Middle Peshtigo/Thunder River

Priority Watershed

Surface Water Resource

Appraisal Report

Submitted by

Mary Gansberg

Wisconsin Department of Natural Resources

May 1997

INTRODUCTION

The purpose of this surface water resource appraisal report is to summarize the existing condition of the water resources, identify causes of surface water use problems, and to provide preliminary surface water resource goals and objectives for each subwatershed in the *Middle Peshtigo/Thunder River Priority Watershed Project*.

The Middle Peshtigo/Thunder River watershed ranked low priority for surface water and high priority for groundwater under the nonpoint source priority watershed selection process. A separate groundwater appraisal report identifies the activities which were conducted to evaluate existing groundwater conditions and land use practices impacting groundwater.

SUMMARY OF WATER RESOURCE CONDITIONS

For the purposes of this project, the Middle Peshtigo/Thunder River watershed is subdivided into six individual subwatersheds. Major tributaries, lakes, wetlands, and subwatershed divides are shown in Figure 1.

Subwatersheds in the Middle Peshtigo/Thunder River Watershed

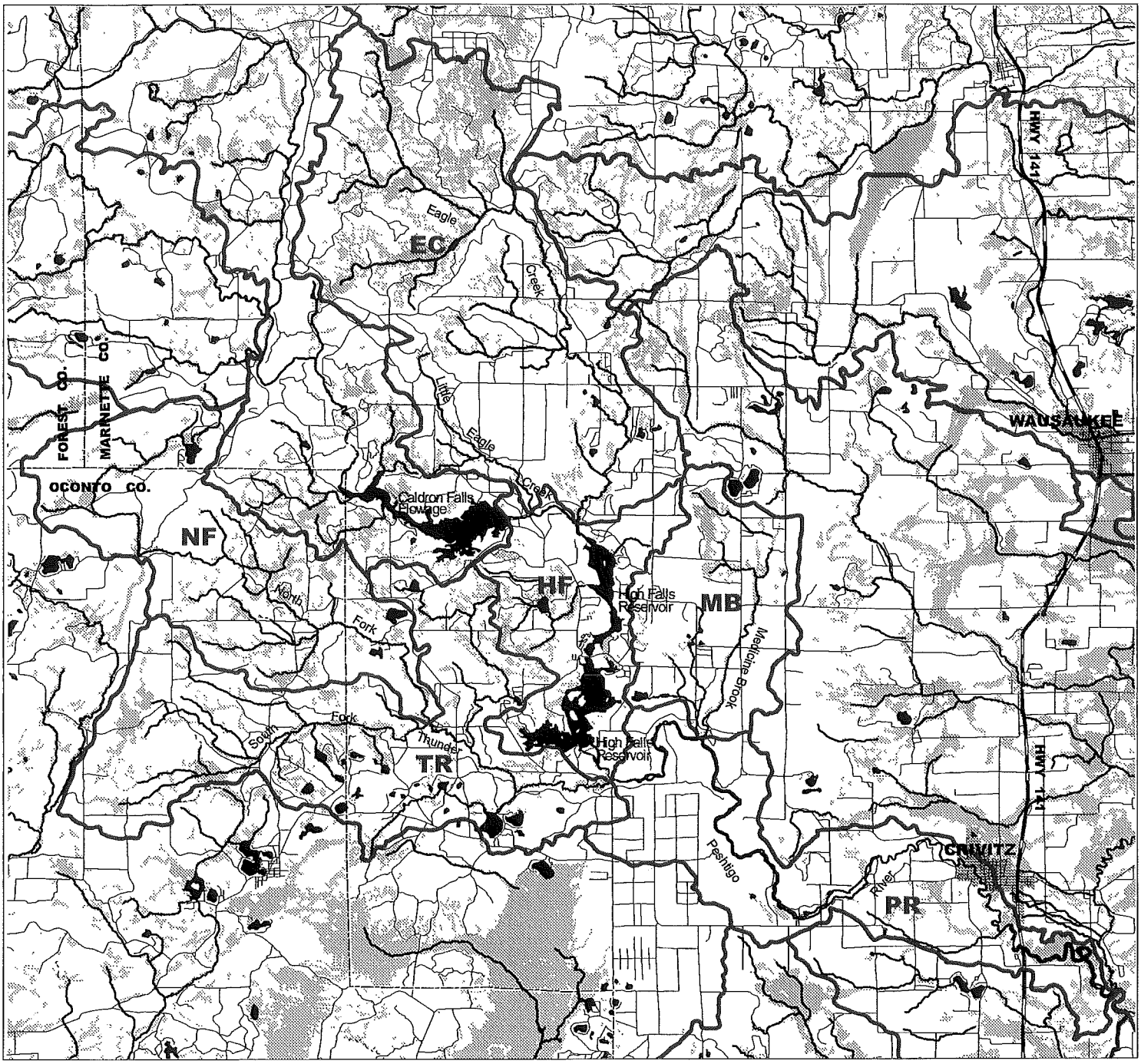
North Fork Thunder River	(NF)
Thunder River	(TR)
High Falls Reservoir	(HF)
Eagle Creek	(EC)
Medicine Brook	(MB)
Peshtigo River	(PR)

Streams

The Middle Peshtigo/Thunder River watershed is located in Marinette and Oconto Counties with a small section in Forest County. A large section of the watershed in Oconto County is within the Nicolet National Forest Boundary. Marinette County Forest Land and Wisconsin Public Service Corporation (WPSC) owns large sections of land in the watershed. The major streams in the watershed include the Peshtigo River, Thunder River, North Fork Thunder River, Eagle Creek, Little Eagle Creek, and Medicine Brook. The entire High Falls Reservoir is also included.

The watershed generally exhibits excellent to good water resource conditions largely because of the rural undeveloped nature of the watershed. The presence of humic and fulvic acids (picked up from organic matter, such as leaves or wood) gives the rivers a brownish color and decreases clarity; however, the color is not an indicator of a water quality problem. During non-runoff periods, the streams are fed by groundwater and run clear. Wetlands are numerous and border many miles of streams and rivers in the watershed. Land use in the watershed is mostly forested,

FIGURE 1. MIDDLE PESHTIGO and THUNDER RIVERS PRIORITY WATERSHED



Study Area

Wisconsin Department of Natural Resources
Northeast Region Drinking Water and
Groundwater Program
May 1997

Subwatershed Codes and Names

EC = Eagle Creek	HF = High Falls Flowage
TR = South Fork Thunder River	MB = Medicine Brook
NF = North Fork Thunder River	PR = Peshtigo River

Scale 1:250,000

0 1 2 3 4 5 Miles

N
W E
S

- Subwatershed Boundary
- Watershed Boundary
- County Boundary
- Stream
- Major Highway
- Local Road
- Wetlands Area
- Open Water
- Municipal Area

The lakes in the watershed generally have good water quality. The trophic state index (TSI) values indicate mesotrophic to oligotrophic conditions, however; total phosphorus values on some lakes are high enough to support algae growth and macrophyte problems on some of the lakes.

The majority of these lakes are made up of warm water fish communities. A number of small spring lakes do support cold water fisheries and a few, most notably Thunder Lake and Sand Lake, support both cold water and warm water fish communities. The flowages are relatively large and have provided a desirable warm water fishery to anglers. In addition to the warm water fishery, brown trout are known to overwinter in Johnson Falls Flowage and emigrate from the flowage into the Thunder River in the late spring. Similar use of trout in tributary streams to High Falls and Sandstone Rapids could be expected.

A paleoecological sediment core in Thunder Lake shows a decline in water quality most likely a result of shoreline development in the last 10-15 years. Even though logging in the late 1800's likely resulted in considerable disturbance in the watershed, it did not result in increases of inlake nutrient levels nearly as much as recent shoreline development. This recent development has also been more destructive than the initial cottage development in the 1950's and 60's.

The greatest threat to the ecological integrity of the watershed lakes is the development of the riparian area. Many of the lakes are heavily developed and do not meet county zoning ordinances for set-backs from the ordinary high water mark, minimum lot size, filling and grading, or amount of clear-cutting.

Overall, the water resources in the Middle Peshtigo/Thunder River watershed are generally very good. Nonetheless, the watershed streams, lakes, wetlands, and groundwater need to be protected, particularly from development and recreational impacts, to sustain these high quality resources.

APPRAISAL METHODS

Following is a brief description of monitoring activities conducted from May 1993 to August 1996 for the surface water resource appraisal. Monitoring procedures are consistent with the quality assurance/quality control "Field Procedures Manual" (WDNR, 1988). Previous monitoring results from the Department of Natural Resources Water Resources and Fisheries Management files are referred to in the discussion section of this report.

Macroinvertebrate

Aquatic macroinvertebrates were collected at nine sites in the watershed using a D-frame net in Spring and Fall 1993 and Spring 1996. Sample results were evaluated using the Hilsenhoff Biotic Index (HBI) (Hilsenhoff, 1987) and Ephemeroptera, Plecoptera, Trichoptera (EPT) Index (Plafkin et al, 1989). The HBI provides a relative measure of organic loading to the stream and a water quality rating. Percent EPT is the percent Ephemeroptera, Plecoptera, Trichoptera genera out of the total number of genera in a sample. These insect orders are generally known to be intolerant of pollution.

Habitat Evaluations

Stream aquatic life habitat conditions were evaluated throughout the watershed in the summer and fall using the stream habitat evaluation guidelines developed by Ball (1982). A matrix was used to numerically rank physical habitat characteristics that may limit the quantity and quality of aquatic life.

Dissolved Oxygen/Temperature

Continuous dissolved oxygen and temperature meters were placed in four streams for two week periods. In addition, grab samples were taken at several other locations. Wisconsin Administrative Code NR 102 establishes minimum dissolved oxygen water quality standards to maintain favorable aquatic life. For cold water streams the standard is 6 mg/l. For warm water streams the standard is 5 mg/l.

Water Chemistry Samples

Water chemistry samples were collected on four streams during snowmelt and rain runoff events in 1993 and 1996. Samples were analyzed for ammonia, nitrates, total and dissolved phosphorus, suspended solids, and biochemical oxygen demand.

Lake Evaluation

Boundary, Little Perch and Lost Lakes were monitored by WDNR in 1996 following the WDNR ambient lakes' protocol. These lakes were monitored through late winter ice, at spring turnover, and in June, July, and August. Total and dissolved phosphorus, secchi depth, chlorophyll-a, pH, and conductivity was measured and dissolved oxygen and temperature profiles charted for each site visit. Ammonia nitrogen, nitrate and nitrite nitrogen, total Kjeldahl nitrogen, and total and suspended solids were measured during the spring turnover sampling. McCaslin Lake was monitored in 1995 and 1996 by the Marinette County Land and Water Conservation Department (LWCD) following the same procedures. Thunder, Eagle, and Island Lakes were monitored in 1992 by a consultant generally following the WDNR protocol. Trophic State Indices (TSI) values were calculated for several lakes in the watershed. Values less than or equal to 39 indicate an oligotrophic state, a value between 40 and 49 indicates a mesotrophic state, and values greater than or equal to 50 indicate an eutrophic state.

In addition, a paleoecological core was obtained at Thunder Lake from bottom sediments. Information obtained from this core was used to learn the history of the lake's water quality. The core was segmented and for each segment, the age was estimated, diatom species diversity and numbers were estimated, and nutrient levels were determined. The ages and nutrient levels will be tied to known land use patterns. Diatom population data is an indicator of water quality.

Marinette County LWCD staff conducted a survey of riparian land use by boat on the six most heavily developed lakes in the watershed. This survey noted the shoreline characteristics, riparian zone habitat, and structures.

Fishery Surveys

A number of methods were used to sample the fisheries. Trout stream surveys were conducted with a 250 volt DC stream shocker using two electrodes. During the 1996 surveys, all fish, sport and forage species were collected. All sport species were measured to the nearest tenth inch. All forage species were collected, identified and counted. Fish assemblages were used to assess environmental degradation using the Index of Biotic Integrity (IBI) (Lyons, 1996) on Medicine Brook, Big Eagle Creek, and North Fork Thunder River.

Data and information from past fishery surveys was heavily used to prepare this report. All streams in the watershed have been surveyed and classified in the past. Methods followed those described above but in most cases forage species were only identified. In some cases only trout were even captured. Although the data is in many cases over 30 years old, it is felt to be quite reliable. A comparison is made from fishery data on the Medicine Brook from 1955, 1965, and 1996 which reflects this claim (Tables 13 and 14).

The lakes were generally surveyed with fyke nets and boomshocking gear. The three flowages have been recently surveyed in the early 1990's in this manor. These reports are on file and have been cited in this document. Many of the lakes in the watershed are completely surrounded by private land or have difficult access. Little fishery information is available on these lakes. Some information is based on experience and word of mouth.

RESULTS AND DISCUSSION

A summary of aquatic macroinvertebrate sample results is presented in Table 1.Table 2 summarizes aquatic life habitat evaluations. Table 3 summarizes the water chemistry results for the streams, while Appendix E shows the results for the lakes. Appendix A-D show dissolved oxygen and temperature monitoring results. A summary of fishery data on all named lakes and streams in the Thunder River, Eagle Creek, and High Falls Reservoir subwatersheds can be found in Tables 4, 5, and 6. Tables 7-14 shows IBI results, population estimates, and a summary of trout in the watershed.

The preliminary surface water resource management goals and objectives for the entire Middle Peshtigo/Thunder River watershed are listed below. The goals are listed first followed by the objectives needed to achieve the goals.

Overall surface water resources goal for the project: *Protect the water resources and the fish and wildlife habitat in the watershed and ultimately the Peshtigo River and Green Bay by meeting the following objectives:*

1. *Educating citizens, commercial interests, county, state, federal, and local units of government about how their personal actions and decisions affect water quality regarding:*
   - *A. Septic systems.*
   - *B. Forestry activities.*
   - *C. Riparian stewardship.*
   - *D. Exotic species.*
   - *E. Recreational use impacts.*
   - *F. Zoning ordinances, laws, and codes.*
   - *G. Fertilizer and pesticide use on lawns.*
   - *H. Construction runoff from homes and roads.*
   - *I. Value of wetlands, habitat, and biotic integrity.*
   - *J. Land use planning.*
   - *K. Agricultural activities.*

2. *Adopting Best Management Practices (BMP's) for all agricultural activities within the watershed focusing on nutrient and pesticide management.*

3. *Adopting good riparian stewardship BMP's such as:*
   - *A. Using low phosphate fertilizers and limiting their use on lakeshore property lawns.*
   - *B. Using construction erosion control measures for development both on the lakeshore and within the lake drainage basin.*
   - *C. Properly maintaining septic systems so that they are functioning correctly and up to code.*
   - *D. Installing porous paving material for roads, drives, and water access.*
   - *E. Protecting and stabilizing eroding shorelines.*
   - *F. Incorporating vegetative buffers along shorelines.*
   - *G. Protecting and restoring riparian wetlands.*
   - *H. Preserving undeveloped shoreland.*
   - *I. Improving public access sites.*

4. *Ensuring forestry BMP's are implemented during site preparation and timber harvesting on all lands.*

5. *Improving enforcement of laws, codes, and ordinances on a federal, state, county, and local level.*

6. *Protecting habitat and sensitive littoral areas from recreational use and development.*

7. *Preserving the cold water nature of the streams by:*
   - *A. Continuation of beaver control.*
   - *B. Protecting cold water springs.*
   - *C. Supporting run-of-river mode of operation for hydroelectric dams.*
   - *D. Protecting riparian cover and habitat.*
   - *E. Ensuring forestry and agricultural BMP's are adopted.*
   - *F. Protecting wetlands.*

8. *Protecting groundwater quality which is a source of water to the streams, lakes, and wetlands.*

The following section provides a description of each subwatershed followed by a summary of the current condition of the water resources including factors threatening or causing surface water quality problems.

North Fork Thunder River Subwatershed (NF)

Description

North Fork Thunder River Subwatershed consists of the North Fork Thunder River, East Thunder Creek, West Thunder Creek, Smith Creek, Mountain Creek, Frieda Creek, and several unnamed tributaries. McCaslin Lake, Mountain Lake, Frieda Lake, Three Little Lakes, and several small unnamed lakes are also in this subwatershed.

Water Quality Conditions

The North Fork Thunder River is classified as Class I trout stream and ORW. This stream joins the South Fork of the Thunder River to form the Thunder River. The North Fork received excellent to good aquatic life habitat ratings. The mix of rocks, gravel, sand, and the wooded corridor provides adequate habitat for fish and other aquatic life. A macroinvertebrate sample collected at Thunder Mountain Road received an excellent water quality rating indicating no apparent organic pollution present. The EPT was 65 percent in Fall 1993. Cryptosporidium and Giardia (both enteric protozoan pathogens) samples were collected monthly from December 1993 to October 1994 at Thunder Mountain Road. Cryptosporidium was detected only once and Giardia was detected twice although no correlation could be made between the presence/absence of these pathogens and land use (Archer, et al, 1995).

A fishery survey was conducted at two sites on the North Fork Thunder River in 1996. A brook and brown trout fishery was found. The IBI was calculated at the site upstream of Mountain Road. The score was 100 which rates excellent. This is also just below the section of the North Branch where a brown trout having overwintered in Johnson Falls Flowage took up summer residence.

This shows the importance of viewing watersheds unobstructed by dams or natural barriers as a whole.

East Thunder Creek is classified as Class I trout water and ORW. It received only good and fair aquatic life habitat ratings because of the small size of the creek and predominantly sand substrate. A macroinvertebrate sample collected at CTH F received an excellent water quality rating with an EPT of 57 percent.

West Thunder Creek is classified as Class I trout water and ERW. The sandy substrate and small size limits available habitat for aquatic life, thus, received a good habitat rating.

Smith Creek is not classified. This stream is approximately 1.5 miles in length. It is probable that it would support brook trout. A fishery investigation of Smith Creek should be conducted in the future.

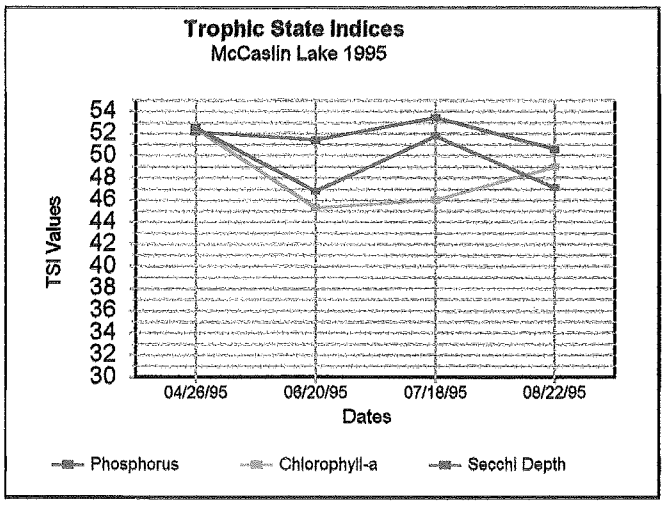
Spring Creek is classified as a Class I trout stream supporting brook trout. It is only 0.5 miles in length.

Mountain Creek is the outlet of Mountain Lake. It is classified as Class II trout water and discharges to the North Fork Thunder River.

Frieda Creek is the outlet of Frieda Lake. It is classified as Class II trout water and also discharges to the North Fork Thunder River.

East Thunder, West Thunder, Smith, Spring, Mountain, and Freida Creeks are all small streams making up the headwaters of the North Branch Thunder River. These stream are important components to the system. They all contain brook trout and provide cold water to the North Fork Thunder River.

McCaslin Lake is located in the northwest corner of the subwatershed. Its TSI values fall into the mesotrophic range. Total phosphorus levels are quite high and support algae growth which limited secchi depths to an average of less than seven feet. Aquatic macrophytes are present at nuisance levels.



The temperature and dissolved oxygen profiles at right indicate that McCaslin Lake does not stratify. The lake has sufficient dissolved oxygen concentrations throughout the year to support aquatic life.

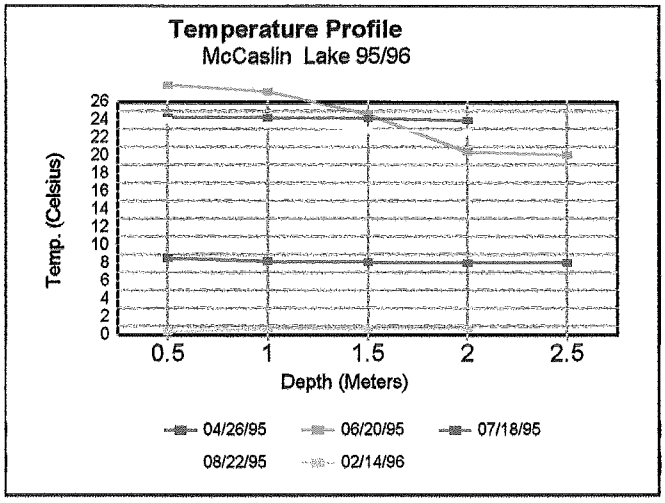
A survey of riparian land use found 27 developed lots around the lake shore. Fifteen, or 56 percent met county zoning ordinances which are as follows.

1) Minimum lot sizes of 100 feet average width and 20,000 square feet for unsewered lots.

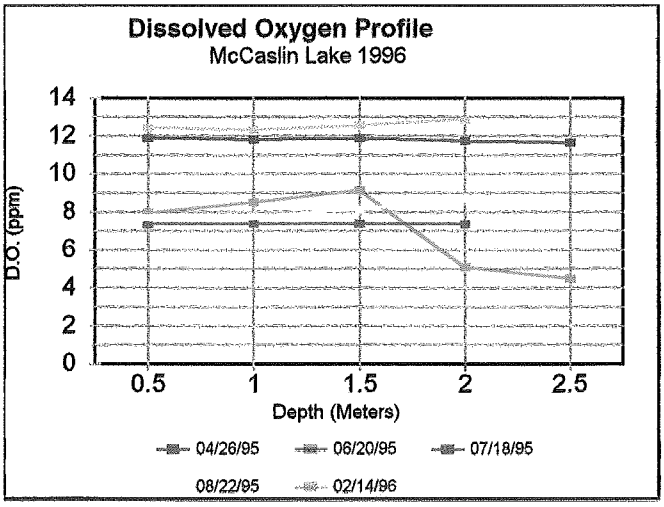
2) Seventy-five foot set backs from the ordinary high water mark (OHWM) for all structures except piers, boat hoists, and boat houses. Decks, gazebos, screen porches, and other accessory structures must be set back.

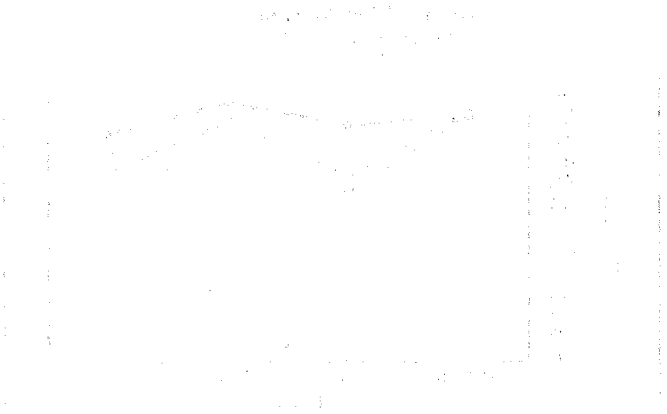
3) In the 35-foot strip adjacent to the OHWM, no more than 50 feet in any 100 feet may be clear cut.

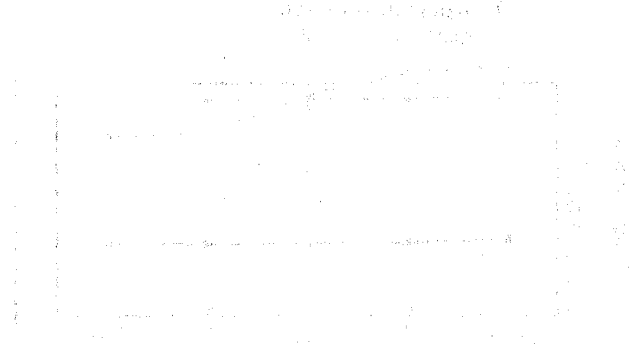
4) Filling and grading activities require permits.

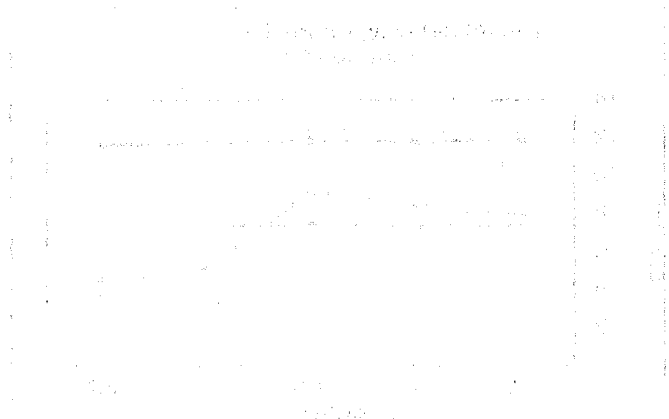


Structures within the 75-foot set back and excessive clearing were the most common reasons for failing to meet ordinance requirements.









Privately conducted fishery surveys have found warm water fisheries in McCaslin and Mountain Lakes. Frieda Lake and Three Little Lakes are spring lakes and may support cold water as well as warm water fishes.

The table below lists the named lakes in this subwatershed. None of these lakes have public access.

North Fork Thunder River Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Frieda Lake Sec 20, T33N, R18E	65	23	spring	No	80	Shoreline is owned by the Thunder Mountain Ranch Co.
McCaslin Lake Sec 33, T34N, R17E	74.2	9	drainage	No	>80	Moderately developed, possible failing sanitary systems and zoning violations, participating in Lake Management Planning Grant program.
Mountain Lake Sec 30 T33N, R18E	26	26	spring	No	100	The entire shoreline is owned by 1 landowner. High development potential.
Three Little Lakes Sec 34, T34N, R17E	2.7	11	drainage	No	25	McCaslin Lake drains into these connected lakes. Ground water recharge area. Shoreline mostly owned by one landowner.

Thunder River Subwatershed (TR)

Description

The Thunder River subwatershed consists of Hay Creek, Forbes Creek, South Fork Thunder River, Handsaw Creek, Thunder Lake Inlet and Outlet, Thunder River, and several unnamed tributaries from lake outlets. The lakes include: Dell, Cedar, Ledge, Wonder, Boundary, Fryingpan, Mirror, Rollins, Kiss, Bottle, Sand, The Spring, Hazel, Borth, Thunder, Eagle, Island, Little Perch, Squaw, Huber, Forbes Springs, and several small unnamed lakes.

Water Quality Conditions

Hay Creek is classified as Class I trout water. Brook trout are present. It received a good aquatic life habitat rating. The small stream size is the most limiting factor influencing this stream. A macroinvertebrate sample collected at LaFave Road received a very good water quality rating with an EPT of 56 percent.

Forbes Creek is classified as Class I trout water. Brook trout are present. Forbes Creek and Hay Creek join to form the South Fork Thunder River. This small stream starts at Forbes Springs. It received a good aquatic life habitat rating, although no macroinvertebrate samples could be attained because of the sandy substrate at LaFave Road crossing.

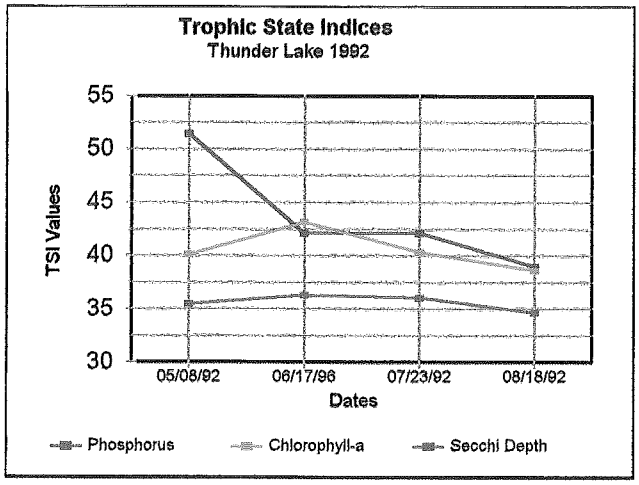
South Fork Thunder River is classified as Class I trout water and ERW. Wetlands are numerous. The Thunder River State Fish Rearing Station is located near the confluence of the North Fork. This facility has a WPDES permit to discharge to the South Fork Thunder River. Brook trout are found above the waterfall at the Thunder River Rearing Station and both brook and brown trout are found downstream of the waterfall.

Handsaw Creek is a Class I trout stream and ERW below the old Bietzel dam site and Class II above the old dam site. Handsaw Creek is tributary to the Thunder River. It received good aquatic life habitat ratings. The predominantly sand substrate made it difficult to collect macroinvertebrates although one sample collected at Thunder Mountain Road received an excellent water quality rating with 52 percent EPT genera. Water chemistry samples collected during two runoff events at Thunder Mountain Road showed low levels of nutrients, biochemical oxygen demand, and suspended solids. In the 1920's two dams were constructed on Handsaw Creek creating Huigen Lake and significantly enlarging Squaw Lake. These dams were constructed without permits. Necessary repairs to the dams required permits, which in the course of public hearings were denied. The dams were eventually removed which established a free flowing Handsaw Creek as it was fifty years prior. Handsaw Creek supports primarily brook trout. It's free-flowing condition is a clear benefit to its trout fishery and that of the Thunder River as well.

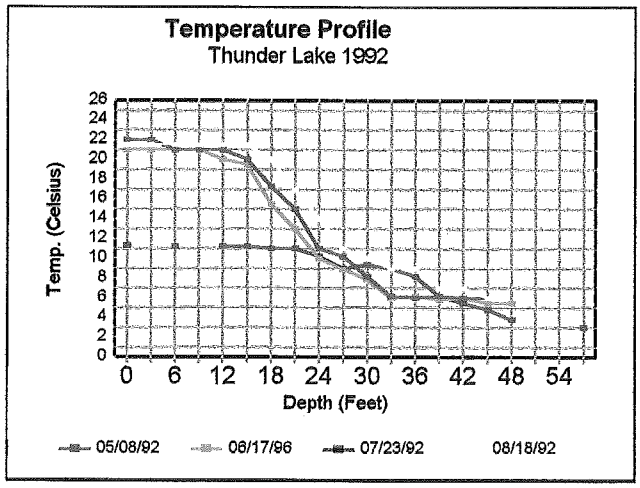
Thunder Lake Inlet and Outlet flow to and from Thunder Lake and are both cold water. The Inlet is classified as Class II, while the Outlet is Class III. Thunder Lake Inlet received good and fair aquatic life habitat ratings.

Thunder River is classified as Class II trout water. The Thunder River received good aquatic life habitat ratings. This large river has adequate size, substrate, and bank cover to support abundant aquatic life. A macroinvertebrate sample collected at Caldron Falls Road received an excellent water quality rating with an EPT of 62 percent. Water chemistry samples collected during two runoff events at Caldron Falls Road showed low levels of nutrients, biochemical oxygen demand, and suspended solids.

There are 21 named lakes in this subwatershed, ranging from 2 to 135 acres in size. Eleven of these lakes have public access. The majority of development is on those lakes with public access. For the most part these lakes have warm water sport fisheries primarily of largemouth bass and panfish species. The notable exceptions are Forbes Springs, Sand Lake, and Thunder Lake. Forbes Springs is a spring pond supporting brook trout. Sand and Thunder Lakes are two story trout lakes supporting both cold water and warm water fish communities. Brook, brown and rainbow trout can be found in these lakes. The rainbow trout can be traced to stockings made by the Department of Natural Resources.

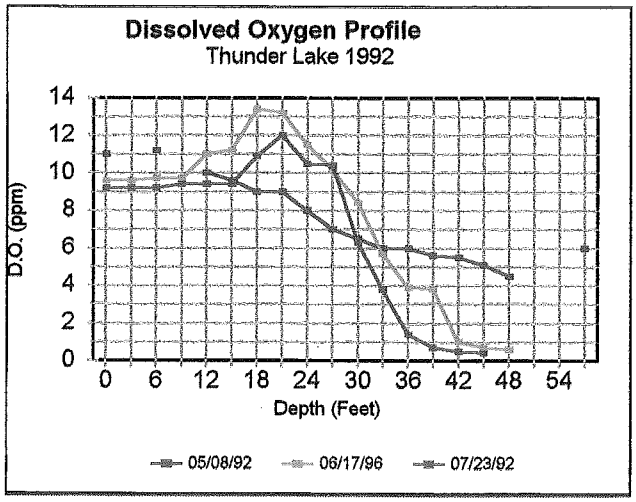


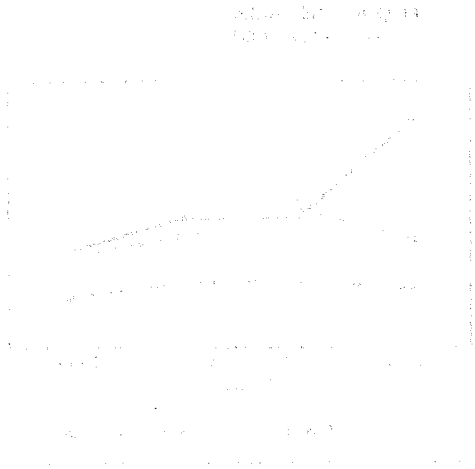
Thunder Lake was monitored in 1992, along with Eagle and Island Lakes under a WDNR lake planning grant. The graphs and comments regarding Thunder, Eagle, and Island Lakes are based on the report prepared by Blue Water Science (1994). Although the TSI values, as shown on the graph to the right, are mesotrophic or better, a phosphorus spike such as the one shown could trigger an alga bloom under favorable conditions.

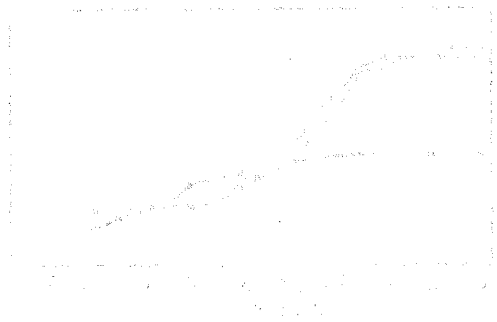


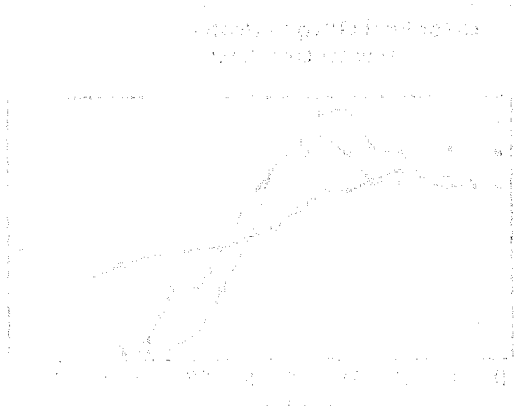
The graphs of temperature and dissolved oxygen at right show the stratification pattern of the lake. The thermocline is at roughly eighteen feet. Early to mid-summer oxygen levels are highest just below the thermocline. Oxygen concentrations do not dip below five ppm until at least a 33-foot depth is reached. Water clarity and quality at Thunder Lake is quite good. Secchi depths greater than 24 feet have been noted and averaged 17.4 in 1992.

Although Eurasian Water Milfoil (*Myriophyllum spicatum*) is present, it currently does not threaten water quality. The greatest threat to the ecological integrity of Thunder Lake is the development of the riparian area. A survey of riparian development was conducted by boat in 1996. The 2.1 miles of shoreline contained 58 developed lots. Of these, 23 or 40 percent met county zoning ordinances. On Thunder Lake, most of the zoning violations were for excessive cutting and removal of natural vegetation in the 35-foot strip adjacent to the OHWM.

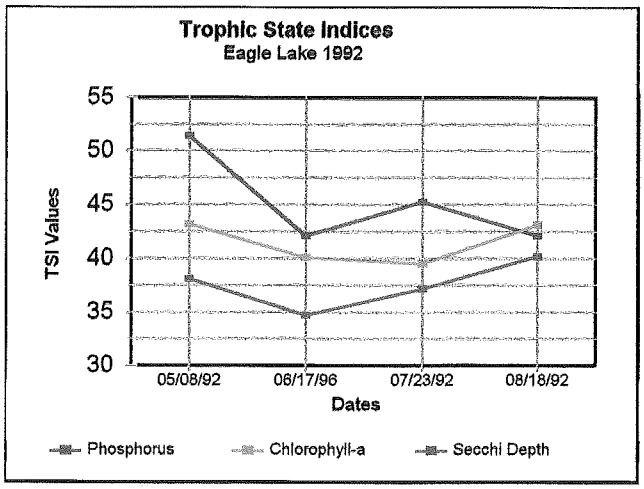




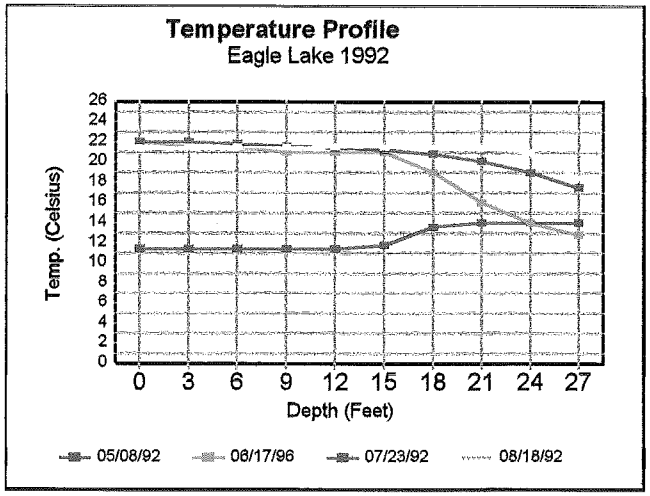




According to the preliminary paleoecological report (Garrison, 1997), Thunder Lake has historically had excellent water quality with low nutrients and high water clarity. This water quality is beginning to decline, most likely as a result of shoreline development in the last 10-15 years. Even though logging in the late 1800's likely resulted in considerable disturbance in the watershed, it did not result in increases of inlake nutrient levels nearly as much as recent shoreline development. This recent development has also been more destructive than the initial cottage development in the late 1950's and 60's.

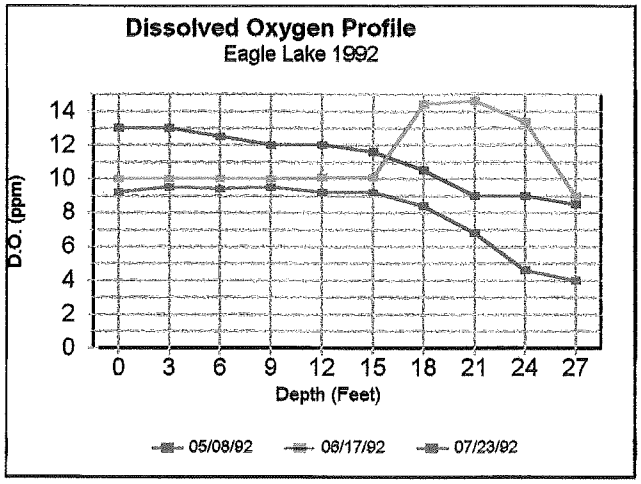


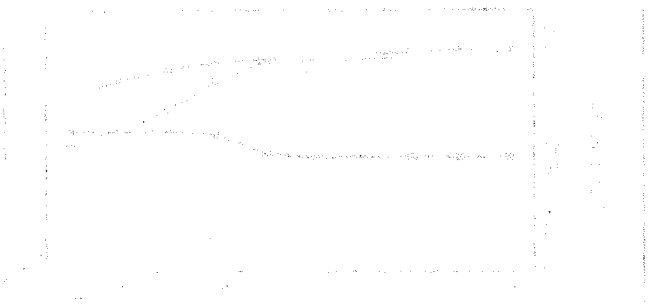
Eagle Lake data is graphed at the right. The graph of TSI indices show the lake to be generally mesotrophic, although the TSI for secchi depth was in the oligotrophic range (15.7 foot average).

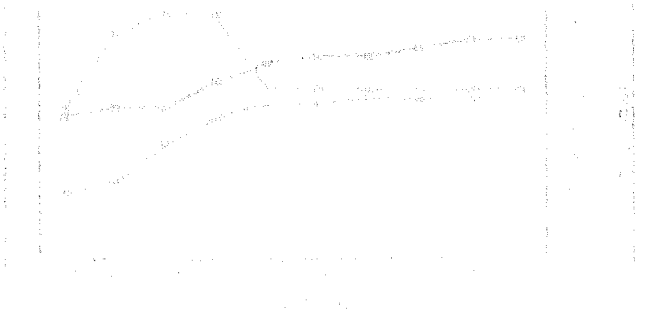


The graphs of the temperature and dissolved oxygen profiles indicate little stratification. Some stratification may have been occurring during June with a subtle thermocline forming. A rise in dissolved oxygen concentration occurs just below it in a pattern similar to Thunder Lake.

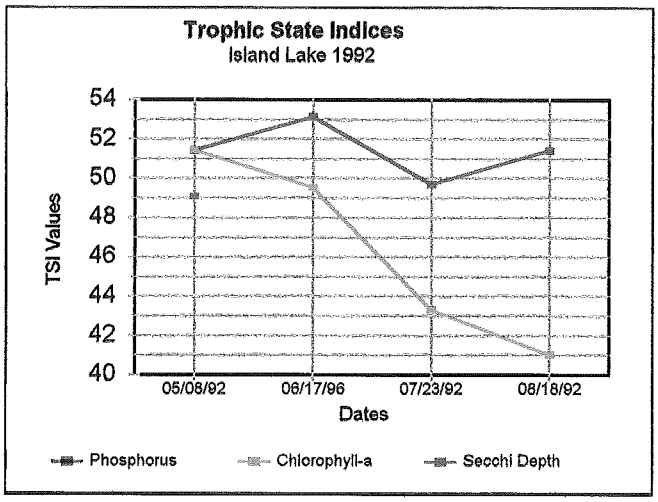
The development survey of Eagle Lake's 1.69 miles of shoreline located 29 developed lots. Here 24, or 83 percent of the lots met zoning standards.



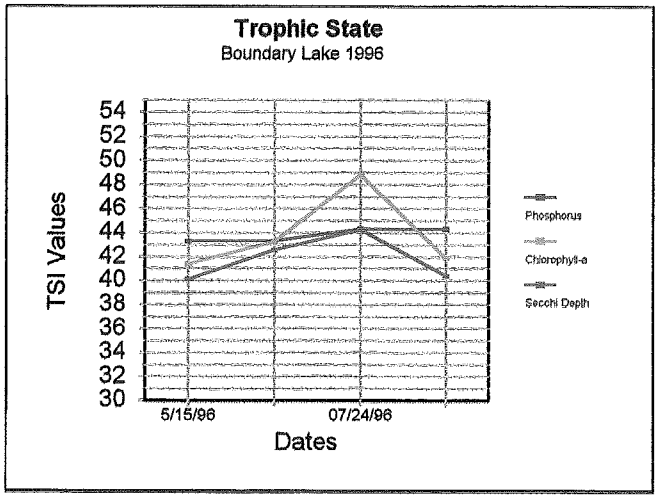




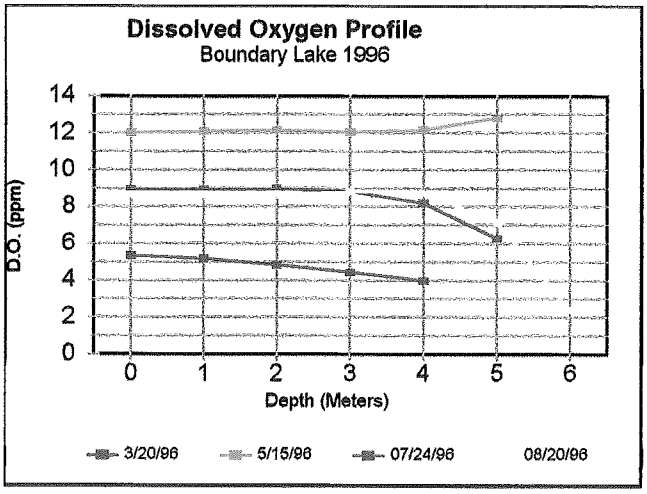
Island Lake data is graphed at the right and shows the TSI data. Because of its shallow depth, temperature and dissolved oxygen profiles were not done. The TSI data indicate that the lake is generally mesotrophic. This lake is heavily developed. The shallow depth and high TSI values suggest that it is at risk for seriously degraded water quality.

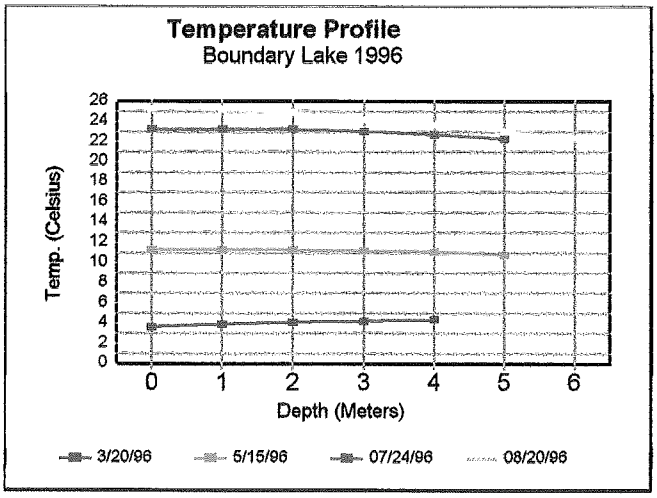


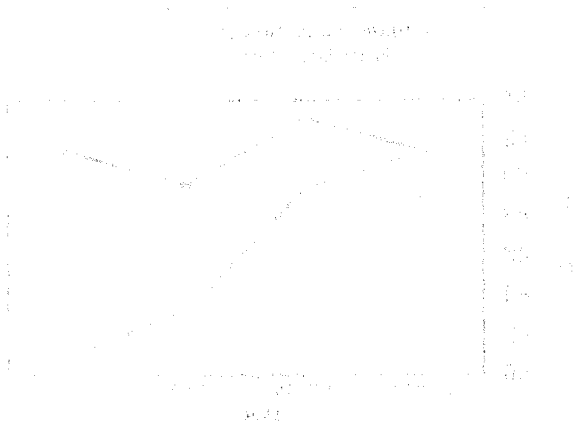
Boundary Lake was monitored in 1996 as part of the water quality appraisal conducted for the priority watershed. The graph at the right shows that the lake is solidly mesotrophic. The depth of Boundary Lake relative to its fetch is not great enough to cause stratification. Dissolved oxygen concentrations remain high enough throughout the year to support aquatic life.

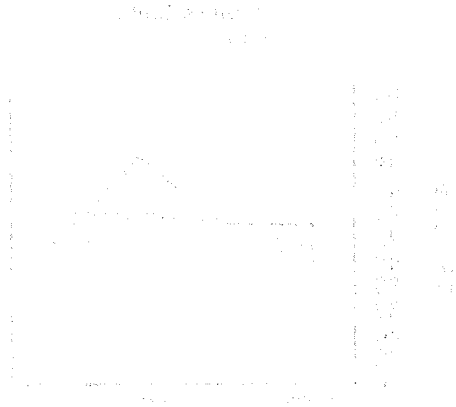


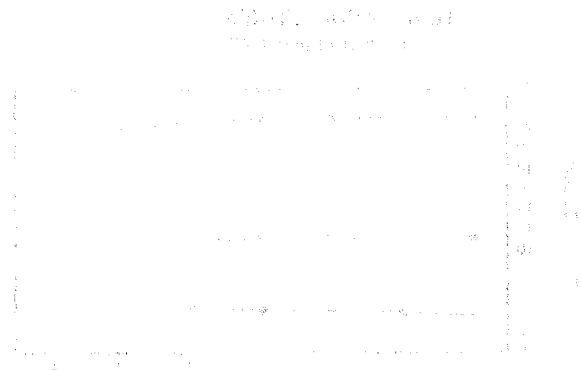
A shoreline land use survey conducted by Marinette County LWCD in 1996 on Boundary Lake revealed that 46 developed lots lined the 0.9 mile shoreline. Of these, 10 lots, or 22 percent met current zoning standards. Those that failed to meet the standards generally had structures within the 75-foot set back or excessive clearing within the 35-foot margin adjacent to the lake.

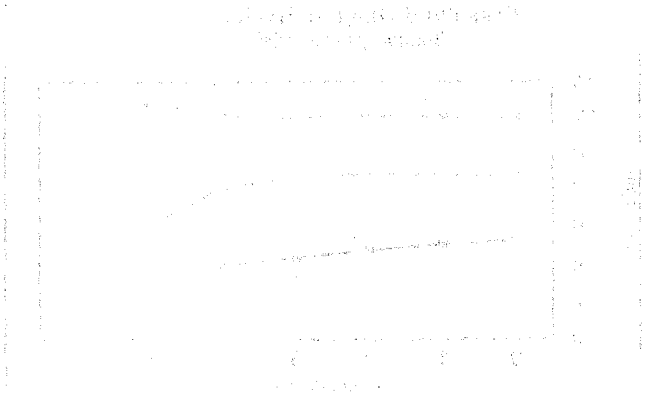




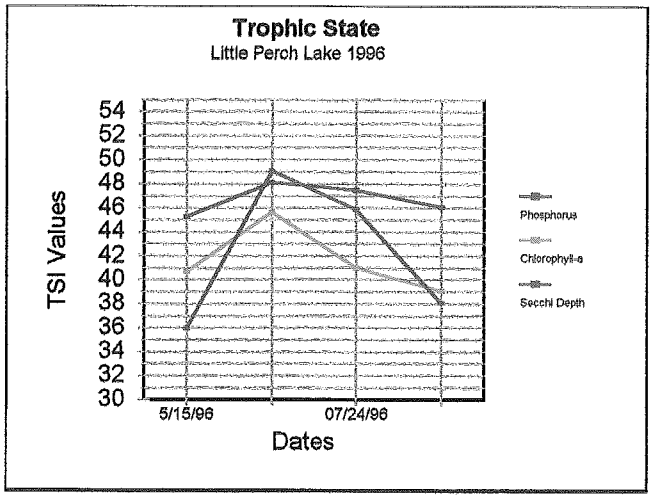




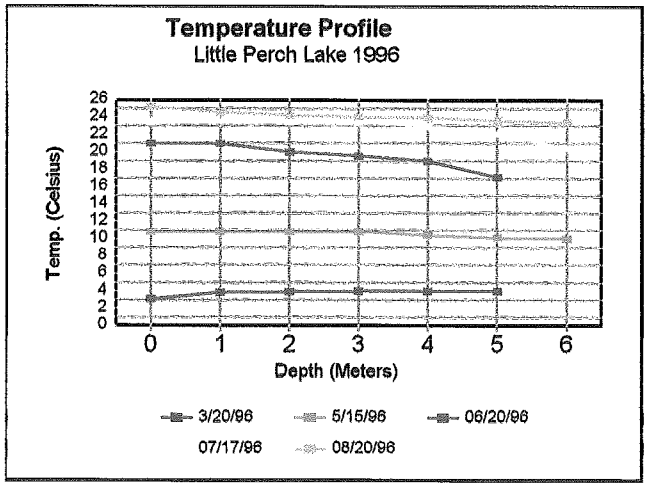




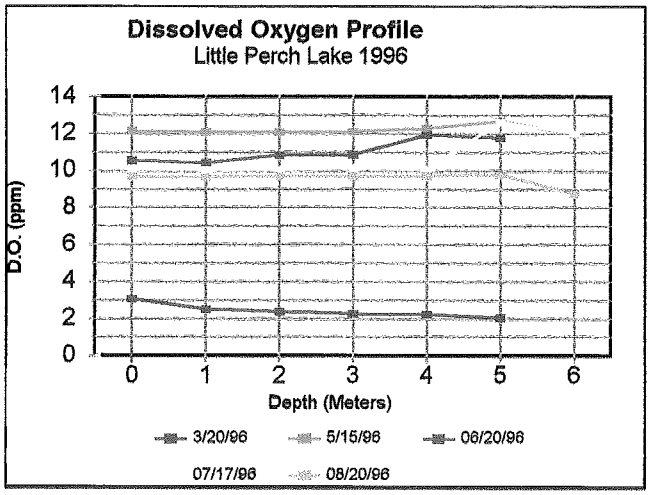
Little Perch Lake has an almost undeveloped shoreline; however, it was recently divided into 23 lots and may be completely ringed by dwellings. The TSI values at right indicate the lake is already mesotrophic. Given its small size, relatively shallow depth, lack of a flushing mechanism, and degree of potential development, this lake faces a severe risk of increased rates of eutrophication. Currently, plant growth is relatively sparse. Secchi depths were variable, but averaged approximately 12 feet.

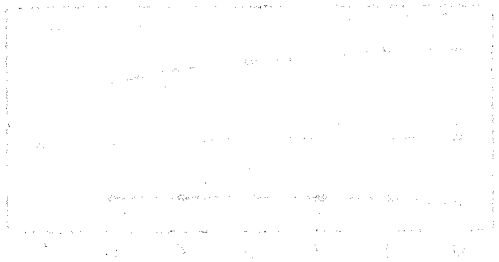


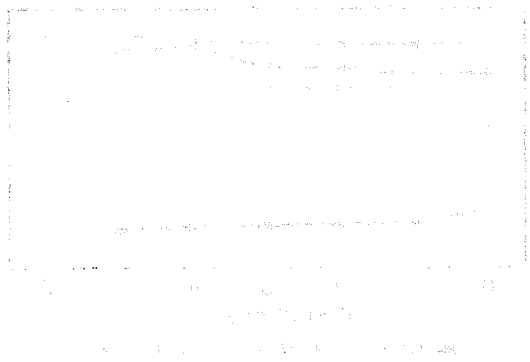
The temperature and dissolved oxygen profiles suggest that Little Perch Lake does not stratify. In late winter, dissolved oxygen concentrations were low enough to be of concern; however, good numbers of largemouth bass and various sunfish species were visible and active during summer sampling.



The Thunder River subwatershed contains some of the more heavily developed lakes in the Middle Peshtigo/Thunder River watershed. Water quality data is lacking for most. The table below lists the named lakes in the Thunder River subwatershed.







Thunder River Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Borth Sec 9, T32N, R18E	9.6	31	seepage	Yes	100	Intensively developed since 1970.
Bottle Lake Sec 8, T32N, R18E	6.2	12	drainage	Yes	100	<10% of shoreline in private ownership.
Boundary Lake Sec 7, T32N, R18E	37	19	drainage	Yes	>90%	>90% of the lake is in Oconto County. Very heavily developed.
Cedar Lake Sec 12, T32N, R17E	20	5	seepage	No	<40	Oconto County, little development.
Dell Lake Sec 12, T32N, R17E	35	10	seepage	Yes	<10	Oconto County, majority of the shoreline in public ownership.
Eagle Lake Sec 15, T32N, R18E	56.3	30	seepage	Yes	>85	Heavily developed and subdivided with increasing back lot development and nearby subdivisions.
Forbes Spring Sec 29, T33N, R17E	2	2	drainage	No	60	Oconto County.
Fryingpan Lake Sec 6, T32N, R18E	27.6	47	seepage	Yes	60	50% of shoreline owned by two landowners. High development potential.
Hazel Lake Sec 8, T32N, R18E	2.8	12	seepage	Yes	0	Entire shoreline in County ownership.
Huber Lake Sec 17, T33N, R18E	29.1	8	drained	No	70	Majority of the shoreline is owned by Paust's Resort and one other landowner. High development potential.
Island Lake Sec 15, T32N, R18E	8.9	10	seepage	No	70	Heavily developed since 1970, subdivided with heavy back lot development. Participated in Lake Management Planning Grant program.

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Kiss Lake Sec 8, T32N, R18E	4.3	15	spring	No	90	Entire shoreline owned by 1 landowner
Ledge Lake Sec 1, T32N, R17E	34	19	seepage	?	<40	Oconto County, little development
Little Perch Lake Sec 11, T32N, R18E	13.5	26	seepage	No	100	The lake was subdivided in 1993, rapidly becoming developed
Mirror Lake Sec 8, T32N, R18E	4.7	10	seepage	No	0	The entire shoreline is owned by two landowners
Rollins Lake Sec 8, T32N, R18E	5.4	27	seepage	No	85	Entire shoreline owned by two landowners
Sand Lake Sec 9, T32N, R18E	19.5	32	spring	Yes	100	Entire shoreline owned by Marinette County, Camp Bird is located on the lake
Squaw Lake Sec 34, T33N, R18E	36	11	drainage	Yes	>90	75% of the shoreline is subdivided, 25% owned by one landowner
The Spring Sec 9, T32N, R18E	6	23	seepage	No	90	Moderate development, some potential for further development
Thunder Lake Sec 15, T32N, R18E	135	62	drainage	Yes	>90	Heavily developed with recent subdivision of the north and west shores. Many zoning violations present. Has recently participated in the Lake Mgmt. Planning Grant program
Wonder Lake Sec 6, T32N, R18E	8	28	seepage	No	85	Entire shoreline owned by the Iroquois Club

High Falls Reservoir Subwatershed (HF)

Description

The High Falls Reservoir subwatershed consists of the Peshtigo River below Caldron Falls dam, High Falls Reservoir, and the Peshtigo River below High Falls Dam downstream to the confluence of the Thunder River. The only named tributary in this subwatershed is Woods Lake Outlet. Old Veterans Lake, Angle Lake, Woods Lake, and several small unnamed lakes are in this subwatershed. Most of the land surrounding the reservoir is owned by WPSC. This land remains undeveloped and is an exceptional recreational resource for the public.

Water Quality Conditions

The Peshtigo River in this subwatershed is classified as warm water sportfish communities. WPSC applied to the Federal Energy Regulatory Commission (FERC) to relicense the Caldron Falls and High Falls Hydroelectric Facilities. With this application, WPSC has completed several studies to determine the impacts of the hydroelectric projects on water quality. Water chemistry sampling in both the flowage and tailwater, continuous dissolved oxygen and temperature monitoring in the tailwater, impoundment sediment sampling, and macrophyte surveys in the impoundments were done. These studies show very good water quality in the reservoirs and Peshtigo River except dissolved oxygen problems directly below the High Falls dam. Total nutrient concentrations are in a range indicating good water quality (FERC, 1996). While many issues are being addressed through the relicensing process, a main concern relative to water quality is that the hydroelectric facilities operate in a run-of-river mode. Eliminating the peaking mode will improve water quality, habitat, and reduce the amount of erosion which occurs below the dams.

Woods Lake Outlet is classified as warm water forage fish communities. This 2-mile-long stream flows from Woods Lake to High Falls Flowage. The substrate is predominantly sand with few riffles present. A macroinvertebrate sample collected at Parkway Road received a good water quality rating with only 29 percent EPT genera present. Woods Lake Outlet's corridor is wetland.

Old Veteran's Lake is a small 10 acre lake with a warm water fish community of walleye, largemouth bass and panfish. It has public access with a county campground.

Angle Lake is a 1.3 acre lake with forage fish species. It has a depth of only 8 feet and may experience winterkill. It has public access.

Woods Lake has a warm water sportfish community. A resort is located on the shoreline although it does not have public access.

The table below lists the named lakes in this subwatershed.

High Falls Flowage Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Angle Sec 11, T33N, R18E	1.3	8	seepage	Yes	90	The shoreline is owned by one landowner.
High Falls Reservoir Sec 36, T33N, R18E	1497	54	drainage	Yes	>90	Majority of the shoreline is owned by WPSC. Many smaller subdivisions are near the flowage. This is the county's most important recreational resources.
Old Veteran Lake Sec 12, T33N, R18E	10.0	18	seepage	Yes	100	Marinette County owns the entire shoreline. 16 camping units maintained at Old Veterans Lake Campground.
Woods Lake Sec 23, T33N, R18E	45.5	27	drained	No	65	>75% of the shoreline owned by Paust's Resort. Balance privately owned.

High Falls Flowage is nearly 1,500 acres in size and is one of the key warm water sportfish communities utilized by anglers in this area of Wisconsin. Numerous surveys of water quality and aquatic life have been conducted in the past and are on file. The sport fishery has remained relatively stable for the past forty years. One difference may be an increase in the muskellunge population and a decrease in the walleye population (these are not related or dependent on each other). The muskies have increased because in time they have come down from Caldron Falls Flowage over the dam. Explanations for the changes in the walleye population are not as clear. Possible explanations do not relate to water quality directly, but may include the very high density of boating activity during the open water season and the water flows during critical spawning periods.

One of the more interesting problems at High Falls Flowage is the tremendous amount of boating activity that occurs during the open water season. There currently are user conflicts between anglers and non-anglers (primarily water skiers and jet skiers). Both groups take their toll on the aquatic life in the flowage. Anglers use big boats and remove fish and non-angling boaters race around through pelagic schools of walleye and dislodge vegetation and stir up the sediments. Both groups spill trace amounts of oil and gasoline through the operation of their outboards. No documentation exists on the specific effects boating activity has on High Falls Flowage, but these issues need to be addressed and protection of the environment put at the top of the list.

Eagle Creek Subwatershed (EC)

Description

The Eagle Creek subwatershed consists of Campbell Creek, Homestead Creek, Eagle Creek, Little Spring Creek, Murbou Creek, Little Eagle Creek, and several unnamed tributaries. Lakes in this subwatershed include: Harwell, Lost, Deer, Murbou, Heart, Spring, Campbell, Homestead, Taylor, Little Spring, Kahles Pond, and several unnamed lakes. Wetlands are abundant in this subwatershed.

Water Quality Conditions

Campbell Creek is a 2-mile-long Class I trout stream which supports brook trout. It is also designated as ERW. Campbell Creek is the outlet of Campbell Lake and is tributary to Homestead Creek.

Homestead Creek is the outlet of Homestead Lake and is classified as Class II trout water. This is a small 3-mile-long tributary to Eagle Creek. Brook trout can be found in Homestead Creek.

Eagle Creek is classified as a Class I trout stream and ORW. This creek is 21-miles long and discharges to the Peshtigo River just above High Falls Reservoir. Aquatic life habitat rated good to fair. Eagle Creek and its tributaries travel through significant wetlands. This probably accounts for the accumulation of silt and soft sediment in the creek bed. Two macroinvertebrate samples collected in 1980 found very good and excellent water quality. A sample in 1993 found excellent water quality with an EPT of 38 percent.

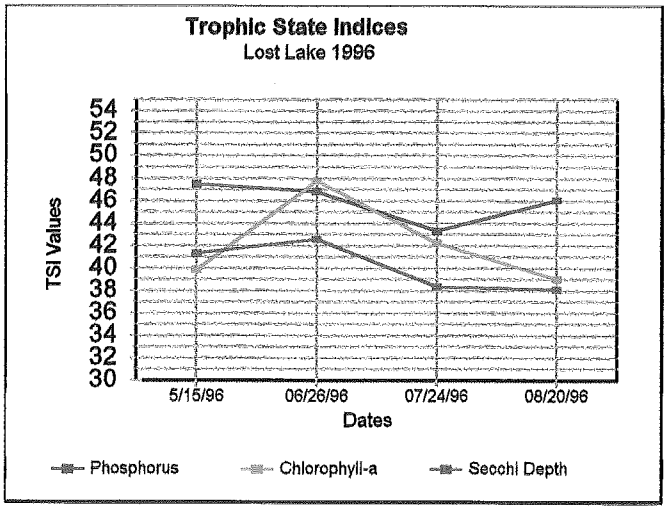
A meter was installed in Eagle Creek near the mouth at Eagle Road for two weeks in summer 1996. It showed very good dissolved oxygen levels with an average water temperature of 59°F (Appendix A). Water chemistry samples collected during a snowmelt and a rain runoff event found low concentrations of nutrients and biochemical oxygen demand although suspended solids were slightly elevated during the snowmelt event. This is probably naturally occurring in a watershed of this size.

A fishery survey was conducted on Big Eagle Creek in 1996. Two stations were sampled. One station ran through a state owned forty in T34N-R18E and the second just upstream. Intensive stream habitat improvement was done on the section of stream in the state owned forty. A good population of brook trout was found even though the habitat area experiences heavy fishing pressure. An IBI score for this area of the stream was 70 which gives an integrity rating of good.

Little Spring Creek is a 2-mile-long Class II trout stream which discharges to Eagle Creek. This creek is the outlet of Little Spring Lake and supports brook trout.

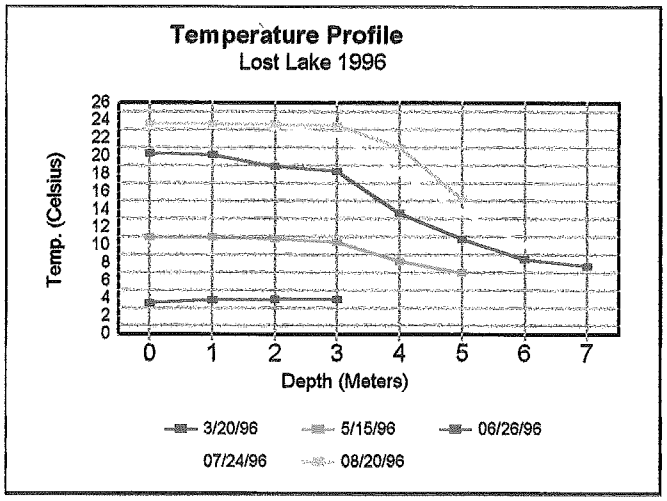
Murbou Creek is a 1-mile-long outlet of Murbou Lake which discharges to Eagle Creek.

Little Eagle Creek is classified as a Class I trout stream and ORW. Both brook and brown trout inhabit Little Eagle Creek. It received only fair aquatic life habitat ratings on two separate occasions because of the small size and sandy substrate. A macroinvertebrate sample collected in 1980 received a very good water quality rating, but received an excellent rating in 1996. Continuous dissolved oxygen and temperature monitoring in Little Eagle Creek at CTH C for two weeks in summer 1996 found cool water temperatures (mean 52°F) and good dissolved oxygen levels (Appendix B).

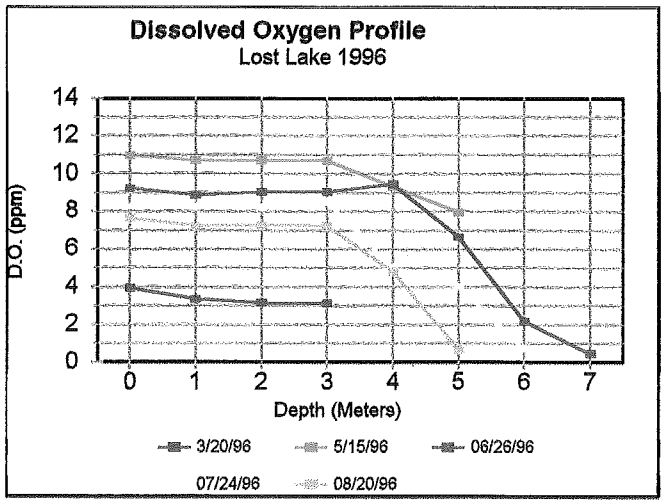


Eleven named lakes are in the Eagle Creek subwatershed. They are small seepage and spring lakes. Fisheries data is limited because there is public access only on three of the lakes. Five of the lakes support warm water sport fish communities and two are known to support trout. All but three of the lakes have at least one development on the shoreline.

Lost Lake was monitored in 1996 as part of the priority watershed appraisal process. The TSI data is graphed at the right and shows that the lake, while variable, stays in the mesotrophic zone. Secchi depth readings were good and averaged almost 13 feet in 1996.



The temperature and dissolved oxygen graphs at right suggest stratification and formation of the thermocline at approximately 4 meters. In 1996, the dissolved oxygen concentrations remained high enough, year round, to support aquatic life.



A survey of riparian land use conducted by the Marinette County LWCD in 1996 found 39 developed lots on the 0.8 miles of shoreline. Twenty-three, or 59 percent, of these lots met county zoning standards. The most common reasons for failing to meet the standards were structures within the 75-foot set back or excessive clearing within the zone adjacent to the OHWM.

Deer Lake was also surveyed by the Marinette County LWCD to determine riparian land use. They found 15 developed lots, of which 4, or 27 percent were meeting zoning standards. The most common reasons for failing to meet standards were structures within the 75-foot set back or excessive clearing of natural vegetation.

The table below lists all of the named lakes in the subwatershed.

Eagle Creek Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Campbell Sec 30, T35N, R18E	4.2	6	spring	Yes	70	100% of shoreline owned by county.
Deer Sec 29, T34N, R19E	13.4	34	seepage	Yes	100	Heavily developed, subdivided sometime after 1980.
Harwell Lake Sec 36, T34N, R18E	14.5	25	seepage	No	100	Shoreline owned by 2 landowners. High development potential.
Heart Sec 25, T34N, R18E	3.8	6	seepage	No	70	Entire shoreline owned by 1 landowner.
Homestead Lake Sec 36, T35N, R17E	4.1	14	spring	No	95	Entire shoreline owned by 1 landowner.
Kahles Pond Sec 6, T33N, R19E	1.2	3	seepage	No	0	Entire shoreline owned by 1 landowner.
Little Spring Lake Sec 36, T34N, R18E	3.3	6	spring	No	0	Entire shoreline owned by 1 landowner.
Lost Lake Sec 31, T34N, R19E	19.1	20	seepage	No	85	Entire shoreline has been subdivided.
Murbou Lake Sec 25, T34N, R18E	19.3	7	spring	No	90	Moderately developed.
Spring Lake Sec 13, T34N, R18E	12.7	5	seepage	No	50	Entire shoreline owned by 1 landowner. High development potential.
Taylor Lake Sec 19, T35N, R18E	4.7	9	spring	Yes	40	Entire shoreline is owned by Marinette County

Medicine Brook Subwatershed (MB)

Description

The Medicine Brook subwatershed consists of the entire Medicine Brook drainage area and Joy Creek. It also includes Kiss Lake, Joy Lake, Star Lake, and several small unnamed lakes. There is some agriculture in this subwatershed.

Water Quality Conditions

Medicine Brook is classified as Class I trout stream and ORW. Habitat evaluations conducted in the stream at several locations ranked aquatic life habitat as good to fair. The variety of sand, rubble, bends, and bank cover provides adequate habitat. Silt has accumulated in slow areas and inside bends. Macroinvertebrate samples collected at High Falls Road on three separate occasions all received excellent water quality ratings indicating no apparent organic pollution present. The spring of 1993 sample had 43 percent EPT genera present, while fall had 56 percent.

Continuous monitoring conducted in the upper reaches (Moonshine Hill Road) and the lower reaches (High Falls Road) for two weeks in August 1996 found that water temperatures and dissolved oxygen levels were much more variable in the upper than the lower reaches. Also, temperatures were significantly higher and dissolved oxygen significantly lower in the upper reaches. Although only slightly, dissolved oxygen levels fell below the 6 mg/l state standard on a daily basis at Moonshine Hill Road (Appendix C and D). These diel fluctuations are caused by periphyton and aquatic plant photosynthesis and respiration. The shallow stream depth and limited bank cover contribute to these readings.

Water chemistry samples collected during four runoff events at High Falls Road found low levels of nutrients, biochemical oxygen demand, and suspended solids.

A fishery investigation of Medicine Brook was conducted at two sites in 1996. Brown trout are the dominant sport fish species present. Brook trout are also present in good numbers. An IBI was calculated for Medicine Brook at two sites. A score of 80 was calculated for the site from the mouth to just upstream of High Falls Road. A score of 100 was calculated for the site between CTH X and Newton Lake Road. The composite score was 90. Taken together or separately, the rating is excellent. In addition, a comparison was made between the trout fishery for the years 1955, 1965, and 1996 at the site between CTH X and Newton Lake Road. Although there are some differences, most notably in year class strength, the trout fishery looks much the same this year as it did 30 and 40 years ago.

Joy Creek is classified as warm water sportfish community. Joy Creek originates at Kiss Lake, flows through Joy Lake and discharges to the Peshtigo River. This small stream occasionally dries up in the summer.

Only three named lakes are found in this subwatershed ranging from 5 to 40 acres. None of the lakes have public access and only limited information is available on the fisheries. Kiss and Joy Lakes are known to support warm water sportfish. Star Lake is a small seepage lake with a maximum depth of three feet. It may be a possible winterkill lake.

Medicine Brook Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Joy Lake Sec 32, T33N, R19E	11.4	16	drainage	No	100	Entire shoreline owned by 1 landowner. High development potential.
Kiss Lake Sec 31, T33N, R19E	40.1	22	spring	No	100	The entire shoreline is owned by 3 landowners (one is Juul Lake Corporation). High development potential.
Star Lake Sec 15, T33N, R19E	4.9	3	seepage	No	0	The lake is subdivided in the plat book, but no development yet.

Peshtigo River Subwatershed (PR)

Description

The Peshtigo River subwatershed consists of the Peshtigo River from the confluence of Thunder River downstream to the confluence of The Outlet. It includes Kirby Lake, Marl Lake, Johnson Falls Flowage, Sandstone Rapids Flowage, and one small unnamed lake. The south part of the Village of Crivitz is in this subwatershed. The Crivitz Sanitary District discharges to the Peshtigo River. There are several hundred acres of cropland in this subwatershed.

Water Quality Conditions

Peshtigo River in this subwatershed is classified as warm water sportfish community from the confluence of the Thunder River downstream to Johnson Falls Hydroelectric Project. The 5.5 miles of free-flowing river between the Johnson Falls dam and Spring Rapids has historically been a fly fishing only area and is designated Class II trout water. Although it is no longer a fly fishing only area by law, it is still a haven for fly fishermen. Anglers do report catching some nice trout in the area of the Peshtigo River. Brook, brown, and rainbow trout are the primary sportfish along with smallmouth bass in this section of the river. Downstream of the fly fishing stretch, the river becomes a warm water fishery and forms the headwaters of Sandstone Rapids Flowage. This river run is approximately 2 miles. The 10-mile river section from the tailwater of Sandstone Rapids to the confluence of the Outlet supports a warm water sportfish community.

Several water quality studies have been conducted by WPSC for the purpose of relicensing the Johnson Falls and Sandstone Rapids hydroelectric facilities. Water chemistry samples in both the flowage and tailwater, continuous dissolved oxygen and temperature monitoring in the tailwater, impoundment sediment samples, and macrophyte surveys in the impoundments were done. These studies show very good water quality in the Peshtigo River with the exception of dissolved oxygen problems directly below the Johnson Falls dam. The Peshtigo River exhibits good overall water quality, largely because of the rural, undeveloped nature of the watershed. Total nutrient concentrations are in a range indicating good water quality (FERC, 1996). While there are many issues being addressed, the main issue relative to water quality is that the hydroelectric facilities operate in a run-of-river mode. Eliminating the peaking mode would reduce the amount of erosion below the dams and significantly stabilize the aquatic habitat.

Johnson Falls Flowage supports primarily a warm water sportfish community; however, it also provides habitat for over-wintering brown trout which emigrate into the Thunder River and into the North Branch Thunder River when the water warms in the spring. This emphasizes the dual nature of a number of waters and the importance of viewing watershed habitats as being whole and connected. The entire shoreline of Johnson Falls Flowage is owned by WPSC and no dwellings are present.

Sandstone Rapids Flowage supports a warm water sportfish community. Bass, walleyes and panfish dominate the sportfish species. At least 59 dwellings are located on the shoreline and WPSC owns a campground for their employees.

The two small lakes in this subwatershed are both seepage lakes and without public access. Kirby Lake has a warm water sport fishery and Marl Lake is only three feet deep with forage fishery base. One dwelling is located on Kirby Lake and none on Marl Lake.

Peshtigo River Subwatershed Named Lakes

Lake	Area (ac)	Depth (ft)	Lake Type	Access	Upland %	Riparian Ownership & Comments
Johnson Falls Flowage Sec 32, T33N, R19E	67.8	40	drainage	Yes	100	Majority of shoreline is owned by WPSC, several small in holdings along the shore.
Kirby Lake Sec 22, T32N, R19E	5.3	36	seepage	No	90	Shoreline owned by 3 landowners.
Marl Lake Sec 30, T32N, R20E	4.5	3	seepage	No	100	Shoreline owned by 2 landowners.
Sandstone Flowage Sec 24, T32N, R19E	152.6	39	drainage	Yes	>75	Majority of shoreline is owned by WPSC, many small in holdings along the shore.

BIBLIOGRAPHY

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

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

Wisconsin Department of Natural Resources. Northeast Region Water Quality Files.

Wisconsin Department of Natural Resources. General fishery files.

Plafkin, J.L., M.T. Barber, K.D. Porter, S.K. Gross, and R.M. Hushes. 1989. Rapid Bioassessment Protocols for use in Streams and Rivers. U.S. Environmental Protection Agency, Office of Water, EPA/444/4-89-001, Wash. D.C. 20460.

Archer, J.R., J.R. Ball, J.H. Standridge, S.R. Greb, P.W. Rasmussen, J.P. Masterson, L. Boushon. (1995). Cryptosporidium spp. Oocyst and Giardia spp. Cyst Occurrence, Concentrations and Distribution in Wisconsin Waters. Wisconsin Department of Natural Resources PUBL-WR420-95.

Blue Water Science. (1994). Thunder Lake, Eagle Lake, and Island Lake Lakes and Watershed Characterization.

Federal Energy Regulatory Commission (FERC) Office of Hydropower Licensing. 1996. Draft Environmental Impact Statement for Relicensing Six Existing Hydroelectric Projects in the Peshtigo River Basin.

Kornely, Greg W. (1991). Investigational Report on the Fishery in Sandstone Flowage, Marinette County. Wisconsin Department of Natural Resources - Peshtigo.

Kornely, Greg W. (1991). Report on the Fishery in Johnson Falls Flowage, Marinette County. Wisconsin Department of Natural Resources - Peshtigo.

Heizer, Russ and Greg Kornely. (1991). Fishery Evaluation Survey of High Falls Flowage, Marinette County. Wisconsin Department of Natural Resources - Peshtigo.

Lyons, John and Tim Simonson. (1996). An Index of Biotic Integrity (IBI) for Cold water Streams in Wisconsin.

Garrison, Paul. 1997. Paleoecological Report for Thunder Lake, Marinette County - Preliminary Report. Wisconsin Department of Natural Resources, Bureau of Research.

Wisconsin Department of Natural Resources - Wisconsin Trout Streams PUB - 6-3600(80).

Table 1. Middle Peshtigo/Thunder River Watershed Macroinvertebrate Sample Results

Subwatershed	River	Location	Date	Macroinvertebrate points/rating [1]	EPT [2]
North Fork Thunder River	North Fork Thunder River	Thunder Mountain Road	10/15/93	1.20/excellent	65%
	East Thunder Creek	CTH F	10/15/93	1.72/excellent	57%
Thunder River	Thunder River	Caldron Falls Road	5/6/93	2.10/excellent	62%
	Hay Creek	LaFave Road FR 2102	4/18/96	3.71/very good	56%
	Handsaw Creek	Thunder Mountain Road	10/15/93	1.86/excellent	52%
High Falls Reservoir	Woods Lake Outlet	Parkway Road	5/8/96	5.22/good	29%
Eagle Creek	Eagle Creek	CTH C	5/6/93	3.19/excellent	38%
		Eagle Road	5/19/80	2.08/very good *	---
		Eagle River Road	5/19/80	1.42/excellent *	---
	Little Eagle Creek	CTH C	4/18/96	2.22/excellent	19%
		Eagle Road	5/19/80	1.94/very good *	---
Medicine Brook	Medicine Brook	High Falls Road	5/19/80	0.60/excellent *	---
			5/6/93	2.83/excellent	43%
			10/15/93	2.98/excellent	56%

1. Excellent = No apparent organic pollution
   Very Good = Possible slight organic pollution
   Good = Some organic pollution
   Fair = Fairly significant organic pollution
   Fairly Poor = Significant organic pollution
   Poor = Very significant organic pollution
   Very Poor = Severe organic pollution

   * 0-5 scale (otherwise, the 0-10 point scale was used)

2. EPT - percent Ephemeroptera, Plecoptera, and Trichoptera genera out of the total

Table 2. Middle Peshtigo/Thunder River
Priority Watershed Habitat Evaluations

Subwatershed	River	Location	Date	Habitat Score Points/Ranking
North Fork Thunder River	North Fork Thunder River	FR 2101	10/15/93	64 / excellent
		Thunder Mountain Rd	10/15/93	64 / excellent
		N2338 - N.Fork Road	7/24/96	73 / good
	East Thunder Creek	CTH F	10/15/93	152 / fair
			7/24/96	106 / good
	West Thunder Creek	CTH F	7/24/96	118 / good
Thunder River	Thunder River	Caldron Falls Road	5/6/93	73 / good
			7/20/93	108 / good
			10/15/93	71 / good
			7/24/96	72 / good
		FR 1623	7/20/93	100 / good
		Veterans Park	7/24/96	75 / good
	Hay Creek	LaFave Road	7/24/96	95 / good
	Handsaw Creek	Ranch Road	7/20/93	118 / good
		Thunder Mountain Rd	10/15/93	118 / good
	Thunder Lake Inlet	Caldron Falls Road	10/15/93	108 / good
			7/24/96	132 / fair
	Forbes Creek	FR 2102 - LaFave Rd	7/24/96	96 / good
Eagle Creek	Eagle Creek	CTH C	5/6/93	96 / good
			7/20/93	159 / fair
			10/15/93	98 / good
		Eagle Road	7/20/93	155 / fair
			7/23/96	100 / good
	Little Eagle Creek	CTH C	10/15/93	151 / fair
			7/23/96	143 / fair
Medicine Brook	Medicine Brook	High Falls Road	5/6/93	108 / good
			7/20/93	118 / good
			10/15/93	89 / good
			8/5/96	93 / good
		CTH X	7/20/93	151 / fair
		Newton Lake Rd South	7/23/96	154 / fair
		Newton Lake Rd North	7/23/96	170 / fair
		Kottke Road	7/23/96	116 / good
		Moonshine Hill Road	7/23/96	140 / fair

Key: <70 = excellent, 71-129 = good, 130-200 = fair, >200 = poor

Table 3. Middle Peshtigo/Thunder River Watershed Water Chemistry Samples

Subwatershed	Location	Date	Flow (cfs)	Biochemical Oxygen Demand (mg/l)	Ammonia (mg/l)	Nitrate & Nitrite (mg/l)	Total Phosphorous (mg/l)	Dissolved Phophorous (mg/l)	Suspended Solids (mg/l)	Temperature °C	Dissolved Oxygen (mg/l)	pH SU
Thunder River	Thunder River at Caldron Falls Road	3/29/93	110.7	<1.0	0.018	0.096	0.05	0.004	28.0	----	----	----
		7/20/93	44.1	<1.0	0.013	0.094	0.02	0.007	6.0	15.0	10.0	8.9
	Handsaw Creek at Thunder Mountain Road	4/18/96	31.7	<3.0	ND	0.084	0.029	0.002	19.0	2.6	11.7	----
		6/20/96 @	----	<3.0	ND	ND	0.022	0.003	12.0	----	----	----
Medicine Brook	Medicine Brook at High Falls Road	3/29/93	18.4	<1.0	0.010	0.308	<0.02	0.004	17.0	----	----	----
		7/20/93	13.7	1	0.009	0.234	<0.02	0.003	6.0	13.0	9.3	8.6
		4/18/96	20.7	<3	ND	0.297	0.016	0.002	8.0	4.2	11.8	----
		6/20/96 @	----	<3	ND	0.134	0.011	0.002	8.0	----	----	----
Eagle Creek	Eagle Creek at CTH "C"	3/29/93	143.1	1.2	0.052	0.097	0.04	0.004	36.0 *	----	----	----
		7/20/93	29.2	<1.0	0.014	0.059	0.02	0.005	2.0	14.0	9.7	8.2

* - Elevated concentration above desirable levels
ND - No detect
@ - Very significant runoff event

Table 4.

THUNDER RIVER SUBWATERSHED

LAKES Name	Type	Acreage	Depth	Public Access	Fish Species	Actual Fishery Survey & Date	No. Dwellings
Dell Lake	Seepage	34.5	10'	Yes	BH, Minnows	No	1
Cedar Lake	Seepage	19.6	5'	Yes	Unknown, possible winterkill	No	1
Ledge Lake	Seepage	33.5	19'	No	BG, YP, PS, BH	No	1
Wonder Lake	Seepage	8	28'	No	LMB, Panfish	No	3
Boundary Lake	Seepage	37.1	20'	Yes	NP, BG, BC, YP, RB, PS, BH, SMB, LMB	Yes, 1969	40
Fryingpan Lake	Seepage	27.6	47	Yes	LMB, Panfish	No	2
Mirrior Lake	Seepage	4.7	10'	No	Panfish, forage fish	No	3
Rollins Lake	Seepage	9.1	4'	No	Probable winterkill		0
Kiss Lake	Spring	4.3	15'	No	LMB, BG	No	1
Bottle Lake	Drained	6.2	12'	Yes	LMB, BG, YP Trout	No	0
Sand Lake	Drained	19.5	32'	Yes	LMB, BG, PS, YP, Wh. Sucker, Brown & Brook T.	Yes, 1996	Camp Bird
The Spring	Seepage	6	23'	No	Rainbow Trout	No	0
Hazel Lake	Seepage	2.8	12'	Yes	LMB, Panfish	No	0
Borth Lake	Seepage	9.6	31'	Yes	LMB, Bluegill	No	2
Thunder Lake	Drained	134.5	62'	Yes	LMB, BG, BC, GS, YP, Rainbow T., Brook T., Brown	Yes, 1976	36
Eagle Lake	Seepage	56.3	30'	Yes	LMB, SMB, WEP, BG, YP, RB, Y. Bullhead	Yes, 1994	6
Island Lake	Seepage	8.9	10'	No	Forage Species	No	Platted
Little Perch Lake	Seepage	13.5	26'	No	LMB, BG, PS,YP	No	1
Huber Lake	Drained	29.1	8'	No	Panfish, Forage Fish	No	3
Forbes Spring	Spring	2	2'	Yes	Brook Trout	No	0

STREAMS Name	Length (mi.)	Trout Water	Last survey	Known Species
So. Fork Thunder R.	3.1	All	1968	Brook & Brown Trout
Forbes Creek	4.6	All	1992	Brook Trout
Thunder Lake Outlet	0.7	All	1968	LMB, BG
Thunder Lake Inlet	1.5	All	1968	Brook & Brown Trout
Thunder River	6.5	All	1968	Brook, Brown & Rainbow Trout
Hay Creek	6.1	All	1990	Brook Trout
Handsaw Creek	7	All		Brook & Brown Trout, N. Redbelly dace, Pearl dace, Common shiner, Blacknose dace, Mottled sculpin, Central mudminnow Iowa darter

Table 5.

EAGLE CREEK SUBWATERSHED

LAKES

Name	Type	Acreage	Depth	Public Access	Fish Species	Actual Fishery Survey & Date	No. Dwelli
Harwell L	Seepage	14.5	25'	No	Bass, Panfish	No	6
Lost Lake	Seepage	19.1	20'	No	NP, Bass, Panfish	No	15
Deer Lake	Seepage	13.4	34'	Yes	WEP, Bass, Panfish	Yes, 1962	3
Murbou L	Spring	19.3	7'	No	Bass, Panfish	No	1
Heart Lak	Seepage	3.8	6'	No	Minnows	No	2
Spring La	Seepage	12.7	5'	No	No information	No	1
Campbell	Spring	24.1	8'	Yes	Bullhead	No	0
Homestea	Spring	4.1	14'	No	Brook Trout	No	1
Taylor La	Spring	4.7	9'	Yes	Trout	No	1
Kahles Po	Seepage	1.2	3'	No	No Info	No	0
Little Spri	Spring	3.3	6'	No	Forage Species	No	0

STREAMS

Name	Length (m	Trout Wat	Class	Last Survey	Known Species
Eagle Creek	12.3	All	I	1996***	Brook Trout, Wh. Sucker, Black
Little Eagle Creek	4.5	All	I	1987	Brook Trout, Brown Trout
Campbell Creek	1.1	All	I	1976	Brook Trout, N. Redbelly Dace,
Homestead Creek	2.4	All	II	No record	Brook Trout
Little Spring Creek	2.4	All	II	No record	Brook Trout
Murbou Creek	0.9	Non trout		No record	Forage species

MEDICINE BROOK SUBWATERSHED

LAKES

Name	Type	Acreage	Depth	Public access	Fish Species	Actual Fishery Survey & Date	No. Dwelli
Kiss Lake	Spring	40.1	22'	No	BG, LMB, SMB, YP, PS, BC	No	3
Joy Lake	Drained	11.4	16'	No	LMB, BG	No	2
Star Lake	Seepage	4.9	3'	No	Unknown, possible winterkill	No	0

STREAMS

Name	Length (m	Trout Wat	Class	Last Survey	Known Species
Joy Creek	1.7	Non-trout		No record	Warmwater species
Medicine Brook	5.4	All	I	1996***	Brook & Brown Trout
					Wh. Sucker, Mottled sculpin
					Central mudminnow, blackside d

NORTH FORK THUNDER RIVER SUBWATERSHED

LAKES

Name	Type	Acreage	Depth	Public Access	Fish Species	Actual Fishery Survey & Date	No. Dwelli
Three Littl	Spring	2.7 (Total)	11'	No	Unknown	No	Unknown
Frieda lak	Spring	65	23'	No	LMB, YP, PS	No	0
Mountain	Spring	26	26'	No	LMB, PS, GS, Wh. Sucker	Private survey	6
McCaslin	Seepage	74.2	9'	No	LMB, YP, PS, BG, BC, BH	Private survey 1992	16
					Golden shiner, Common shiner		

STREAMS

Name	Length (m	Trout Wat	Class	Last Survey	Known Species
East Thunder Creek	2.2	All	I	1968	Brook Trout
Mountain Creek	0.2	All	II	No record	Brook Trout
Frieda Creek	0.4	All	II	No record	Brook Trout
West Thunder Creek	1.3	All	I	No record	Brook Trout
Smith Creek	1.5	Probable		No record	Unknown
Spring Creek	0.5	All	I	No record	
No. Fork Thunder Riv	12.4	All	I	1996***	Brook, Brown & Rainbow Trout
					Mottled sculpin, Longnose dace,
					Pearl dace, Northern redbelly da
					BG, Golden shiner

Table 6.

HIGH FALLS FLOWAGE SUBWATERSHED

LAKES	Name	Type	Acreage	Depth	Public Access	Fish Species	Actual Fishery Survey & Date	No. Dwellings
	Old Veterans Lake	Seepage	10.1	18'	Yes	Walleye, Br. BH, LMB, Panfish	No	0
	Angle Lake	Seepage	1.3	8'	Yes	Minnows, possible winterkill	No	0
	Woods Lake	Seepage	10.5	10'	No	LMB, NP, Panfish	No	Resort
	High Falls Res.	Drained	1,498	54'	Yes	Walleye, NP, LMB, SMB, Yp, B Muskellunge, Wh. sucker, Carp Br.BH, Bl. BH, Golden shiner, Bluntnose minnow	Yes 1993	43 & 2 Resorts

STREAMS	Name	Length (mi.)	Trout Water	Last Survey	Known Species
	Woods Lake Outlet	1.4	Non-trout	None	Forage species
	Peshtigo River	2	Non-trout	None	Tailwater Caldron Falls dam to High Falls Flowage Species composition similar to that of Flowage noted above.

PESHTIGO RIVER SUBWATERSHED

LAKES	Name	Type	Acreage	Depth	Public access	Fish Species	Actual Fishery Survey & Date	No. Dwellings
	Kirby Lake	Seepage	5.3	36'	No	BG, RB, BC, YP	No	1
	Marl Lake	Seepage	4.5	3'	No	Forage Species	No	0
	Johnson Falls Fl.	Drained	158	37'	Yes	Brown, Brook & Rainbow Trout, Walleye, SMB, Muskellunge, RB, YP, BC, BG, PS, Y. BH, Bl. BH, Wh. sucker, Brook Trout, Golden shiners	Yes 1990	0
	Sandstone Fl.	Drained	153	39	Yes	NP, SMB, LMB, Walleye Muskellunge, BG, RB, BC, PS, YP Bl. BH, Y. BH, Golden shiner, Wh. sucker	Yes 1990	59 & 1 Resort

STREAMS	Name	Length (mi)	Trout Water	Last Surv	Class	Known Species
	Peshtigo River	5.5	Tailwater II - Tailwater Johnson Falls dam to Spring Rapids	None	II	Brown, Brook & Rainbow Trout, SMB
	Peshtigo River	2	Spring Rapids to the Sandstone Impoundment	None	Non-trout	Warmwater species
	Peshtigo River	10	Tailwater Sandstone dam to confluence with The Outlet	None	Non-trout	Warmwater species

Table 7.

Index of Biotic Integrity - IBI

North Fork Thunder River - Upstream Mountain Road

FISH SPECIES	# Fish
Brook Trout	90
Brown Trout	12
Mottled sculpin	21
Longnose dace	17
White sucker	2
Bluegill	3
IBI Score	100 - Rating excellent

Fishery survey conducted August 8, 1996. Station length 1250'.

Table 8.

Priority Watershed

Middle Peshtigo/Thunder River Trout Summary

	NFT - Brook Trout	NFT - Brown Trout	MB1 - Brook Trout	MB1 - Brown Trout	MB2 - Brook Trout	MB2 - Brown Trout	BE1 - Brook Trout	BE2 - Brook Trout	NFT2 - Brook Trout	NFT2 - Brown Trout
1"				1	2	8				
2"	5	1		12	19	45	12	7		
3"	7			9	12	6				
4"	15		2	36	18	62	4	5	15	
5"	34	2		22	13	32	12	14	55	3
6"	17	2	1	17	6	27	23	27	28	2
7"	8	3		7	2	23	8	6	12	2
8"	3	2		2	1	18	6	6	3	
9"	1	1		2	1	16	5	7	3	2
10"		1		5		12				
11"						7		1		
12"				1		4				
13"						3				
14"				1		1				
15"										
16"						1				2
17"						1				
	No. Fork Thunder R.	No. Fork Thunder R.	Medicine Brook	Medicine Brook	Medicine Brook	Medicine Brook	Big Eagle Creek	Big Eagle Creek	No. Fork Thunder R.	No. Fork Thunder R.
	Above Mtn. Road	Above Mountain Road	Mouth to High Falls Rd	Mouth to High Falls Rd	Cty X to Newton Lk Rd	Cty X to Newton Lk Rd	Habitat Area/State 40	Above Habitat area	Above pipeline	Above pipeline
	1250'	1250'	2850'	2850'	2100'	2100'	1500'	1130"	2000'	2000'

Length frequency of all trout captured during watershed / fishery appraisals in1996

Table 9.

PE#: PE96Hab
STREAM: BIG EAGLE CREEK
COUNTY: MARINETTE
DATE: July 7 & 11, 1996
INVESTIGATO: Kornely & Rhode

*** NOTE *** 12 yoy brook trout captured but not included in population estimate.
They ranged from 2.0 to 2.9 inches. No brown trout were captured in this survey.
Other fish species captured included blacknose dace, creek chubs, white sucker, mottled sculpin, & central mudminnow.
Stream length and width are estimates and need to be verified.

STATION NO: 1
STATION DES: Habitat Area State 40
LENGTH: 1500 WIDTH: 20 ACRES: 0.69 MILES: 0.28
SPECIES: BROOK TROUT

TOTAL		LEGAL FISH >= 7.0 IN.	
POP EST:	75	POP EST:	24
NO./MILE:	263	NO./MILE:	83
NO./ACRE:	109	NO./ACRE:	34
LBS/ACRE:	13.51	LBS/ACRE:	8.14
AVG LNGTH:	6.72	AVG LNGTH:	8.40
AVG WT:	56.44	AVG WT:	108.35
		% OF POP:	31

SIZE RANGE	1ST RUN (M)	2ND RUN (C)	RECAPS (R)	AVG WEIGHT	POP EST [(M+1)(C+1)/(R+1)]-1	AVG LNGTH OF RANGE	AVG LNGTH TIMES POP EST	STANDING CROP
<1					0	0.5	0.00	0.00
1.0-1.4					0	1.2	0.00	0.00
1.5-1.9					0	1.7	0.00	0.00
2.0-2.4					0	2.2	0.00	0.00
2.5-2.9					0	2.7	0.00	0.00
3.0-3.4					0	3.2	0.00	0.00
3.5-3.9					0	3.7	0.00	0.00
4.0-4.4	2	1	1	10.5	2	4.2	8.40	21.00
4.5-4.9	2	2	2	17	2	4.7	9.40	34.00
5.0-5.4	3	3	1	21	7	5.2	36.40	147.00
5.5-5.9	5	5	2	27.8	11	5.7	62.70	305.80
6.0-6.4	11	12	8	35.7	16	6.2	101.27	583.10
6.5-6.9	6	3	1	45.1	13	6.7	87.10	586.30
7.0-7.4	3	1	1	58.3	3	7.2	21.60	174.90
7.5-7.9	4	2	1	73.5	7	7.7	50.05	477.75
8.0-8.4	5	1	1	96.4	5	8.2	41.00	482.00
8.5-8.9	1			116	1	8.7	8.70	116.00
9.0-9.4	1	1		141	3	9.2	27.60	423.00
9.5-9.9	2	1		174.5	5	9.7	48.50	872.50
10.0-10.4					0	10.2	0.00	0.00
10.5-10.9					0	10.7	0.00	0.00
11.0-11.4					0	11.2	0.00	0.00
11.5-11.9					0	11.7	0.00	0.00
12.0-12.4					0	12.2	0.00	0.00
12.5-12.9					0	12.7	0.00	0.00
13.0-13.4					0	13.2	0.00	0.00
13.5-13.9					0	13.7	0.00	0.00
14.0-14.4					0	14.2	0.00	0.00
14.5-14.9					0	14.7	0.00	0.00
15.0-15.4					0	15.2	0.00	0.00
15.5-15.9					0	15.7	0.00	0.00
16.0-16.4					0	16.2	0.00	0.00
16.5-16.9					0	16.7	0.00	0.00
17.0-17.4					0	17.2	0.00	0.00
17.5-17.9					0	17.7	0.00	0.00
18.0-18.4					0	18.2	0.00	0.00
18.5-18.9					0	18.7	0.00	0.00
19.0-19.4					0	19.2	0.00	0.00
19.5-19.9					0	19.7	0.00	0.00
20.0-20.4					0	20.2	0.00	0.00
20.5-20.9					0	20.7	0.00	0.00
21.0-21.4					0	21.2	0.00	0.00
21.5-21.9					0	21.7	0.00	0.00
22.0-22.4					0	22.2	0.00	0.00
22.5-22.9					0	22.7	0.00	0.00
23.0-23.4					0	23.2	0.00	0.00
23.5-23.9					0	23.7	0.00	0.00
24.0-24.4					0	24.2	0.00	0.00
24.5-24.9					0	24.7	0.00	0.00
25 +					0			0.00
								0.00
TOTAL	45	32	18		75	TOTAL	502.72	4223.35
						AVG LNGT	6.72	

Table 10.

PE#: PE96Abhab
STREAM: Big Eagle Creek
COUNTY: Marinette
DATE: July 9 & 11, 1996
INVESTIGA Komely & Rhode

*** NOTE *** 7 yoy brook trout were captured but are not included in population estimate. They ranged from 2.0 to 2.9 inches. No brown trout were captured. Other fish species captured included blacknose dace, creek chubs, white sucker, mottled sculpin, & central mudminnow. IBI calculated: Score 70, Rating Good. Stream length and width are estimates and need to be verified.

STATION N 2
STATION D Above Habitat area and State 40
LENGTH: 1130 WIDTH: 20 ACRES: 0.52 MILES: 0.21
SPECIES: BROOK TROUT

TOTAL		LEGAL FIS	>= 7.0 IN.
POP EST:	81	POP EST:	21
NO./MILE:	380	NO./MILE:	96
NO./ACRE:	157	NO./ACRE:	40
LBS/ACRE:	18.85	LBS/ACRE:	9.86
AVG LNGT	6.56	AVG LNGT	8.65
AVG WT:	54.54	AVG WT:	113.24
		% OF POP:	25

SIZE RANGE	1ST RUN (M)	2ND RU (C)	RECAPS (R)	AVG WEIGHT	POP EST [(M+1)(C+1)/(R+1)]-1	AVG LNGTH RANGE	AVG LNGTH TIMES POP EST	STANDING CROP
<1					0	0.5	0.00	0.00
1.0-1.4					0	1.2	0.00	0.00
1.5-1.9					0	1.7	0.00	0.00
2.0-2.4					0	2.2	0.00	0.00
2.5-2.9					0	2.7	0.00	0.00
3.0-3.4					0	3.2	0.00	0.00
3.5-3.9					0	3.7	0.00	0.00
4.0-4.4	2	1		13.7	5	4.2	21.00	68.50
4.5-4.9	1	1		14	3	4.7	14.10	42.00
5.0-5.4	4	4	1	23.8	12	5.2	59.80	273.70
5.5-5.9	5	6	4	31.4	7	5.7	42.18	232.36
6.0-6.4	6	11	4	38.7	16	6.2	97.96	611.46
6.5-6.9	11	7	4	48.9	18	6.7	121.94	889.98
7.0-7.4	2	3	2	65	3	7.2	21.60	195.00
7.5-7.9	2	3	2	79	3	7.7	23.10	237.00
8.0-8.4	2	3	2	89	3	8.2	24.60	267.00
8.5-8.9	2	3	2	112.5	3	8.7	26.10	337.50
9.0-9.4	4	1	1	134.5	4	9.2	36.80	538.00
9.5-9.9	2	2	1	149.7	4	9.7	33.95	523.95
10.0-10.4					0	10.2	0.00	0.00
10.5-10.9					0	10.7	0.00	0.00
11.0-11.4	1	1	1	223	1	11.2	11.20	223.00
11.5-11.9					0	11.7	0.00	0.00
12.0-12.4					0	12.2	0.00	0.00
12.5-12.9					0	12.7	0.00	0.00
13.0-13.4					0	13.2	0.00	0.00
13.5-13.9					0	13.7	0.00	0.00
14.0-14.4					0	14.2	0.00	0.00
14.5-14.9					0	14.7	0.00	0.00
15.0-15.4					0	15.2	0.00	0.00
15.5-15.9					0	15.7	0.00	0.00
16.0-16.4					0	16.2	0.00	0.00
16.5-16.9					0	16.7	0.00	0.00
17.0-17.4					0	17.2	0.00	0.00
17.5-17.9					0	17.7	0.00	0.00
18.0-18.4					0	18.2	0.00	0.00
18.5-18.9					0	18.7	0.00	0.00
19.0-19.4					0	19.2	0.00	0.00
19.5-19.9					0	19.7	0.00	0.00
20.0-20.4					0	20.2	0.00	0.00
20.5-20.9					0	20.7	0.00	0.00
21.0-21.4					0	21.2	0.00	0.00
21.5-21.9					0	21.7	0.00	0.00
22.0-22.4					0	22.2	0.00	0.00
22.5-22.9					0	22.7	0.00	0.00
23.0-23.4					0	23.2	0.00	0.00
23.5-23.9					0	23.7	0.00	0.00
24.0-24.4					0	24.2	0.00	0.00
24.5-24.9					0	24.7	0.00	0.00
25 +					0			0.00
								0.00
TOTAL	44	46	24		81	TOTAL	534.33	4439.45
						AVG LN	6.56	

PE#:
STREAM:
COUNTY:
DATE:
INVESTIGA

STATION NO:
STATION D
LENGTH: WIDTH: ACRES: 0.00 MILES: 0.00
SPECIES: BROWN TROUT

TOTAL		LEGAL FIS	>= 7.0 IN.
POP EST:	0	POP EST:	0
NO./MILE:	0	NO./MILE:	0
NO./ACRE:	0	NO./ACRE:	0
LBS/ACRE:	0.00	LBS/ACRE:	0.00
AVG LNGT	ERR	AVG LNGT	ERR
AVG WT:	ERR	AVG WT:	ERR
		% OF POP:	ERR

SIZE RANGE	1ST RUN (M)	2ND RU (C)	RECAPS (R)	AVG WEIGHT	POP EST [(M+1)(C+1)/(R+1)]-1	AVG LNGTH RANGE	AVG LNGTH TIMES POP EST	STANDIN CROP
<1					0	0.5	0.00	0.00
1.0-1.4					0	1.2	0.00	0.00
1.5-1.9					0	1.7	0.00	0.00
2.0-2.4					0	2.2	0.00	0.00
2.5-2.9					0	2.7	0.00	0.00
3.0-3.4					0	3.2	0.00	0.00
3.5-3.9					0	3.7	0.00	0.00
4.0-4.4					0	4.2	0.00	0.00
4.5-4.9					0	4.7	0.00	0.00
5.0-5.4					0	5.2	0.00	0.00
5.5-5.9					0	5.7	0.00	0.00
6.0-6.4					0	6.2	0.00	0.00
6.5-6.9					0	6.7	0.00	0.00
7.0-7.4					0	7.2	0.00	0.00
7.5-7.9					0	7.7	0.00	0.00
8.0-8.4					0	8.2	0.00	0.00
8.5-8.9					0	8.7	0.00	0.00
9.0-9.4					0	9.2	0.00	0.00
9.5-9.9					0	9.7	0.00	0.00
10.0-10.4					0	10.2	0.00	0.00
10.5-10.9					0	10.7	0.00	0.00
11.0-11.4					0	11.2	0.00	0.00
11.5-11.9					0	11.7	0.00	0.00
12.0-12.4					0	12.2	0.00	0.00
12.5-12.9					0	12.7	0.00	0.00
13.0-13.4					0	13.2	0.00	0.00
13.5-13.9					0	13.7	0.00	0.00
14.0-14.4					0	14.2	0.00	0.00
14.5-14.9					0	14.7	0.00	0.00
15.0-15.4					0	15.2	0.00	0.00
15.5-15.9					0	15.7	0.00	0.00
16.0-16.4					0	16.2	0.00	0.00
16.5-16.9					0	16.7	0.00	0.00
17.0-17.4					0	17.2	0.00	0.00
17.5-17.9					0	17.7	0.00	0.00
18.0-18.4					0	18.2	0.00	0.00
18.5-18.9					0	18.7	0.00	0.00
19.0-19.4					0	19.2	0.00	0.00
19.5-19.9					0	19.7	0.00	0.00
20.0-20.4					0	20.2	0.00	0.00
20.5-20.9					0	20.7	0.00	0.00
21.0-21.4					0	21.2	0.00	0.00
21.5-21.9					0	21.7	0.00	0.00
22.0-22.4					0	22.2	0.00	0.00
22.5-22.9					0	22.7	0.00	0.00
23.0-23.4					0	23.2	0.00	0.00
23.5-23.9					0	23.7	0.00	0.00
24.0-24.4					0	24.2	0.00	0.00
24.5-24.9					0	24.7	0.00	0.00
25 +					0			0.00
					0			0.00
TOTAL	0	0	0		0	TOTAL	0.00	0.00
						AVG LN	ERR	

Table 11.

Index of Biotic Integrity - IBI

Big Eagle Creek - Habitat Area, 1500', upstream 1130'

FISH SPECIES	# Fish - Habitat Area	# Fish - Above Habitat Area	Combined
Brook Trout	51	46	97
White sucker	18	6	24
Blacknose dace	5	4	9
Creek chub	4	9	13
Mottled sculpin	19	2	21
Central mudminnow	1		1
IBI Score	70 - Rating Good	70 - Rating Good	70 - Rating Good

Fishery survey conducted July 9 & 11, 1996

Table 12.

Index of Biotic Integrity - IBI

Medicine Brook

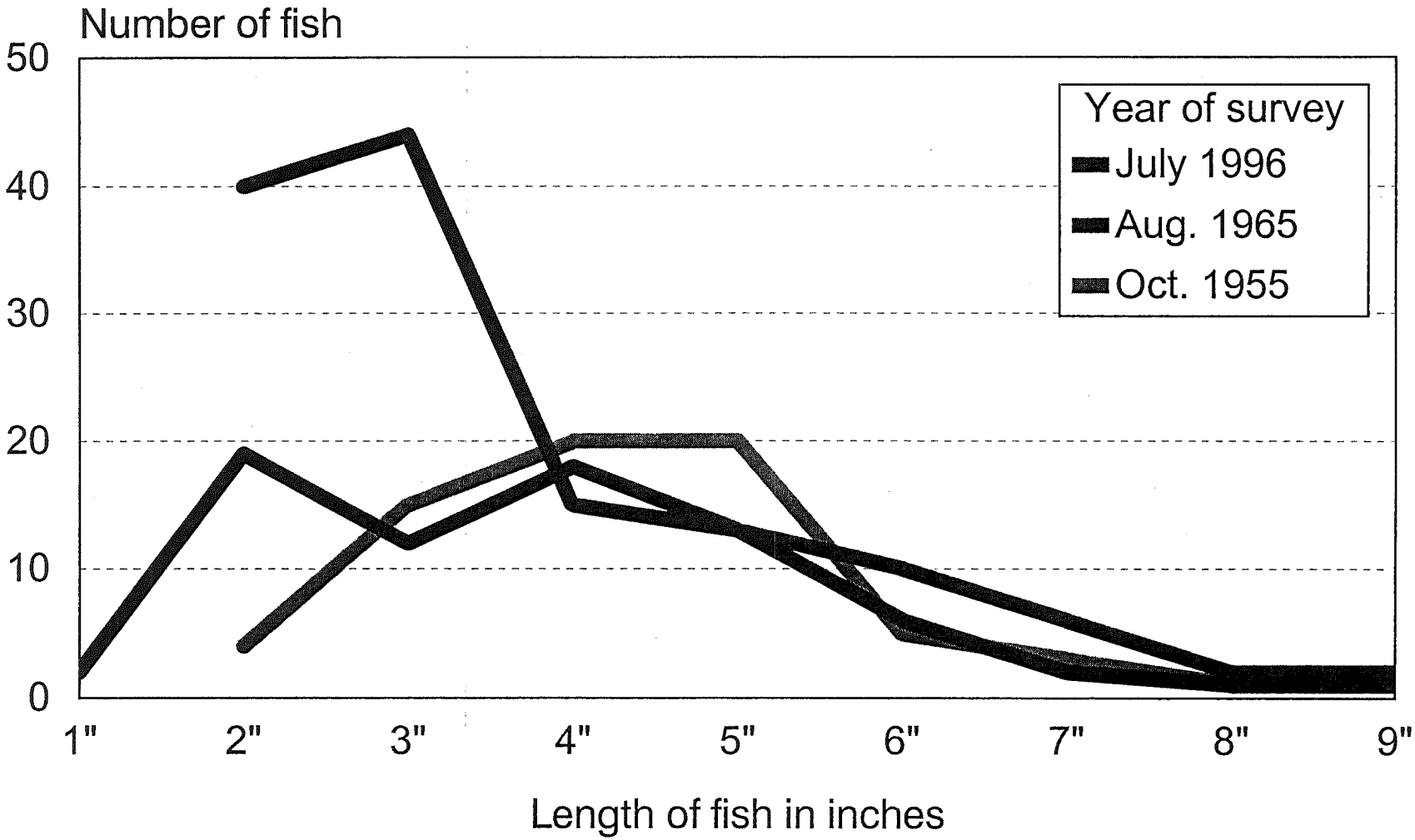
FISH SPECIES	# Fish, Mouth to High Falls Road	# Fish, Cty X to Newton Lake Road	Combined
Brown Trout	115	266	381
Brook Trout	3	74	77
White sucker	27		27
Mottled sculpin	3	30	33
Central mudminnow	1	13	14
Blackside darter	1		1
IBI Score	80 -Rating Excellent	100 - Rating Excellent	90 - Rating Excellent

Fishery survey conducted July 18 & 25, 1996

Table 13.

Medicine Brook

Brook Trout - 1996, 1965, 1955

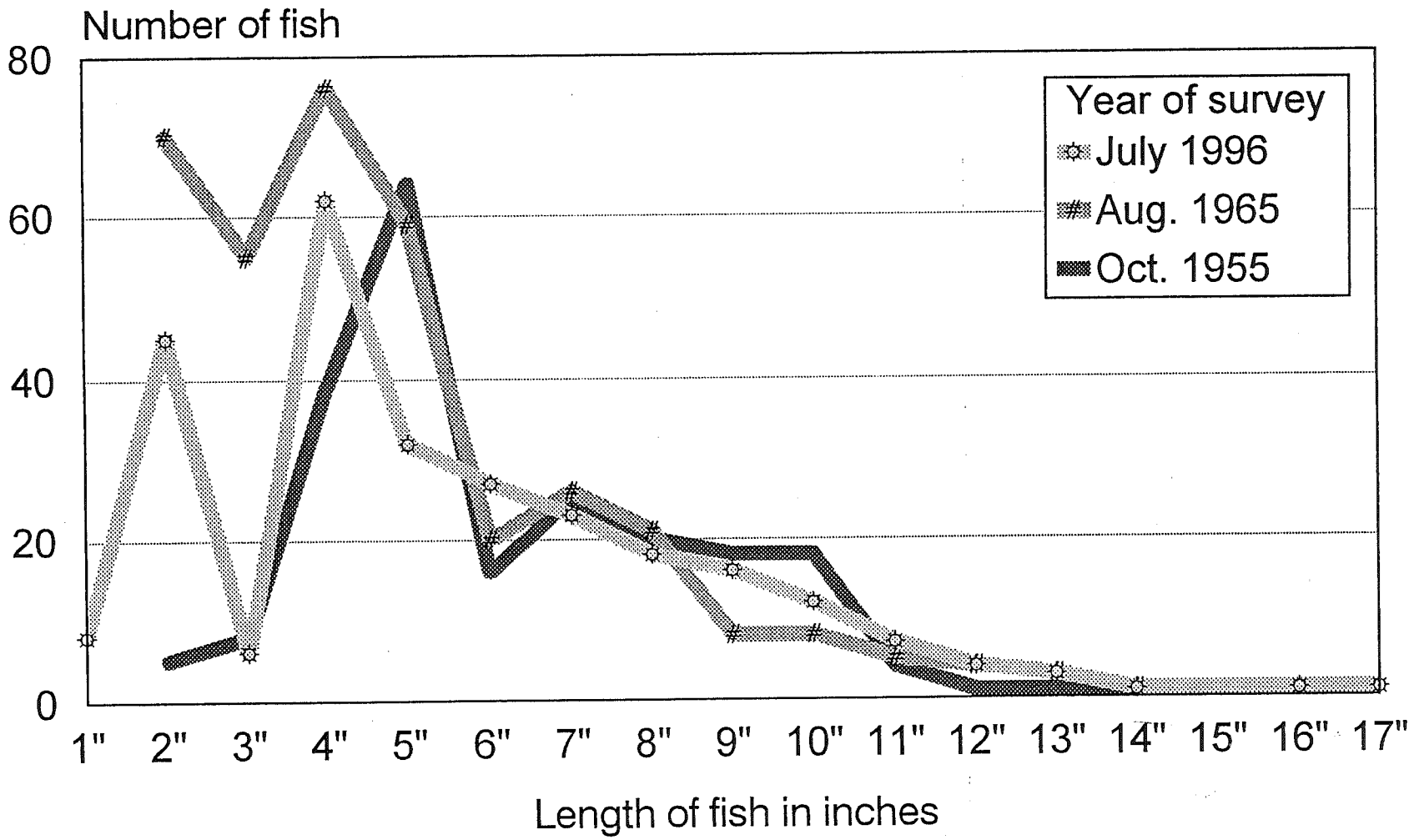


Station: Cty X to Newton Lake Road

Table 14.

Medicine Brook

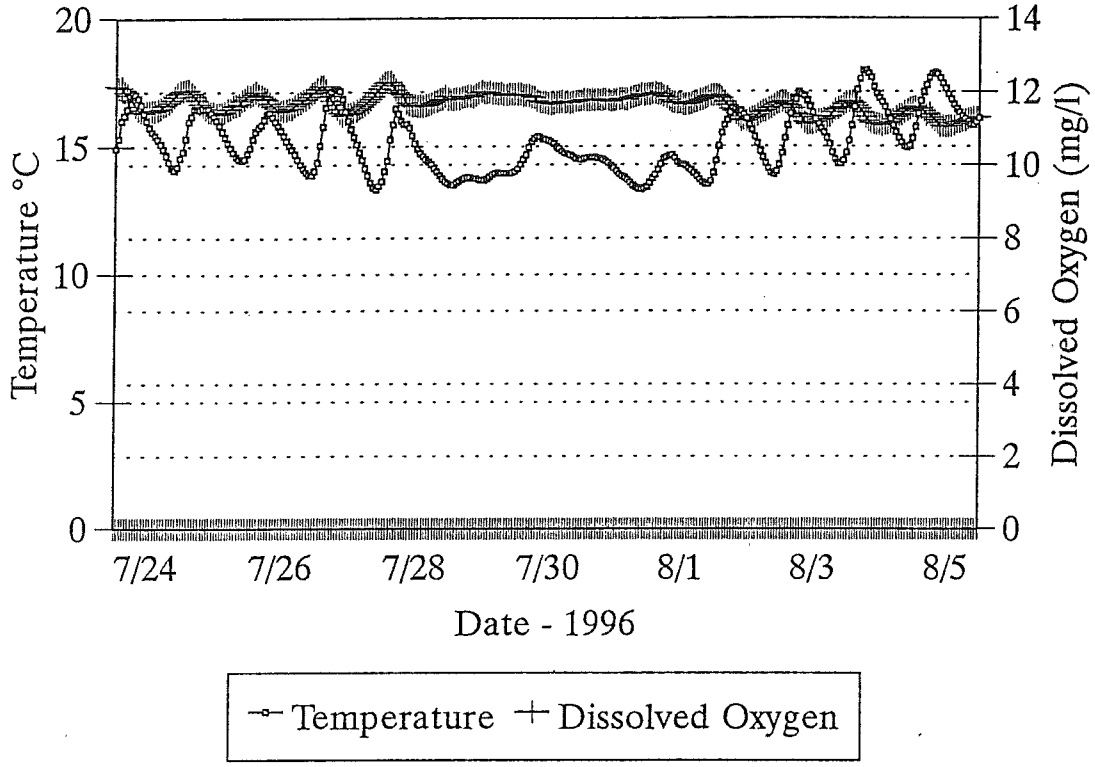
Brown Trout - 1996, 1965, 1955



Station: Cty X to Newton Lake Road

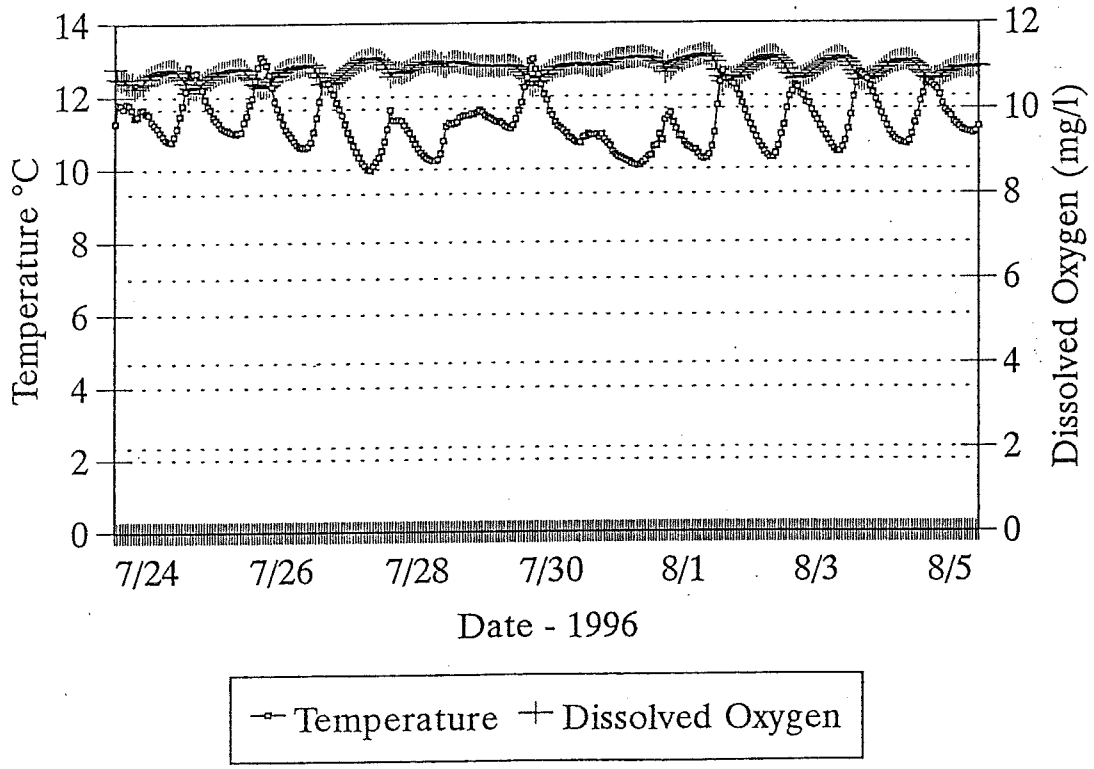
Appendix A.

Eagle Creek
Eagle Road



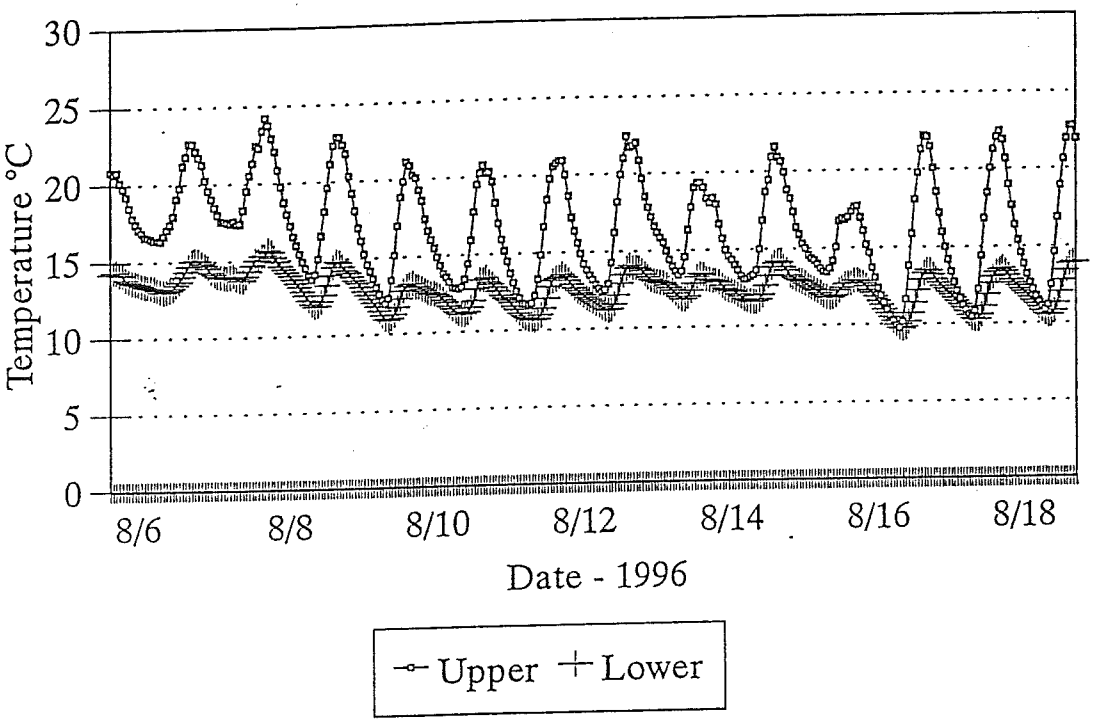
Appendix B.

Little Eagle Creek
CTH C



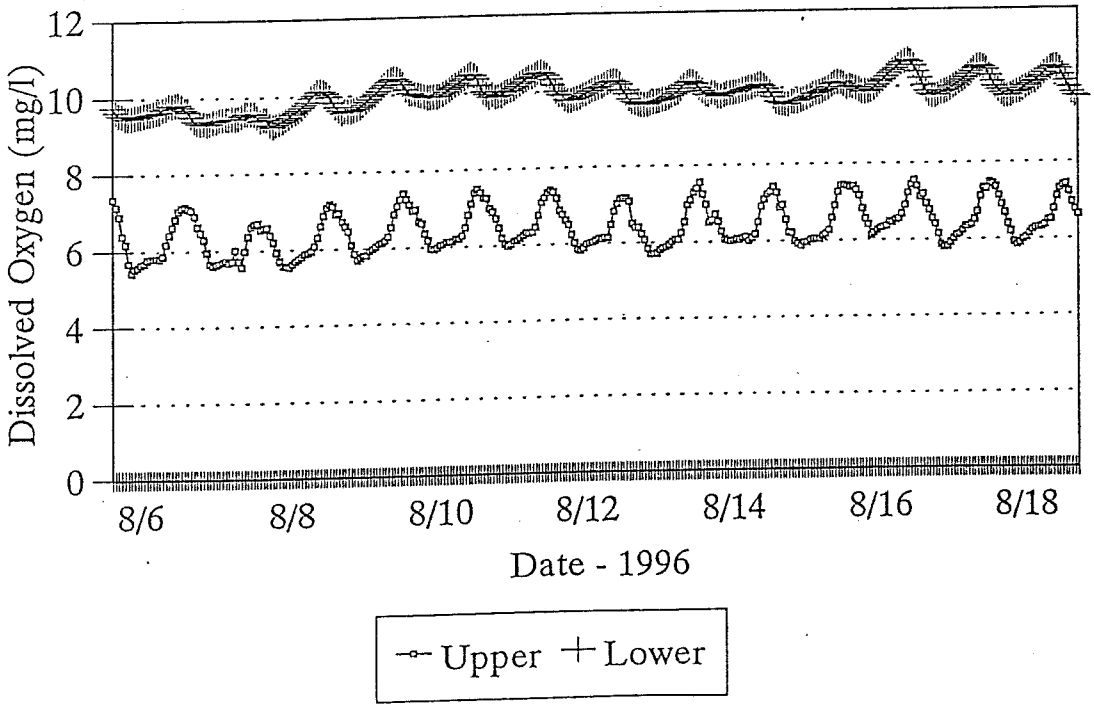
Medicine Brook
Upper and Lower Reaches
Water Temperature

Appendix C.



Medicine Brook
Upper and Lower Reaches
Dissolved Oxygen

Appendix D.



Appendix E Water Chemistry Data

Thunder Lake 1992

DATE	DEPTH (Feet)	TEMP. (Celsius)	D.O. (ppm)	pH (SU)	Ammonia Nitrogen (MG/L)	NO2 + NO3 Nitrogen (MG/L)	Kjeldahl Nitrogen (MG/L)	Total Phosphorus (UG/L)	Total Solids (MG/L)	Suspended Solids (MG/L)	Secchi Depth (Feet)	Chlorophyll a (UG/L)	Conductivity (UMHOS/cm)
05/08/92	0	11.3	11										
	3						0.2	20			18	2	172
	6	11.2	11.2										
	9												
	12	11.2	10										
	15	11.2	9.6										
	18	11	9										
	21	11	9										
	24	10.2	8										
	27	9	7										
	30	9.4	6.5										
	33	9	6										
	36	8.2	6										
	39	6.2	5.6										
	42	5.5	5.5										
	45	4.8	5.1					20					
	48	3.8	4.5										
	51												
	54												
	55	3	6										
06/17/96	0	21	9.6										
	3	21	9.6		0.011		0.006	6			17	3	215
	6	21	9.7										
	9	21	9.7										
	12	20	11										
	15	19.5	11.2										
	18	15.5	13.4										
	21	13	13.2										
	24	10	11.5										
	27	8.9	10.2										
	30	7.9	8.4										
	33	6	5.7										
	36	6.2	3.9										
	39	5.8	3.8										
	42	6	1										
	45	5.5	0.7					13					
	48	5.5	0.6										
07/23/92	0	22	9.2										
	3	22	9.2		0.015		0.3	6			17.3	2.06	
	6	21	9.2										
	9	21	9.4										
	12	21	9.4										
	15	20	9.4										
	18	17.3	10.9										
	21	15	12										
	24	11	10.5										
	27	10.2	10.4										
	30	8.2	6.3										
	33	6.2	3.8										
	36	6	1.4										
	39	6.2	0.7										
	42	6	0.5					53					
	45	6	0.4										
08/18/92	0	21.5											
	3	21.5					0.2	4			19	1.65	
	6	21.5											
	9	21.5											
	12	21.5											
	15	21.5											
	18	20											
	21	17											
	24	14.1											
	27	11											
	30	10											
	33	9											
	36	9											
	39	7											
	42	7			4								
	45	6											

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
05/08/92	51.4	40.1	35.4
06/17/96	42.1	43.1	36.3
07/23/92	42.1	40.3	36.0
08/18/92	39.0	38.6	34.7

Eagle Lake 1992

DATE	DEPTH (Feet)	TEMP. (Celsius)	D.O. (ppm)	pH (SU)	Ammonia Nitrogen (MG/L)	NO2 + NO3 Nitrogen (MG/L)	Kjeldahl Nitrogen (MG/L)	Total Phosphorus (UG/L)	Total Solids (MG/L)	Suspended Solids (MG/L)	Secchi Depth (Feet)	Chlorophyll a (UG/L)	Conductivity (UMHOS/cm)
05/08/92	0	11.4	13										
	3	11.4	13		0.016		0.6	20			15	3	
	6	11.4	12.5										
	9	11.4	12										
	12	11.4	12										
	15	11.8	11.6										
	18	13.6	10.5										
	21	14	9										
	24	14	9										
	27	14	8.5										
06/17/92	0	22	10										
	3	21.5	10		0.017		0.3	6			19	2	190
	6	21.5	10										
	9	21	10										
	12	21	10.1										
	15	21	10.1										
	18	19	14.4										
	21	16	14.6										
	24	14	13.4										
	27	12.8	9										
07/23/92	0	22	9.2										
	3	22	9.5				0.4	9			16	1.85	
	6	21.8	9.4										
	9	21.6	9.5										
	12	21.4	9.2										
	15	21.2	9.2										
	18	20.8	8.4										
	21	20.1	6.8										
	24	19	4.6										
	27	17.5	4										
08/18/92	0	21.4											
	3	21.5					0.3	6			13	2.99	
	6	21.5											
	9	21.5											
	12	21.5											
	15	21.5											
	18	21.5											
	21	21.5											
	24	21											
	27	18.5											

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
05/08/92	51.4	43.1	38.1
06/17/96	42.1	40.1	34.7
07/23/92	45.2	39.5	37.1
08/18/92	42.1	43.1	40.1

Appendix E Water Chemistry Data

Little Perch Lake 1996

DATE	DEPTH (Meters)	TEMP. (Celsius)	D.O. (ppm)	pH (SU)	Ammonia Nitrogen (MG/L)	NO2 + NO3 Nitrogen (MG/L)	Kjeldahl Nitrogen (MG/L)	Total Phosphorus (UG/L)	Total Solids (MG/L)	Suspended Solids (MG/L)	Secchi Depth (Feet)	Chlorophyll a (UG/L)	Conductivity (UMHOS/cm)
3/20/96	1	3.06	3.05					ND					159
	2	3.85	2.49										159
	3	3.93	2.36										159
	4	3.97	2.26										159
	5	3.97	2.21										160
	6	4	2.02					ND					162
5/15/96	0	10.8	12.14										129
	1	10.82	12.07	8	0.097	0.029	0.5	9	86	ND	17.4	2.17	129
	2	10.8	12.05										129
	3	10.82	12.08										129
	4	10.46	12.28										129
	5	10.15	12.63										128
	6	10.03	11.97	7.9	0.093	0.028	0.5	12	86	ND			129
06/20/96	1	20.98	10.54	7				13			7	4.19	130
	2	20.98	10.4										130
	3	20	10.8										130
	4	19.55	10.86										130
	5	18.96	11.91										131
	6	17.11	11.73	8.22				13					136
07/17/96	0	23.54	10.09										136
	1	23.56	10.02	8.66				12			8.75	2.26	140
	2	23.49	10.03										140
	3	23.38	10.12										140
	4	23.04	10.07										141
	5	22.14	12.6										146
	6	20.43	11.99	8.51				13					161
08/20/96	0	25.17	9.69										228
	1	24.55	9.62	8.98				10			15	1.75	227
	2	24.18	9.7										227
	3	24.07	9.69										227
	4	23.98	9.71										229
	5	23.65	9.77										234
	6	23.42	8.73	8.89				12					267

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
3/20/96	ND		
5/15/96	45.2	40.7	35.9
06/20/96	48.1	45.7	49.1
07/24/96	47.5	41.0	45.8
08/20/96	46.0	39.1	38.1

McCaslin Lake 1995

DATE	DEPTH (Meters)	TEMP. (Celsius)	D.O. (ppm)	pH (SU)	Ammonia Nitrogen (MG/L)	NO2 + NO3 Nitrogen (MG/L)	Kjeldahl Nitrogen (MG/L)	Total Phosphorus (UG/L)	Total Solids (MG/L)	Suspended Solids (MG/L)	Secchi Depth (Feet)	Chlorophyll a (UG/L)	Conductivity (UMHOS/cm)
04/26/95	0.5	8.58	11.89	8.05	ND	ND	0.5	22			5.5	10.3	
	1	8.23	11.8	7.98									
	1.5	8.15	11.86	7.91									
	2	8.04	11.75	7.84									
	2.5	8.03	11.64	7.73	ND	ND	0.5	21					
06/20/95	0.5	27.91	7.96	7.5	ND	0.015	0.5	20			8.2	4	
	1	27.17	8.48	7.6									
	1.5	24.67	9.14	7.63									
	2	20.47	5.08	6.83									
	2.5	20.1	4.47	6.74	ND	ND	0.5	27					
07/18/95	0.5	24.37	7.37	7.65	ND	ND	0.6	26			5.8	4.39	
	1	24.27	7.38	7.6									
	1.5	24.22	7.39	7.58									
	2	23.98	7.37	7.53	ND	ND	0.6	22					
08/22/95	0.5	24.01	7.7	7.77	0.052	ND	0.6	18			8	6.51	
	1	23.49	7.77	7.77									
	1.5	22.93	8.11	7.9									
	2	22.71	8.75	8.04	ND	ND	0.6	16					
02/14/96	0.5	0.29	12.42	6.42				12					

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
04/26/95	52.1	52.5	52.5
06/20/95	51.4	45.3	46.8
07/18/95	53.4	46.0	51.8
08/22/95	50.6	49.0	47.1

Appendix E Water Chemistry Data

Lost Lake 1996

DATE	DEPTH (Meters)	TEMP. (Celsius)	D.O. (ppm)	pH (SU)	Ammonia Nitrogen (MG/L)	NO2 + NO3 Nitrogen (MG/L)	Kjeldahl Nitrogen (MG/L)	Total Phosphorus (UG/L)	Total Solids (MG/L)	Suspended Solids (MG/L)	Secchi Depth (Feet)	Chlorophyll a (UG/L)	Conductivity (UMHOS/cm)
3/20/96	1	3.53	3.94	6.99									20.2
	2	3.9	3.34	6.84									19.9
	3	3.95	3.16	6.71									19.9
	4	3.95	3.11	6.62									19.9
5/15/96	0	10.92	10.97	7.49									15.4
	1	10.9	10.7	7.3	0.284	0.067	0.8	12	0.26	ND	12	1.94	15.4
	2	10.74	10.69	7.21									15.4
	3	10.38	10.67	7.05									15.2
	4	8.18	9.31	6.86									15.6
	5	6.93	7.95	6.39	0.254	ND	0.8	9	0.24	ND			15.4
06/26/96	0	20.33	9.21	7.34									14.2
	1	20.16	8.87	7.06				11			11	5.52	14.2
	2	18.86	9.02	6.98									14
	3	18.31	9.03	6.9									14.1
	4	13.62	9.42	6.66									15.3
	5	10.69	6.64	6.26									15.6
	6	8.44	2.18	6				16					17.8
	7	7.7	0.47	5.91									22.3
07/24/96	0	23.52	8.26	7.5									14.8
	1	23.47	8.24	7.45				7			14.75	2.66	14.8
	2	23.34	8.25	7.36									14.8
	3	22.53	8.55	7.33									14.7
	4	18.16	5.05	6.72									16.9
	5	13.8	4.01	6.46									17.2
	6	10.1	0.74	6.29				16					20.6
08/20/96	0	23.71	7.64	6.6									14.1
	1	23.67	7.21	6.49				10			15	1.74	14.1
	2	23.61	7.27	6.36									14.1
	3	23.45	7.24	6.25									14.1
	4	21.01	4.81	5.86									16.7
	5	15.19	0.68	5.36				10					16.9

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
5/15/96	47.5	39.8	41.3
06/26/96	46.8	47.7	42.5
07/24/96	43.3	42.2	38.3
08/20/96	46.0	39.0	38.1

Boundary Lake 1996

DATE	DEPTH (Meters)	TEMP. (Celsius)	D.O. (ppm)	pH (SU)	Ammonia Nitrogen (MG/L)	NO2 + NO3 Nitrogen (MG/L)	Kjeldahl Nitrogen (MG/L)	Total Phosphorus (UG/L)	Total Solids (MG/L)	Suspended Solids (MG/L)	Secchi Depth (Feet)	Chlorophyll a (UG/L)	Conductivity (UMHOS/cm)
3/20/96	1	3.65	5.34										
	2	3.89	5.17										
	3	4.09	4.82										
	4	4.24	4.43										
	5	4.37	3.98										
5/15/96	0	11.28	12										
	1	11.28	12.09	8	0.04	0.015	0.6	7	156	ND	13	2.39	233
	2	11.28	12.13										
	3	11.23	12.06										
	4	11.11	12.16										
	5	10.77	12.79	8.1	0.041	0.026	0.6	ND	152	ND			232
06/20/96	1	20.2	7.8	8.2				7			11	3.06	235
	2												
	3												
	4												
	5	19.1	6.9	8.1				8					238
07/24/96	0	23.25	8.93										
	1	23.27	8.93	8.24				8			9.75	6.4	247
	2	23.25	8.95										
	3	23.04	8.8										
	4	22.73	8.19	8.19				8					251
	5	22.3	6.27										
08/20/96	0	25.32	8.64										
	1	25.23	8.67	8.6				8			12.75	2.55	227
	2	24.95	8.68										
	3	24.25	8.83										
	4	23.74	8.74										
	5	23.05	7.18	8.31				10					234
	6	22.41	2.42										

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
3/20/96	NA	NA	NA
5/15/96	43.3	41.4	40.1
06/20/96	43.3	43.3	42.5
07/24/96	44.3	48.9	44.3
08/20/96	44.3	41.9	40.4

Island Lake 1992

DATE	DEPTH (Meters)	TEMP. (Celsius)	D.O. (ppm)	pH	Ammonia Nitrogen	NO2 + NO3 Nitrogen	Kjeldahl Nitrogen	Total Phosphorus	Total Solids	Suspended Solids	Secchi Depth	Chlorophyll a
05/08/92							0.4	20				9
06/17/96					0.07		0.8	25				7
07/23/92					0.022		0.8	16				3.07
08/18/92							0.6	20			7	2.27

DATE	TSI Phosphorus	TSI Chlorophyll-a	TSI Secchi Depth
05/08/92	51.4	51.4	NA
06/17/96	53.1	49.5	NA
07/23/92	49.7	43.3	NA
08/18/92	51.4	41.0	49.1