaeriidae	10	8
Undetermined Turbellaria	8	6
Zavrelia sp.	9	9

Appendix XI. Impact Source Determination Methods and Community Models

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. ISD 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 was 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 ISD (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 percent, 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 subsamples of 100-organisms each that are taken from traveling kick samples of New York State streams. Application of these methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the models.

Impact Source Determination 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

Impact Source Determination Models

NONPOINT NUTRIENTS, PESTICIDES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
Isonychia	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
Caenis/Tricorythodes	-	-	-	-	5	-	-	5	-	5
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	5	-	-	5	-	5	5	-	-	-
Optioservus	10	-	-	5	-	-	15	5	-	5
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	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	-
Simulium vittatum	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	10	15	10	5	-	-	-	-	5	5
Eukiefferiella/ Tvetenia	-	15	10	5	-	-	-	-	5	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Microtendipes	-	-	-	-	-	-	-	-	-	20
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

Impact Source Determination Models

	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

Impact Source Determination Models

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

Impact Source Determination Models

	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 XII. Part 701: Classifications-Surface Waters and Groundwaters
(Statutory authority: Environmental Conservation Law, §§ 1-0101, 3-0301 [2][m],15-0313, 17-0101, 17-0301, 17-0303, 17-0809)

§701.6 Class A fresh surface waters
(a) The best usages of Class A waters are: a source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
(b)This classification may be given to those waters that, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to reduce naturally present impurities, meet or will meet New York State Department of Health drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

§701.7 Class B fresh surface waters
The best usages of Class B waters are primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival.

§701.8 Class C fresh surface waters
The best usage of Class C waters is fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

§701.9 Class D fresh surface waters
The best usage of Class D waters is fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the waters will not support fish propagation. These waters shall be suitable for fish, shellfish, and wildlife survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Historical Note
Sec. filed July 3, 1985; repealed, new filed Aug. 2, 1991 eff. 30 days after filing. The text reflects revisions filed January 17, 2008 and effective February 16, 2008.

§701.25 Trout waters (T or TS)

(a) The symbol (T), appearing in an entry in the "standards" column in the classification tables of Parts 800 through 941 of this Title, means that the classified waters in that specific Item are trout waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout or trout waters applies.

(b) The symbol (TS), appearing in an entry in the "standards" column in the classification tables of Parts 800 through 941 of this Title, means that the classified waters in that specific Item are trout spawning waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout, trout spawning, trout waters, or trout spawning waters applies.

Historical Note

The text reflects revisions filed January 17, 2008 and effective February 16, 2008.

Appendix XIII. Biological Impacts of Waters with High Conductivity

Definition: Conductivity is a measure of the ability of an aqueous solution to carry an electric current. It may be used to estimate salinity, total dissolved solids (TDS), and chlorides. Salinity is the amount of dissolved salts in a given amount of solution. TDS, although not precisely equivalent to salinity, is closely related, and for most purposes can be considered synonymous. EPA has not established ambient water-quality criteria for salinity; for drinking water, maximum contaminant levels are 250 mg/L for chlorides, and 500 mg/L for dissolved solids (EPA, 1995).

Measurement: Conductivity is measured as resistance and is reported in micromhos per centimeter (μmhos/cm), which is equivalent to microsiemens per centimeter (μS/cm). To estimate TDS and salinity, multiply conductivity by 0.64 and express the result in parts per million. For marine waters, salinity is usually expressed in parts per thousand. To estimate chlorides, multiply conductivity by 0.21 and express the result in parts per million. Departures from these estimates can occur when elevated conductivity is a result of natural conditions, such as in situations of high alkalinity (bicarbonates), or sulfates.

Effects on macroinvertebrates: Bioassays on test animals found the toxicity threshold for *Daphnia magna* to be 6-10 parts per thousand salinity (6000-10,000 mg/L) (Ingersoll et al., 1992). Levels of concern for this species were set at 0.3-6 parts per thousand salinity (300-6000 mg/L) (U.S. Dept. of Interior, 1998).

Stream Biomonitoring findings: Of 22 New York State streams sampled with specific conductance levels exceeding 800 μmhos/cm, 9% were assessed as severely impacted, 50% were assessed as moderately impacted, 32% were assessed as slightly impacted, and 9% were assessed as non-impacted. Many of the benthic communities in the impacted streams were dominated by oligochaetes, midges, and crustaceans (scuds and sowbugs). Thirty-five percent of the streams were considered to derive their high conductance primarily from natural sources, while the remainder were the result of contributions from point and nonpoint anthropogenic (human caused) sources. For nearly all streams with high conductivity, other contaminants are contained in the water column, making it difficult to isolate effects of high conductance.

Recommendations: Conductivity may be best used as an indicator of elevated amounts of anthropogenic-source contaminants. Based on findings that the median impact at sites with specific conductance levels exceeding 800 μmhos/cm is moderate impact, 800 μmhos/cm is designated as a level of concern with expected biological impairments. Eight-hundred μmhos/cm corresponds to ~170 mg/L chlorides, ~510 parts per million Total Dissolved Solids, and ~0.51 parts per thousand salinity.

References:

US Dept. of Interior. 1998. Guidelines for interpretation of the biological effects of selected constituents in biota, water, and sediment. Nat. Irrigat. Water Qual. Prog. Inform. Rep. 3.

Ingersoll, C.G., F.J. Dwyer, S.A. Burch, M.K. Nelson, D.R. Buckler, and J.B. Hunn. The use of freshwater and saltwater animals to distinguish between the toxic effects of salinity and contaminants in irrigation drain water. Environmental Toxicology and Chemistry 11:503-511.

U.S. EPA. 1995. Drinking water regulations and health advisories. U.S. Environmental Protection Agency, Office of Water, Washington, D.C., 11 pages.