New York State
Department of Environmental Conservation

Division of Water

Kelsey Creek

Biological Assessment

2000 Survey

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BIOLOGICAL STREAM ASSESSMENT

Kelsey Creek
Jefferson County, New York

Survey date: September 6, 2000
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Stream: Kelsey Creek, Jefferson County, New York

Reach: Route 37 to West Main Street, Watertown, New York

Background:

The Stream Biomonitoring Unit conducted biological sampling on Kelsey Creek on September 7, 2000. At five sites on the main stem and on Oily Creek, a tributary, macroinvertebrate communities were sampled using kick sampling techniques. Crayfish were collected at the three Kelsey Creek sites for tissue analysis for metals and PCBs. This investigation was conducted at the request of Philip Waite (NYSDEC, Environmental Remediation). The purpose of the sampling was to assess water quality and invertebrate body burdens, and compare to results of sampling in 1991.

Traveling kick samples for macroinvertebrates were taken in riffle areas at five sites using methods described in the Quality Assurance document (Bode et al., 1996) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT value, and percent model affinity (see Appendices II and III). Table 4 provides a listing of sampling sites, and Table 5 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.

Crayfish were collected with aquatic nets at three sites on the main stem of Kelsey Creek, and processed as described in Appendix XI. The samples were submitted to the Wadsworth Center, New York State Department of Health, for Aroclor analysis of PCBs.

Results and Conclusions:

1. Water quality in Kelsey Creek and Oily Creek was assessed as moderately impacted. Water quality improved slightly compared to 1991 sampling, when most sites were assessed as severely impacted.

2. Elevated levels of PCBs persist in crayfish in the lower portion of Kelsey Creek, downstream of Route 12 (Bradley Street).

Discussion

The purpose of this sampling was to assess water quality and measure invertebrate body burdens, and compare these to the 1991 findings. Biological sampling in 1991 (Bode et al., 1991) found severe impairment in the lower 0.5 mile reach of Kelsey Creek, and elevated body burdens of PCBs and several metals. In recent years, remediation efforts in the Kelsey Creek watershed were performed, including excavation of portions of the creek bed, and installation of stormwater treatment. Three sites that were sampled in 1991 coincide with the three mainstream sites in the present survey: Stations 2, 4, and 5. In the 1991 sampling, water quality at Station 2 was assessed as moderately impacted, and Stations 4 and 5 were assessed as severely impacted.

Based on analysis of macroinvertebrate communities in the present survey, all sites sampled in Kelsey and Oily Creeks were assessed as moderately impacted (Figure 1). Impact Source Determination (Table 1) showed that all sites were affected primarily by municipal/industrial influences; the upstream sites were also affected by impoundment effects. All macroinvertebrate communities were dominated by Gammarus scuds (side-swimming crustaceans), and all sites were affected to some degree by poor habitat.

The tissue analysis portion of this study documented elevated levels of PCBs in crayfish tissues in Kelsey Creek in the lower 0.5 mile reach (Table 2). The highest PCB levels were found in crayfish collected at the Bradley Street site (KLSY-4); no crayfish were analyzed from this site in 1991. The provisional level of concern for total PCBs in crayfish tissues in New York State is 200 ppb dry weight (Bode et al., 1996). This data shows that there is a source of PCBs in Kelsey Creek upstream of the Route 12 site (Bradley Street).

Tissue analysis of crayfish for metals showed reductions in body burdens for some metals, compared to 1991 levels (Table 3). Reductions were documented for lead, mercury, and titanium. The present levels are all below the levels of concern. The 1991 levels of concern for mercury and titanium, which were exceeded in the 1991 study at Station 5, were adjusted in the 1996 QA document (Bode et al., 1996), and these do not appear as exceedances in Table 3.

Based on macroinvertebrate community analysis and tissue analysis, slight improvement has occurred in Kelsey Creek since the 1991 sampling, but some problems persist. The lower 0.5 mile reach of the river shows changes in community composition, improving from severely impacted to moderately impacted (Figure 2), but PCB levels remain nearly as high as in 1991. Other PCB sources should be explored upstream of the Bradley Street site, and in Oily Creek. Mayflies, considered indicators of good water quality, were not found in the 1991 survey, but were found at 3 of the 5 sites in the present survey, and are noteworthy signs of recovery in Kelsey Creek.

Figure 1. Biological Assessment Profile of index values, Kelsey and Oily Creeks, 2000. 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.

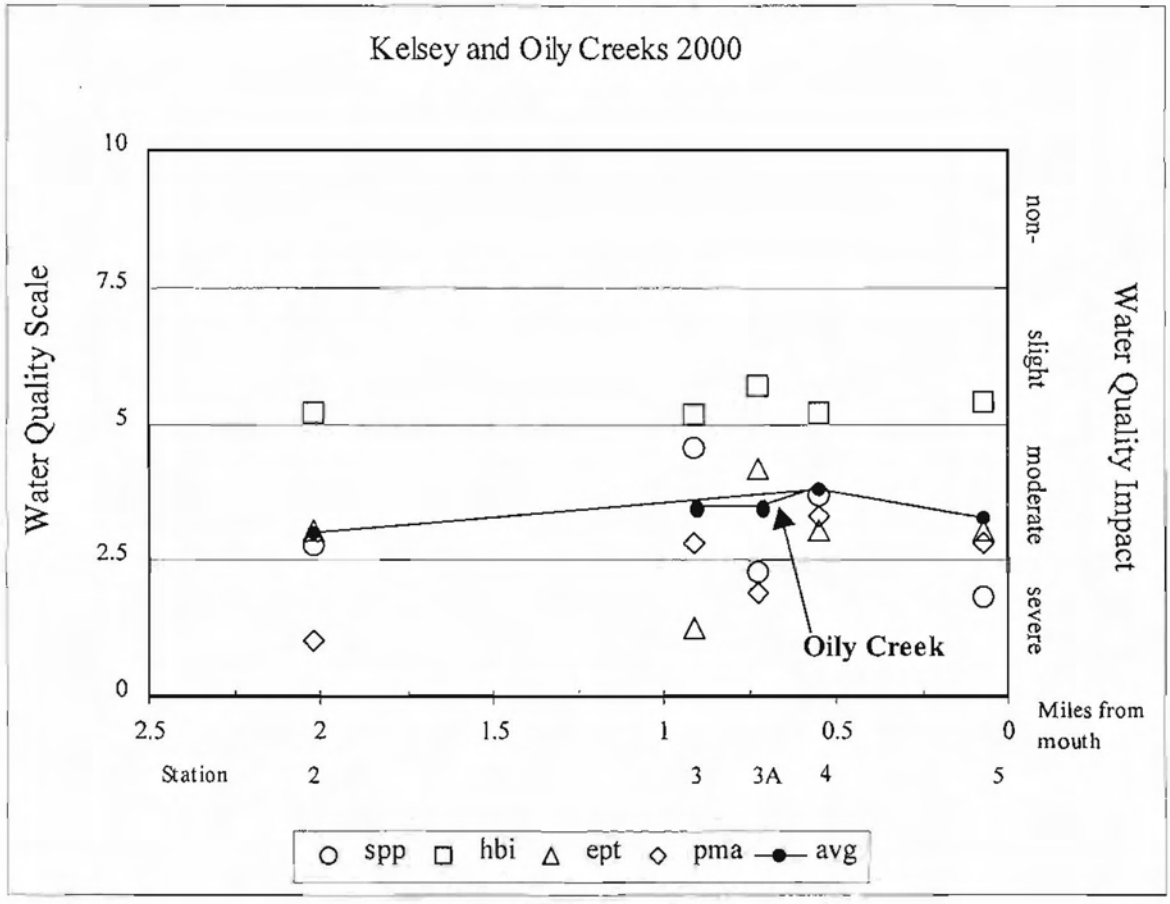

Figure 2. Biological Assessment Profile of index values, Kelsey Creek, 1991 and 2000. Values are plotted on a normalized scale of water quality. Averages are shown for each year of sampling.

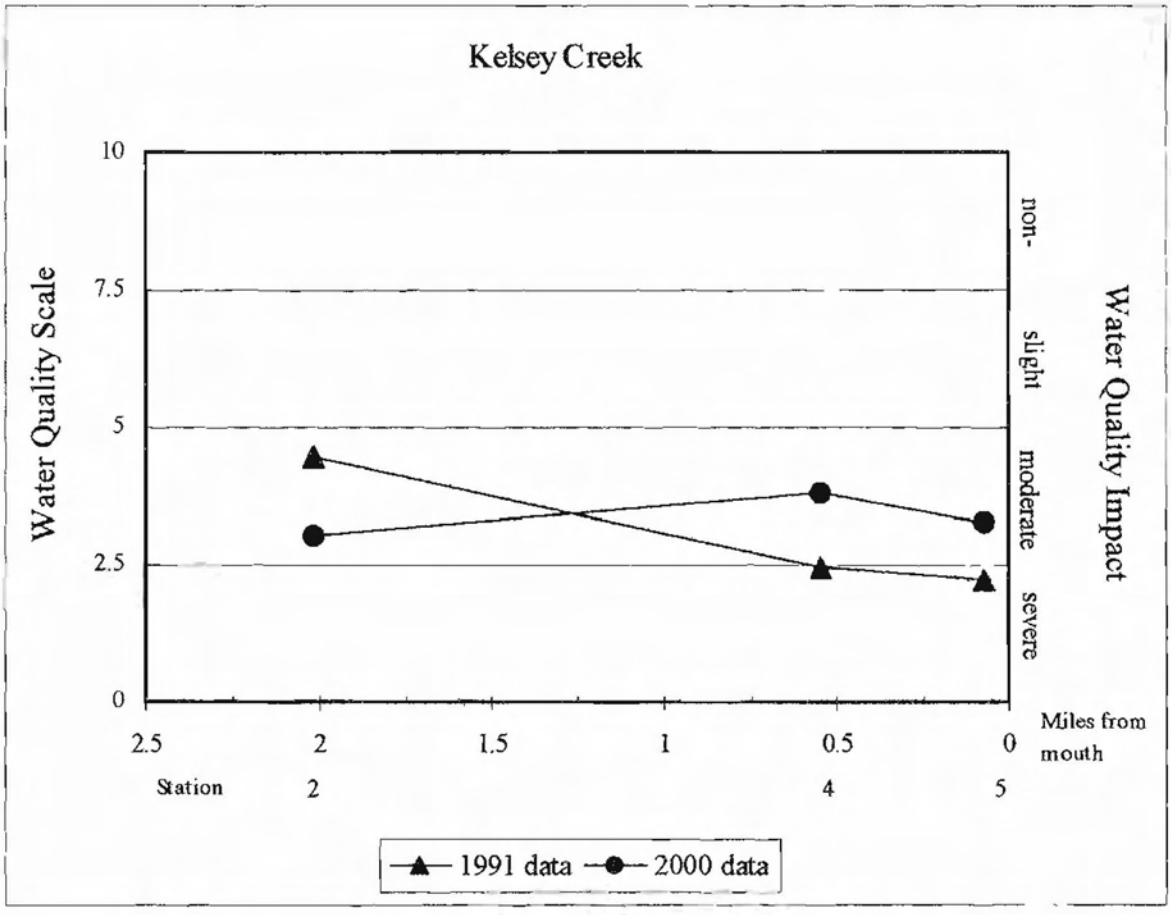

Table 1. Impact Source Determination, Kelsey Creek and Oily Creek, 2000. Numbers represent similarity to community type models for each impact category. The highest similarity at each station is highlighted. Similarities less than 50% are less conclusive.

	STATION				
Community Type	KLSY-2	KLSY-4	KLSY-5	KLSY-3 (Oily Cr.)	KLSY-3A (Oily Cr.)
Natural: minimal human impacts	20	19	19	19	20
Nutrient additions; mostly nonpoint, agricultural	34	25	36	38	21
Toxic: industrial, municipal, or urban run-off	41	35	53	53	41
Organic: sewage effluent, animal wastes	47	25	41	43	35
Complex: municipal/industrial	59	59	63	64	57
Siltation	33	34	35	37	22
Impoundment	59	57	55	56	48

Table 2. Levels of PCBs in Kelsey Creek crayfish.

	Kelsey Creek sampling, September 6, 2000			
STATION	Miles from mouth	Station description	Total PCBs (ppb)*	1991 PCB levels
KLSY-2	2.0	Below Route 37 bridge	<150	no sample
KLSY-4	0.5	Below Route 12 bridge	2320	no sample
KLSY-5	0.02	Above Main St. bridge	920	1190

* total PCBs, ppb dry weight

Literature Cited:

Bode, R. W., M. A. Novak, and L. E. Abele. 1991. Biological stream assessment, Kelsey Creek. New York State Department of Environmental Conservation, Technical Report, 20 pages.

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

Overview of field data

On the date of sampling, September 6, 2000, Kelsey Creek and Oily Creek at the sites sampled was 2-5 meters wide, 0.2 meters deep, and had current speeds of 70-125 cm/sec in riffles. Dissolved oxygen was 7.1-11.2 mg/l, specific conductance was 772-848 µmhos, pH was 7.5-7.9, and the temperature was 14.4-16.2 °C (58-61 °F). Measurements for each site are found on the field data summary sheets.

Table 3. Levels of metals in crayfish tissue, Kelsey Creek, 1991 and 2000. All values in mg/kg (parts per million) dry weight. Exceedances of levels of concern highlighted.

	STATION				
Metal	KLSY-2 2000	KLSY-5 2000	KLSY-2 1991	KLSY-5 1991	level of concern
Arsenic	0.44	0.88	< 2	< 2	5
Cadmium	0.09	0.42	< 3	< 3	2
Chromium	0.43	0.76	< 3	< 3	5
Copper	58.9	140	62.2	68.4	200
Lead	0.29	0.63	< 2	39.6	20
Mercury	0.07	0.06	.13	.28	.3
Nickel	0.33	0.61	< 3	< 3	2
Selenium	[3.2]*	[3.9]*	0.9	< 1	1
Titanium	1.7	5.4	5.9	9.0	10
Zinc	64.9	70.9	61.6	86.9	150

* selenium results not considered reliable, due to high variability in spiked sample recovery.

TABLE 4. STATION LOCATIONS FOR KELSEY CREEK, JEFFERSON COUNTY, NEW YORK (see map).

STATION	LOCATION
Kelsey Creek	
02	Watertown 15 m below Rt. 37 bridge 2.0 river miles upstream of mouth 44°00'20"; 75°54'09"
04	Watertown 100 m below Rt. 12 (Bradley St) bridge 0.50 river miles upstream of mouth 43°59'26"; 75°55'01"
05	Watertown 5 m above RR bridge at Rt. 12E 0.02 river miles upstream of mouth 43°59'22"; 75°55'27"
Oily Creek	
03	Watertown 75 m above Morrison Ave 0.04 river miles upstream of mouth 43°59'27"; 75°54'46"
03A	Watertown trailer park at LeRay St 0.24 river miles upstream of mouth 43°59'27"; 75°54'35"

Figure 2	Site Location Map	Kelsey Creek

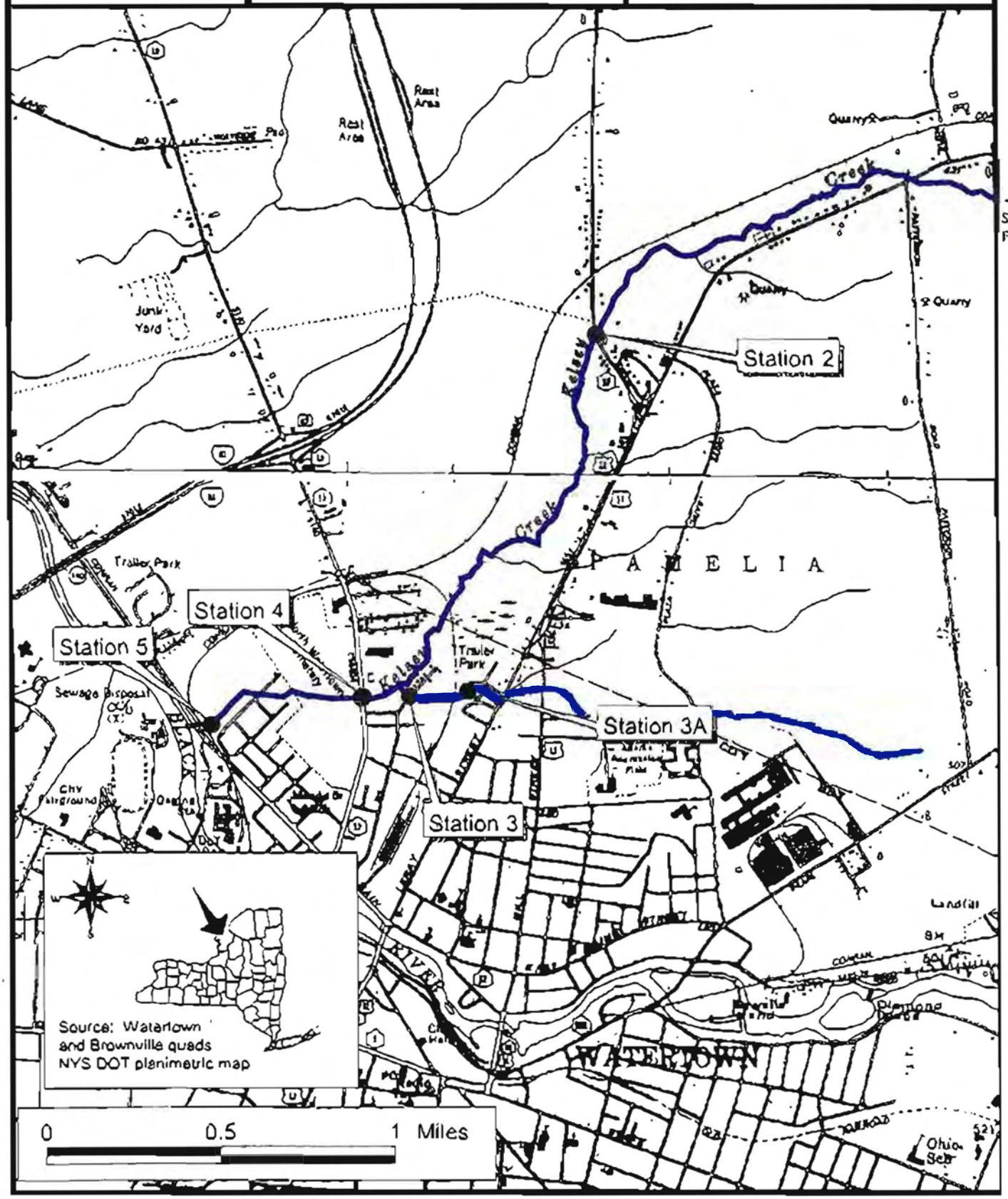

TABLE 5. MACROINVERTEBRATE SPECIES COLLECTED IN KELSEY CREEK, JEFFERSON COUNTY, NEW YORK, 2000.

PLATYHELMINTHES
- TURBELLARIA
  - Undetermined Turbellaria

ANNELIDA
- OLIGOCHAETA
  - LUMBRICINA
    - Undetermined Lumbricina
  - Enchytraeidae
    - Undetermined Enchytraeidae
  - Tubificidae
    - Undet. Tubificidae w/o cap. setae
  - Naididae
    - Nais variabilis

MOLLUSCA
- GASTROPODA
  - Physidae
    - Physella sp.
- PELECYPODA
  - Sphaeriidae
    - Pisidium sp.

ARTHROPODA
- CRUSTACEA
  - ISOPODA
    - Asellidae
      - Caecidotea racovitzai
      - Caecidotea sp.
  - AMPHIPODA
    - Gammaridae
      - Gammarus sp.

INSECTA
- EPHEMEROPTERA
  - Heptageniidae
    - Stenonema femoratum
- ODONATA
  - Coenagrionidae
    - Undetermined Coenagrionidae

TRICHOPTERA
- Hydropsychidae
  - Cheumatopsyche sp.
  - Hydropsyche betteni
  - Hydropsyche sparna

DIPTERA
- Tipulidae
  - Antocha sp.
  - Pedicia sp.
  - Undetermined Tipulidae
- Simuliidae
  - Simulium sp.
- Empididae
  - Hemerodromia sp.
- Muscidae
  - Undetermined Muscidae
- Chironomidae
  - Tanypodinae
    - Thienemannimyia gr. spp.
  - Diamesinae
    - Diamesa sp.
  - Orthocladiinae
    - Cardiocladius obscurus
    - Cricotopus bicinctus
    - Cricotopus tremulus gr.
    - Cricotopus trifascia gr.
    - Eukiefferiella claripennis gr.
    - Paralimnophyes sp.
    - Parametriocnemus lundbecki
    - Tvetenia bavarica gr.
  - Chironominae
    - Chironomini
      - Microtendipes pedellus gr.
      - Polypedilum flavum

STREAM SITE:	Kelsey Creek, Station 2
LOCATION:	Rte 37 bridge, Watertown
DATE:	6 September 2000
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA	Planariidae	Undetermined Turbellaria	2
ANNELIDA			
OLIGOCHAETA	Enchytraeidae	Undetermined Enchytraeidae	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	26
AMPHIPODA	Gammaridae	Gammarus sp.	38
INSECTA			
ODONATA	Coenagrionidae	Undetermined Coenagrionidae	1
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	22
		Hydropsyche betteni	1
DIPTERA	Simuliidae	Simulium sp..	3
	Empididae	Hemerodromia sp..	1
	Chironomidae	Microtendipes pedellus gr.	3
		Polypedilum flavum	2

SPECIES RICHNESS	11 (poor)
BIOTIC INDEX	6.33 (good)
EPT RICHNESS	2 (poor)
MODEL AFFINITY	26 (very poor)
ASSESSMENT	moderately impacted

DESCRIPTION

The kick sample was taken 5 meters downstream of the Route 37 bridge. The substrate consisted primarily of gravel, with some rubble, sand, and silt. The upstream area was sluggish and wide. The macroinvertebrate fauna was dominated by scuds, sowbugs, and caddisflies. Based on the community indices, water quality was assessed as moderately impacted, although poor habitat is partly responsible for this assessment.

STREAM SITE:	Kelsey Creek, Station 4
LOCATION:	Rte 12, Watertown
DATE:	6 September 2000
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA	Planariidae	Undetermined Turbellaria	3
MOLLUSCA			
PELECYPODA	Sphaeriidae	Pisidium sp.	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea sp..	5
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	3
		Hydropsyche sparna	6
DIPTERA	Tipulidae	Antocha sp.	1
		Pedicia sp.	1
	Chironomidae	Cardiocladius obscurus	1
		Cricotopus bicinctus	19
		Cricotopus tremulus gr.	16
		Cricotopus trifascia gr.	2
		Parametriocnemus lundbecki	1
		Tvetenia bavarica gr.	1

SPECIES RICHNESS	14 (poor)
BIOTIC INDEX	6.33 (good)
EPT RICHNESS	2 (poor)
MODEL AFFINITY	39 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION

The sampling site was downstream of Route 12 (Bradley Street), accessed at the cemetery. Most of the stream bottom consisted of bedrock; some areas of rubble were located, mostly near shore, and these were sampled. The macroinvertebrate fauna consisted primarily of scuds and midges, and most community indices were poor. Overall water quality was assessed as moderately impacted.

STREAM SITE:	Kelsey Creek, Station 5
LOCATION:	Main St., Watertown, 100 meters upstream
DATE:	6 September 2000
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	8
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
TRICHOPTERA	Hydropsychidae	Hydropsyche betteni	19
		Hydropsyche sparna	17
DIPTERA	Chironomidae	Diamesa sp.	4
		Cardiocladius obscurus	3
		Cricotopus bicinctus	1
		Cricotopus tremulus gr.	7
		Cricotopus trifascia gr.	1

SPECIES RICHNESS	9 (very poor)
BIOTIC INDEX	6.17 (good)
EPT RICHNESS	2 (poor)
MODEL AFFINITY	36 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION

The sampling site was approximately 100 meters upstream of Main Street. The riffle was considered adequate, and small rainbow trout were caught in the net while kick sampling. The macroinvertebrate fauna was dominated by scuds and caddisflies. Based on the community indices, water quality was assessed as moderately impacted.

STREAM SITE:	Oily Creek, Station 3
LOCATION:	Morrison Avenue, Watertown, 75 meters above Kelsey Creek
DATE:	6 September 2000
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	12
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
EPHEMEROPTERA	Heptageniidae	Stenonema femoratum	1
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	24
		Hydropsyche betteni	3
		Hydropsyche sparna	10
	Chironomidae	Cricotopus bicinctus	1
		Cricotopus tremulus gr.	2
		Parametriocnemus lundbecki	4
		Tvetenia bavarica gr.	3

SPECIES RICHNESS	10 (very poor)
BIOTIC INDEX	5.94 (good)
EPT RICHNESS	4 (poor)
MODEL AFFINITY	31 (very poor)
ASSESSMENT	moderately impacted

DESCRIPTION

This sampling site on Oily Creek was located approximately 75 meters upstream of its confluence with Kelsey Creek. The habitat was acceptable, with the substrate primarily rubble and with an adequate current. Most rocks had long strands of filamentous algae. The macroinvertebrate fauna was heavily dominated by scuds; initially they constituted 85% of the subsample, but this was limited to the 40% maximum, based on procedures defined in the Quality Assurance document (Bode et al., 1996). Based on the community indices, water quality was assessed as moderately impacted.

STREAM SITE:	Oily Creek, Station 3A
LOCATION:	LeRay Avenue, Watertown, access via trailer park
DATE:	6 September 2000
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA			
LUMBRICINA		Undetermined Lumbricina	3
	Tubificidae	Undet. Tubificidae w/o cap. setae	2
	Naididae	Nais variabilis	1
MOLLUSCA			
GASTROPODA	Physidae	Physella sp..	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	18
AMPHIPODA	Gammaridae	Gammarus sp.	35
INSECTA			
TRICHOPTERA	Hydropsychidae	Hydropsyche sparna	1
DIPTERA	Tipulidae	Undetermined Tipulidae	1
	Simuliidae	Simulium sp.	1
	Muscidae	Undetermined Muscidae	2
	Chironomidae	Thienemannimyia gr. spp.	1
		Cricotopus bicinctus	7
		Cricotopus trifascia gr.	1
		Eukiefferiella claripennis gr.	2
		Paralimnophyes sp.	2
		Parametriocnemus lundbecki	20
		Tvetenia bavarica gr.	2

SPECIES RICHNESS	17 (poor)
BIOTIC INDEX	6.36 (good)
EPT RICHNESS	1 (very poor)
MODEL AFFINITY	36 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION

This upstream site on Oily Creek had an adequate substrate and current speed. Three rainbow trout fingerlings were caught in the net during kick sampling. The macroinvertebrate fauna was dominated by scuds, sowbugs, and midges. Community indices resulted in a water quality assessment of moderately impacted.

LABORATORY DATA SUMMARY				
STREAM NAME: Kelsey Creek **DATE SAMPLED: 09/06/00**		**DRAINAGE: 08** **COUNTY: Jefferson**		
SAMPLING METHOD: Traveling Kick				
STATION **LOCATION**	02 Rt. 37 bridge	04 Rt. 12 Bradley St.	05 Main St.	
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Gammarus sp. 38 % facultative scud	Gammarus sp. 40 % facultative scud	Gammarus sp. 40 % facultative scud	
2.	Caecidotea racovitzai 26 % tolerant sowbug	Cricotopus bicinctus 19 % tolerant midge	Hydropsyche betteni 19 % facultative caddisfly	
3.	Cheumatopsyche sp. 22 % facultative caddisfly	Cricotopus tremulus gr. 16 % facultative midge	Hydropsyche sparna 17 % facultative caddisfly	
4.	Simulium sp. 3 % facultative black fly	Hydropsyche sparna 6 % facultative caddisfly	Caecidotea racovitzai 8 % tolerant sowbug	
5.	Microtendipes pedellus gr. 3 % facultative midge	Caecidotea sp. 5 % tolerant sowbug	Cricotopus tremulus gr. 7 % facultative midge	
Intolerant = not tolerant of poor water quality **Facultative = occurring over a wide range of water quality** **Tolerant = tolerant of poor water quality**				
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	5 (2)	40 (6)	16 (5)	
Trichoptera (caddisflies)	23 (2)	9 (2)	36 (2)	
Ephemeroptera (mayflies)	0 (0)	0 (0)	0 (0)	
Plecoptera (stoneflies)	0 (0)	0 (0)	0 (0)	
Coleoptera (beetles)	0 (0)	0 (0)	0 (0)	
Oligochaeta (worms)	1 (1)	0 (0)	0 (0)	
Other	71 (6)	51 (6)	48 (2)	
SPECIES RICHNESS	11	14	9	
BIOTIC INDEX	6.33	6.33	6.17	
EPT RICHNESS	2	2	2	
PERCENT MODEL AFFINITY	26	39	36	
FIELD ASSESSMENT	good	good	poor	
OVERALL ASSESSMENT	moderate impact	moderate impact	moderate impact	

LABORATORY DATA SUMMARY				
STREAM NAME: Oily Creek **DATE SAMPLED: 09/06/00**		**DRAINAGE: 08** **COUNTY: Jefferson**		
SAMPLING METHOD: Traveling Kick				
STATION **LOCATION**	03A LeRay	03 Morrison Ave.		
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Gammarus sp. 35 % facultative scud	Gammarus sp. 40 % facultative scud		
2. **Intolerant = not tolerant of poor water quality**	Parametriocnemus lundbecki 20 % facultative midge	Cheumatopsyche sp. 24 % facultative caddisfly		
3. **Facultative = occurring over a wide range of water quality**	Caecidotea racovitzai 18 % tolerant sowbug	Caecidotea racovitzai 12 % tolerant sowbug		
4. **Tolerant = tolerant of poor water quality**	Cricotopus bicinctus 7 % tolerant midge	Hydropsyche sparna 10 % facultative caddisfly		
5.	Undetermined Lumbricina 3 % tolerant worm	Parametriocnemus lundbecki 4 % facultative midge		
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	35 (7)	10 (4)		
Trichoptera (caddisflies)	1 (1)	37 (3)		
Ephemeroptera (mayflies)	0 (0)	1 (1)		
Plecoptera (stoneflies)	0 (0)	0 (0)		
Coleoptera (beetles)	0 (0)	0 (0)		
Oligochaeta (worms)	6 (3)	0 (0)		
Other	58 (6)	52 (2)		
SPECIES RICHNESS	17	10		
BIOTIC INDEX	6.36	5.94		
EPT RICHNESS	1	4		
PERCENT MODEL AFFINITY	36	31		
FIELD ASSESSMENT	poor	poor		
OVERALL ASSESSMENT	moderate impact	moderate impact		

FIELD DATA SUMMARY

STREAM NAME: Kelsey Creek **DATE SAMPLED: 09/06/00**
REACH: Rt. 37 through Watertown
FIELD PERSONNEL INVOLVED:Abele, Bode, Moore

STATION	02	04	05	
ARRIVAL TIME AT STATION	12:00	12:35	2:10	
LOCATION	Rt. 37 bridge	Rt. 12, Bradley St.	Main St.	
PHYSICAL CHARACTERISTICS				
Width (meters)	2	5	3	
Depth (meters)	0.2	0.2	0.2	
Current speed (cm per sec.)	70	100	-	
Substrate (%)				
Rock (>25.4 cm, or bedrock)		10	10	
Rubble (6.35 - 25.4 cm)	20	60	40	
Gravel (0.2 – 6.35 cm)	40	10	20	
Sand (0.06 – 2.0 mm)	20	10	10	
Silt (0.004 – 0.06 mm)	20	10	20	
Clay (< 0.004 mm)				
Embeddedness (%)	20	0	10	
CHEMICAL MEASUREMENTS				
Temperature (° C)	15.5	15.2	16.2	
Specific Conductance (umhos)	848	817	815	
Dissolved Oxygen (mg/l)	7.1	10.8	10.3	
pH	7.5	7.8	7.9	
BIOLOGICAL ATTRIBUTES				
Canopy (%)	0	0	80	
Aquatic Vegetation				
algae – attached, filamentous				
algae - diatoms	present	present	present	
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X		
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X	X	
Coleoptera (beetles)				
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)		X	X	
Simuliidae (black flies)		X		
Decapoda (crayfish)	X	X	X	
Gammaridae (scuds)	X	X	X	
Mollusca (snails, clams)	X	X	X	
Oligochaeta (worms)				
Other	X	X	X	
FIELD ASSESSMENT	good	good	poor	

FIELD DATA SUMMARY

STREAM NAME: Oily Creek **DATE SAMPLED: 09/06/00**
REACH: Watertown
FIELD PERSONNEL INVOLVED:Abele, Bode, Moore

STATION	03A	03		
ARRIVAL TIME AT STATION	1:30	1:10		
LOCATION	LeRay	Morrison Ave.		
PHYSICAL CHARACTERISTICS				
Width (meters)	2	2		
Depth (meters)	0.2	0.2		
Current speed (cm per sec.)	125	100		
Substrate (%)				
Rock (>25.4 cm, or bedrock)				
Rubble (6.35 - 25.4 cm)	60	60		
Gravel (0.2 – 6.35 cm)	20	20		
Sand (0.06 – 2.0 mm)	10	10		
Silt (0.004 – 0.06 mm)	10	10		
Clay (< 0.004 mm)				
Embeddedness (%)	10	20		
CHEMICAL MEASUREMENTS				
Temperature (°C)	14.4	15.3		
Specific Conductance (umhos)	773	772		
Dissolved Oxygen (mg/l)	9.2	11.2		
pH	7.4	7.8		
BIOLOGICAL ATTRIBUTES				
Canopy (%)	40	0		
Aquatic Vegetation				
algae – attached, filamentous	abundant	abundant		
algae - diatoms	present			
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)				
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X		
Coleoptera (beetles)				
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X	X		
Simuliidae (black flies)	X			
Decapoda (crayfish)				
Gammaridae (scuds)	X	X		
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other	X	X		
FIELD ASSESSMENT	poor	poor		

SAMPLE ID: 200004199 SAMPLE RECEIVED:12/11/2000 CHARGE: 11.00
PROGRAM: 7000:BUREAU OF TECHNICAL SERVICES AND RESEARCH - GENERAL
SOURCE ID: DRAINAGE BASIN:08 GAZETTEER CODE:2201
POLITICAL SUBDIVISION:WATERTOWN C. COUNTY:JEFFERSON
LATITUDE:44 00 20. LONGITUDE:75 54 09. Z DIRECTION:
LOCATION: KELSEY CREEK IN WATERTOWN
DESCRIPTION:CRAY;00-160;KLSY;00002;RTE 37 BRIDGE
REPORTING LAB: TOX:LAB FOR ORGANIC ANALYTICAL CHEMISTRY
TEST PATTERN: PCBS:PCBs' IN SOLIDS
SAMPLE TYPE: 742:AQUATIC INSECTS
TIME OF SAMPLING: 09/06/2000 DATE PRINTED:03/06/2001
CASE:M100 SDG:0500B CUST.NO.:00-160

ANALYSIS: PCBS PCBs' IN SOLID SAMPLE
DATE REPORTED: 02/08/2001 REPORT MAILED OUT

PARAMETER	RESULT
AROCLOR 1221	< 150. MCG/KG
AROCLOR 1016/1242	< 150. MCG/KG
AROCLOR 1248	< 150. MCG/KG
AROCLOR 1254	< 150. MCG/KG
AROCLOR 1260	< 150. MCG/KG

**** ADDITIONAL PARAMETERS ****

ANALYSIS: 610SKG POLYNUCLEAR AROMATIC HYDROCARBONS - SOIL/SEDIMENT
DATE PRINTED: 03/06/2001 FINAL REPORT

PARAMETER	RESULT
NAPHTHALENE	< 150. MCG/KG
ACENAPHTHYLENE	< 150. MCG/KG
ACENAPHTHENE	< 150. MCG/KG
FLUORENE	< 150. MCG/KG
PHENANTHRENE	62. MCG/KG
ANTHRACENE	4. MCG/KG [EE]
FLUORANTHENE	13. MCG/KG
PYRENE	190. MCG/KG
BENZO(a)ANTHRACENE	250. MCG/KG
CHRYSENE	180. MCG/KG
BENZO(b)FLUORANTHENE	< 3. MCG/KG
BENZO(k)FLUORANTHENE	< 3. MCG/KG
BENZO(a)PYRENE	< 3. MCG/KG
DIBENZ(A,H)ANTHRACENE	< 3. MCG/KG
BENZO(ghi)PERYLENE	< 3. MCG/KG
INDENO(1,2,3-cd)PYRENE	< 3. MCG/KG

**** END OF REPORT ****

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PAGE 1 RESULTS OF EXAMINATION FINAL REPORT

SAMPLE ID: 200004198 SAMPLE RECEIVED:12/11/2000 CHARGE: 11.00
PROGRAM: 7000:BUREAU OF TECHNICAL SERVICES AND RESEARCH - GENERAL
SOURCE ID: DRAINAGE BASIN:08 GAZETTEER CODE:2201
POLITICAL SUBDIVISION:WATERTOWN C. COUNTY:JEFFERSON
LATITUDE: . LONGITUDE: . Z DIRECTION:
LOCATION: KELSEY CREEK IN WATERTOWN
DESCRIPTION:CRAY;00-073;KLSY;00004;BRADLEY ST. BRIDGE
REPORTING LAB: TOX:LAB FOR ORGANIC ANALYTICAL CHEMISTRY
TEST PATTERN: PCBS:PCBs' IN SOLIDS
SAMPLE TYPE: 742:AQUATIC INSECTS
TIME OF SAMPLING: 09/06/2000 DATE PRINTED:03/06/2001
CASE:M100 SDG:0500B CUST.NO.:00-073

ANALYSIS: PCBS PCBs' IN SOLID SAMPLE
DATE REPORTED: 02/08/2001 REPORT MAILED OUT

PARAMETER	RESULT
AROCLOR 1221	< 400. MCG/KG
AROCLOR 1016/1242	< 400. MCG/KG
AROCLOR 1248	< 400. MCG/KG
AROCLOR 1254	1800. MCG/KG
AROCLOR 1260	520. MCG/KG

**** ADDITIONAL PARAMETERS ****

ANALYSIS: 610SKG POLYNUCLEAR AROMATIC HYDROCARBONS - SOIL/SEDIMENT
DATE PRINTED: 03/06/2001 FINAL REPORT

PARAMETER	RESULT
NAPHTHALENE	< 400. MCG/KG
ACENAPHTHYLENE	< 400. MCG/KG
ACENAPHTHENE	< 400. MCG/KG
FLUORENE	< 400. MCG/KG
PHENANTHRENE	120. MCG/KG
ANTHRACENE	9. MCG/KG
FLUORANTHENE	56. MCG/KG
PYRENE	360. MCG/KG
BENZO(a)ANTHRACENE	610. MCG/KG
CHRYSENE	460. MCG/KG
BENZO(b)FLUORANTHENE	< 5. MCG/KG
BENZO(k)FLUORANTHENE	5. MCG/KG
BENZO(a)PYRENE	7. MCG/KG
DIBENZ(A,H)ANTHRACENE	< 5. MCG/KG
BENZO(ghi)PERYLENE	< 5. MCG/KG
INDENO(1,2,3-cd)PYRENE	< 5. MCG/KG

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PAGE 1 RESULTS OF EXAMINATION FINAL REPORT

SAMPLE ID: 200004200 SAMPLE RECEIVED:12/11/2000 CHARGE: 11.00
PROGRAM: 7000:BUREAU OF TECHNICAL SERVICES AND RESEARCH - GENERAL
SOURCE ID: DRAINAGE BASIN:08 GAZETTEER CODE:2201
POLITICAL SUBDIVISION:WATERTOWN C. COUNTY:JEFFERSON
LATITUDE:43 59 22. LONGITUDE:75 55 27. Z DIRECTION:
LOCATION: KELSEY CREEK IN WATERTOWN
DESCRIPTION:CRAY;00-162;KLSY;00005;ABOVE RR BRIDGE
REPORTING LAB: TOX:LAB FOR ORGANIC ANALYTICAL CHEMISTRY
TEST PATTERN: PCBS:PCBs' IN SOLIDS
SAMPLE TYPE: 742:AQUATIC INSECTS
TIME OF SAMPLING: 09/06/2000 DATE PRINTED:03/06/2001
CASE:M100 SDG:0500B CUST.NO.:00-162

ANALYSIS: PCBS PCBs' IN SOLID SAMPLE
DATE REPORTED: 02/08/2001 REPORT MAILED OUT

PARAMETER	RESULT
AROCLOR 1221	< 200. MCG/KG
AROCLOR 1016/1242	< 200. MCG/KG
AROCLOR 1248	< 200. MCG/KG
AROCLOR 1254	920. MCG/KG
AROCLOR 1260	< 200. MCG/KG

**** ADDITIONAL PARAMETERS ****

ANALYSIS: 610SKG POLYNUCLEAR AROMATIC HYDROCARBONS - SOIL/SEDIMENT
DATE PRINTED: 03/06/2001 FINAL REPORT

PARAMETER	RESULT
NAPHTHALENE	< 210. MCG/KG
ACENAPHTHYLENE	< 210. MCG/KG
ACENAPHTHENE	< 120. MCG/KG
FLUORENE	< 210. MCG/KG
PHENANTHRENE	290. MCG/KG
ANTHRACENE	11. MCG/KG
FLUORANTHENE	190. MCG/KG
PYRENE	630. MCG/KG
BENZO(a)ANTHRACENE	700. MCG/KG
CHRYSENE	530. MCG/KG
BENZO(b)FLUORANTHENE	12. MCG/KG
BENZO(k)FLUORANTHENE	7. MCG/KG
BENZO(a)PYRENE	11. MCG/KG
DIBENZ(A,H)ANTHRACENE	< 5. MCG/KG
BENZO(ghi)PERYLENE	< 5. MCG/KG
INDENO(1,2,3-cd)PYRENE	< 5. MCG/KG

**** END OF REPORT ****

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METALS

-1-

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

00-161 KLSY-02

ıtract: R2005046

Code: Case No.: MIR00 SAS No.: SDG NO.: 0400B

rix (soil/water): SOLID Lab Sample ID: 429545

el (low/med): LOW Date Received: 12/08/00

olids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.44	U	N	P
7440-43-9	Cadmium	0.09	B		P
7440-47-3	Chromium	0.43	B		P
7440-50-8	Copper	58.9			P
7439-92-1	Lead	0.29	B		P
7439-97-6	Mercury	0.07	B		CV
7440-02-0	Nickel	0.33	B		P
7782-49-2	Selenium	3.2		*	P
7440-32-6	Titanium	1.7	B		P
7440-66-6	Zinc	64.7			P

olor Before: ORANGE Clarity Before: Texture: MEDIUM

olor After: YELLOW Clarity After: CLEAR Artifacts:

omments:

Form I - IN

METALS

-1-

INORGANIC ANALYSIS DATA SHEET

SAMPLE NO.

00-163 KLSY-05

Contract: R2005046

Lab Code: Case No.: MIR00 SAS No.: SDG NO.: 0400B

Matrix (soil/water): SOLID Lab Sample ID: 429546

Level (low/med): LOW Date Received: 12/08/00

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.88	U	N	P
7440-43-9	Cadmium	0.42	B		P
7440-47-3	Chromium	0.76	B		P
7440-50-8	Copper	140			P
7439-92-1	Lead	0.63	B		P
7439-97-6	Mercury	0.06	B		CV
7440-02-0	Nickel	0.61	U		P
7782-49-2	Selenium	3.9		*	P
7440-32-6	Titanium	5.4	B		P
7440-66-6	Zinc	70.9			P

Color Before: ORANGE Clarity Before: Texture: MEDIUM

Color After: YELLOW Clarity After: CLEAR Artifacts:

Comments:

Appendices (Click each for a link to an external document)

I. Biological methods for kick sampling

II. Macroinvertebrate community parameters

III. Levels of water quality impact in streams

IV. Biological Assessment Profile derivation

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

XI. Macroinvertebrate tissue analysis sampling

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.

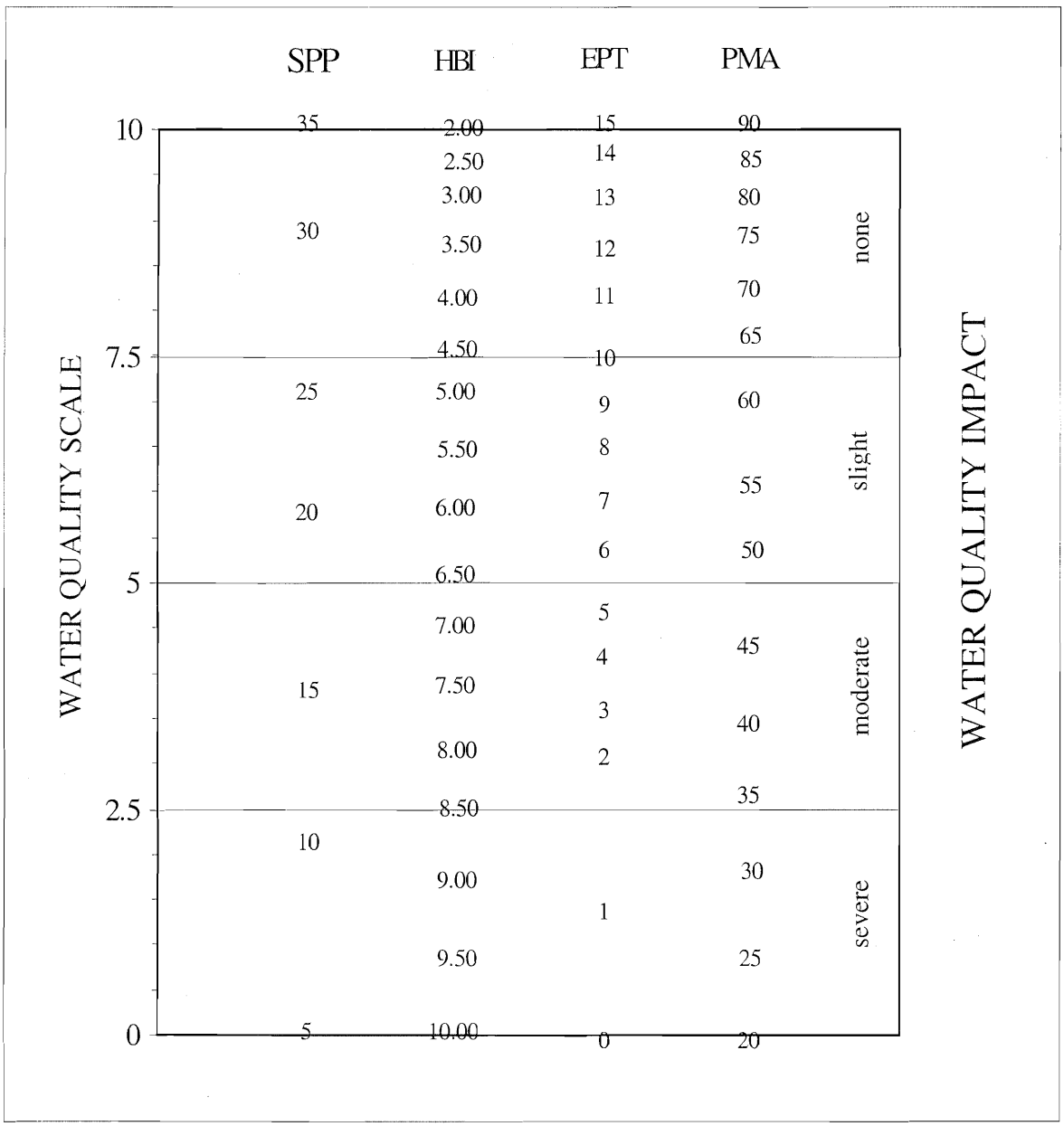
2. *Slightly impacted* Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. 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

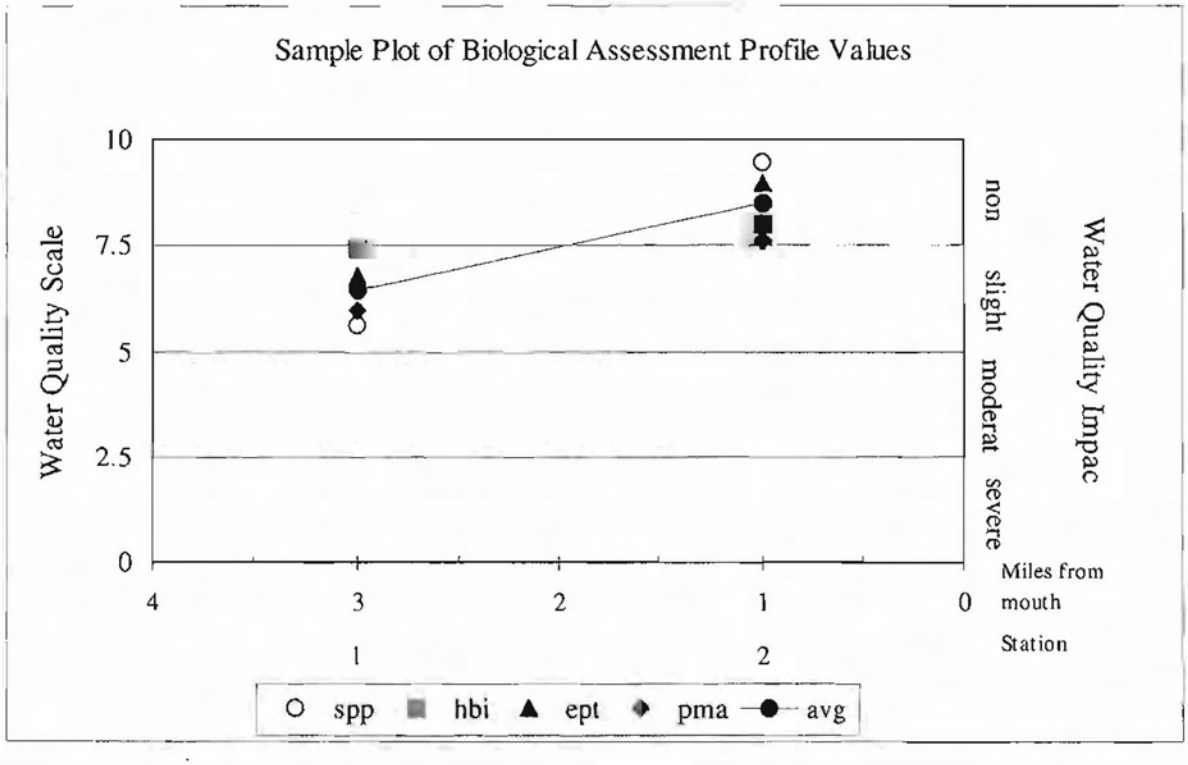
To plot survey data:

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 ——

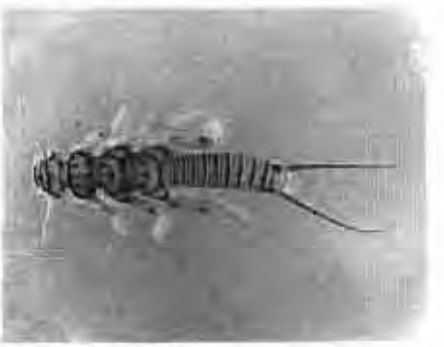
Rocks and sediment in the stream riffle are dislodged by foot upstream of a net; dislodged organisms are carried by the current in the net. Sampling is continued for a specified time, gradually moving downstream to cover a specified distance.

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.

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

SOWBUGS

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

MACROINVERTEBRATE TISSUE ANALYSIS MONITORING

Rationale

Macroinvertebrates, in addition to being useful at the community level as monitors of overall water quality, can also be used to monitor specific contaminants by having their tissues chemically analyzed. They are of particular interest because (1) they bioconcentrate contaminants to levels several times that found in water, (2) they occupy a middle position in the aquatic food chain, and may be linked to levels found in fish, (3) they are less mobile and shorter lived than fish, and may be used to pinpoint a contaminant source in relation to time and location, and (4) they are easily collected in most streams.

Field collection

For routine monitoring, it is desirable to collect the same type of organism at each site to allow maximum comparison of results. The organisms most commonly found in the majority of streams in adequate biomass for analysis are net-spinning caddisflies (Trichoptera: Hydropsychidae) and crayfish (Crustacea: Decapoda). The live field-collected organisms are placed in Hexane-washed glass jars containing water from the stream being sampled. The jars are kept on ice in a cooler until returned to the laboratory.

Laboratory processing

In the laboratory, the specimens are identified to genus or species; larger foreign particles are removed from the organisms. The organisms are placed in scintillation vials (without water) or 4-ounce glass jars and stored in a freezer until preparation for analysis. Prior to submitting specimens for analysis, they are weighed (wet-weight), freeze-dried, and re-weighed (dry-weight).

Chemical analysis

Specimens are submitted to an outside analytical chemistry laboratory for analysis.

Derivation of contaminant guidelines for invertebrate tissues

Original levels of concern for PCBs for caddisflies were derived from correlations with levels in fish tissues. Levels of concern for crayfish were correlated with levels in caddisflies. The level of 0.2 ppm dry weight in crayfish tissues is expected to correlate to levels of 2.0 ppm wet weight in fish collected at the corresponding site.