2010 BIOLOGICAL MONITORING REPORT FOR THE BAYFIELD RIVER IN THE VICINITY OF THE BAYFIELD SEWAGE TREATMENT PLANT

MUNICIPALITY OF BLUEWATER
HURON COUNTY

Prepared for:

THE MUNICIPALITY OF BLUEWATER

By:

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INTRODUCTION

The Bayfield Sewage Treatment Plant (STP) site was constructed in 2002 to service the Village of Bayfield when sanitary sewers were installed within the community. Since that time, several large seasonal campground developments, located immediately adjacent to Bayfield, were connected to the system. As well, significant infilling has occurred within the community along with several large residential subdivision developments. The STP is now nearing it's design capacity and needs to be expanded to service additional infilling within the community and capacity committed to existing residential subdivision developments.

Macroinvertebrate monitoring was conducted in the Bayfield River on April 5, 2010 to document water quality in the river in the vicinity of the outlet of the Bayfield STP. This information will provide background water quality information for the planning processes involved with expanding the sewage system.

MATERIALS AND METHODS

To assess the water quality (ability of the water resource to support aquatic life) of the Bayfield River in the vicinity of the Bayfield STP, three sample sites were established (Figure 1). The final effluent from the STP is discharged on the south side of the river to a side channel, which meanders approximately 430m in a northerly direction where it joins the main channel of the Bayfield River. The flow from the river would inundate portions of this side channel during flood events. Site 1 was located in the main channel of the Bayfield River approximately 100m upstream from the discharge structure of the STP. Site 2 was located approximately 640m downstream from Site 1 and approximately 210m downstream of the confluence of the side channel. Site 3 was located approximately 1km downstream from Site 1.

Courtesy of Huron County 2007

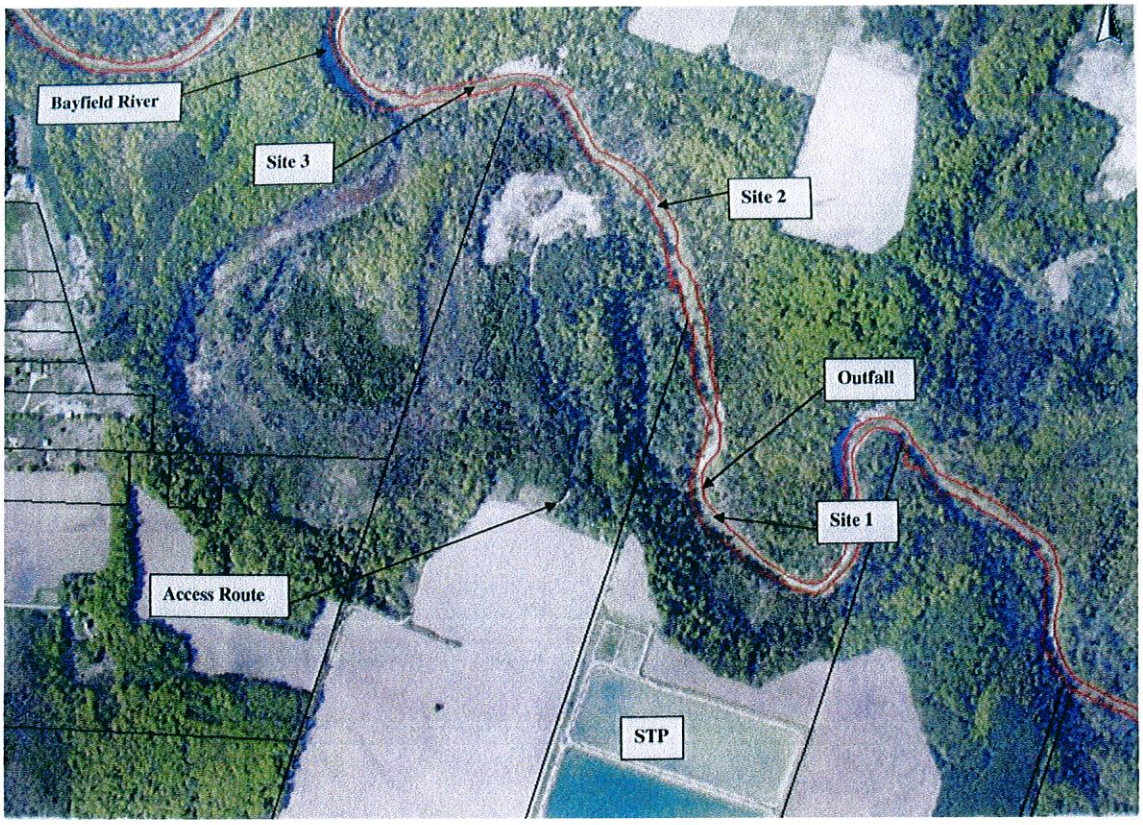

Figure 1: Location of biological sample Site 1, Site 2 and Site 3 in the Bayfield River in the vicinity of the Bayfield Sewage Treatment Plant, April 5, 2010.

Sample Site Locations

Site 1- 43° 33' 3 8" N 81° 39' 13" W

Site 2- 43° 34' 1" N 81° 39' 22" W

Site 3- 43° 34' 7" N 81° 39' 34" W

Benthic macroinvertebrates were collected on April 5, 2010. Standard BioMAP sampling procedures were used to sample the benthic fauna (Griffiths 1999). A Surber sampler (0.09 m^2) was used to collect the quantitative samples. Two samples were collected at each site, sample 1 on the right side of the riffle and sample 2 on the left side looking upstream. Surber samples were taken at a water depth of 30cm to 35cm at all the sites. A 30 minute qualitative sample was also collected at each site by employing a D frame dip net with 600μm mesh. The macroinvertebrates collected were live picked using forceps and white enamel trays. The processed samples were preserved in 80% ethanol and retained for further study. The BioMap (d) and (q) Water Quality Index's (WQI) were used to provide a measure of water quality.

Observations of stream characteristics, plant, algae growth, fish and wildlife were noted. Water temperature was measured with a Taylor mercury pocket case thermometer. Conductivity and pH were measured at each sample site with a Hanna HI 98129 meter. A Hanna HI 3810 dissolved oxygen test kit was used to measure dissolved oxygen levels at each site.

RESULTS AND OBSERVATIONS

The Bayfield STP is located on the North Pt. of Lot 7, Bayfield Concession, within the Stanley Ward of the Municipality of Bluewater. The final effluent from the STP is discharged on the south side of the river on a seasonal basis to a side channel, which meanders approximately 430m in a northerly direction where it joins the main channel of the Bayfield River. The STP was not discharging during the macroinvertebrate sample collection. The stream flows through a steep forested riparian valley area and it has a cobble rock and stone substrate. Site 1 was located in the Bayfield River approximately 100m upstream from the discharge structure. The bankfull width was documented as 45m wide at Site 1 and water depths ranged from 5cm to 0.5m deep. Site 2 had a bankfull width of 61m and water depths ranged from 5cm to 0.5m deep. The bankfull width at Site 3 was 63m and the water depth ranged from 5cm to 0.7m deep.

The substrate of the river at all sample sites was composed of cobble/rock and stones. A light layer of marl (calcium carbonate) covered the larger rocks and cobble.

The field measurements taken during the study are tabulated in TABLE A:

TABLE A: Temperature, dissolved oxygen, conductivity and pH measurements documented April 5, 2010 in the Bayfield River. All measurements were taken between 2:00pm and 3:00pm.

	Site 1	Site 2	Site 3
Sample Date: April 5, 2010			
Water Temperature °C	17	15	15
Dissolved Oxygen mg/L	8.1	8.0	8.0
Conductivity μS/cm.	546	563	560
pH	8.2	8.2	8.2

Dissolved oxygen levels meet the Provincial Water Quality Objectives (PWQO) for cold water biota. The pH levels are characteristic of watercourses located in areas of limestone bedrock in Southern Ontario. The PWQO for pH is a range between 6.5 and 8.5. Conductivity levels are normal at all three sites. Conductivity values for similar type streams in Huron, Bruce and Grey Counties are < 650μS/cm.

The filamentous green alga *Cladophora* was present but sparse at all the sample sites, covering up to 10% of the cobble/rock stream substrate. It was mainly present on the larger rocks. The filament length of the *Cladophora* was short, <1cm long.

Fish were not sampled during the study but observations of their presence were documented. There were unidentified minnows/shiners present at all the sites.

Macroinvertebrate densities (number of organisms per 0.09 m^2) and the number of taxa per sample are listed in TABLE B. The total number of different taxa per site (species richness) is listed in TABLE C. The number of taxa collected at all sites totaled 96. Midge larvae were an abundant group, comprising 22% of the total number of taxa

collected and 48% of the individuals. Midge accounted for 56%, 30% and 62% respectively of the total individuals at each site. Caddisflies were also abundant at all sites and comprised 18% of the total number of taxa and 28% of the total number of individual organisms. They comprised 25% of individuals at Site 1, 35% at Site 2 and 23% at Site 3. Hydropsychids were the most abundant group and were well represented at all the sites. These caddisflies are filter feeders and weave fine silk nets to trap fine organic particulate matter, mostly algae/diatoms.

Mayflies were represented at all the sites comprising approximately 8%, 6% and 9% of the total number of individuals, respectively, while the numbers of types accounted for 28% of the total number of taxa collected from all sites. Mayflies belonging to the Family Heptageniidae were common to all sites. These mayflies feed on algae/diatoms by scraping and collecting.

Beetles were present at all the sites, comprising < 3% of total numbers of organisms respectively but comprised 11% of the total taxa. Beetles of the Family Elmidae were common to all the sites. These beetles feed by scraping, collecting and gathering fine organic particulate. They are characteristic of clear flowing well-oxygenated waters.

Blackfly (Simuliidae) larvae were collected at all sites but were only abundant at Site 2 where they accounted for 23% of the total number of individuals. At Site 1 and Site 3 these larvae accounted for 4% and 2% of the total number of individuals. Blackfly larvae can be filter feeders and/or collectors feeding on organic detritus. They are characteristic of clear flowing water.

The BioMAP Water Quality Index (d), a biological measure of water quality for creeks, streams and rivers (Griffiths 1999), was calculated for the macroinvertebrate data collected at each of the three sites (TABLE B). The Water Quality Index (d) values are listed in TABLE C.

TABLE C: BioMAP Water Quality Index (d) (WQI) average values and species richness at three Sites along the Bayfield River on April 5, 2010.			
	Site 1	Site 2	Site 3
BioMap Water Quality Index (d)	13.5	13.3	14.0
Species Richness Per Site	67	65	69

The BioMAP (d) WQI provides a water quality classification at sites in creeks, streams and rivers. The water quality is deemed to be unimpaired or impaired or in a gray zone between threshold values. The following chart outlines the BioMAP (d) WQI values.

Water Quality Classification

	Unimpaired	Impaired
Creeks	>16	<14
Streams	>12	<10
Rivers	>9	<7

Unimpaired water quality is recognized by the presence of benthic species whose environmental requirements match those expected at that site. For example, creeks contain specific creek dwelling species. Impaired water quality is indicated by the occurrence of species that are out of place, for example, the predominance of stream dwelling organisms in a creek. The Bayfield River Sites 1, 2 and 3 are considered to be river sites as defined by the BioMAP protocols (bankfull width 16m to 64m).

The BioMap qualitative (q) WQI was also applied and it provides a measure of water quality based solely on the value of the top 25% of the taxa at a site. The BioMap (d) WQI provides a more detailed expression of water quality as an abundance weighted sensitivity value that uses all the taxa to contribute to this value. A (q) WQI value of 3.06 was calculated for Site 1, a value of 3.13 at Site 2 and a value of 3.16 at Site 3. The BioMap (q) WQI values for rivers >2.4 classifies the water quality as unimpaired and

<2.0 as impaired. Based on the BioMap (q) WQI values calculated the water quality is therefore unimpaired at all of the three sites.

The number of taxa per site at the three sites is within the expected range of 40 to 80 for rivers in southern Ontario. Density of organisms, number of individuals per 0.9 m^2, was low for all three sites as average densities of 293, 322 and 264, respectively, were documented. Densities of 360 to 1440 per 0.9 m^2 are characteristic of southern Ontario rivers. Southern Ontario streams have densities of individual organisms of 180 to 720 per 0.9 m^2.

In summary, the BioMAP (d) WQI values for rivers indicate unimpaired water quality conditions at Site 1, Site 2 and Site 3 in the Bayfield River upstream and downstream from the discharge of the community of Bayfield's STP as the (d) WQI values of 13.5, 13.3 and 14 were >9. The BioMap (q) WQI values of 3.06, 3.13 and 3.16 were >2.4. The BioMAP (q) WQI values indicate unimpaired water quality conditions.

Species richness was good at all sites with representation of Midge, Mayflies and Caddisflies characteristic of higher quality stream environments. The density of organisms was also more indicative of stream environments.

The data and information outlined in this monitoring report provides baseline data (historical measure) sufficient to allow comparison with any future biological monitoring surveys.

John D. Westwood

REFERENCES

Griffiths, R.W. 1999. BioMAP: Bioassessment of Water Quality. Published by: The Centre for Environmental Training, Niagara College, Glendale Campus, Niagara-on-the Lake, Ontario Canada. LOS 1JO. 110 pp. ISBN 0-9685921-0-4.

TABLE B: BENTHIC MACROINVERTEBRATES COLLECTED FROM BAYFIELD RIVER, APRIL 2010.

Station / Replicate	Sensitivity Value	STN 1 Q	STN 1 1	STN 1 2	STN 2 Q	STN 2 1	STN 2 2	STN 3 Q	STN 3 1	STN 3 2
FLATWORMS										
P. Platyhelminthes										
Cl. Turbellaria										
O. Tricladida	3	-	-	-	✓	1	1	✓	-	-
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Tubificidae										
Limnodrilus hoffmeisteri	0	-	-	1	-	-	-	✓	-	-
immatures without hair chaetae	0	-	-	-	-	-	1	-	-	-
F. Lumbriculidae										
Stylodrilus heringianus	*	-	-	1	✓	-	-	-	-	-
LEECHES										
Cl. Hirudinea										
F. Haemopidae										
Haemopis marmorata	1	-	-	-	-	-	-	✓	-	-
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	*	-	-	-	-	-	-	-	-	1
WATER SCUDS										
O. Amphipoda										
F. Hyalellidae										
Hyalella	2	✓	-	-	✓	-	-	✓	-	-
AQUATIC SOW BUGS										
O. Isopoda										
F. Asellidae										
Caecidotea	1	-	-	-	✓	-	-	-	-	1
CRAYFISH										
O. Decapoda										
F. Cambaridae										
Cambarus robustus	1	-	-	-	-	-	-	✓	-	-
Orconectes propinquus	2	✓	-	-	-	-	-	-	1	-
Orconectes	2	-	-	-	-	-	-	✓	-	-
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	*	-	-	-	-	1	-	-	-	-
INSECTS										
Cl. Insecta										
BEETLES										
O. Coleoptera										
F. Dryopidae										
Helichus	2	-	-	-	✓	-	-	-	-	-
F. Dytiscidae										
Agabus	2	✓	-	-	✓	-	-	-	-	-
Neoporus	2	✓	-	-	✓	-	-	-	-	-
F. Elmidae										
Dubiraphia minima	1	-	-	-	✓	-	-	-	-	1
Dubiraphia larvae	*	-	-	1	-	-	-	-	-	-
Microcylloepus pusillus	3	-	-	-	✓	-	-	-	2	2
Stenelmis crenata	2	✓	1	-	✓	-	-	✓	1	2
Stenelmis larvae	*	✓	3	3	✓	1	1	✓	1	3
F. Gyrinidae										
Gyrinus	1	✓	-	-	-	-	-	-	-	-
F. Psephenidae										
Ectopria	3	-	-	-	-	-	-	-	-	1

TABLE B: BENTHIC MACROINVERTEBRATES COLLECTED FROM BAYFIELD RIVER, APRIL 2010.

Station / Replicate	Sensitivity Value	STN 1 Q	STN 1 1	STN 1 2	STN 2 Q	STN 2 1	STN 2 2	STN 3 Q	STN 3 1	STN 3 2
MAYFLIES										
O. Ephemeroptera										
F. Ameletidae										
Ameletus	4	✓	-	-	✓	-	-	✓	-	-
F. Baetidae										
Acerpenna pygmaea	2	-	2	1	-	-	-	✓	1	-
Baetis	*	-	-	1	✓	1	-	-	-	-
F. Caenidae										
Caenis	1	✓	7	-	✓	1	6	✓	-	3
F. Caenidae										
Ephemera	2	✓	1	1	✓	-	-	-	-	1
F. Ephemerellidae										
Ephemerella subvaria	3	✓	5	9	✓	-	2	✓	2	3
Eurylophella bicolor	3	✓	2	-	✓	-	1	✓	1	-
Serratella	3	✓	-	1	-	2	4	-	1	-
F. Heptageniidae										
Maccaffertium mediopunctatum	3	✓	2	4	✓	-	8	-	-	4
Maccaffertium terminatum	2	✓	4	-	-	-	2	✓	4	2
Maccaffertium vicarium	3	-	3	-	✓	-	-	✓	6	3
Stenacron	2	✓	1	-	✓	-	1	✓	-	6
Stenonema femoratum	1	-	1	-	-	-	-	-	-	-
F. Isonychiidae										
Isonychia	2	✓	1	-	✓	-	4	✓	2	-
F. Leptohyphidae										
Tricorythodes	2	-	1	-	✓	-	8	-	-	4
F. Leptophlebiidae										
Leptophlebia	1	✓	-	-	✓	-	-	-	-	-
O. Megaloptera										
FISHFLIES & DOBSONFLIES										
F. Corydalidae										
Corydalus	2	-	-	-	-	-	-	✓	-	-
Nigronia	3	✓	-	-	✓	-	-	-	-	-
O. Odonata										
DAMSELFLIES										
F. Calopterygidae										
Calopteryx maculata	3	-	-	-	✓	-	-	-	-	-
F. Coenagrionidae										
Enallagma	*	✓	-	-	-	-	-	-	-	-
DRAGONFLIES										
F. Aeshnidae										
Aeshna	2	✓	-	-	-	-	-	-	-	-
Basiaeschna janata	1	-	-	-	-	-	-	✓	-	-
Boyeria	2	-	-	-	✓	-	-	-	-	-
STONEFLIES										
O. Plecoptera										
F. Capniidae										
Allocapnia	*	✓	-	-	✓	-	-	✓	-	-
F. Nemouridae										
Nemoura	3	-	-	-	✓	-	-	-	-	-
F. Nemouridae										
Acroneuria	2	-	-	1	✓	-	-	-	-	-
Paragnetina	3	✓	1	-	✓	1	1	✓	-	-
F. Taeniopterygidae										
Strophopteryx	4	-	-	-	-	-	-	✓	-	-
BUGS										
O. Hemiptera										
F. Belostomatidae										
Belostoma	0	-	-	-	✓	-	-	-	-	-
F. Corixidae										
Sigara modesta	0	✓	-	-	-	-	-	-	-	-
CADDISFLIES										

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Station / Replicate	Sensitivity Value	STN 1 Q	STN 1 1	STN 1 2	STN 2 Q	STN 2 1	STN 2 2	STN 3 Q	STN 3 1	STN 3 2
O. Trichoptera										
F. Brachycentridae										
Micrasema	4	-	-	-	-	-	-	-	-	1
F. Helicopsychidae										
Helicopsyche	2	-	-	-	✓	-	2	-	-	1
F. Hydropsychidae										
Cheumatopsyche	*	✓	7	8	✓	10	21	✓	3	17
Hydropsyche betteni	2	-	2	3	✓	3	-	-	-	-
Hydropsyche bronta	3	✓	11	11	✓	6	16	✓	8	13
Hydropsyche dicantha	2	✓	16	10	✓	11	35	✓	7	9
Hydropsyche morosa	2	✓	25	23	✓	17	80	✓	16	25
Hydropsyche placoda	2	✓	3	1	-	1	2	✓	2	4
Hydropsyche sparna	3	-	5	4	-	2	6	✓	1	2
F. Leptoceridae										
Ceraclea	1	-	-	-	-	-	-	-	2	3
Oecetis	2	-	-	4	-	-	1	-	-	1
F. Limnephilidae										
Hydatophylax	4	-	-	-	✓	-	-	-	-	-
Pycnopsyche	3	✓	-	-	-	-	-	✓	-	-
F. Philopotamidae										
Chimarra	3	✓	7	3	✓	8	7	✓	1	3
F. Phryganeidae										
Ptilostomis	2	-	-	-	✓	-	-	✓	-	-
F. Polycentropodidae										
Neureclipsis	2	-	1	1	-	-	-	-	-	-
F. Rhyacophilidae										
Rhyacophila lobifera	3	-	1	-	-	-	-	✓	-	-
TRUE FLIES										
O. Diptera										
F. Athericidae										
Atherix	3	-	1	-	✓	-	-	-	-	-
MIDGES										
F. Chironomidae										
chironomid pupae	*	✓	**5**	**8**	-	**4**	**1**	-	**1**	**2**
S.F. Chironominae										
Chironomus	0	-	1	-	-	-	-	-	-	-
Micropsectra	3	-	1	1	-	-	1	✓	-	2
Microtendipes	2	✓	1	1	✓	1	-	-	-	-
Paratanytarsus	1	✓	-	-	-	-	-	-	-	-
Rheotanytarsus	3	✓	-	-	-	-	-	-	1	1
Stempellinella	3	-	-	-	-	-	-	✓	-	-
Tanytarsus	2	✓	-	-	-	-	-	✓	-	-
S.F. Diamesinae										
Diamesa	3	-	-	-	✓	-	-	-	-	-
S.F. Orthocladiinae										
Cricotopus/Orthocladius	*	✓	39	66	✓	16	13	✓	20	85
Eukiefferiella brevicalcar group	3	✓	49	52	✓	15	17	✓	25	77
Eukiefferiella devonica group	3	-	1	4	✓	3	3	-	2	6
Hydrobaenus	1	-	-	-	-	-	-	✓	-	-
Orthocladius	*	✓	42	17	✓	42	40	✓	27	39
Orthocladius (Euorthocladius) rivularun	*	-	-	-	✓	1	2	-	-	3
Orthocladius (Euorthocladius)	*	✓	28	15	-	20	15	✓	26	3
Parakiefferiella	2	-	-	-	-	-	-	✓	-	-
Parametriocnemus	3	-	-	-	-	1	3	✓	-	1
Tvetenia	2	-	3	-	-	1	1	-	1	-
S.F. Tanypodinae										
Conchapelopia	2	✓	-	-	-	-	-	✓	-	-
Helopelopia	3	-	-	-	-	-	-	✓	-	-
Rheopelopia	3	-	1	1	✓	-	-	✓	1	5
Thienemannimyia complex	*	✓	-	-	✓	-	-	✓	-	-
F. Empididae										

TABLE B: BENTHIC MACROINVERTEBRATES COLLECTED FROM BAYFIELD RIVER, APRIL 2010.

Station	Sensitivity	STN 1			STN 2			STN 3		
Replicate	Value	Q	1	2	Q	1	2	Q	1	2
Clinocera	2	✓	1	1	✓	-	-	-	-	2
Hemerodromia	2	-	-	1	-	-	1	-	1	-
F. Simuliidae	2	✓	4	22	✓	75	74	✓	8	2
F. Tipulidae										
Antocha	3	-	10	5	✓	11	6	-	2	6
MOLLUSCS										
P. Mollusca										
SNAILS										
Cl. Gastropoda										
F. Lymnaeidae										
Fossaria	1	✓	-	-	-	-	-	✓	-	-
F. Physidae										
Physella	0	✓	-	-	✓	1	-	✓	-	-
CLAMS										
Cl. Bivalvia										
F. Sphaeriidae										
Sphaerium (Amesoda) striatinum	2	-	-	-	-	-	-	✓	-	-
TOTAL NUMBER OF ORGANISMS		-	300	286	-	257	387	-	177	350
TOTAL NUMBER OF TAXA *		44	38	33	53	27	34	49	29	38
BioMAP (WQI_d)			13.2	13.8		13.6	13.1		13.7	14.3
Average BioMAP (WQI_a)				13.5			13.3			14
BioMAP (WQI_a)		3.06			3.13			3.16		

*Bold entries excluded from taxa count