

**Lake Noquebay Watershed
Stream Water Resource
Appraisal**

Submitted by

Mary Gansberg

Wisconsin Department of Natural Resources

March, 1994

I. INTRODUCTION

A water resource appraisal is being completed for the *Lake Noquebay Priority Lake Project*. As a component of that appraisal, surface water quality of the streams in the Lake Noquebay Watershed (Figure 1) were evaluated to determine existing conditions. This report summarizes the results of the stream monitoring and should be incorporated into the overall water quality appraisal report.

II. SUMMARY OF WATER RESOURCE CONDITIONS

The Lake Noquebay Priority Lake watershed is 153 square miles in size and is located solely in Marinette County. Surface waters in the watershed include Lake Noquebay and its tributaries. The majority of the watershed is forested. Agriculture makes up about 20% of the land use and is concentrated in Smith Creek, Lower Middle Inlet, and Middle Inlet subwatersheds. Dairy farming is the principal agricultural land use. Soils in the eastern portion of the watershed are primarily poor drained, mucky soils. Wetlands are common in this part of the watershed. Soils in the western portion of the watershed are primarily well-drained, sandy and loamy.

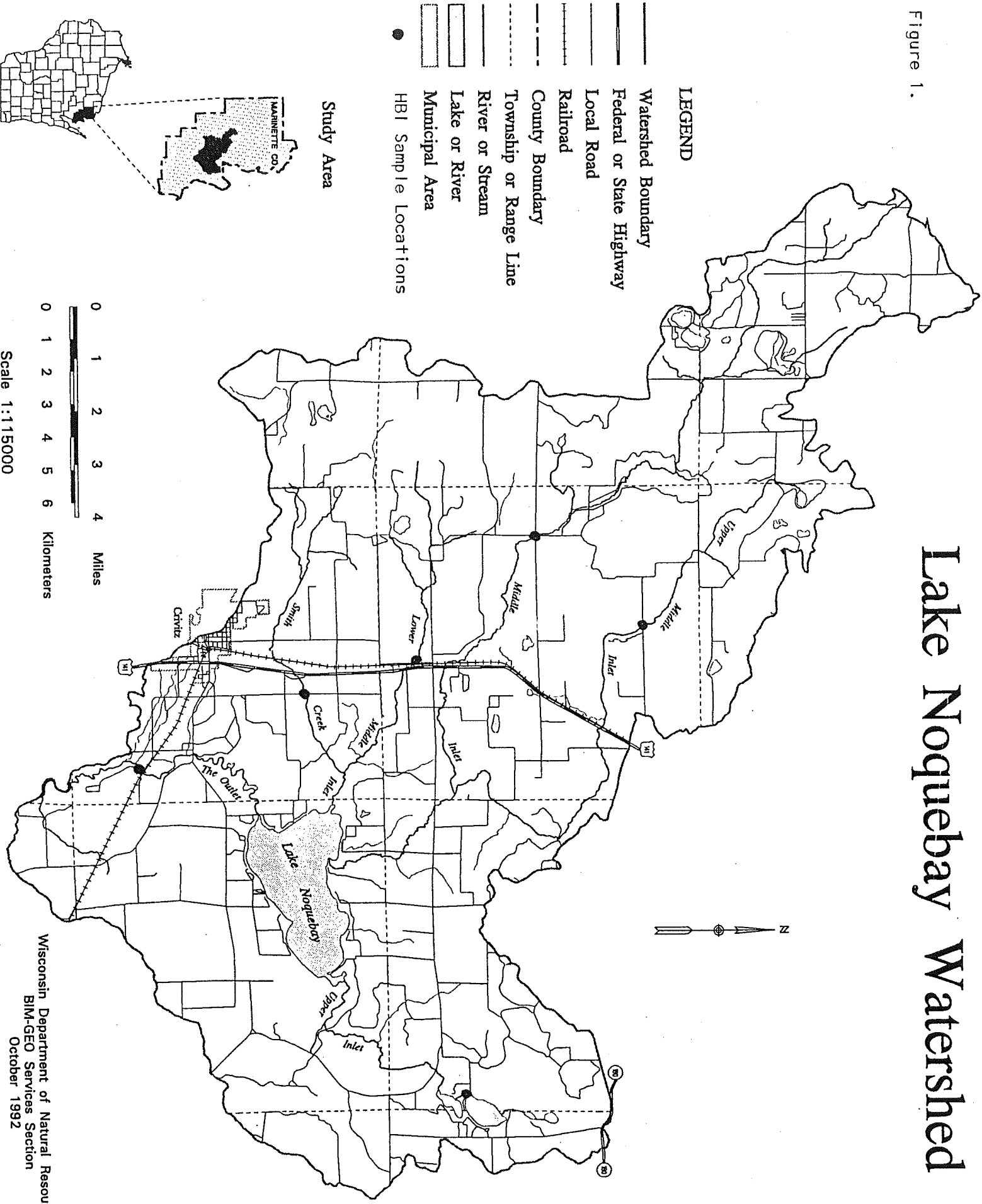
Stream habitat in this watershed is generally in good condition. Streambank erosion and cattle access appear to be minimal. Bank vegetative cover is generally greater than 90% with diverse trees, shrubs, and grasses. There is adequate depth in pools and riffle areas and good stream flow. Several of the streams have predominately shifting sand substrate. Macroinvertebrate biomass is generally lower in areas with a predominantly sand substrate than a stream substrate with a mix of gravel, rubble and sand. Habitat suitable for some macroinvertebrate species is generally limited to riffle areas below bridge abutments where rubble and gravel from rip-rap is present.

The streams support high quality cold water Class I and II trout communities except The Outlet and Upper Inlet, which support warm water sport fish communities. As defined in NR102.10 and NR102.11, Middle Inlet and Upper Middle Inlet are designated as Outstanding Resource Waters (ORW) and Lower Middle Inlet and Smith Creek are designated as Exceptional Resource Waters (ERW). Outstanding designation means that they have the highest value as a resource, excellent water quality and high quality fisheries with no wastewater discharge. Exceptional designation means they have excellent water quality and valued fisheries but may receive wastewater discharge.

Nutrients, suspended solids, and biochemical oxygen demand in the streams are generally very low during runoff conditions.

Figure 1.

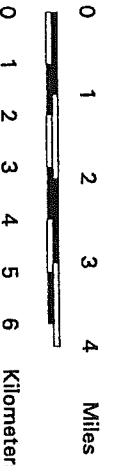
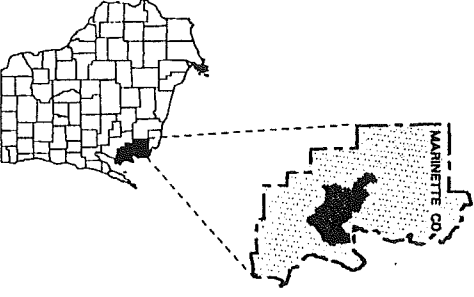
Lake Noguebay Watershed



LEGEND

- Watershed Boundary
- Federal or State Highway
- Local Road
- Railroad
- County Boundary
- Township or Range Line
- River or Stream
- Lake or River
- Municipal Area
- HBI Sample Locations

Study Area



Scale 1:115000

Nonpoint source control measures installed in this watershed would likely prevent nonpoint source pollution from becoming a problem in these otherwise very high quality resources.

III. APPRAISAL METHODS

Since historical information for the watershed streams was scarce, additional water quality data was collected to complete the stream water resource appraisal. Monitoring activities were initiated in the watershed in September 1992 and completed in August 1993. Monitoring procedures comply with the WDNR Field Procedures Manual (WDNR, 1988). Following is a brief description of appraisal monitoring conducted.

Macroinvertebrate

Aquatic macroinvertebrates were collected throughout the watershed in Fall 1992 and Spring 1993 and sent to UW-Stevens Point for sorting and identification. Sample results were evaluated using the Hilsenhoff Biotic Index (HBI) which provides a relative measure of organic loading to the streams (Hilsenhoff, 1987).

Habitat Evaluations

Stream habitat conditions were evaluated throughout the watershed in the spring and fall. A matrix was used to numerically rank physical habitat characteristics that may limit the quantity and quality of aquatic life (Ball, 1982 - Form Appendix A).

Dissolved Oxygen/Temperature/pH

Dissolved oxygen, temperature, and pH measurements were taken in the streams. Wisconsin Administrative Code NR 102 establishes a 5 mg/L dissolved oxygen water quality standard for fish and aquatic life classified streams and a 6 mg/l standard for Cold water trout streams.

Water Chemistry Samples

Water samples were collected on two occasions (March 25, and June 6, 1993) to represent runoff from snowmelt and rain events. Stream flow was also collected concurrently with chemistry samples to estimate pounds per day of nutrient loadings to the receiving waterbody.

IV. RESULTS AND DISCUSSION

A summary of habitat evaluation results, biotic index results, stream classifications, and special resource status for the major streams in the Lake Noquebay watershed are presented in Table 1. Water chemistry results are presented in Table 2. Stream monitoring locations are indicated on Figure 1.

Following is a discussion of appraisal results for each of the major watershed streams.

UPPER INLET

Upper Inlet originates at Stephenson Lake, travels through Mud Lake, Lake Mary and Lake Julia before entering into Lake Noquebay's northeast side. Sampling was conducted at Lake Mary Road where the Upper Inlet leaves Lake Mary.

Upper Inlet has an average depth of 0.6 feet and an average width of 12 feet. This stream is classified as warm water sport fish communities. Soils in this area are poorly drained and have a considerable amount of adjoining wetlands.

Upper Inlet at Lake Mary Road received a habitat evaluation ranking of good and fair during two different times of the year. The creek substrate is generally soft and mucky with little rock, gravel and other stable habitat. This is likely due to the wetland influence on the stream. Macrophytes in the stream are common. The biotic index scores of 5.94 and 6.67 rates the Upper Inlet as fair and fairly poor water quality with fairly significant to significant organic pollution. I believe the lack of a suitable monitoring location contributes to the fair rating and not necessarily organic pollution.

Water chemistry samples collected during snowmelt runoff shows low concentrations and loadings of nutrients, biochemical oxygen demand and suspended solids.

UPPER MIDDLE INLET

Upper Middle Inlet is a perennial tributary to the Middle Inlet. The stream has an average depth of 0.7 feet and an average width of 13 feet. Sampling was conducted on the Upper Middle Inlet at Nejedlo Road and McMahan Road.

Table 1. Water Resource Conditions for Stream in the Lake Noguebay Watershed

Stream	Location	Habitat Rating ¹		Biotic Index ²		Stream Classification ³	Special Status ⁴
		1992	1993	1992	1993		
Upper Inlet	Lake Mary Road	good/160	fair/136	5.94/ Fair	6.67/ Fairly Poor	WWSF	—
Upper Middle Inlet	Nejedlo Road	good/103	good/114	2.93/ Excellent	3.40/ Excellent	Class I & II	ORW
Middle Inlet	Camp 5 Road & Moonshine Hill Road	good/102	good/110	2.71/ Excellent	3.29/ Excellent	Class I & II	ORW
Lower Middle Inlet	Cemetery Road	good/96	good/94	1.61/ Excellent	1.96/ Excellent	Class I	ERW
Smith Creek	St. Paul Road	good/110	fair/143	2.73/ Excellent	4.73/ Good	Class I	ERW
The Outlet	St. Paul Road	—	good/79	—	4.04/ V. Good	WWSF	—

1. Habitat Rating (See Appendix A):

- <70 = excellent habitat
- 71 - 129 = good habitat
- 130 - 200 = fair habitat
- >200 = poor habitat

2. Hilsenhoff Biotic Index (HBI):

Biotic Index	Water Quality	Degree of Organic Pollution
0-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.0	Very poor	Severe organic pollution

3. Stream Classification:

- Cold - cold water trout stream
- Class I - natural reproduction
- Class II - some natural reproduction
- Class III - no natural reproduction
- WWSF - warm water sport fishery
- WMFF - warm water forage fishery
- LFF - limited forage fishery

4. Special Resource Status:

- ORW - Outstanding Resource Waters
- ERM - Exceptional Resource Waters

Lake Noguebay Priority Watershed
Water Chemistry

Location	Flow cfs	BOD ₅ mg/l	BOD ₅ lbs/day	Ammonia mg/l	Ammonia lbs/day	Nitrate Nitrite-N mg/l	Nitrate Nitrite-N lbs/day	Total Kjel-N mg/l	Total Kjel-N lbs/day	Total Phos mg/l	Total Phos lbs/day	Diss Phos mg/l	Diss Phos lbs/day	Susp Solids mg/l	Susp Solids lbs/day	Temp °C	Diss oxygen mg/l	pH	
Date: 3/25/93																			
Middle Inlet	23.9	<1	---	0.009	1.16	0.157	20.22	0.2	25.76	<0.02	---	0.002	0.26	6	772.93				
Upper Middle Inlet	9.1	1.1	53.95	0.012	0.59	0.399	19.57	0.3	14.71	<0.02	---	0.003	0.15	9	441.44				
Smith Creek	6.2	1.2	40.10	0.022	0.74	0.704	23.53	0.4	13.37	<0.02	---	0.005	0.17	7	233.93				
Upper Inlet	2.4	1.0	12.94	0.043	0.56	0.085	1.10	0.6	7.76	<0.02	---	0.002	0.03	<2	---				
Lower Middle Inlet	10.7	8.3	478.69	0.501	28.89	0.703	40.54	1.9	109.58	0.19	10.96	0.10	5.77	16	922.77				

Date: 6/10/93																			
The Outlet	---	<1	---	0.026	---	0.011	---	0.5	---	<0.02	---	0.002	---	<2	---	18.3	7.6	9.4	
Upper Middle Inlet	43.2	<1	---	0.021	4.89	0.039	9.08	0.5	116.42	<0.02	---	0.006	1.40	4	931.39	12.2	6.4	7.3	
Middle Inlet	65.9	<1	---	0.018	6.39	0.052	18.47	0.7	248.64	0.03	10.66	0.003	1.07	18	6,393.62	14.0	9.2	8.2	
Lower Middle Inlet	27.5	<1	---	0.030	4.45	0.110	16.30	0.7	103.76	0.03	4.45	0.010	1.48	4	592.90	14.7	7.2	8.9	
Smith Creek	23.6	1.1	139.92	0.026	3.31	0.059	7.50	1.0	127.20	0.03	3.82	0.003	0.38	11	1,399.24	15.0	5.7	9.2	

* Note: All samples collected during rain or snowmelt runoff.

This stream is classified as a Cold Water Class I and II trout stream fully meeting its potential use. The Upper Middle Inlet is also classified as Outstanding Resource Waters.

Habitat evaluations on two occasions ranked this stream as having good habitat. Much of the stream corridor consists of wetland areas. The creek bed is mostly sand with significant deposition of soft sediment and silt near the creek edges. The tributary has dark stained water; however, macrophytes such as Vallisneria (Water Celery) is quite abundant. Macroinvertebrate samples received biotic index values of 2.93 and 3.40 which rates the Upper Middle Inlet as excellent water quality with no apparent organic pollution. Fisheries Management has identified stream bank pasturing as a concern in this stream, however at Nejeldo and McMahon Roads there was no evidence of bank erosion problems.

Water chemistry samples collected during rain and snowmelt runoff show very low concentrations and loadings of nutrients, biochemical oxygen demand, and suspended solids.

MIDDLE INLET

Middle Inlet is a perennial stream that drains directly to Lake Noquebay's north side. This creek has also been known as Eagle's Nest Creek. Sampling on the Middle Inlet was conducted at CTH "X", Sweetheart City Road, and the junction of Moonshine Hill Road and Camp 5 Road.

This stream is classified as a Cold Water Class I and II trout stream that is fully meeting its potential use. Middle Inlet is also designated as Outstanding Resource Waters.

Habitat evaluations on two occasions ranked this stream as having good habitat. The creek has an average width of 15 feet and an average depth of 9 feet. Macrophytes in the stream are common. The creek bed consists mostly of sand with some silt present near the banks. Rock, rubble, and other stable habitat is generally limited to riffle areas below bridge abutments where rip-rap is present. The upper reaches of this watershed is mostly wooded with some wetlands and little agriculture land. Macroinvertebrate samples received biotic index values of 2.71 and 3.29 which rates the Middle Inlet as excellent water quality with no apparent organic pollution.

Water chemistry results show very low concentrations of nutrients, biochemical oxygen demand, and suspended solids during both rain and snowmelt runoff.

LOWER MIDDLE INLET

Lower Middle Inlet is a perennial tributary which discharges to the northwest side of Lake Noquebay. The stream has an average depth of 0.9 feet and an average width of 10 feet. Sampling was conducted on the Lower Middle Inlet at Cemetery Road and Quarry Road.

Lower Middle Inlet is classified as a Cold Water Class I trout stream only partly meeting it's potential use. Lower Middle Inlet is designated as Exceptional Resource Waters.

Much of the stream riparian area is wetland. Habitat evaluations ranked this stream as having good habitat. It has extensive stretches of rock and rubble riffle areas and also many deep pools. Silt and sediment are common in the slow moving areas of bends and near the banks. Vegetation is common in this creek. In the unshaded open rocky areas, a combination of Bryophyta - a leafy moss and strands of filamentous algae are present. In the shaded areas, vallisneria is very common. Macroinvertebrate samples received biotic index values of 1.61 and 1.96 which rates the Lower Middle Inlet as excellent water quality with no apparent organic pollution. Mayflies (Ephemeroptera) were the most abundant organism present.

Water chemistry samples collected during snowmelt runoff showed slightly elevated concentrations of biochemical oxygen demand, ammonia, phosphorus, and suspended solids compared to other chemistry samples in the watershed during the same runoff event.

SMITH CREEK

Smith Creek is a perennial tributary to Lower Middle Inlet. The creek has an average width of 5 feet and an average depth of 0.5 feet. Sampling was conducted on Smith Creek at St. Paul Road and Louisa Road.

This stream is classified as a Cold Water Class I trout stream that is fully meeting it's potential use. Smith Creek is also designated as Exceptional Resource Waters.

Habitat evaluations at different times of the year ranked Smith Creek as having good to fair habitat. Most of the riparian area is wetland. Sand is the predominant stream bed substrate with some silt accumulated near the banks. Rock and rubble is generally limited to riffle areas below bridge abutments where rip-rap is present. Macrophytes in the stream were common. Macroinvertebrate samples received biotic index values of 4.73 and 2.73 which rates Smith Creek as good to excellent water quality with some to no apparent organic pollution.

Water chemistry results show very low concentrations of nutrients, biochemical oxygen demand, and suspended solids during both rain and snowmelt runoff. However, a dissolved oxygen measurement of 5.7 mg/l was noted on June 10, 1993. This is below the state standard of 6 mg/l. This depressed level does not appear to correlate with high water temperature or elevated nutrient runoff.

THE OUTLET

The Outlet is a large river that originates from Lake Noguebay and drains to the Peshtigo River about six miles downstream. The Outlet has an average depth of 1.7 feet and an average width of 73 feet. Sampling was conducted on the Outlet at St. Paul Road and CTH "W".

The Outlet is classified as Warm Water Sport Fish Communities fully meeting its potential use.

Habitat evaluations ranked this stream as having good habitat. The river at St. Paul Road is very fast and hazardous to sample. The substrate is mostly rock, rubble and other stable habitat. Filamentous algae was present on many of the boulders. A macroinvertebrate sample in Spring, 1993 received a biotic index value of 4.04 which rates The Outlet as very good water quality with possible slight organic pollution.

Water chemistry samples collected during a summer rain runoff event shows very low concentrations of nutrients, biochemical oxygen demand, and suspended solids.

V. REFERENCES

Ball, Joe, 1982. Stream Classification Guidelines for Wisconsin. Wisconsin Department of Natural Resources.

Wisconsin Department of Natural Resources, 1988. Field Procedures Manual. Draft 2nd Edition.

Wisconsin Department of Natural Resources, Lake Michigan District Water Quality Files.

Wisconsin Department of Natural Resources, 1975. Surface Water Resources of Marinette County.

Hilsenhoff, William, 1987. An Improved Biotic Index of Organic Stream Pollution.

Wisconsin Department of Natural Resources, 1993. Upper Green Bay Basin Water Quality Management Plan.

Appendix A.

Stream _____ Reach Location _____ Reach Score/Rating _____
 County _____ Date _____ Evaluator _____ Classification _____

Rating Item	Category							
	Excellent	Good	Fair	Poor				
Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16				
Watershed Nonpoint Sources	No evidence of significant sources. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16				
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20				
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18				
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16				
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18				
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20				
Bottom Substrate/Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22				
Avg. Depth Riffles and Runs	Cold >1'	0	6" to 1'	6	3" to 6"	18	<3"	24
	Warm >1.5'	0	10" to 1.5'	6	6" to 10"	18	<6"	24
Avg. Depth of Pools	Cold >4'	0	3' to 4'	6	2' to 3'	18	<2'	24
	Warm >5'	0	4' to 5'	6	3' to 4'	18	<3'	24
Flow, at Rep. Low Flow	Cold >2 cfs	0	1-2 cfs	6	.5-1 cfs	18	<.5 cfs	24
	Warm >5 cfs	0	2-6 cfs	6	1-2 cfs	18	<1 cfs	24
Pool/Riffle, Run/Bend Ratio (distances between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20				
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16				

Column Totals: _____

Column Scores E _____ + G _____ + F _____ + P _____ = _____ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

