

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU
JUNE 2005

STAFF REPORT

A BIOLOGICAL SURVEY OF THE BEAR RIVER WATERSHED AND SELECTED EMMET
COUNTY STREAMS IN CHARLEVOIX AND EMMET COUNTIES, MICHIGAN
AUGUST 2003

INTRODUCTION

Staff of the Surface Water Assessment Section (SWAS) conducted a qualitative biological survey of the Bear River watershed, as well as selected Emmet County streams tributary to Lake Michigan in August 2003. Sampling stations were located in wadable segments of the selected streams. The biological surveys were performed according to GLEAS Procedure #51 (SWQD 1997; available upon request). Water samples were also collected from selected locations in the watersheds for chemical analysis.

The Bear River is located within Charlevoix and Emmet Counties in the northwestern Lower Peninsula. The Bear River discharges into Little Traverse Bay. Emmet County streams include Carp Lake River, which discharges to Cecil Bay; Wycamp Creek, which originates at Wycamp Lake and flows into Lake Michigan, and Tannery Creek, which empties into Little Traverse Bay. The Bear River and Emmet County streams are designated trout streams (MDNR 2000).

This area of the state has many lakes and forests; Mackinaw State Forest spans both counties. Fisherman's Island State Park and Lake Charlevoix (17,260 acres) are located in Charlevoix County. Mackinaw State Forest and Wilderness State Park comprise a large portion of the land area in Emmet County. Many lakes are located in the county as well; the larger include Lake Paradise and Crooked Lake (MEDC 2004).

The Bear River watershed and Emmet County streams are part of the North Central Hardwood Forest ecoregion in Michigan. Elevation in this area ranges from 175 m to 480 m (Albert et al. 1986). In general, the Bear River watershed and Emmet County streams are characterized by well drained, sandy and/or loamy soils (USDA 1973, 1974). Originally, northern hardwood forests were present on the well-drained soils, and conifer and hardwood conifer swamps on the poorly drained soils (Albert et al. 1986). In some areas, white pine and hemlock were removed by logging; red oak and trembling and bigtooth aspen have increased. Cherry and apple orchards and vineyards are common in western Charlevoix County. In western Emmet County, northern hardwood forests are still found on the steep slopes (Albert et al. 1986).

Petoskey is the major city in the watershed. Tourism and manufacturing contribute to the economic base in Charlevoix County. Emmet County mainly relies on retail trade and services as its economic base; agriculture accounts for fifteen percent of the land area (MEDC 2004). In addition, Emmet County is one of the fastest growing counties in Michigan.

In general, previous SWAS biological surveys in 1993 (Walker 1994) and 1998 (Walsh 2002) indicated that the fish and macroinvertebrate communities in the Bear River watershed and Emmet County streams were meeting biological integrity requirements of the Michigan Water Quality

Standards (MWQS). The Bear River at Howard Street scored 'poor' for habitat in the 1993 biological survey (Walker 1994). The 'poor' score was attributed to sand sedimentation and the lack of stable habitat. This site was not assessed in the present survey because of high water levels.

Biological Survey Objectives

Assessments of the Bear River watershed and selected streams in Emmet County were conducted to: 1) document current water quality conditions, 2) identify any nonpoint source impairments or potential threats to water quality, 3) determine attainment status with MWQS, and 4) determine if changes in water quality conditions have occurred over time.

RESULTS

P51 habitat and macroinvertebrate community and/or water chemistry assessments were conducted at a total of eight stations in the Bear River watershed and Emmet County streams (Table 1). Site visits were performed at three stations. Station locations for the six habitat, six macroinvertebrate, eight water chemistry, and three site visit stations are shown in Figure 1. Macroinvertebrate community, physical habitat, and water chemistry results are summarized in Tables 2 - 4.

Macroinvertebrate Community Status

The macroinvertebrate community was assessed at six stations in the Bear River watershed and Emmet County streams (Table 2). The macroinvertebrate community data collected during this survey indicate that all stations were meeting biological integrity related requirements of the MWQS. The benthic macroinvertebrate communities rated 'acceptable' at all stations. No stations rated 'excellent' or 'poor.'

The total number of taxa ranged from 17 (Station 8) – 30 (Station 10). The percentage of Ephemeroptera, Plecoptera, or Trichoptera (EPT) taxa ranged from 35.6% (Station 9) – 62.4% (Station 10). EPT taxa are indicators of water quality; generally as the percentage of EPT taxa increases, the better the water quality. A low percentage of isopods, snails, or leeches and a low percentage of surface water breathers coupled with a high percentage of EPT taxa can indicate good water quality.

The macroinvertebrate community rated 'acceptable' in Wycamp Creek at Cross Village u/s CR-119 (Station 9). This site, however, had an overall metric score of -3 and is two points from a 'poor' rating. This is a very sandy lake outlet stream with a very low gradient and flow. Even though Station 9 rated on the low end of 'acceptable,' the stream appears to be naturally marginal with minimal human impact.

Three stations that were assessed in previous surveys were also assessed in the current survey. In general, when compared with previous biological surveys, macroinvertebrate scores either remained the same or improved.

The GLEAS P51 macroinvertebrate metric was modified in 1997. Therefore, the macroinvertebrate scores from surveys conducted prior to 1997 can not be directly compared with results obtained after 1997. General comparisons, however, can be made. At Spring Brook u/s Spring Vale Rd. (Station 1), the total number of taxa increased from 18 in 1993 (Walker 1994) to 26 in 1998 (Walsh 2002), and decreased slightly to 25 in the current survey. The percentage of EPT taxa increased from 27% in 1993 (Walker 1994) to 40% in 1998 (Walsh 2002), and then 41% in the current survey. The percentage of surface air breathers decreased from 6.3% in 1993 (Walker

1994) to 3.0% in 1998 (Walsh 2002), and increased slightly to 3.5% in the current survey. The macroinvertebrate community rated 'acceptable' with a metric score of +1 in 1998 (Walsh 2002) and remained the same in the current 2003 survey.

The macroinvertebrate community at Bear River US-31 was assessed in 1993 (Walker 1994). The total number of taxa decreased slightly from 19 in 1993 (Walker 1994) to 18 in the current survey. The percentage of EPT taxa increased from 47% in 1993 (Walker 1994) to 60% in the current survey. The percentage of surface air breathers remains unchanged at 2.8% in 1993 (Walker 1994) and 2.4% in the current survey. The percentage of isopods, snails, and leaches decreased from 16.7% in 1993 (Walker 1994) to 9.5% in the current survey. Besides the increase in the percentage of EPT taxa and decrease in the percentage of isopods, snails, and leaches, it appears that the macroinvertebrate community at Bear River US-31 has not changed much from 1993 to 2003.

Macroinvertebrates at Tannery Creek US-31 (Station 8) were not assessed using P51 during the 1987 survey (McMahon 1989); however, some comparisons between the present survey and the 1987 survey can be made. Changes in the presence or absence of EPT taxa occurred at Tannery Creek US-31 (Station 8) between the surveys. New taxa included leptocerids, limnephilids, and philopotamids. Glossosomatids were sparse in 1987 (McMahon 1989) and not present in the current 2003 survey. Stoneflies were moderately abundant in 1987, however, only one individual was present in 2003. The total number of taxa increased from 12 in 1987 (McMahon 1989) to 17 in 2003.

The 1998 survey found 'acceptable' macroinvertebrates at Bear River at County Line Rd (Walsh 2002), however, macroinvertebrates were not sampled during the 2003 survey due to high water levels.

Physical Habitat Conditions

Instream and streamside habitat conditions were assessed at the same six stations where macroinvertebrates were assessed (Table 3). Habitat condition rated 'good' at one station (Station 9) and 'excellent' at five stations (Stations 1, 2, 7, 8, and 10).

The P51 cumulative habitat scores ranged from 155 – 181 for stations rated 'excellent' (out of 200 maximum). The habitat score for Station 1, scored as a glide/pool, was slightly depressed by several sediment related factors. In general, habitat scores for stations scored as riffles/runs were slightly affected by sediment related factors, riparian and bank structure characteristics, and uniform velocity/depth regimes. Station 8 flows through a golf course and suffers from low riparian zone width and only moderate bank vegetative protection.

The habitat condition in Wycamp Creek at Cross Village u/s CR-119 (Station 9) rated 'good.' The P51 cumulative habitat score was 139 (out of 200 maximum). The habitat score was lowered by sediment related factors and flashy flow status. No obvious anthropogenic sources of sediment were observed at this station. Wycamp Creek at Cross Village u/s CR-119 is located downstream of Wycamp Lake and has low gradient.

Three stations that were assessed in previous surveys were also assessed in the current survey. It appears that habitat condition, in general, has not changed much at two of these stations. Limited habitat information was collected for Tannery Creek US-31 (Station 8) in the 1987 survey (McMahon 1989). Therefore, direct comparisons can not be made for this station.

Spring Brook u/s Spring Vale Rd (Station 1) was assessed in 1993 (Walker 1994) and 1998 (Walsh 2002). The GLEAS P51 habitat metric was modified in 2002. Therefore, habitat scores from the

1993 and 1998 surveys can not be directly compared, however, general comparisons between these surveys and the current survey can be made. Habitat rated 'fair' at Spring Brook u/s Spring Vale Rd (Station 1) in 1993 (Walker 1994) and improved to 'good' in 1998 (Walsh 2002). Most habitat metric scores did not change between the 1993 and 1998 surveys, however, the velocity-depth regime and bottom deposition scores increased. In the current survey, habitat rated 'excellent' at Spring Brook u/s Spring Vale Rd (Station 1). Spring Brook u/s Spring Vale Rd (Station 1) in the current survey was assessed as a glide/pool; therefore, the velocity/depth regime metric was not evaluated and can not be compared with the previous surveys. Sediment deposition remains relatively unchanged in the current survey when compared to the 1998 survey. In the 2003 survey, sediment deposition scored 9 out of a possible 20 and in the 1998 survey (Walsh 2002), sediment deposition scored 7 out of out of a possible 15. It appears that habitat condition, in general, has either remained the same or improved slightly.

The Bear River at US 31 was assessed in 1993 (Walker 1994). Habitat scores from the 1993 survey and the current survey can not be compared directly. The habitat scored 'excellent' in both surveys. Velocity/depth regime was the only habitat characteristic that changed much between the 1993 and current survey. In 1993, velocity/depth regime received a higher score than the current survey (1993: 20 out of 20 and 2003: 11 out of 20). Even though habitat scores cannot be directly compared, it is likely that the overall habitat of the Bear River at US 31 has either remained the same or decreased slightly.

Bear River at County Line Rd rated 'good' for habitat in 1998 (Walsh 2002). However, habitat was not sampled in the 2003 survey due to high water levels and turbidity.

Site Visits

Substrate at the South Branch Spring Brook was mainly sand with some silt/detritus/muck. Flow was good. Woody debris and aquatic plants were abundant. Riparian vegetation was mainly trees and was greater than 100 ft on each bank. This is a natural area and appears to be in good condition.

The substrate at the North Branch Spring Brook at Major Rd was mainly sand with some silt. Flow was good, some tannins were present. Aquatic plants were present, and wood in the channel was abundant. Riparian vegetation consisted of shrubs and trees and was greater than 100 ft on each bank. For the most part, upstream of the study site was natural; however, there was a fence across the water. A new residential development was located downstream. Some sand was entering the stream at the road crossing.

The substrate at the Bear River at Sheridan Road was half cobble/gravel and half sand. Plenty of water was present in the channel, however, flow was sluggish. Logs/woody debris and aquatic plants were present in the channel. Riparian vegetation consisted of grass, shrubs, and trees. This is a residential area with development, and there is potential for road runoff.

Nuisance aquatic plant conditions were not evident at any of the sites.

Water Chemistry

Water samples were collected at eight stations and submitted to the Michigan Department of Environmental Quality - Environmental Laboratory for chemical analysis. The analytical results are shown in Table 4. Chemical data generated for the stations indicate that no toxic chemicals were detected at levels that exceed their respective Rule 57 water quality values.

Total phosphorus ranged between 0.011 (Station 9) – 0.037 mg P/L (Station 2). Total nitrogen – Kjeldahl ranged between 0.33 (Station 1) – 0.71 mg N/L (Station 9). Ammonia ranged between 0.007 (Station 8) – 0.091 mg N/L (Station 9). Comparisons of the water chemistry data between other northwestern Lower Peninsula Michigan trout streams collected in 1967 – 68 and the streams in the current survey can be made. Phosphorus concentrations at two stations (Stations 2 and 7) were about twice as high as the mean phosphorus concentration (0.017 mg/l) in several northwestern Lower Peninsula Michigan trout streams (MWRC and DNR 1973). Chloride concentrations at both stations on Tannery Creek (Stations 7 and 8) were about four times higher than the mean concentration of chloride (6.7 mg/l) of several Michigan trout streams. Ammonia concentrations at Stations 10 and 11 were three to four times higher than the mean concentration of ammonia (0.006 mg/l) of several Michigan trout streams. The ammonia concentration at Station 9 was fifteen times higher than the mean concentration of ammonia (0.006 mg/l) of several Michigan trout streams.

Non-Point Sources of Water Quality Impairment

There are no federal 319 or Clean Michigan Initiative non-point source grant projects in the Bear River watershed or Emmet County streams. Although no serious non-point source problems were evident at any of the sites, mild sedimentation (or the potential for such) was evident in some of the Bear River watershed streams. Specifically, moderate sedimentation was evident at Spring Brook upstream of Springvale Road. Likewise, construction and new development along the North Branch Spring Brook could contribute to increased sediment inputs along the waterbody, and mild sediment inputs were evident at the Major Road crossing. Tannery Creek upstream of US-31 runs through/along a golf course, which affected the riparian vegetation width. However, the benthic invertebrate scores and water chemistry results were very similar to a site on Tannery Creek upstream of the golf course. In fact, levels of total phosphorus, suspended solids, and dissolved solids were substantially higher at the upstream location. Therefore, golf course impacts on benthic macroinvertebrates and water chemistry appear minimal at this time. Finally, there is potential for road runoff from the residential area at the Bear River Sheridan Road crossing.

CONCLUSIONS

The Bear River watershed and Emmet County streams sampled in August 2003 indicate that these waters are supporting healthy, diverse macroinvertebrate communities and were meeting Michigan Water Quality Standards.

The Bear River at Howard Street, last assessed in 1993, should be re-visited in 2008 or sooner when water levels are suitable for P51 biological assessment. Existing and potential sediment problems could impact streams in the Bear River watershed in the future. Spring Brook upstream of Springvale Road, North Branch Spring Brook at Major Road and downstream of the construction and new development on the North Branch Spring Brook should be re-visited in future surveys to assess sedimentation issues.

REFERENCES

- Albert, D.A., S.R. Denton, and B.V. Barnes. 1986. Regional Landscape Ecosystems of Michigan. School of Natural Resources, University of Michigan. 32 pp.
- McMahon, M. 1989. A Biological Survey of Tannery Creek, Emmett County, Michigan, July 21, 1987. Staff Report MI/DNR/SWQ-89/001.
- MDNR. 2000. Directors Order. Designated Trout Streams for the State of Michigan. Report No. FO-210.01.

Michigan Economic Development Council (MEDC). 2004. Charlevoix and Emmet Counties.
World Wide Web <http://medc.michigan.org/milInfo/> Downloaded January 30, 2004.

Michigan Water Resources Commission, Bureau of Water Resources Management and
Department of Natural Resources, State of Michigan. 1973. Trout Water Quality. 38 pp.

Surface Water Quality Division (SWQD). 1997. GLEAS Procedure #51. Qualitative Biological and
Habitat Survey Protocols for Wadable Streams and Rivers.

Surface Water Quality Division (SWQD). 1998. Update of GLEAS Procedure #51. Metric Scoring
and Interpretation. Staff Report MI/DEQ/SWQ-96/068.

USDA. 1973. Soil Survey of Emmet County, Michigan. Soil Conservation Service. 99 pp, illus.

USDA. 1974. Soil Survey of Charlevoix County, Michigan. Soil Conservation Service. 122 pp,
illus.

Walker, B.R. 1994. A biological survey of Bear River in Emmet and Charlevoix Counties,
Michigan, July 26 – 27, 1993. Staff Report MI/DNR/SWQ-94/046.

Walsh, S. 2002. A biological survey of Charlevoix County streams, Charlevoix County, Michigan,
September, 1998. Staff Report MI/DEQ-02/016.

Field Work By: Gary Kohlhepp, Aquatic Biologist
Dawn Roush, Aquatic Biologist

Report By: Kay Edly, Aquatic Biologist
Surface Water Assessment Section
Water Bureau

Table 1- Station locations in the Bear River watershed and Emmet County streams visited in August 2003.

Station	Location	Site	P51	WC	SV	Latitude	Longitude	Storet #
Bear River Watershed								
1	Spring Brook	u/s Spring Vale Rd	X	X		45.26167	-84.89583	150189
2	Bear River	US-31	X	X		45.37456	-84.96379	240142
3	Bear River	County Line Rd./Bear River Rd.		X		45.290668	-84.91345	150188
4	Bear River	Sheridan Rd			X	45.36445	-84.96171	
5	N Br. Spring Brook Creek	Major Rd. (Chandler Hills Rd.)			X	45.23896	-84.83602	
6	S Br. Spring Brook Creek				X	45.2305	-84.83586	
Emmet County Streams								
7	Tannery Ck	Country Club Rd	X	X		45.383892	-84.9125	240072
8	Tannery Ck	u/s US-31	X	X		45.38816	-84.91437	240145
9	Wycamp Ck	Cross Village u/s CR-119	X	X		45.65105	-85.01335	240144
10	Carp Lake River	Cecil Bay Rd	X	X		45.73161	-84.82587	240143
11	Carp Lake River	Reed Rd.		X		45.67681	-84.79222	240146

WC = water chemistry

SV = site visit

Table 2A. Qualitative macroinvertebrate sampling results for selected waterbodies in the Bear River watershed, August 2003.

TAXA	Spring Brook u/s SpringVale Rd 8/7/2003 STATION 1	Bear River US-31 8/4/2003 STATION 2
ANNELIDA (segmented worms)		
Hirudinea (leeches)	1	2
Oligochaeta (worms)	2	3
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	4	2
Decapoda (crayfish)	2	5
Isopoda (sowbugs)	5	6
Arachnoidea		
Hydracarina	2	
Insecta		
Ephemeroptera (mayflies)		
Baetidae	10	5
Heptageniidae		9
Isonychiidae		3
Tricorythidae	3	
Odonata		
Anisoptera (dragonflies)		
Aeshnidae	1	
Gomphidae	1	
Zygoptera (damselflies)		
Calopterygidae	2	
Plecoptera (stoneflies)		
Perlidae	1	10
Pteronarcyidae	1	
Hemiptera (true bugs)		
Gerridae	3	2
Megaloptera		
Sialidae (alder flies)	1	
Trichoptera (caddisflies)		
Brachycentridae	5	
Glossosomatidae		3
Hydropsychidae	10	8
Hydroptilidae		1
Leptoceridae	1	3
Limnephilidae	5	4
Philopotamidae		4
Coleoptera (beetles)		
Elmidae		6
Diptera (flies)		
Chironomidae	8	8
Simuliidae	14	
Tabanidae	2	
MOLLUSCA		
Gastropoda (snails)		
Hydrobiidae	1	
Physidae	1	
Pelecypoda (bivalves)		
Sphaeriidae (clams)	1	
TOTAL INDIVIDUALS	87	84

Table 2B. Macroinvertebrate metric evaluation of selected waterbodies in the Bear River watershed.

METRIC	Spring Brook w/s SpringVale Rd 8/7/2003 STATION 1		Bear River US-31 8/4/2003 STATION 2	
	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	25	1	18	0
NUMBER OF MAYFLY TAXA	2	0	3	0
NUMBER OF CADDISFLY TAXA	4	0	6	1
NUMBER OF STONEFLY TAXA	2	1	1	0
PERCENT MAYFLY COMP.	14.94	0	20.24	0
PERCENT CADDISFLY COMP.	24.14	0	27.38	0
PERCENT DOMINANT TAXON	16.09	1	11.90	1
PERCENT ISOPOD, SNAIL, LEECH	9.20	-1	9.52	-1
PERCENT SURF. AIR BREATHERS	3.45	-1	2.38	0
TOTAL SCORE		1		1
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for selected waterbodies in Emmet County, August 2003.

TAXA	Tannery Ck Country Club Rd 8/4/2003 STATION 7	Tannery Ck u/s US-31 8/4/2003 STATION 8	Wycamp Ck Cross Village u/s CR-119 8/6/2003 STATION 9	Carp Lake River Cecil Bay Rd 8/6/2003 STATION 10
PORIFERA (sponges)			1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1			
Oligochaeta (worms)	2	2	2	3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	10	8		3
Decapoda (crayfish)		1		2
Isopoda (sowbugs)	7	2		
Arachnoidea				
Hydracarina	1			2
Insecta				
Ephemeroptera (mayflies)				
Baetidae	9	3		7
Ephemerellidae				1
Heptageniidae	6	7	6	5
Isonychiidae				4
Leptophlebiidae	1			
Tricorythidae				2
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	1	10	3
Gomphidae			10	2
Plecoptera (stoneflies)				
Leuctridae				1
Perlidae		1	9	8
Hemiptera (true bugs)				
Gerridae		2	4	2
Saldidae				1
Megaloptera				
Corydalidae (dobson flies)	3	1	3	2
Trichoptera (caddisflies)				
Brachycentridae				8
Glossosomatidae	5			10
Hydropsychidae	10	10	6	10
Leptoceridae	4	3	2	
Limnephilidae	2	4	9	8
Philopotamidae	3	5	3	12
Psychomyiidae				2
Rhyacophilidae			1	
Coleoptera (beetles)				
Elmidae			3	6
Diptera (flies)				
Ceratopogonidae			1	
Chironomidae	10	8	8	7
Simuliidae	12	6	15	7
Tabanidae			1	
Tipulidae	3	2		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				2
Lymnaeidae			5	1
Physidae				1
Viviparidae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)			2	2
TOTAL INDIVIDUALS	90	66	101	125

Table 2B. Macroinvertebrate metric evaluation of selected waterbodies in Emmet County.

METRIC	Tannery Ck Country Club Rd 8/4/2003 STATION 7		Tannery Ck u/s US-31 8/4/2003 STATION 8		Wycamp Ck Cross Village u/s CR-119 8/6/2003 STATION 9		Carp Lake River Cecil Bay Rd 8/6/2003 STATION 10	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	18	0	17	0	20	0	30
NUMBER OF MAYFLY TAXA	3	0	2	0	1	-1	5	1
NUMBER OF CADDISFLY TAXA	5	0	4	0	5	0	6	1
NUMBER OF STONEFLY TAXA	0	-1	1	0	1	0	2	1
PERCENT MAYFLY COMP.	17.78	0	15.15	0	5.94	-1	15.20	0
PERCENT CADDISFLY COMP.	26.67	0	33.33	0	20.79	0	40.00	0
PERCENT DOMINANT TAXON	13.33	1	15.15	1	14.85	1	9.60	1
PERCENT ISOPOD, SNAIL, LEECH	8.89	-1	3.03	-1	4.95	-1	4.00	-1
PERCENT SURF. AIR BREATHERS	0.00	1	3.03	-1	3.96	-1	2.40	0
TOTAL SCORE		0		-1		-3		4
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 3. Habitat evaluation for selected waterbodies in the Bear River watershed, August 2003.

	Spring Brook u/s SpringVale Rd GLIDE/POOL STATION 1	Bear River US-31 RIFFILE/RUN STATION 2
HABITAT METRIC		
Substrate and Instream Cover		
Epifaunal Substrate/ Avail Cover	11	17
Embeddedness*		17
Velocity/Depth Regime*		11
Pool Substrate Characterization**	13	
Pool Variability**	15	
Channel Morphology		
Sediment Deposition	9	16
Flow Status - Maint. Flow Volum	9	10
Flow Status - Flashiness	9	8
Channel Alteration	19	20
Frequency of Riffles/Bends*		20
Channel Sinuosity**	13	
Riparian and Bank Structure		
Bank Stability (L)	10	10
Bank Stability (R)	10	10
Vegetative Protection (L)	10	10
Vegetative Protection (R)	10	10
Riparian Veg. Zone Width (L)	10	5
Riparian Veg. Zone Width (R)	10	7
TOTAL SCORE (200):	158	171

HABITAT RATING:	EXCELLENT (NON- IMPAIRED)	EXCELLENT (NON- IMPAIRED)
------------------------	--	--

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/7/2003	8/4/2003
Weather:	Partly Cloudy	Partly Cloudy
Air Temperature:	80 Deg. F.	80 Deg. F.
Water Temperature:	70 Deg. F.	62 Deg. F.
Ave. Stream Width:	30 Feet	32 Feet
Ave. Stream Depth:	1 Feet	0.6 Feet
Surface Velocity:	0.5 Ft./Sec.	2.5 Ft./Sec.
Estimated Flow:	15 CFS	48 CFS
Stream Modifications:	None	None
Nuisance Plants (Y/N):	N	N
Report Number:		
STORET No.:	150189	240142
Stream Name:	Springbrook	Bear River
Road Crossing/Location:	u/s SpringVale Rd	US-31
County Code:	15	24
TRS:	33N05W14	34N05W06
Latitude (dd):	45.26167	45.37456
Longitude (dd):	-84.89583	-84.96379
Ecoregion:	NCHF	NCHF
Stream Type:	Coldwater	Coldwater
USGS Basin Code:	4060105	4060105

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3. Habitat evaluation for selected waterbodies located in Emmet County, August 2003.

	Tannery Ck Country Club Rd RIFFLE/RUN STATION 7	Tannery Ck u/s US-31 RIFFLE/RUN STATION 8	Wycamp Ck Cross Village u/s CR-119 RIFFLE/RUN STATION 9	Carp Lake River Cecil Bay Rd RIFFLE/RUN STATION 10
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover	19	18	7	19
Embeddedness*	18	17	6	16
Velocity/Depth Regime*	8	12	15	20
Pool Substrate Characterization**				
Pool Variability**				
Channel Morphology				
Sediment Deposition	15	18	7	15
Flow Status - Maint. Flow Volum	10	10	8	9
Flow Status - Flashiness	9	9	6	6
Channel Alteration	20	18	19	19
Frequency of Riffles/Bends*	20	20	17	20
Channel Sinuosity**				
Riparian and Bank Structure				
Bank Stability (L)	9	7	8	9
Bank Stability (R)	9	9	9	10
Vegetative Protection (L)	8	4	8	10
Vegetative Protection (R)	8	7	9	10
Riparian Veg. Zone Width (L)	5	1	10	8
Riparian Veg. Zone Width (R)	9	5	10	10
TOTAL SCORE (200):	167	155	139	181

HABITAT RATING:	EXCELLENT (NON- IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)
------------------------	--	--	---	--

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/4/2003	8/4/2003	8/6/2003	8/6/2003
Weather:	Cloudy	Partly Cloudy	Sunny	Sunny
Air Temperature:	70 Deg. F.	80 Deg. F.	70 Deg. F.	80 Deg. F.
Water Temperature:	59 Deg. F.	59 Deg. F.	70 Deg. F.	69 Deg. F.
Ave. Stream Width:	12 Feet	8 Feet	20 Feet	20 Feet
Ave. Stream Depth:	0.25 Feet	0.33 Feet	0.5 Feet	0.67 Feet
Surface Velocity:	2 Ft./Sec.	2 Ft./Sec.	0.67 Ft./Sec.	1.5 Ft./Sec.
Estimated Flow:	6 CFS	5.28 CFS	6.7 CFS	20.1 CFS
Stream Modifications:	None	None	None	Bank Stabilization
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	240072	240145	240144	240143
Stream Name:	Tannery Ck	Tannery Ck	Wycamp Ck	Carp Lake River
Road Crossing/Location:	Country Club Rd	u/s US-31	u/s 119	Cecil Bay Rd
County Code:	24	24	24	24
TRS:	35N05W34	35N05W33	38N05W35	39N04W32
Latitude (dd):	45.38431	45.38816	45.65105	45.73161
Longitude (dd):	-84.91377	-84.91437	-85.01335	-84.82587
Ecoregion:	NCHF	NCHF	NCHF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060105	4060105	4060105	4060105

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 4. Analytical results for water samples collected from the Bear River watershed, August 2003.

Stream Name		Spring Brook Cr.	Bear River	Bear River
Location		u/s Springvale Rd.	US-31	County Line Rd
Station		1	2	3
STORET ID #		150189	240142	150188
Parameter	Units			
Alkalinity - Bicarbonate	mg/L	175	144	143
Alkalinity - Carbonate	mg/L	ND (<10)	ND (<10)	ND (<10)
Alkalinity (as CaCO ₃)	mg/L	175	144	132
Ammonia	mg N/L	0.011	0.013	0.016
Calcium - Total	mg/L	56.6	47.5	46.3
Chloride	mg/L	3	9	6
Conductivity	umho/cm	363	326	316
Hardness - Calculated	mg/L	197	164	162
Magnesium - Total	mg/L	13.5	11	11.2
Nitrate + Nitrite	mg N/L	0.071	0.077	0.037
Nitrite	mg N/L	0.003	0.005	0.004
Total Nitrogen - Kjeldahl	mg N/L	0.33	0.68	0.55
Total Phosphorus	mg P/L	0.014	0.037	0.021
Ortho-phosphate	mg P/L	0.001	0.005	0.004
pH	pH	8.13	7.98	7.67
Solids-Suspended	mg/L	ND (<4)	20	8
Solids-Total Dissolved	mg/L	230	220	220
Sulfate	mg/L	2	6	3
TOC	mg/L	7.7	14	12
COD	mg/L	20	47	37
BOD - Total 5 days	mg/L	ND (<2)	ND (<2)	ND (<2)
Hexavalent Chromium	ug/L	ND (<5)	ND (<5)	ND (<5)

ND - Value reported is less than the criterion of detection (trace level).

Table 4 (cont.). Analytical results for water samples collected from Emmet County streams, August 2003.

Stream Name		Tannery Cr	Tannery Cr.	Wycamp Creek	Carp Lake River	Carp River
Location		Country Club Rd.	US 31	Cross Village w/s CR-119	Cecil Bay Rd.	Reed Rd.
Station		7	8	9	10	11
STORET ID #		240072	240145	240144	240143	240146
Parameter	Units					
Alkalinity - Bicarbonate	mg/L	249	228	131	119	102
Alkalinity - Carbonate	mg/L	ND (<10)	22	ND (<10)	ND (<10)	ND (<10)
Alkalinity (as CaCO3)	mg/L	249	250	131	119	102
Ammonia	mg N/L	0.008	0.007	0.091	0.021	0.02
Calcium - Total	mg/L	80.2	80.2	31.1	36	32.4
Chloride	mg/L	28	28	3	8	10
Conductivity	umho/cm	555	549	277	280	250
Hardness - Calculated	mg/L	268	267	138	139	123
Magnesium - Total	mg/L	16.3	16.2	14.6	11.9	10.1
Nitrate + Nitrite	mg N/L	0.6	0.6	0.02	0.058	ND (<0.01)
Nitrite	mg N/L	0.004	0.004	0.002	0.004	0.002
Total Nitrogen - Kjeldahl	mg N/L	0.6	0.41	0.71	0.54	0.66
Total Phosphorus	mg P/L	0.032	0.013	0.011	0.019	0.02
Ortho-phosphate	mg P/L	0.003	0.002	0.001	0.003	0.002
pH	pH	8.23	8.41	8.11	8.32	8.12
Solids-Suspended	mg/L	28	4	ND (<4)	6	ND (<4)
Solids-Total Dissolved	mg/L	370	360	190	180	160
Sulfate	mg/L	ND (<2)	ND (<2)	ND (<2)	ND (<2)	ND (<2)
TOC	mg/L	8.3	8.2	8.9	11	12
COD	mg/L	32	34	31	36	39
BOD - Total 5 days	mg/L	ND (<2)	ND (<2)	ND (<2)	ND (<2)	ND (<2)
Hexavalent Chromium	ug/L	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)

ND - Value reported is less than the criterion of detection (trace level).

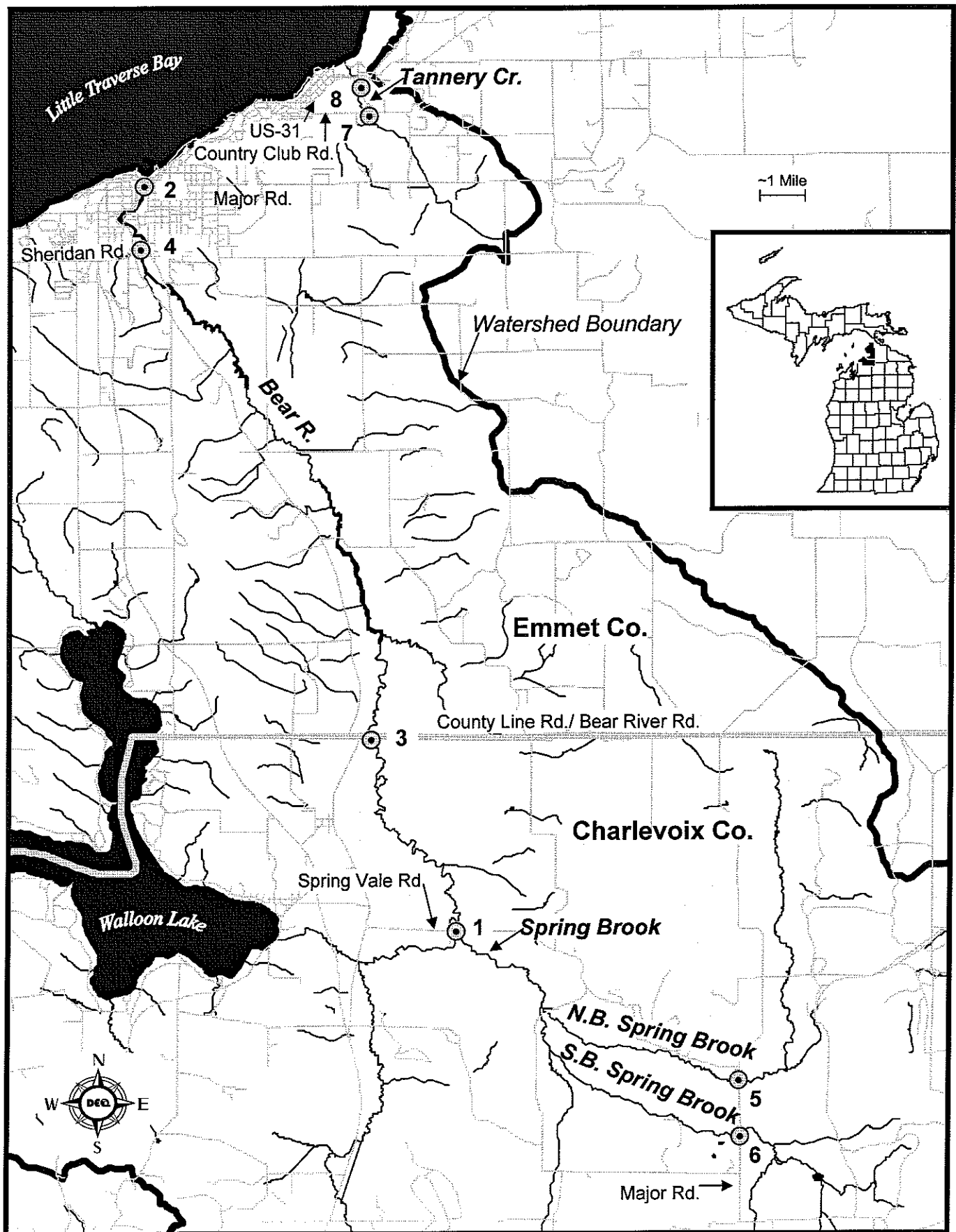


Figure 1a- Station locations in the Bear River watershed and Tannery Creek, August 2003.

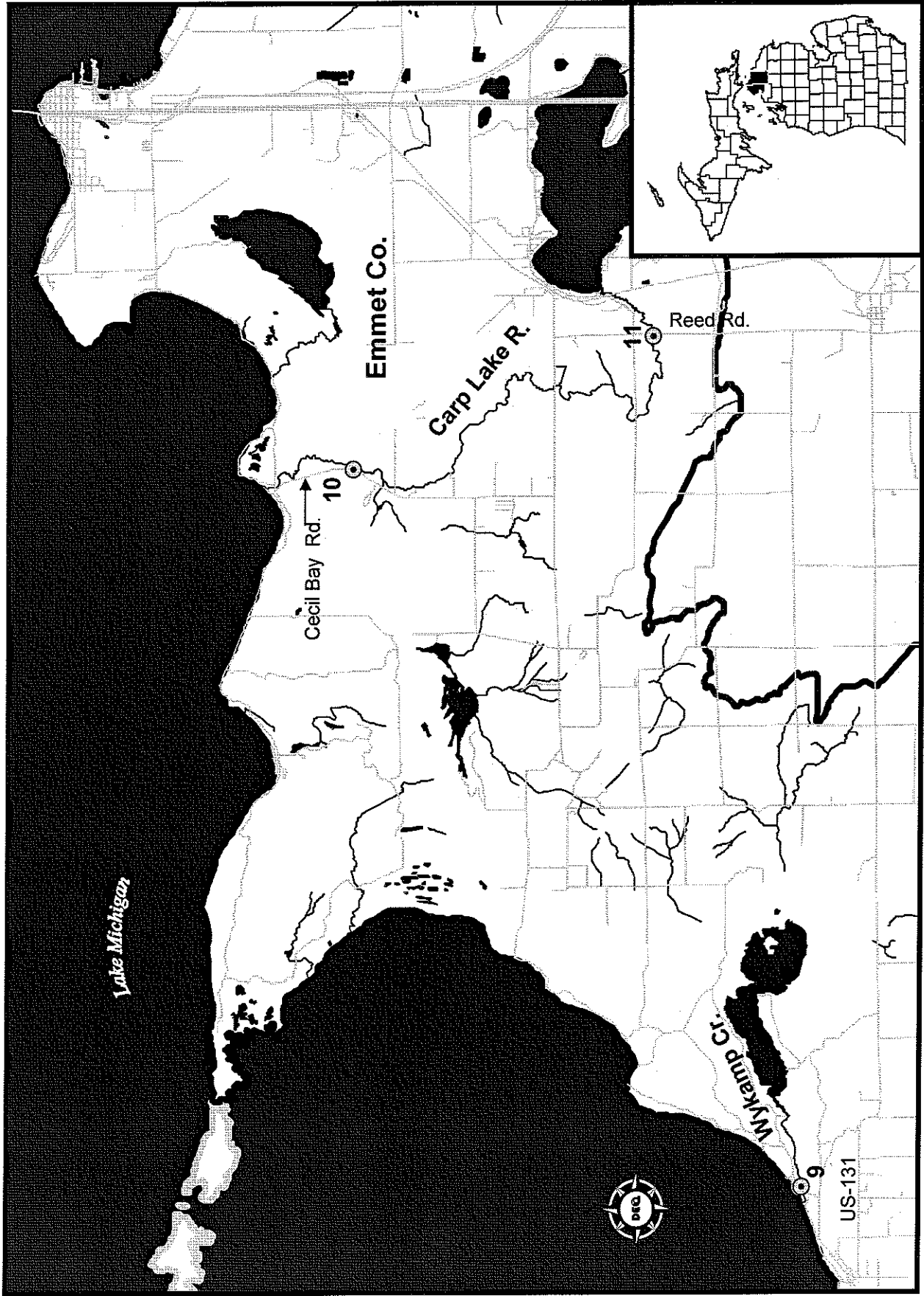


Figure 1b- Station locations in Emmet County, August 2003.