New York State
Department of Environmental Conservation

Division of Water

Halfway Creek

Biological Assessment

2001 Survey

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BIOLOGICAL STREAM ASSESSMENT

Halfway Creek
Warren County, New York

Survey date: September 5, 2001
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Stream: Halfway Creek, Warren County, New York

Reach: Rte. 9 to Meadowbrook Road, Glens Falls

Background:

The Stream Biomonitoring Unit conducted a biological survey of Halfway Creek on September 5, 2001. The purpose of sampling was to assess general water quality and compare results to previous surveys. Portions of the Halfway Creek are on the NYS DEC Priority Waterbodies List (NYS DEC, 1996). Traveling kick samples were taken in riffle areas at 4 sites on the mainstem of Halfway Creek. Kick samples were also taken at 2 sites on Crandall Park tributary and one site on Cemetery Brook tributary. All samples were taken 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 richness, and percent model affinity (see Appendices II and III). Crayfish were collected at the four mainstem sites and at two of the tributary sites. These tissue samples were analyzed for PAHs (polycyclic aromatic hydrocarbons). Figure 2 and Table 2 summarize the PAH results. Table 3 provides a listing of sampling sites and Table 4 provides a listing of all macroinvertebrate species collected in the present survey. This is followed by macroinvertebrate data reports, including individual site descriptions and raw invertebrate data from each site.

Results and Conclusions:

1. Based on macroinvertebrate communities, water quality in Halfway Creek was assessed as slightly impacted at all of the mainstem sites.

2. The Crandall Park tributary site at Webster Avenue was assessed as moderately impacted, possibly as a result of habitat and municipal/industrial inputs. All other tributary locations were found to be slightly impacted.

3. PAHs (polycyclic aromatic hydrocarbons) in crayfish tissues were not elevated at any of the stream locations sampled.

Discussion:

Halfway Creek was previously sampled by the Stream Biomonitoring Unit in 1998 at Fort Ann, as part of the Rotating Intensive Basin Studies. The results of that sampling showed slight impact, likely from agricultural nonpoint source runoff. In 1999, the creek was sampled at 6 sites from Glens Falls to Fort Ann, and water quality ranged from non-impacted to slightly impacted. The decline in water quality at the time of sampling occurred in the reach downstream of the city of Glens Falls. The present sampling was designed to assess the contributions of the tributaries to Halfway Creek that are found between Route 9 and Meadowbrook Road.

Twelve miles of Halfway Creek are listed on the Priority Waterbodies List (NYS DEC, 1996); 3 miles in Warren County and 9 miles in Washington County. The primary use impairments listed are fish propagation and fish survival, and the primary pollutants listed are thermal effects from urban runoff, heavy sediment loads, and sand from road sanding. Cemetery Brook, a tributary of Halfway Creek, is listed for possible siltation from construction.

Results of the present study show slightly impacted water quality for all sites on the mainstem of Halfway Creek (Figure 1). The overall assessment of water quality at Station 2 decreased from non-impacted in 1999 to slightly impacted for the present sampling event. The numbers of mayflies and stoneflies decreased significantly at this site in the 2001 sample, while filter-feeding caddisflies were more abundant. The possible causes of impairment indicated at this site include impoundment effects, siltation, and organic enrichment (Table 1).

The Crandall Park tributary contributes poor water quality to Halfway Creek (Figure 1b). Water quality in the Cemetery Brook tributary is similar to that found at Halfway Creek, Station 2. The causes of impairment in the tributaries appear to encompass nutrient enrichment, organic enrichment, unknown municipal/industrial inputs, siltation and impoundment effects (Table 1).

Tissue analysis for PAHs (polycyclic aromatic hydrocarbons) was conducted on crayfish collected at 6 sampling sites. No organisms were collected for analysis from the Crandall Park tributary site, Station 2C2.

PAHs constitute a class of organic compounds characterized by two or more benzene rings. PAHs with lower molecular weights exhibit acute toxicity but are considered noncarcinogenic; higher weight PAHs are less toxic, but have been shown to be carcinogenic to fish and other aquatic life. PAHs are typically produced by the incomplete combustion of petroleum products, wood, and other organic materials. Major sources of PAHs in surface waters include airborne deposition, municipal wastewater discharges, and urban storm runoff.

The levels of concern for PAHs in invertebrates (Table 2b) were re-evaluated in 2001 (Bode et. al., in press), utilizing a larger database than was previously available (Bode et. al., 1996). The concentration of PAHs found in the crayfish tissue sampled in 2001 (Figure 2, Table 2a) was nearly 90% lower than the levels found in the 1999 tissue analysis of crayfish. PAHs were not elevated in any of the 2001 Halfway Creek samples, based on the new criteria. In 1999, PAH analysis showed elevated levels at all 5 sites analyzed, and PAH values were highest at Station 3 (4452 ng/gm). The 2001 sample of PAHs at Station 3 was almost 90% less, 509 ng/gm.

Some differences in water quality and PAH levels may be flow-related. 2001 was considered a drought year; 1999 was also considered a drought year, although a heavy flood occurred one week prior to sampling, while 1998 flows were normal to high. Long-term sampling, especially at Stations 2 and 3, would be needed to determine year-to-year water quality patterns in Halfway Creek. More frequent sampling may also provide an explanation for the fluctuations in PAH levels found at these sites between 1999 and 2001.

Literature cited

NYS DEC. 1996. Priority Waterbodies List, Statewide Summary Report. New York State Department of Environmental Conservation, Albany, NY. NYS DEC Technical Report, pp 147.

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.

New York State Department of Environmental Conservation. 1996. The 1996 priority waterbodies list for the Lake Champlain basin. NYS DEC Technical bulletin, 128 pages.

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, Albany, NY. NYS DEC Technical Report, 107 pages.

Overview of field data:

On the date of sampling, September 5, 2001, the Halfway Creek and tributary sites sampled were 1.5 - 6 meters wide, 0.1 - 0.5 meters deep in riffles, and had current speeds of 20 - 100 cm/sec in riffles. Dissolved oxygen was 6.7 - 9.5 mg/l, specific conductance was 460 - 807μmhos, pH was 7.4 - 8.1, and the temperature was 13.8 - 18.2 °C (57 - 65 of). Measurements for each site on Halfway Creek and its tributaries are found on the field data summary sheets.

Figure 1a. Biological Assessment Profile of index values, Halfway Creek, 2001. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for more complete explanation.

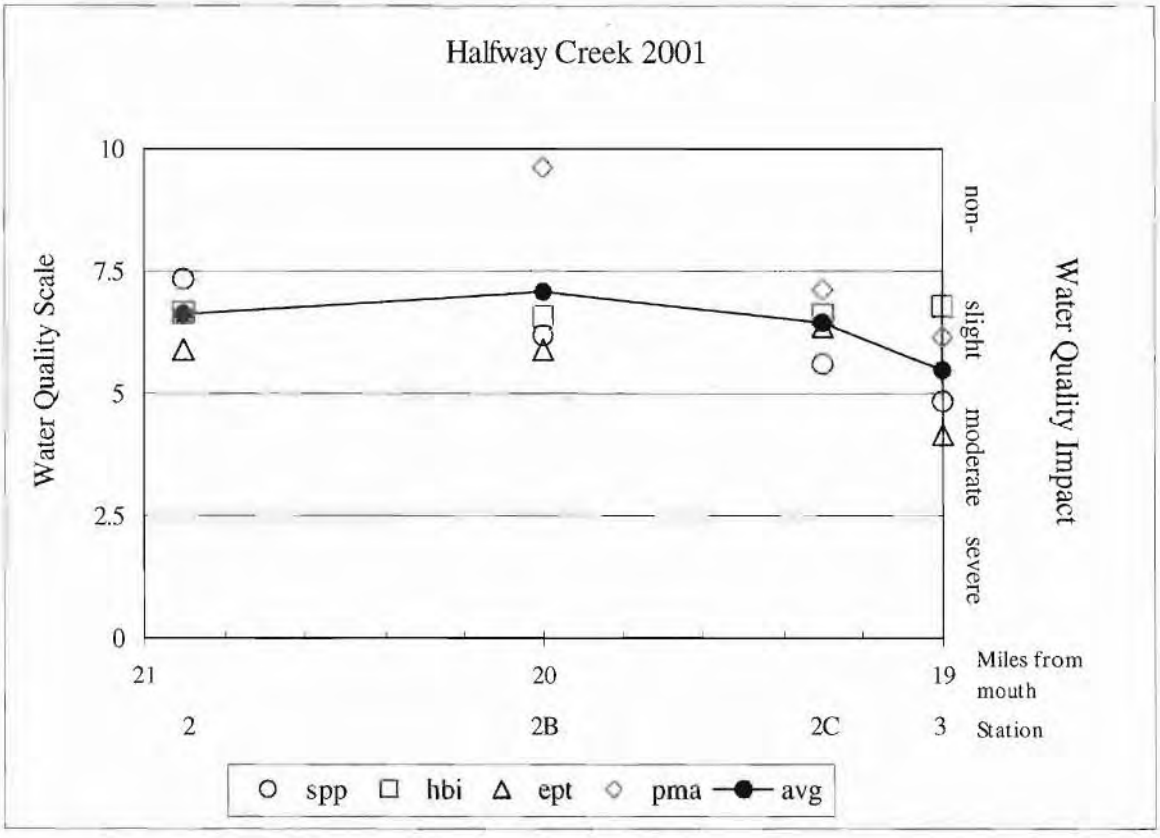


Figure 1b. Biological Assessment Profile of index values, Halfway Creek tributaries; Cemetery and Crandall Park 2001. Values are plotted on a normalized scale of water quality.

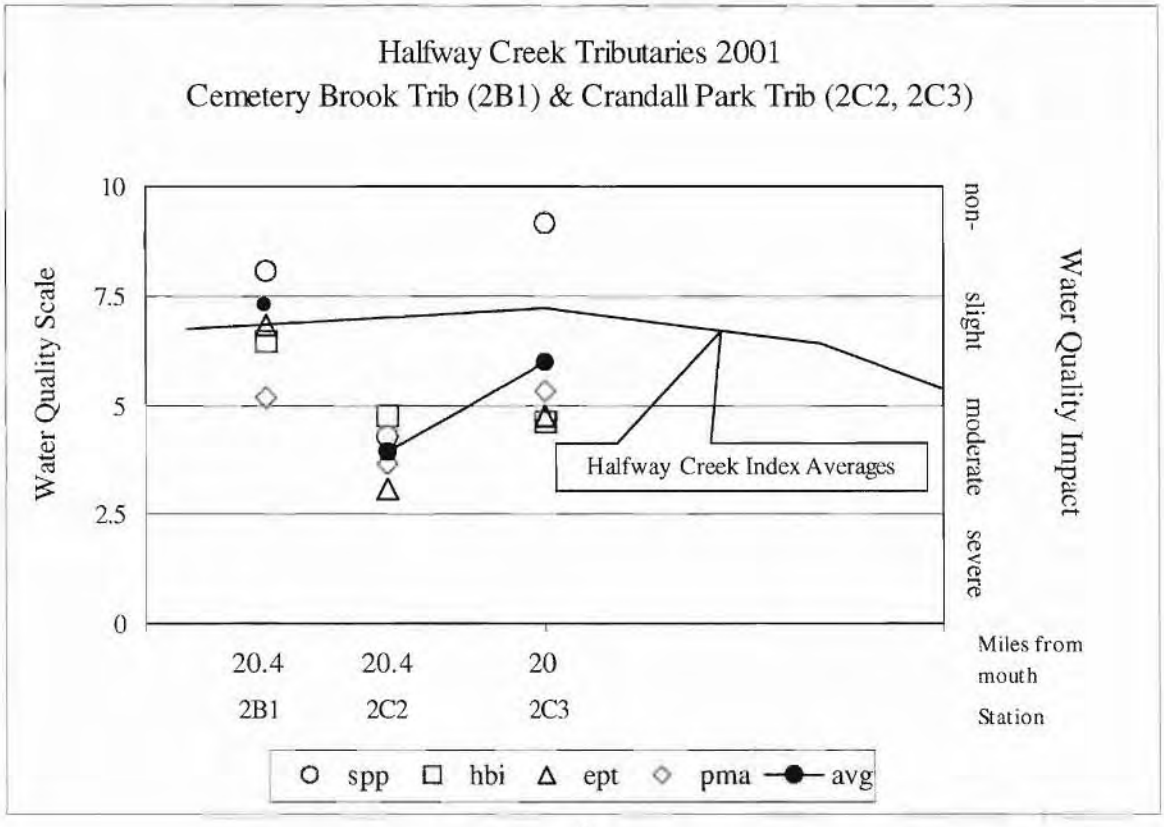


Table 1. Impact Source Determination, Halfway Creek, 2001. Numbers represent similarity to community type models for each impact category. The highest similarities at each station are highlighted. Similarities less than 50% are less conclusive. See Appendix XIII for a more complete explanation of Impact Source Determination.

	STATION						
Community Type	2	2B	2C	3	2B1	2C2	2C3
Natural: minimal human impacts	44	52	37	38	38	18	27
Nutrient additions; mostly nonpoint,agricultural	54	49	55	55	46	39	30
Toxic: industrial, municipal, or urban run-off	56	45	45	44	51	46	35
Organic: sewage effluent, animal wastes	67	46	58	54	48	35	59
Complex: municipal/industrial	55	41	54	59	45	48	38
Siltation	62	66	47	48	54	36	29
Impoundment	65	50	57*	64*	55*	41	33

* these impoundment values are considered spurious

TABLE SUMMARY:

Station #	Community Most Characteristic of:
2	Organic; siltation; impoundment
2B	Siltation
2C	Nonpoint and agricultural nutrient additions; organic; municipal/industrial
3	Nonpoint and agricultural nutrient additions; organic; municipal/industrial
2B1	Urban run-off; siltation
2C2	Municipal/industrial
2C3	Organic

Figure 2. PAHs in Invertebrates Collected in Halfway Creek, September 5, 2001 (ng/gm; ppb).

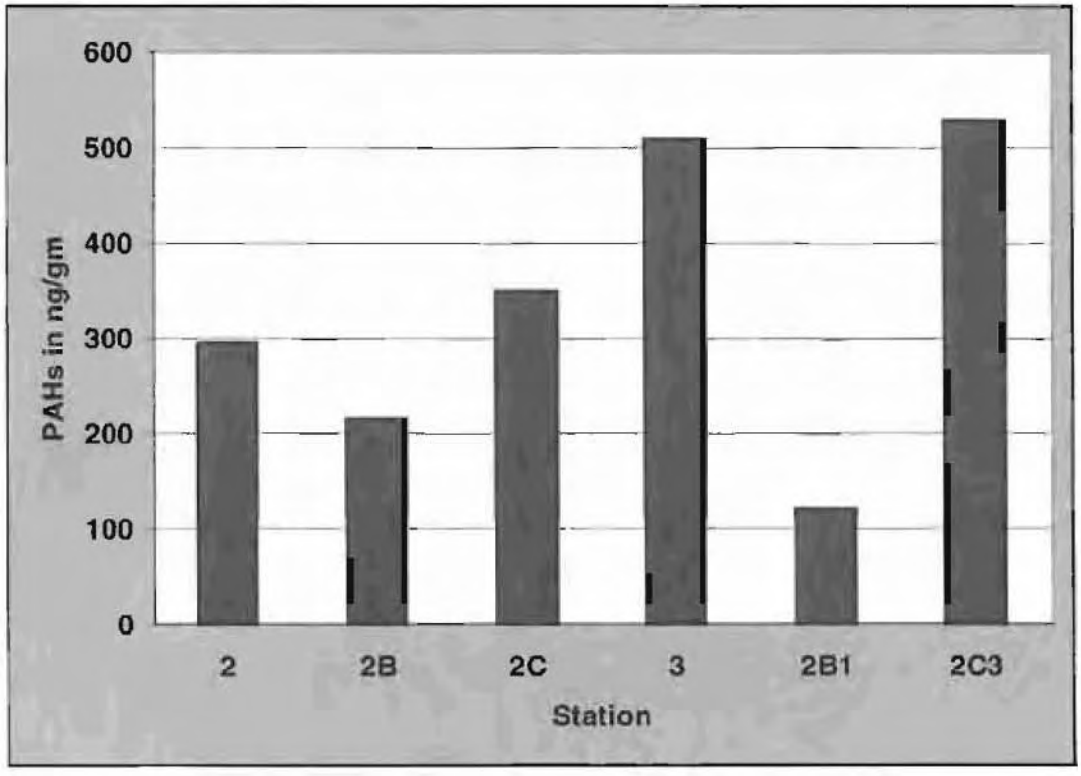


TABLE 2a.	PAHs in crayfish in Halfway Creek, September 5, 2001.					
	HALF-2	HALF-2B	HALF-2C	HALF-3	HALF-2B1	HALF-2C3
Phenanthrene	42	<46	54	59	26	63
Anthracene	5	4	5	12	2	10
Fluoranthene	39	65	32	41	24	43
Pyrene	74	47	98	130	18	120
Benzo (a) anthracene	59	6	80	150	5	150
Chrysene	32	15	38	78	8	75
Benzo (b) fluoranthene	7	6	6	6	6	13
Benzo (k) fluoranthene	5	5	4	3	4	6
Benzo (a) pyrene	3	2	2	2	3	4
Dibenz (A,H) anthracene	<1	3	3	2	2	5
Benzo (ghi) perylene	8	6	10	10	9	12
Indeno (1,2,3-cd) pyrene	20	11	17	16	15	28
TOTAL PAHs	295	216	349	509	122	529

All values in ng/gm (ppb) dry weight
No values exceed provisional level of concern for crayfish

Table 2b.	Levels of concern for PAHs in invertebrates Concentrations in μg/kg (ppb) dry weight			
	Crayfish	Caddisflies	Hellgrammites Stoneflies, and Odonata	Mollusks
Chrysene	400	500	800	100
Fluoranthene	150	500	200	100
Phenanthrene	200	500	300	100
Pyrene	400	1000	600	100
Benzo [A] Anthracene	400	1000	600	100

TABLE 3. STATION LOCATIONS FOR HALFWAY CREEK, WASHINGTON COUNTY, NEW YORK (see map).

STATION	LOCATION
02	Glens Falls 20 meters downstream of Rt. 9 bridge 20.9 river miles above the mouth latitude/longitude: 43°19'33"; 73°39'50"
02B	Glens Falls 30 meters downstream of Bay Rd. bridge 20 river miles above the mouth latitude/longitude: 43°19'58"; 73°39'10"
02C	Glens Falls 5 meters downstream of Cronin Rd bridge 19.3 river miles above the mouth latitude/longitude: 43°20'14"; 73°38'45"
03	Glens Falls 1 meter upstream of Meadowbrook Rd. bridge 19.0 river miles above the mouth latitude/longitude: 43°20'28"; 73°38'39"
Cemetery Brook Tributary	
02B1	Glens Falls 20 meters downstream of Glenwood Rd bridge 20.4 river miles above the mouth latitude/longitude: 43°19'56"; 73°39'41"
Crandall Park Tributary	
2C2	Glens Falls 10 meters downstream of Webster Ave. bridge 20.4 river miles above the mouth latitude/longitude: 43°19'27"; 73°39'41"
2C3	Glens Falls 5 meters upstream of Homer Rd. bridge 20 river miles above the mouth latitude/longitude: 43°19'48"; 73°38'59"

Figure 3	Site Overview Map	Halfway Creek

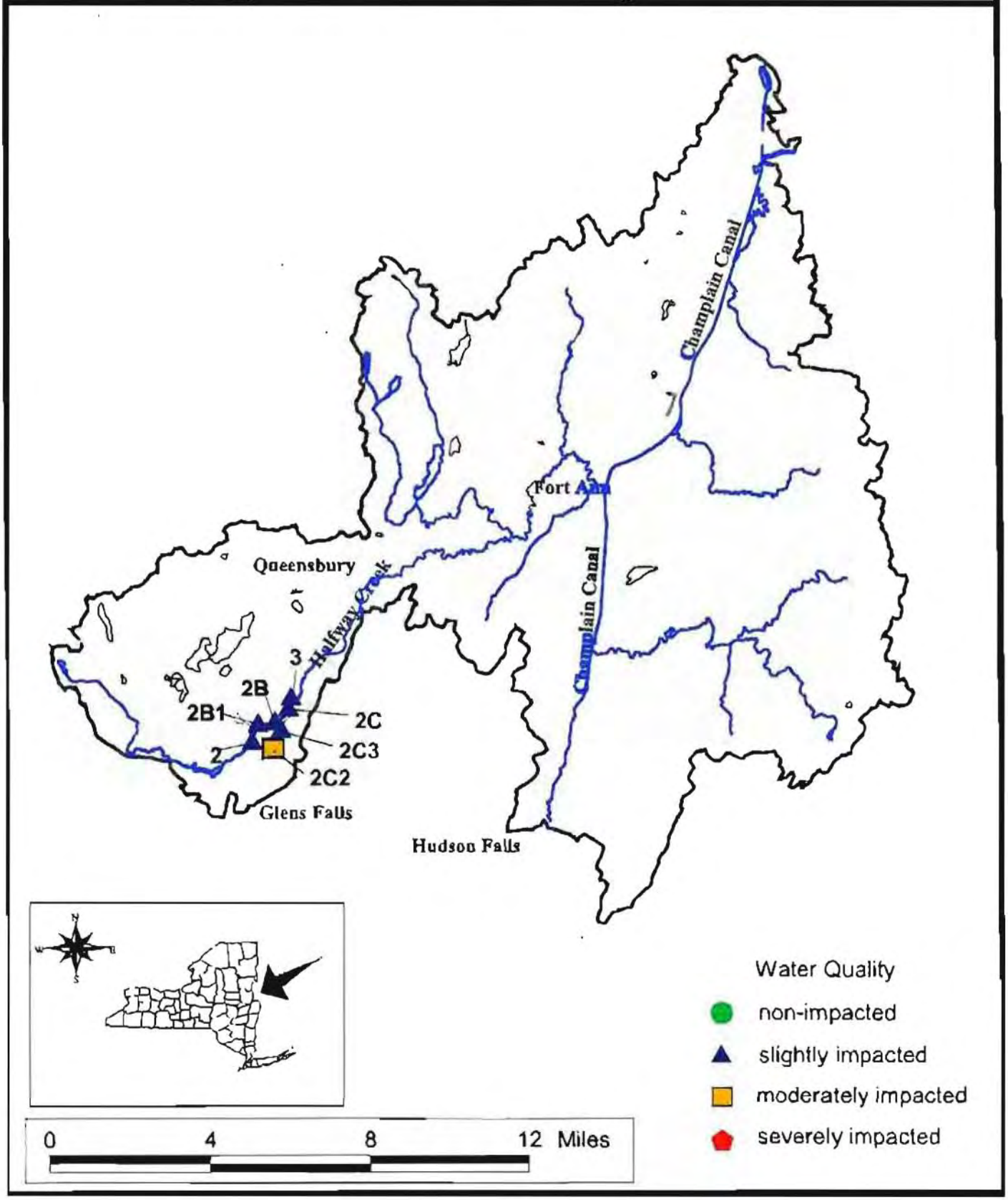


Figure 4	Site Location Map	Halfway Creek

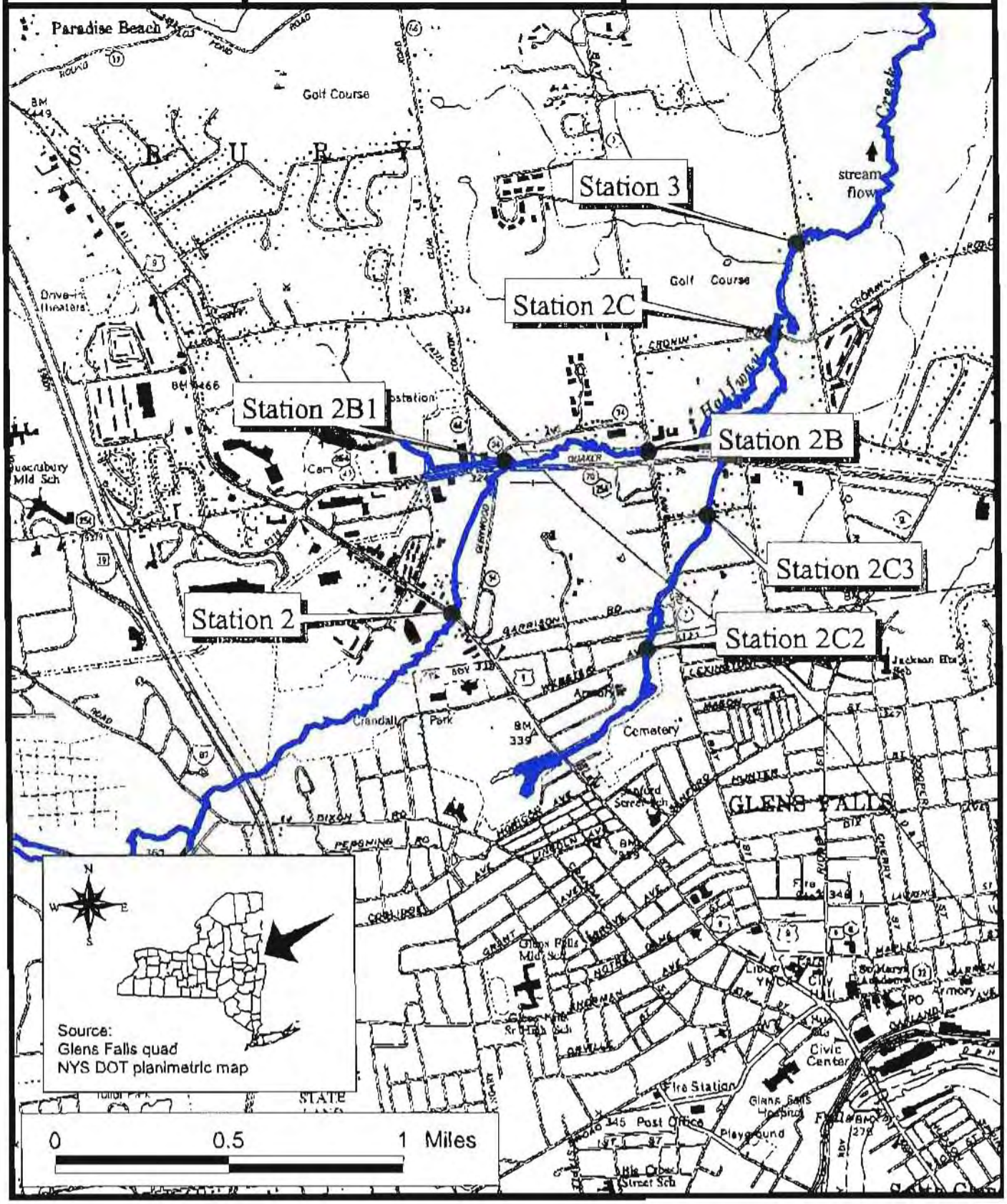


TABLE 4. MACROINVERTEBRATE SPECIES COLLECTED IN HALFWAY CREEK, WARREN COUNTY, NEW YORK, 2001.

NEMERTEA
- Undetermined Nemertea

PLATYHELMINTHES
- TURBELLARIA
  - Undetermined Turbellaria

ANNELIDA
- OLIGOCHAETA
  - Undetermined Lumbricina
  - Tubificidae
    - Limnodrilus hoffmeisteri
    - Undet. Tubificidae w/ cap. setae
    - Undet. Tubificidae w/o cap. setae
  - Naididae
    - Stylaria lacustris

HIRUDINEA
- Undetermined Hirudinea

MOLLUSCA
- GASTROPODA
  - Lymnaeidae
    - Undetermined Lymnaeidae
- PELECYPODA
  - Sphaeriidae
    - Undetermined Sphaeriidae

ARTHROPODA
- CRUSTACEA
  - ISOPODA
    - Asellidae
      - Caecidotea racovitzai
      - Caecidotea sp.
  - AMPHIPODA
    - Gammaridae
      - Gammarus sp.
  - DECAPODA
    - Cambaridae
    - Undetermined Cambaridae
- INSECTA
  - EPHEMEROPTERA
    - Baetidae
      - Acentrella sp.
      - Baetis flavistriga
      - Baetis intercalaris
      - Plauditus sp.
    - Heptageniidae
      - Stenacron interpunctatum
      - Stenonema modestum
      - Stenonema sp.
  - ODONATA
    - Aeschnidae
      - Boyeria sp.
    - Calopterygidae
      - Calopteryx sp.
  - PLECOPTERA
    - Perlidae
      - Paragnetina media
  - COLEOPTERA
    - Haliplidae
      - Peltodytes sp.
    - Hydrophilidae
      - Undetermined Hydrophilidae
    - Elmidae
      - Dubiraphia sp.
      - Macronychus glabratus
      - Promoresia tardella
      - Stenelmis crenata
  - MEGALOPTERA
    - Corydalidae
      - Nigronia serricornis
  - TRICHOPTERA
    - Philopotamidae
      - Chimarra aterrima?
      - Dolophilodes sp.
    - Psychomyiidae
      - Psychomyia flavida
    - Hydropsychidae
      - Cheumatopsyche sp.
      - Hydropsyche betteni
    - Hydroptilidae
      - Leucotrichia sp.
    - Leptoceridae
      - Oecetis sp.

TABLE 4. (continued) MACROINVERTEBRATE SPECIES COLLECTED IN HALFWAY CREEK, WARREN COUNTY, NEW YORK, 2001.

DIPTERA
- Tipulidae
  - Antocha sp.
  - Tipula sp.
- Culicidae
  - Undetermined Culicidae
- Ceratopogonidae
  - Undetermined Ceratopogonidae
- Simuliidae
  - Simulium tuberosum
  - Simulium venustum
  - Simulium vittatum
  - Simulium sp.
- Empididae
  - Hemerodromia sp.
- Muscidae
  - Undetermined Muscidae
- Chironomidae
  - Tanypodinae
    - Ablabesmyia mallochi
    - Natarsia sp. A
    - Thienemannimyia gr. spp.
  - Diamesinae
    - Pagastia sp. A
  - Orthocladiinae
    - Brillia sp.
    - Cricotopus bicinctus
    - Cricotopus tremulus gr.
    - Cricotopus trifascia gr.
    - Cricotopus vierriensis
    - Eukiefferiella brehmi gr.
    - Eukiefferiella claripennis gr.
    - Eukiefferiella devonica gr.
    - Parametriocnemus lundbecki
    - Rheocricotopus robacki
    - Synorthocladius nr. semivirens
    - Thienemanniella xena?
    - Tvetenia bavarica gr.
  - Chironominae
    - Chironomini
      - Chironomus sp.
      - Cryptochironomus fulvus gr.
      - Polypedilum aviceps
      - Polypedilum flavum
      - Polypedilum illinoense
      - Polypedilum scalaenum gr.
      - Stictochironomus sp.
    - Tanytarsini
      - Micropsectra aristata gr.
      - Micropsectra dives gr.
      - Micropsectra polita
      - Paratanytarsus confusus
      - Rheotanytarsus distinctissimus gr.
      - Rheotanytarsus exiguus gr.
      - Tanytarsus guerlus gr.

STREAM SITE:	Halfway Creek, Station 2
LOCATION:	Glens Falls, New York, below Route 9 bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Tubificidae	Undet. Tubificidae w/ cap. setae	2
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	1
INSECTA			
EPHEMEROPTERA	Baetidae	Acentrella sp.	1
		Baetis flavistriga	1
	Heptageniidae	Stenonema modestum	7
PLECOPTERA	Perlidae	Paragnetina media	1
COLEOPTERA	Elmidae	Stenelmis crenata	15
MEGALOPTERA	Corydalidae	Nigronia serricornis	1
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	2
	Hydropsychidae	Hydropsyche betteni	40
	Leptoceridae	Oecetis sp.	1
DIPTERA	Ceratopogonidae	Undetermined Ceratopogonidae	1
	Simuliidae	Simulium tuberosum	7
	Empididae	Hemerodromia sp.	3
	Chironomidae	Thienemannimyia gr. spp.	1
		Pagastia sp. A	2
		Cricotopus bicinctus	1
		Cricotopus vierriensis	2
		Parametriocnemus lundbecki	1
		Synorthocladius nr. semivirens	1
		Thienemanniella xena?	1
		Polypedilum flavum	2
		Micropsectra aristata gr.	2
		Rheotanytarsus distinctissimus gr.	2
		Rheotanytarsus exiguus gr.	1
		Tanytarsus guerlus gr.	1

SPECIES RICHNESS	26(good)
BIOTIC INDEX	5.18(good)
EPT RICHNESS	7(good)
MODEL AFFINITY	59(good)
ASSESSMENT	slightly impacted

DESCRIPTION

This sample was taken 10 meters downstream of the culvert passing under Route 9 in Glens Falls. The substrate contained large percentages of gravel, sand and silt. Some impoundment effects were evident in the macroinvertebrate fauna, as filter-feeding caddisflies were abundant and few mayflies were present. The index values placed the water quality assessment as slightly impacted.

STREAM SITE:	Halfway Creek, Station 2B
LOCATION:	Glens Falls, New York, below Bay Road bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

NEMERTEA		Undetermined Nemertea	1
ANNELIDA			
OLIGOCHAETA	Tubificidae	Undet. Tubificidae w/o cap. setae	7
HIRUDINEA		Undetermined Hirudinea	2
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	5
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis flavistriga	2
		Baetis intercalaris	4
	Heptageniidae	Stenacron interpunctatum	12
		Stenonema modestum	17
ODONATA	Aeschnidae	Boyeria sp.	1
PLECOPTERA	Perlidae	Paragnetina media	2
COLEOPTERA	Elmidae	Macronychus glabratus	1
		Stenelmis crenata	9
MEGALOPTERA	Corydalidae	Nigronia serricornis	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	7
		Hydropsyche betteni	14
DIPTERA	Chironomidae	Ablabesmyia mallochi	1
		Cricotopus bicinctus	1
		Cricotopus vierriensis	3
		Rheocricotopus robacki	3
		Chironomus sp.	1
		Cryptochironomus fulvus gr.	1
		Tanytarsus guerlus gr.	4

SPECIES RICHNESS	22 (good)
BIOTIC INDEX	5.25 (good)
EPT RICHNESS	7 (good)
MODEL AFFINITY	86 (very good)
ASSESSMENT	slightly impacted

DESCRIPTION The sampling site was just downstream of the intersection of Bay Road and Route 254. The substrate consisted mostly of sand. The macroinvertebrate fauna was dominated by tolerant filter-feeding caddisflies and mayflies and biomass was low. The summary of indices placed water quality in the range of slight impact.

STREAM SITE:	Halfway Creek, Station 2C
LOCATION:	Glens Falls, New York, below Cronin Road bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA		Undetermined Lumbricina	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea sp.	2
AMPHIPODA	Gammaridae	Gammarus sp.	4
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis intercalaris	3
		Plauditus sp.	3
	Heptageniidae	Stenacron interpunctatum	1
		Stenonema modestum	7
		Stenonema sp.	5
COLEOPTERA	Elmidae	Macronychus glabratus	3
MEGALOPTERA	Corydalidae	Nigronia serricornis	2
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	1
	Hydropsychidae	Cheumatopsyche sp.	4
		Hydropsyche betteni	40
	Simuliidae	Simulium sp.	1
DIPTERA	Chironomidae	Cricotopus bicinctus	2
		Cricotopus vierriensis	1
		Rheocricotopus robacki	4
		Tvetenia bavarica gr.	1
		Polypedilum flavum	1
		Rheotanytarsus exiguus gr.	14

SPECIES RICHNESS	20 (good)
BIOTIC INDEX	5.21 (good)
EPT RICHNESS	8 (good)
MODEL AFFINITY	62 (good)
ASSESSMENT	slightly impacted

DESCRIPTION

The kick sample was taken just below Cronin Road bridge. Gradient was low both upstream and downstream, with a sandy base along the entire length; therefore the sample was taken in a narrow band of rubble that lay across the stream. The macroinvertebrate fauna was heavily dominated by the tolerant filter-feeding caddisfly, *Hydropsyche betteni*. This species comprised 64% of the original sample, but this was reduced to 40% using quality assurance techniques. The indices were similar to those found at Station 2, and water quality was similarly assessed as slightly impacted.

STREAM SITE:	Halfway Creek, Station 3
LOCATION:	Glens Falls, New York, above Meadowbrook Road bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	9
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis intercalaris	10
	Heptageniidae	Stenonema modestum	9
	Hydrophilidae	Undetermined Hydrophilidae	1
COLEOPTERA	Elmidae	Promoresia tardella	1
MEGALOPTERA	Corydalidae	Nigronia serricornis	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	8
		Hydropsyche betteni	40
DIPTERA	Tipulidae	Antocha sp.	1
		Tipula sp.	1
	Simuliidae	Simulium venustum	3
	Chironomidae	Thienemannimyia gr. spp.	1
		Cricotopus bicinctus	4
		Parametriocnemus lundbecki	2
		Rheocricotopus robacki	3
		Tvetenia bavarica gr.	1
		Polypedilum aviceps	1
		Rheotanytarsus exiguus gr.	3

SPECIES RICHNESS	18 (poor)
BIOTIC INDEX	5.09 (good)
EPT RICHNESS	4 (poor)
MODEL AFFINITY	56 (good)
ASSESSMENT	slightly impacted

DESCRIPTION

The sampling site was just upstream of the Meadowbrook Road bridge. The stream was rather flat in this reach, and the kick sample was taken in a narrow band of rubble that lay across the stream. The macroinvertebrate fauna was dominated by the tolerant filter-feeding caddisfly, *Hydropsyche betteni*. As with previous stations the summary of indices placed water quality in the range of slight impact.

STREAM SITE:	Cemetery Brook Tributary, Station 2B1
LOCATION:	Glens Falls, New York, below Glenwood Road bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA		Undetermined Lumbricina	2
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	10
INSECTA			
EPHEMEROPTERA	Baetidae	Acentrella sp.	1
	Heptageniidae	Stenacron interpunctatum	2
		Stenonema modestum	5
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	1
		Dolophilodes sp.	1
	Psychomyiidae	Psychomyia flavida	1
	Hydropsychidae	Cheumatopsyche sp.	24
		Hydropsyche betteni	6
	Hydroptilidae	Leucotrichia sp.	1
DIPTERA	Tipulidae	Antocha sp.	3
	Empididae	Hemerodromia sp.	1
	Chironomidae	Pagastia sp. A	2
		Brillia sp.	1
		Cricotopus bicinctus	15
		Cricotopus tremulus gr.	2
		Cricotopus trifascia gr.	1
		Cricotopus vierriensis	1
		Eukiefferiella brehmi gr.	3
		Eukiefferiella devonica gr.	1
		Parametriocnemus lundbecki	3
		Rheocricotopus robacki	1
		Thienemanniella xena?	1
		Tvetenia bavarica gr.	6
		Polypedilum flavum	3
		Micropsectra polita	1
		Rheotanytarsus exiguus gr.	1

SPECIES RICHNESS	28 (very good)
BIOTIC INDEX	5.34 (good)
EPT RICHNESS	9 (good)
MODEL AFFINITY	50 (good)
ASSESSMENT	slightly impacted

DESCRIPTION The site was located just above the confluence with Halfway Creek. Substrate consisted of sand and rubble. The stream rocks had little growth on them, indicating that the stream may be intermittent. The fauna was again dominated by caddisflies and biomass was low. Water quality was similarly assessed as slightly impacted.

STREAM SITE:	Crandall Park Tributary, Station 2C2
LOCATION:	Glens Falls, New York, below Webster Avenue bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA		Undetermined Turbellaria	2
ANNELIDA			
OLIGOCHAETA	Tubificidae	Limnodrilus hoffmeisteri	1
MOLLUSCA			
PELECYPODA	Sphaeriidae	Undetermined Sphaeriidae	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	20
AMPHIPODA	Gammaridae	Gammarus sp.	2
INSECTA			
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	10
		Hydropsyche betteni	13
DIPTERA	Simuliidae	Simulium vittatum	12
	Muscidae	Undetermined Muscidae	4
	Chironomidae	Thienemannimyia gr. spp.	7
		Brillia sp.	1
		Cricotopus bicinctus	2
		Cricotopus tremulus gr.	4
		Tvetenia bavarica gr.	1
		Micropsectra dives gr.	1
		Micropsectra polita	19

SPECIES RICHNESS	16 (poor)
BIOTIC INDEX	6.69 (poor)
EPT RICHNESS	2 (poor)
MODEL AFFINITY	41(poor)
ASSESSMENT	moderately impacted

DESCRIPTION

The kick sample was taken just below the culvert passing under Webster Avenue, across from the cemetery. The substrate contained large percentages of gravel, sand and silt. A kick sample was taken in a narrow band of rubble that lay across the stream, similar to that at Station 2C. The sample was dominated by caddisflies and sowbugs, with an absence of mayflies and stoneflies. The index values placed the water quality assessment as moderately impacted.

STREAM SITE:	Crandall Park Tributary, Station 2C3
LOCATION:	Glens Falls, New York, below Webster Avenue bridge
DATE:	September 5, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Tubificidae	Undet. Tubificidae w/o cap. setae	2
	Naididae	Stylaria lacustris	1
MOLLUSCA			
GASTROPODA	Lymnaeidae	Undetermined Lymnaeidae	1
PELECYPODA	Sphaeriidae	Undetermined Sphaeriidae	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	39
AMPHIPODA	Gammaridae	Gammarus sp.	2
DECAPODA	Cambaridae	Undetermined Cambaridae	1
INSECTA			
EPHEMEROPTERA	Baetidae	Acentrella sp.	1
	Heptageniidae	Stenacron interpunctatum	1
		Stenonema sp.	2
ODONATA	Calopterygidae	Calopteryx sp.	1
COLEOPTERA	Haliplidae	Peltodytes sp.	2
	Elmidae	Dubiraphia sp.	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	2
		Hydropsyche betteni	11
DIPTERA	Culicidae	Undetermined Culicidae	1
	Simuliidae	Simulium venustum	1
		Simulium vittatum	2
	Chironomidae	Natarsia sp. A	1
		Thienemannimyia gr. spp.	1
		Pagastia sp. A	1
		Eukiefferiella brehmi gr.	1
		Eukiefferiella claripennis gr.	1
		Rheocricotopus robacki	1
		Polypedilum flavum	1
		Polypedilum illinoense	1
		Polypedilum scalaenum gr.	1
		Stictochironomus sp.	1
		Micropsectra dives gr.	2
		Micropsectra polita	2
		Paratanytarsus confusus	3
		Rheotanytarsus exiguus gr.	10

SPECIES RICHNESS	32 (very good)
BIOTIC INDEX	6.81 (poor)
EPT RICHNESS	5 (poor)
MODEL AFFINITY	51 (good)
ASSESSMENT	slightly impacted

DESCRIPTION

This site was located just below the culvert on Homer Road. While the substrate still consisted of mostly gravel and sand, the current from the culvert washed silt from the bottom, leaving cobbles. The macroinvertebrate fauna was dominated by sowbugs and Chironomidae. The indices for this site pointed to slightly impacted water quality.

LABORATORY DATA SUMMARY				
STREAM NAME: Halfway Creek		DRAINAGE: 10		
DATE SAMPLED: 09/05/01		COUNTY: Warren		
SAMPLING METHOD: Traveling Kick				
STATION	02	02B	02C	03
LOCATION Glens Falls	Route 9	Bay Rd.	Cronin Rd.	Meadowbrook Rd
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Hydropsyche betteni 40 % facultative caddisfly	Stenonema modestum 17 % intolerant mayfly	Hydropsyche betteni 40 % facultative caddisfly	Hydropsyche betteni 40 % facultative caddisfly
2. Intolerant = not tolerant of poor water quality	Stenelmis crenata 15 % facultative beetle	Hydropsyche betteni 14 % facultative caddisfly	Rheotanytarsus exiguus gr. 14 % facultative midge	Baetis intercalaris 10 % facultative mayfly
3. Facultative = occurring over a wide range of water quality	Stenonema modestum 7 % intolerant mayfly	Stenacron interpunctatum 12 % facultative mayfly	Stenonema modestum 7 % intolerant mayfly	Gammarus sp. 9 % facultative scud
4. Tolerant = tolerant of poor water quality	Simulium tuberosum 7 % intolerant black fly	Stenelmis crenata 9 % facultative beetle	Stenonema sp. 5 % intolerant mayfly	Stenonema modestum 9 % intolerant mayfly
5.	Hemerodromia sp. 3 % facultative dance fly	Undet. Tubificidae w/o cap. setae 7 % tolerant worm	Gammarus sp. 4 % facultative scud	Cheumatopsyche sp. 8 % facultative caddisfly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	17.0 (12.0)	14.0 (7.0)	23.0 (6.0)	15.0 (7.0)
Trichoptera (caddisflies)	43.0 (3.0)	21.0 (2.0)	45.0 (3.0)	48.0 (2.0)
Ephemeroptera (mayflies)	9.0 (3.0)	35.0 (4.0)	19.0 (5.0)	19.0 (2.0)
Plecoptera (stoneflies)	1.0 (1.0)	2.0 (1.0)	0.0 (0.0)	0.0 (0.0)
Coleoptera (beetles)	15.0 (1.0)	10.0 (2.0)	3.0 (1.0)	2.0 (2.0)
Oligochaeta (worms)	2.0 (1.0)	7.0 (1.0)	1.0 (1.0)	0.0 (0.0)
Mollusca (clams and snails)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Crustacea (crayfish, scuds, sowbugs)	1.0 (1.0)	5.0 (1.0)	6.0 (2.0)	9.0 (1.0)
Other insects (odonates, diptera)	12.0 (4.0)	3.0 (2.0)	3.0 (2.0)	7.0 (4.0)
Other (Nemertea, Platyhelminthes)	0.0 (0.0)	3.0 (2.0)	0.0 (0.0)	0.0 (0.0)
SPECIES RICHNESS	26	22	20	18
BIOTIC INDEX	5.18	5.25	5.21	5.09
EPT RICHNESS	7	7	8	4
PERCENT MODEL AFFINITY	59	86	62	56
FIELD ASSESSMENT	Slight	Slight	Non	Slight
OVERALL ASSESSMENT	Slightly impacted	Slightly impacted	Slightly impacted	Slightly impacted

LABORATORY DATA SUMMARY			
STREAM NAME: Halfway Creek		DRAINAGE: 10	
DATE SAMPLED: 09/05/01		COUNTY: Warren	
SAMPLING METHOD: Traveling Kick			
STATION LOCATION Glens Falls	02B1 Cemetery Trib	02C2 Crandall Park Trib	02C3 Crandall Park Trib
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME			
1.	Cheumatopsyche sp. 24 % facultative caddisfly	Caecidotea racovitzai 20 % tolerant sowbug	Caecidotea racovitzai 39 % tolerant sowbug
2. Intolerant = not tolerant of poor water quality	Cricotopus bicinctus 15 % tolerant midge	Micropsectra polita 19 % facultative midge	Hydropsyche betteni 11 % facultative caddisfly
3. Facultative = occurring over a wide range of water quality	Caecidotea racovitzai 10 % tolerant sowbug	Hydropsyche betteni 13 % facultative caddisfly	Rheotanytarsus exiguus gr. 10 % facultative midge
4. Tolerant = tolerant of poor water quality	Hydropsyche betteni 6 % facultative caddisfly	Simulium vittatum 12 % facultative black fly	Paratanytarsus confusus 3 % facultative midge
5.	Tvetenia bavarica gr. 6 % facultative midge	Cheumatopsyche sp. 10 % facultative caddisfly	Undet. Tubificidae w/o cap. setae 2 % tolerant worm
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)			
Chironomidae (midges)	42.0 (15.0)	35.0 (7.0)	27.0 (14.0)
Trichoptera (caddisflies)	34.0 (6.0)	23.0 (2.0)	13.0 (2.0)
Ephemeroptera (mayflies)	8.0 (3.0)	0.0 (0.0)	4.0 (3.0)
Plecoptera (stoneflies)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Coleoptera (beetles)	0.0 (0.0)	0.0 (0.0)	4.0 (2.0)
Oligochaeta (worms)	2.0 (1.0)	1.0 (1.0)	3.0 (2.0)
Mollusca (clams and snails)	0.0 (0.0)	1.0 (1.0)	2.0 (2.0)
Crustacea (crayfish, scuds, sowbugs)	10.0 (1.0)	22.0 (2.0)	42.0 (3.0)
Other insects (odonates, diptera)	4.0 (2.0)	16.0 (2.0)	5.0 (4.0)
Other (Nemertea, Platyhelminthes)	0.0 (0.0)	2.0 (1.0)	0.0 (0.0)
SPECIES RICHNESS	28	16	32
BIOTIC INDEX	5.34	6.69	6.81
EPT RICHNESS	9	2	5
PERCENT MODEL AFFINITY	50	41	51
FIELD ASSESSMENT	Slight	Moderate	Moderate
OVERALL ASSESSMENT	Slightly impacted	Moderately impacted	Slightly impacted

FIELD DATA SUMMARY

STREAM NAME: Halfway Creek **DATE SAMPLED: 09/05/01**
REACH: Rte 9, Glens Falls to Meadowbrook Rd.
FIELD PERSONNEL INVOLVED: Abele, Heitzman, Jaffe

STATION	02	02B	02C	03
ARRIVAL TIME AT STATION	9:30	11:20	1:50	1:00
LOCATION Glens Falls	Rte. 9	Bay Rd.	Cronin Rd.	Meadowbrook Rd.
PHYSICAL CHARACTERISTICS				
Width (meters)	4	6.0	5	5
Depth (meters)	0.3	0.4	0.3	0.3
Current speed (cm per sec.)	30	50	80	100
Substrate (%)				
Rock (>25.4 cm, or bedrock)	0	10	30	30
Rubble (6.35 - 25.4 cm)	0	10	40	30
Gravel (0.2 – 6.35 cm)	40	10		30
Sand (0.06 – 2.0 mm)	40	50	20	10
Silt (0.004 – 0.06 mm)	20	20	10	
Embeddedness (%)	50	50	20	10
CHEMICAL MEASUREMENTS				
Temperature (° C)	17.3	16.6	18.2	17.1
Specific Conductance (umhos)	460	583	591	610.2
Dissolved Oxygen (mg/l)	7.9	8.7	8.6	9.0
pH	7.9	7.9	7.8	8.1
BIOLOGICAL ATTRIBUTES				
Canopy (%)	100	5	10	0
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous		X		
algae - diatoms	X	X	present	
macrophytes or moss		X	present	present
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)	X	X		
Megaloptera(dobsonflies,alderflies)		X		
Odonata (dragonflies, damselflies)		X		
Chironomidae (midges)				X
Simuliidae (black flies)				
Decapoda (crayfish)				
Gammaridae (scuds)	X	X	X	X
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other				
FIELD ASSESSMENT	Slight	Slight	Non	Slight

FIELD DATA SUMMARY

STREAM NAME: Halfway Creek **DATE SAMPLED: 09/05/01**
REACH: Rte 9, Glens Falls to Meadowbrook Rd.
FIELD PERSONNEL INVOLVED: Abele, Heitzman, Jaffe

STATION	02B1	02C2	02C3	
ARRIVAL TIME AT STATION	12:00	10:00	10:42	
LOCATION Glens Falls	Cemetery Trib	Crandall Park Trib	Crandall Park Trib	
PHYSICAL CHARACTERISTICS				
Width (meters)	3.0	2	1.5	
Depth (meters)	0.2	0.1	0.5	
Current speed (cm per sec.)	40	40	20	
Substrate (%)				
Rock (>25.4 cm, or bedrock)	0	10		
Rubble (6.35 - 25.4 cm)	30	10	20	
Gravel (0.2 – 6.35 cm)	10	40	40	
Sand (0.06 – 2.0 mm)	40	40	40	
Silt (0.004 – 0.06 mm)	20	20	20	
Embeddedness (%)	40	60	701	
CHEMICAL MEASUREMENTS				
Temperature (°C)	16.5	13.8	16.3	
Specific Conductance (umhos)	807	590	626	
Dissolved Oxygen (mg/l)	9.5	8.4	6.7	
pH	8.1	7.4	7.5	
BIOLOGICAL ATTRIBUTES				
Canopy (%)	80	80	0	
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous				
algae - diatoms				
macrophytes or moss			present	
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X		X	
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X	X	
Coleoptera (beetles)			X	
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)			X	
Chironomidae (midges)	X	X	X	
Simuliidae (black flies)				
Decapoda (crayfish)				
Gammaridae (scuds)		X	X	
Mollusca (snails, clams)				
Oligochaeta (worms)		X		
Other	X			
FIELD ASSESSMENT	Slight	Moderate	Moderate	

Appendices

I. Biological methods for kick sampling

II. Macroinvertebrate community parameters

III. Levels of water quality impact in streams

IV. Biological Assessment Profile derivations

V. Water quality assessment criteria

VI. Traveling kick sample illustration

VII. Macroinvertebrate illustrations

VIII. Rationale for biological monitoring

IX. Glossary

X. Methods for Impact Source Determination

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 five minutes for a distance of five meters. The net contents are emptied into a pan of stream water. The contents are then examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol.

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

E. Organism Identification. All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species, and the total number of individuals in the subsample is recorded on a data sheet. All organisms from the subsample are archived (either slide-mounted or preserved in alcohol). 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.

MACROINVERTEBRATE COMMUNITY PARAMETERS

1. Species richness is the total number of species or taxa found in the 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; less than 11, severely impacted.

2. EPT Richness 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. Hilsnhoff 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; 4.5 1-6.50, slightly impacted; 6.5 1-8.50, 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 seven major macroinvertebrate groups (Novak and Bode, 1992). Percent 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.

Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. NY S 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.

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 Macroinvertebrate Community Parameters Appendix*). 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-organism 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. 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.

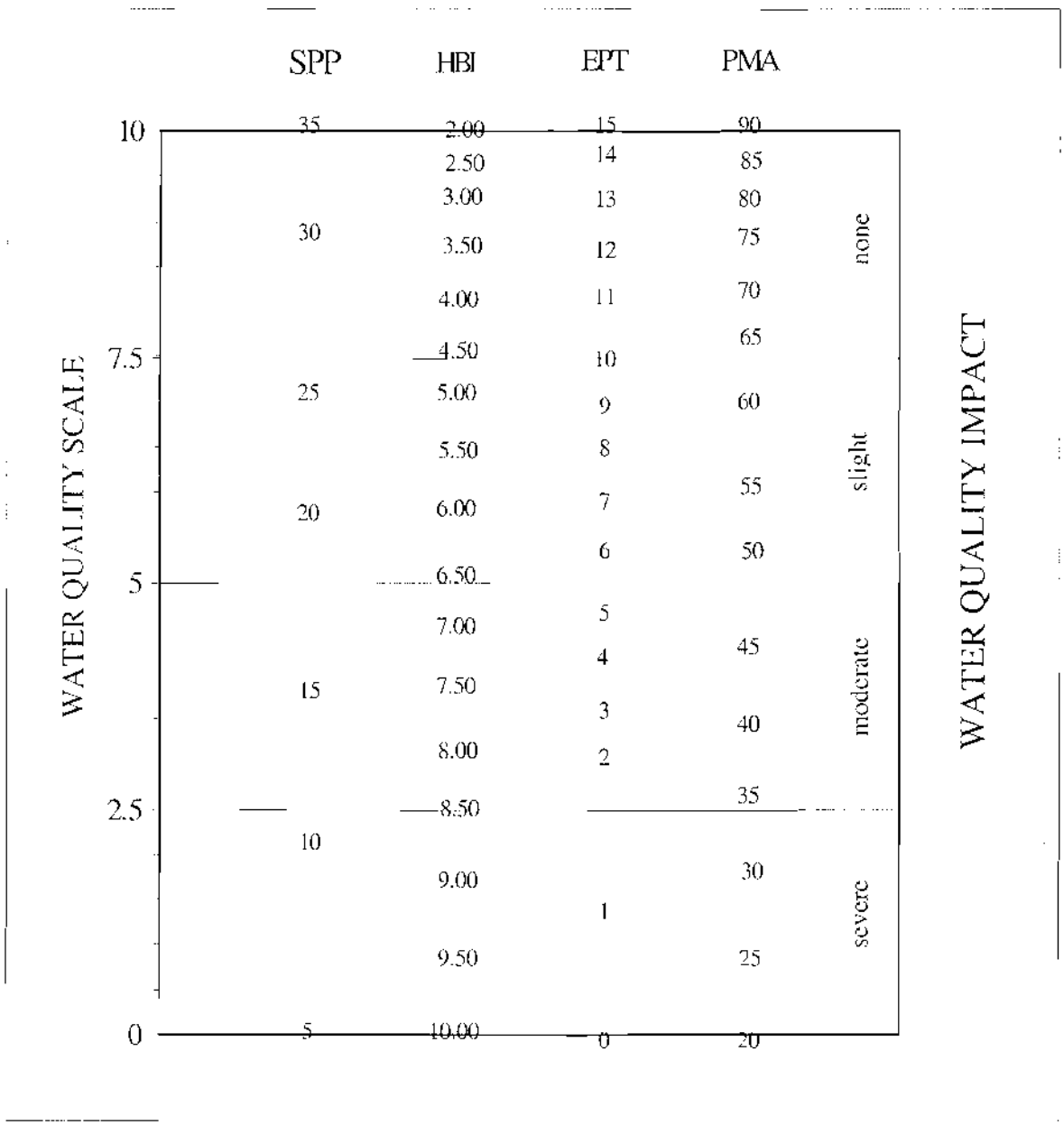
2. *Slightly impacted* Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50.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

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

4. *Severely impacted* Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or less. Mayflies, stoneflies, and caddisflies are rare or absent; EPT richness 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.

Biological Assessment Profile: Conversion of Index values to Common 10-Scale

The Biological Assessment Profile 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 four indices, defined in the Macroinvertebrate Community Parameter Appendix, 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.



Biological Assessment Profile: Plotting Values

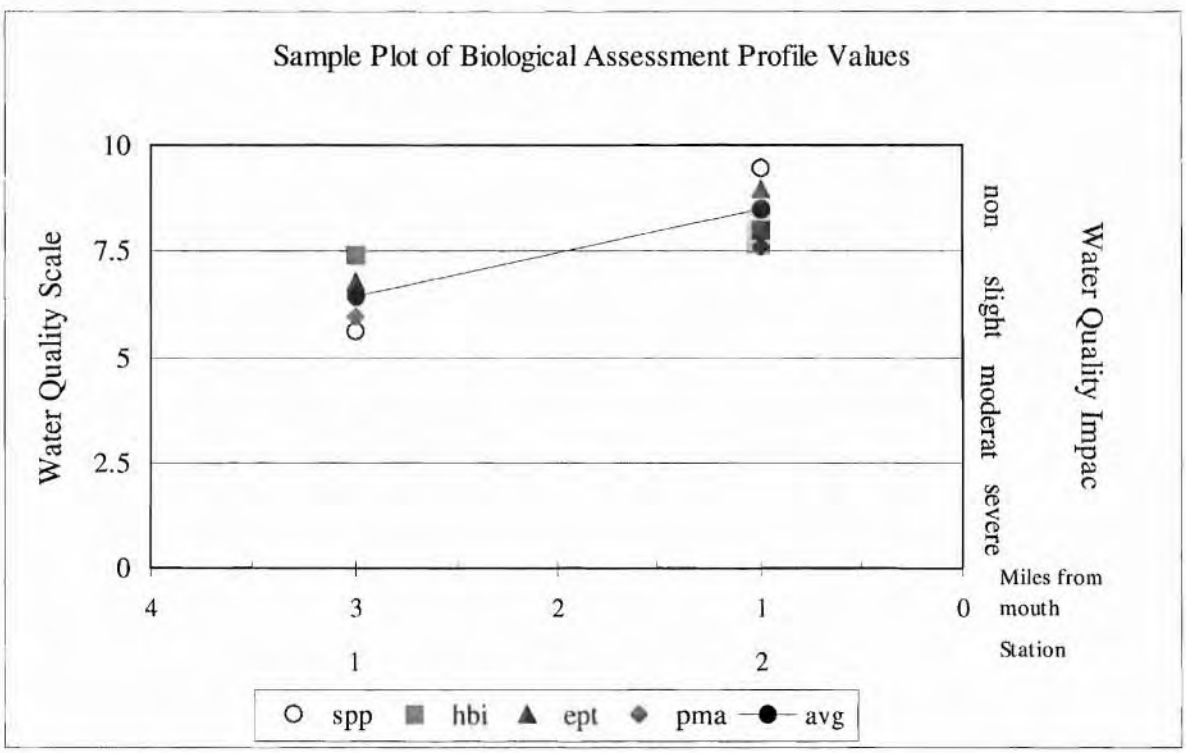
To plot survey data:

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-)

Table IV-B. Sample Plot of Biological Assessment Profile values



Water Quality Assessment Criteria

Water Quality Assessment Criteria for Non-Navigable Flowing Waters

	Species Richness	Hilsenhoff Biotic Index	EPT Richness	Percent Model Affinity#	Species 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 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.

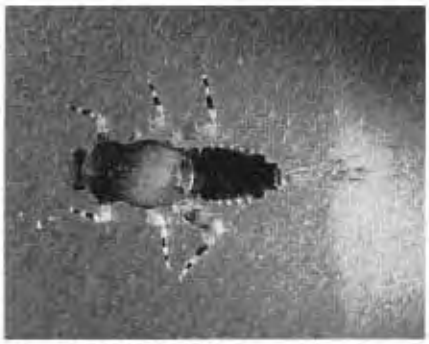
THE TRAVELING KICK SAMPLE

← 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.

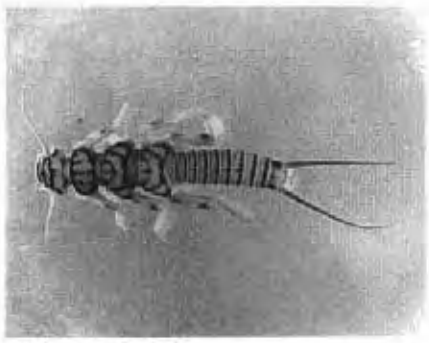
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

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



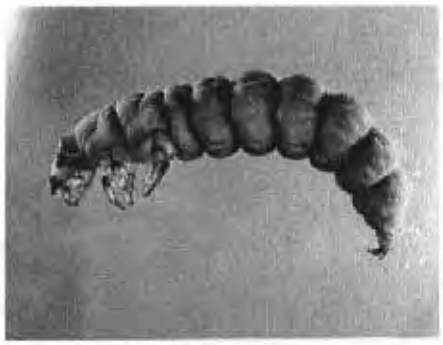
MAYFLIES

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



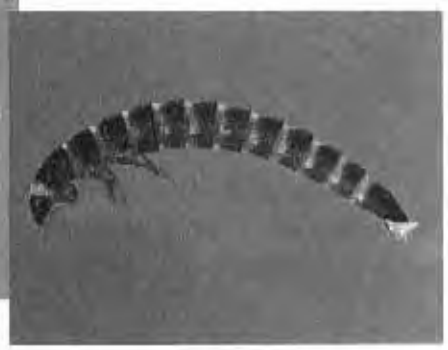
STONEFLIES

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



CADDISFLIES

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



BEETLES

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

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

MIDGES

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

BLACK FLIES

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

WORMS

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

SOWBUGS

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

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:

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, e.g. 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 ail 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.

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

EPT richness: the number of species of mayflies (**E**phemeroptera), stoneflies (**P**lecoptera), and caddisflies (**Tr**ichoptera) 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 time; usually involves kick sampling and laboratory subsampling of the sample

Riffle: wadeable stretch of stream usually having a rubble bottom and sufficient current to break the water surface; 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

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