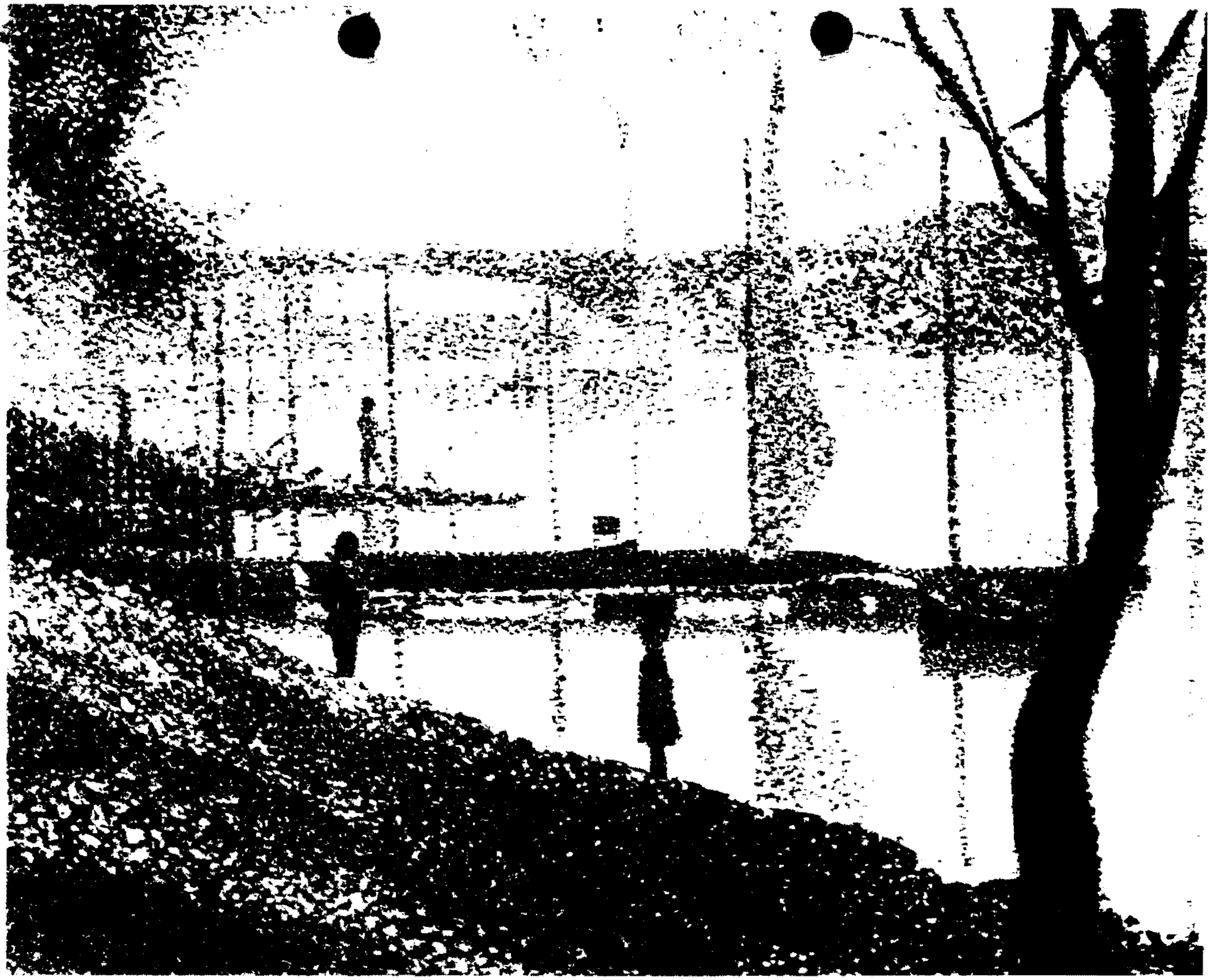


Georges Seurat: *Courbevoie Bridge,* 1886/87

Water Quality Study and Lake Management Plan for Lower Turtle Lake, Barron County, Wisconsin

May 1995

Submitted to:
Lower Turtle Lake Management District
Almena, Wisconsin

Prepared by:
Steve McComas
Jo Stuckert
Blue Water Science
St. Paul, MN 55116
612.690.9602

SUMMARY

The Lower Turtle Lake is 276 acres in area with a mean depth of 15 feet and is located in Barron County, Wisconsin.

Goals The goals of this project were:

- to examine existing lake conditions and review data that were collected in the past.
- to develop a lake management plan that protects, maintains, and enhances the lakes water quality.

Watershed Characteristics

- The Lower Turtle Lake's watershed is approximately 5,265 acres. About 2,800 acres drain by way of small streams to Lower Turtle Lake. Another 2,465 acres.
- The watershed is composed of a mix of agricultural, wetland, and forested acreage.

Water Quality and Quantity Monitoring Methods

- For this study sampling was conducted in April, June, July, and August 1994.
- Field measurements and surveys were made and chemical analysis was conducted by the Wisconsin Laboratory of Hygiene.

The following parameters were analyzed:

Chlorophyll a	Temperature	Dissolved Oxygen
Conductivity	Nitrate plus Nitrite	Total Kjeldahl Nitrogen
Total Phosphorus	Secchi Disc	Ammonia
Underwater Video	Stream monitoring	Aquatic Plant Survey
Septic Leachate Survey		

Dissolved Oxygen and Temperature

- Lower Turtle Lake temperature profiles indicate that the thermocline is not strongly formed. Oxygen is generally found throughout the lake's water column in the summer months.

Nutrients

- We are assuming that phosphorus is the limiting nutrient based on TKN to TP ratios of over 15. Phosphorus concentrations ranged from about 24 to 66 ppb in the surface waters with a summer average of 30 ppb. Phosphorus concentrations in the bottom waters of Lower Turtle Lake were 31 to 142 ppb.

Macrophyte Status

- Rooted plants were found to a water depth of 8 feet.
- Overall, rooted aquatic plants occupy about 31% of the bottom area (86 acres) in Lower Turtle Lake.

Lake Water Quality Trends

- Water chemistry results in 1994 are comparable to North Central Hardwood Forest Ecoregion values
- The data base does not go back far enough to examine trends, however Lower Turtle was in better shape in 1994 in regard to phosphorus concentrations and transparency compared to data from 1990 through 1993.

Lake Modeling

- We used the WLMS lake modeling program developed by the WDNR.
- For Lower Turtle Lake, the model predicted a lake phosphorus concentration range of 30 to 87 ppb of phosphorus. The actual lake phosphorus level was 30 ppb in 1994.

Lake Status

The Trophic State Index (TSI) rates a lake from 1 to 100, with low numbers being the best. Lower Turtle Lake is currently rated as a eutrophic lake. Lower Turtle Lake has been worse in previous years. The current average TSI for Lower Turtle Lake is 52 (TSI ratings are based on the chlorophyll a level, total phosphorus concentrations, and secchi disk transparency).

Conclusions

Lower Turtle Lake appears to be on the threshold of clear water conditions, which is usually preferable to algae dominated systems. In 1994, Lower Turtle Lake had acceptable water clarity. The reasons for this "good" year are not certain. One contributing factor was two farms that had been active were idle in 1993 and 1994. It is possible that reduced nutrient inputs from runoff produced lower algae blooms. It may be that no rainstorms were severe enough in 1994 to produce high levels of nutrient runoff. In years with big rainfalls (over 2 inches), high nutrient loads may move into Lower Turtle Lake. Conditions that we found in 1994 indicated Lower Turtle Lake has the potential to have good water quality in the future. Projects will be designed to maintain these lake conditions.

Recommended Lake Management Projects

1. Work with the Barron County Land Conservation Department on watershed projects.
These projects include:

1-A. Nutrient management for field crops
1-B. Runoff treatment from livestock holding areas

2. Work with WDNR on stream, wetland, and lake projects. These projects include:

2-A. Wetland restoration
2-B. Stream management to enhance fish spawning
2-C. Lake level control policy
2-D. Install fish cribs

<u>3. Lake residents have several projects they could implement and include.</u> These projects include:

- 3-A. Aquascaping/native plant reestablishment.
- 3-B. Lake shoreland projects.
- 3-C. On-site system maintenance program.
- 3-D. Continue a lake monitoring program.

Water Quality Study and Lake Management Plan for Lower Turtle Lake, Barron County, Wisconsin

--Contents--

ACKNOWLEDGEMENTS

A large number of agencies and individuals generously gave of their time and aided by collecting information, providing advice and comments, and helping preparation of this report.

Lower Turtle Lake Management District Commissioners

Dick Fields
Al Moris
Richard Murray
John Bussewitz
Henry Heintz

Barron County

Dale Hanson
Nathen Olsen (summer intern)

Wisconsin Department of Natural Resources (DNR)

Danny Ryan
Rick Cornelius

1. Introduction and Project Setting

Lower Turtle Lake is a drainage lake located in Barron County, Wisconsin (Figure 1). Lower Turtle Lake is a eutrophic lake with phosphorus levels ranging from 30-67 ug/l and a secchi disc transparency range of 3-8 feet in summer.

The goals of this project were to examine existing lake conditions and to develop lake management plans to protect, maintain, and enhance lake water quality for the short term and long term.

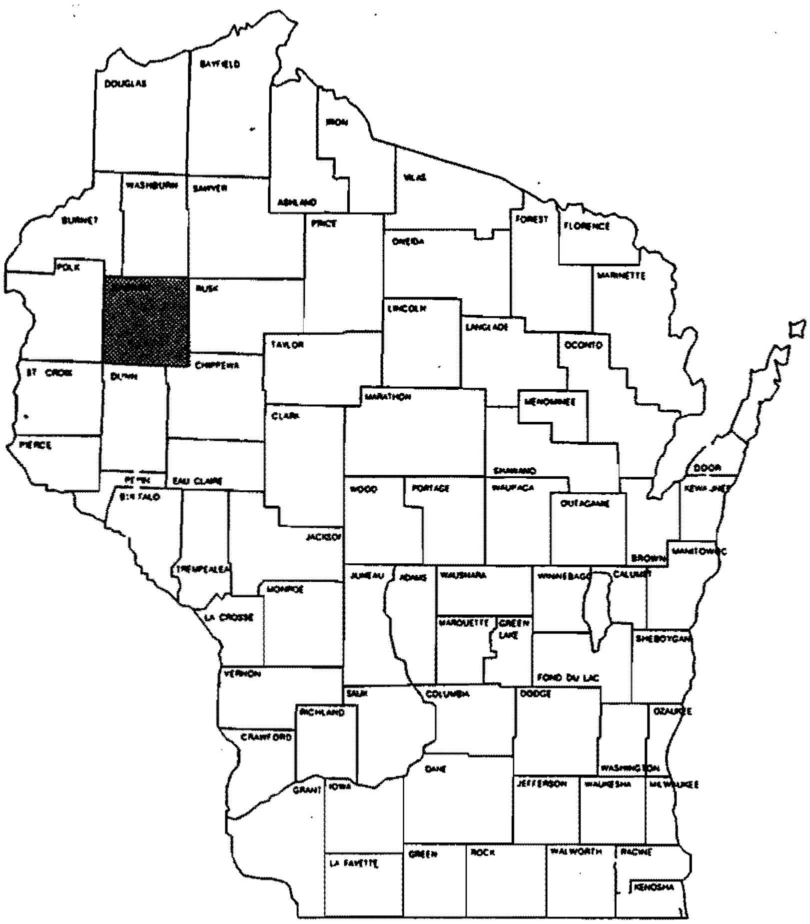
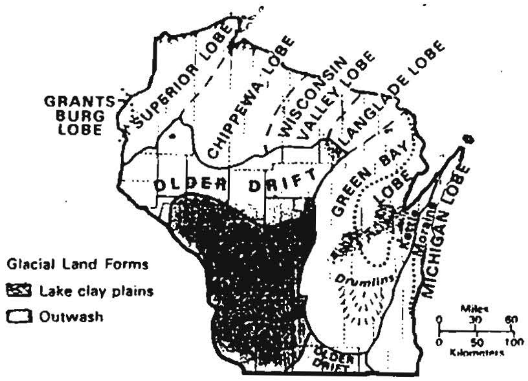


Figure 1. Location of Barron County, Wisconsin.

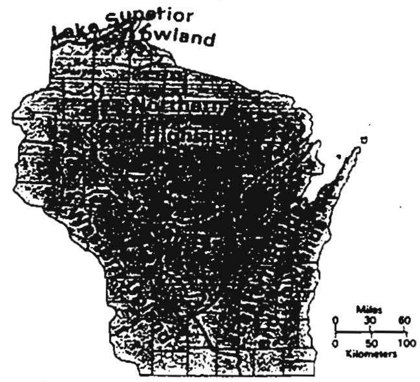
2. Geologic Setting

Lower Turtle Lake is located in the older drift outwash and was not effected by the last glaciation (Figure 2, Map 6). Lower Turtle Lake is located in the central plains of Wisconsin (Figure 2, Map 8). Lower Turtle Lake drains to the Red Cedar River which eventually feeds into the Mississippi River (Figure 2, Map 9). Most of the land area is agricultural (Figure 2, Map 11).



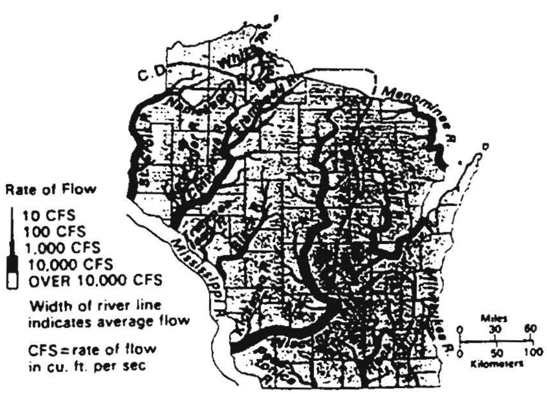
Map 6. GLACIAL GEOLOGY

The last major advance of the ice sheet over Wisconsin was about 16,000 years ago. It covered all but the "driftless" and "older drift" areas. A later ice advanced about 11,000 years ago (dotted boundaries), burying a forest in Manitowoc County. Many land forms were created by the glacial ice and meltwaters: Moraines (solid lines), elongated hills called drumlins, outwash, and lake clay plains. Many peat bogs and lakes occupy glacial pits called kettles.



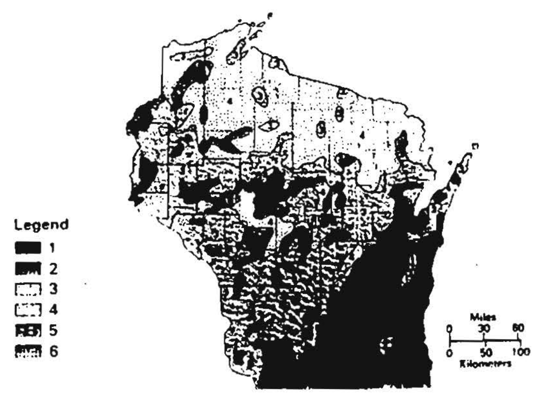
Map 8. GEOGRAPHIC PROVINCES (after Martin, 1932)

The Lake Superior Lowland is an old glacial lake bottom sitting in a much older depression in the bedrock surface. The Northern Highland is a glacial-drift-covered Precambrian "dome," a southern extension of the "Canadian Shield" of igneous and metamorphic rocks. The Central Plain is on an arc of Cambrian sandstones. The drift-covered Eastern Ridges and Lowlands are crossed by dolomite escarpments. The Western Upland is dissected by numerous tributaries to the Mississippi and Wisconsin Rivers.



Map 9. PRINCIPAL RIVERS AND THEIR AVERAGE FLOW

Thirty percent of the state drains to the St. Lawrence River basin, and the remaining 70 percent to the Mississippi River basin. The dashed line represents the continental divide (C.D.) between these two major basins. Peak flows are in March, April and June. The Wisconsin River drains 21 percent of the area of the state; the Chippewa-Flambeau system drains 17 percent; the Fox-Wolf system in northeastern Wisconsin drains 12 percent of the state.



Map 11. AGRICULTURAL AND FORESTRY LAND USE

The map shows land use in terms of proportions of land devoted to agriculture and forestry. Highly productive farm land (1), with less than 15 percent of woodland, is in southern counties. Productive farm land (2), with the same extent of woodland, is prominent in the east, but is also widely scattered. Agricultural land with 15 to 50 percent in woodland (3), occupies about half of the area of the state. Forest lands, not sandy (4), are prominent in the north. Jack pine (5), and scrub oak (6) sandy lands are concentrated in the central plain and northern counties.

Figure 2. Geological, Hydrological, and Agricultural maps of Wisconsin, showing Lower Turtle's location.

3. Watershed Characteristics

The discharge to Lower Turtle Lake from first order streams is about 2,800 acres (determined by Barron County LCD). However, another 2,465 acres drain to Lower Turtle Lake by way of Turtle Creek which flows out of Upper Turtle Lake and into Lower Turtle Lake. Therefore, the entire drainage area is 5,265 acres. The direct drainage areas to Lower Turtle are shown in Figure 3 (watershed outlines were constructed by Steve Prestin).

The watershed has four major categories of land use: wetlands, forest/open land, agricultural, and residential. Agricultural land use dominates.

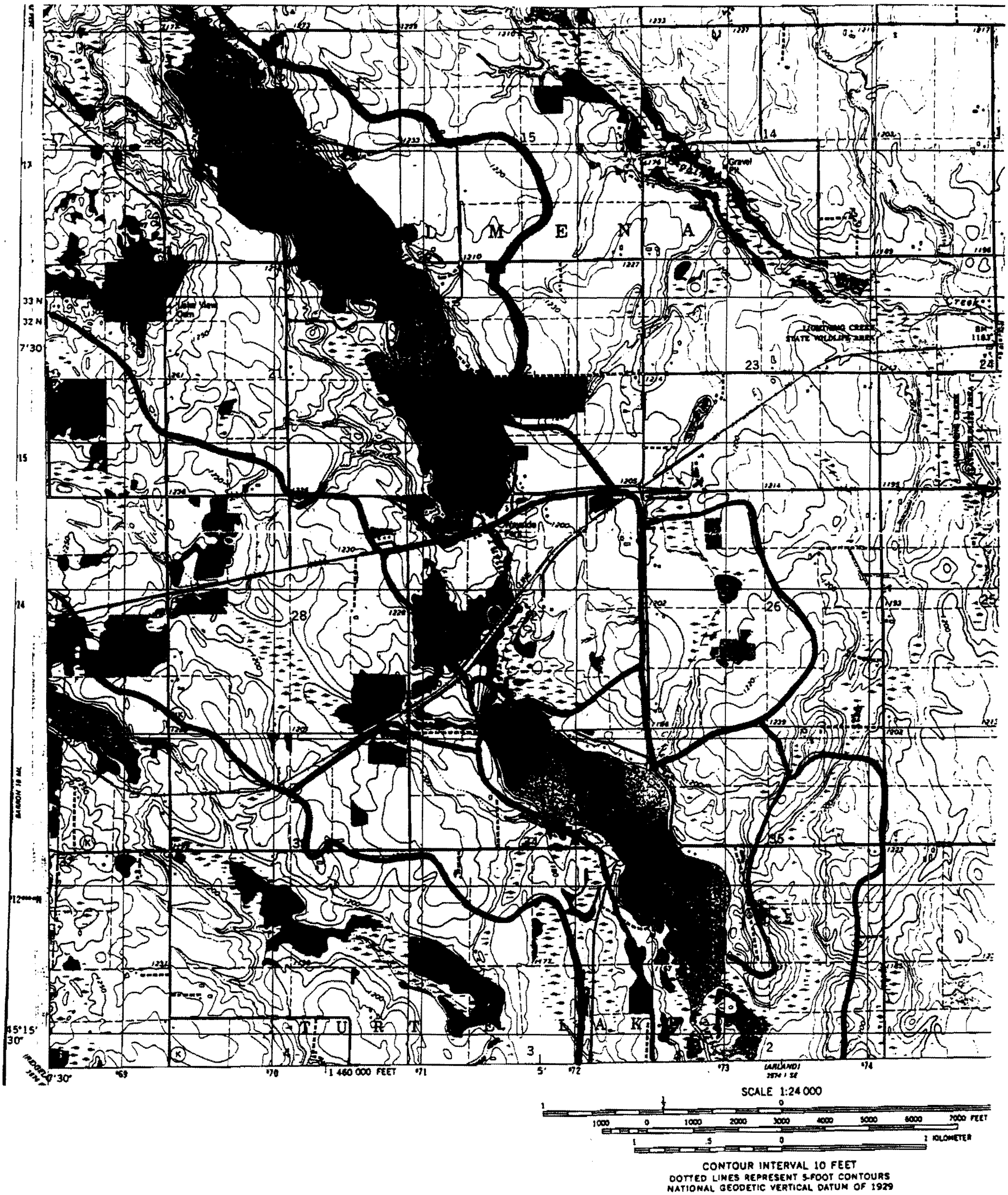


Figure 3. Subwatershed to Lower Turtle Lake (Source: Steve Prestin, Lower Turtle Lake District).

The following report is excerpted form the "Lower Turtle Lake Watershed Study", Final Version, June 1994. It was prepared by Barron County Land Conservation Department.

AREA AND SCOPE OF STUDY: The study area of the Lower Turtle Lake Watershed is about 2800 acres in size. The watershed study area extends to the north and northwest of Lower Turtle Lake. To the northwest the study area begins along Highway 63, near Muskrat Lake. To the north the study areas begins just south of Highway 8. The watershed study area is shown in Figure 4.

The scope of the study included a streambank survey of Turtle Creek, a shoreline survey of Lower Turtle Lake, a barnyard survey, and an estimate of sediment delivery to the lake using the computer program WINHUSLE.

STREAMBANK SURVEY RESULTS: The area of Turtle Creek that was surveyed was between Upper Turtle Lake and Lower Turtle Lake. The banks of Turtle Creek are currently undisturbed. Evidence that some areas were once pastured were found, but there is no current pasturing along the creek. A rocked stream crossing was found near the old Soo Line railroad. The stream crossing does not appear to be currently used and is grown over with vegetation.

Turtle Creek is in good condition and the majority is bordered by wetlands on both sides.

SHORELINE SURVEY RESULTS: The shoreline of Lower Turtle Lake is generally in very good conditions. Only very minimal erosion of the shoreline was found.

The only source of lakeshore erosion was the road bank near the recently installed culverts along 4 $^1/_4$ Street north of the public boat landing. The township should be contacted so they can properly seed and cover the exposed soil.

Although the shoreline was not eroding, in many areas there is no shoreline buffer. A shoreline buffer should be a minimum of 30 feet wide. A buffer will help keep the shoreline from eroding, and it will also act as a filter for nutrients. A buffer will filter out many nutrients and sediment before they reach the lake. The lake district should encourage all lakeshore residents to create a buffer zone along the shoreline.

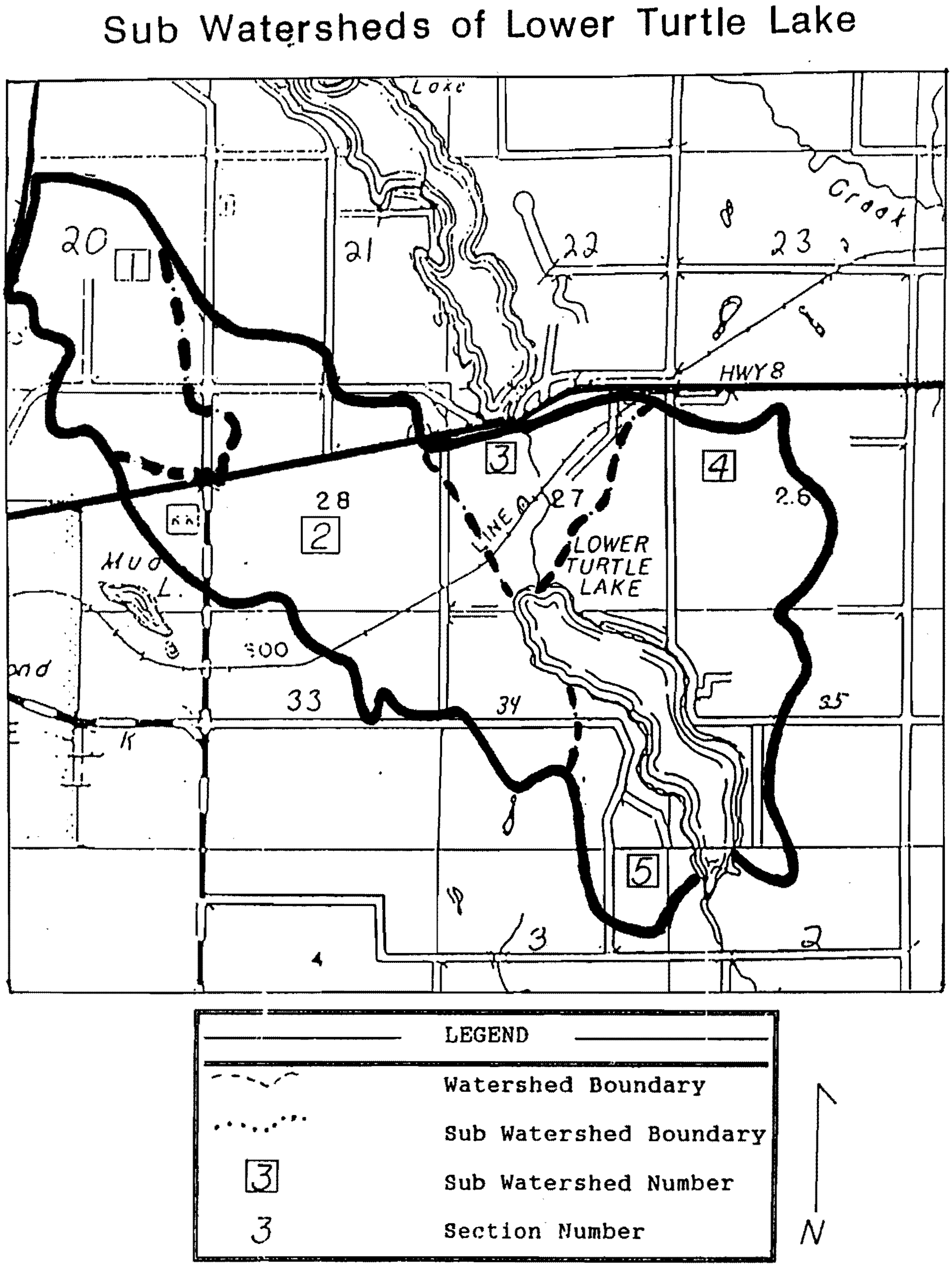


Figure 4. Subwatersheds of Lower Turtle Lake (Source: Barron Co. LCD).

Two springs were found along the west shore. Because springs represent a source of clean water, special care should be exercised to protect them.

BARNYARD SURVEY RESULTS: In the watershed study area there are currently eight feedlots and barnyards that could be contributing animal manure nutrients to Lower Turtle Lake. When the barnyard survey was done, the barnyards were ranked according to potential water quality impact. Those with the highest potential for water pollution were given a "1", a medium a "2", and a low ranking barnyard was given a "3". Of the eight barnyards surveyed, three received a ranking of "3", three received a rank of "2", and two received a rank of "1". A serious barnyard runoff problem can have a significant impact on water quality, and can also be very costly to correct. The Lake District should encourage farmers to correct runoff problems. Often moving the feedlot a short distance and installing a buffer area can reduce the amount of runoff. If expensive measures are necessary, the farmer can be encouraged to apply for Federal funding to assist with the cost.

THE WINHUSLE MODEL: The WINHUSLE (Wisconsin Non-Point Hydrologic Unit Sediment Load Estimation) program is the second generation of a program that estimated not only soil loss but also how much sediment is actually delivered to the lake. The program was first introduced in 1992 and is endorsed by the USDA-Soil Conservation Service.

WINHUSLE required that only 10% of a watershed be inventoried in order to give accurate results. Due to the small size of the watershed, data from over 80% of the watershed study area was collected for WINHUSLE. This means the information received from this program should be quite precise. The inventory of each crop field included the slope of the land, the length of the slope, soil type, crop rotation and conservation practices that exist.

The results of WINHUSLE indicate that approximately 232 tons of sediment enter the lake each year from the watershed. The model also estimates that 1132 pounds of phosphorus enter the lake each year with the sediment.

The areas with the highest contributors of sediment are listed below. Subwatershed locations are shown in Figure 4.

Subwatershed 1 is to the far north west of Turtle Lake. This area has a rating of "low". It is given the rating because of its small area and a relatively small amount of sediment comes from the area.

Subwatershed 2 is just north west of the lake itself. It is given a "high" rating. Although the soil loss/acre in this area is not real high when we ran the soil loss equation, WINHUSLE indicates that enough of the eroded soil reaches the lake.

Subwatershed 3 is just north of Lower Turtle Lake and included Turtle Creek. This area is rated "moderate". Though the soil loss is not as high as other areas, it is very close to Turtle Creek. Due to its proximity to Turtle Creek any soil that is lost has a greater chance of reaching the creek and Lower Turtle Lake.

Subwatershed 4 is to the north east of the lake. It is given the rating of "high". This area is not very large yet it has a significant soil loss and is close to the lake.

Subwatershed 5 is south west of Lower Turtle Lake. A rating of "low" was given to this area. Even though it is very close to the lake, it delivers very little sediment to the lake.

The abundance of hills in the watershed area accounts for the high sediment delivery and phosphorus loads. This does not mean that the current situation cannot be corrected. After further study with the computer model we found a simple/feasible way to cut the soil loss and phosphorus load by about 24% each.

This can be done if the Lower Turtle Lake District works with all of the farmers in the watershed to encourage them to adopt the practice of no-till or reduced tillage. Using reduced till means that all of the previous years crop residue is not plowed into the soil. Rather some or all of the crop residue remains on the surface to protect the soil from eroding.

Another possible source of nutrients and sediment for Lower Turtle Lake is the water coming out of Upper Turtle Lake. This study does not inventory the watershed of Upper Turtle, however, if water quality testing during the Lake Study indicate significant amounts of phosphorus, sediment, or other BODs coming from Upper Turtle, those sources could be identified.

MISCELLANEOUS: Just west of 3rd Street, and north of the railroad bed, in Section 28 of Almena Township is a major intermittent stream that flows to the lake. The intermittent stream is currently dammed by beavers and there are nearly 20 acres of open water behind the dam. This open water is creating some excellent wildlife habitant and the beaver dam is also creating a sediment trap. This benefits the lake, however beaver dams are usually temporary. If in the future the beaver dam is gone, the Land Conservation Department recommends that the Lower Turtle Lake Protection District consider building an agriculture sediment basin consisting of a permanent dam at this site. In the fall of 1994 after the leaves were off, LCD and DNR personnel visited the site. It appears that the site is suitable to the construction of a dam. A more detailed survey must be completed to know for sure.

CONCLUSION: The Barron County Land Conservation Department recommends that the Lower Turtle Lake Lake District address the management of runoff from the lake's watershed in two parts. The first part would be management of the rural agricultural watershed, and the second part would be management of the lakeshore watershed.

As far as the rural agricultural watershed. Farmers in the watershed should be encouraged to adopt soil erosion control practices such as reduced tillage, no-till, contour cropping where possible and grassed waterways. The spreading of animal wastes on frozen ground should be avoided where possible and farmers who have manure storage facilities should be encouraged to incorporated the manure as soon as it is spread. Furthermore, feedlots and barnyards that are located near intermittent streams that can deliver animal waste to Lower Turtle Lake should be encouraged to relocate their feedlots if possible, or to install barnyard runoff systems. Manure storage facilities can also be installed where they currently do not exist. The Lower Turtle Lake Lake District should encourage landowners to enroll for funds for expensive practices with the Barron County CFSA (Consolidated Farm Service Agency, formerly ASCS) in Barron.

As far as the shoreline watershed of Lower Turtle Lake. The Lake District should undertake and educational program to make shoreline residents of Lower Turtle Lake aware of activities that can be harmful to the lake. Malfunctioning septic systems can be a significant source of nutrients and bacteria to a body of water. Also, seemingly harmless activities can often be quite harmful and shoreline residents should be made aware of these activities. For instance, burning brush and other things along the shoreline can result in the ash being washed into the lake. Over fertilization of the lawns, the use of pesticides around the home, and a whole host of other activities that a non lakeshore owner can usually do without significant impact to the environment can become very harmful when done in the proximity of a lake.

Lower Turtle Lake which annually experiences a rather significant algae bloom will probably never be a crystal clear algae and weed free lake. However, with common sense activities in the watershed and around the lake, Lower Turtle Lake should remain an excellent fishing and recreational lake for future generations.

The results of the sediment delivery study are included in the chart below and the next page. The chart shows the estimated amount of sediment delivered to the lake annually, along with predicted reductions with reduced tillage and no till. The quantities for reduced tillage and no-till assume that all farmers in a sub watershed adopt the practice.

The subwatershed with the largest phosphorus delivery amount is subwatershed 4. Examples of potential phosphorus sources from subwatershed 4 to Lower Turtle Lake are shown in Figures 5 and 6.

Sub-Watershed Area	Tons of Sediment Delivered Now	Tons of Sediment with Reduced Tillage	Tons of Sediments with No-Till
1	16	14	12
2	78	63	48
3	11	8	7
4	122	87	67
5	4	4	3

The WINHUSLE sediment delivery study also predicts how much phosphorus is delivered to the lake with the sediment. The chart below shows the estimated amount of phosphorus delivered to the lake annually, along with predicted reductions with reduced tillage and no till. the figures for reduced tillage and no-till assume that all farmers in a sub watershed adopt the practice.

Sub-Watershed Area	Pounds of Phosphorus Delivered Now	Pounds of Phosphorus with Reduced Tillage	Pounds of Phosphorus with No-Till
1	82	73	64
2	391	314	239
3	57	44	38
4	575	409	319
5	23	22	18

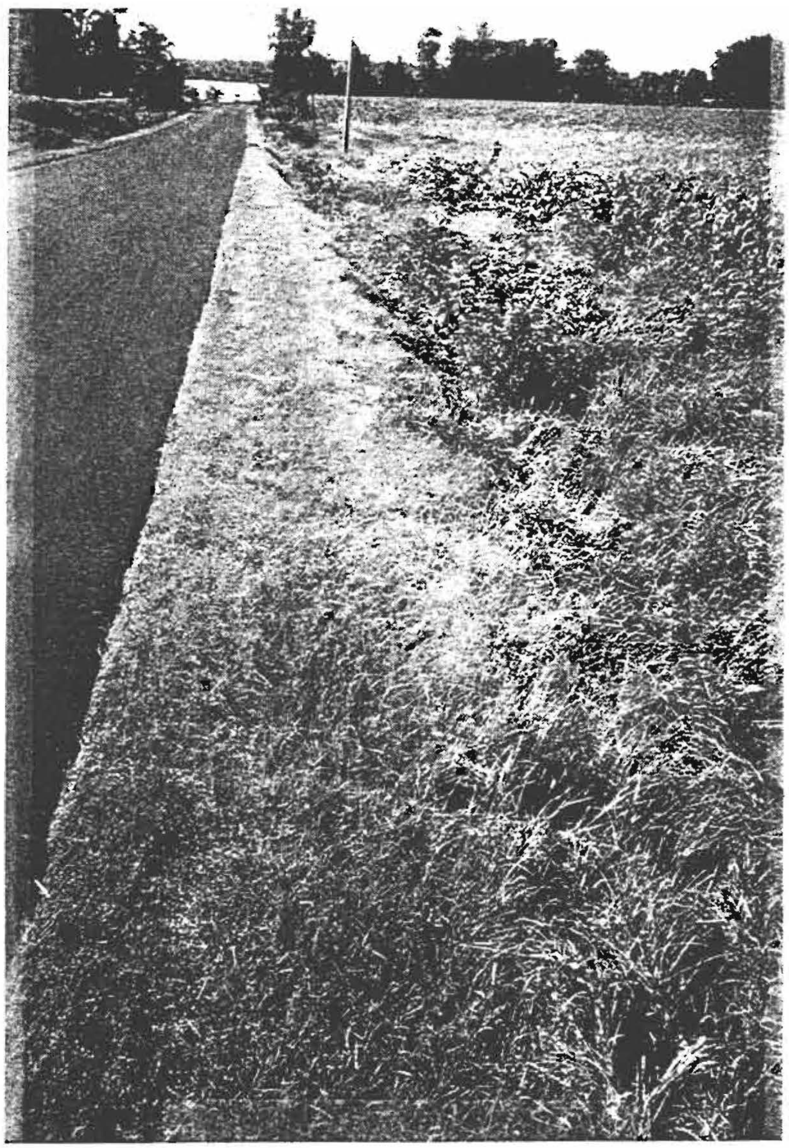
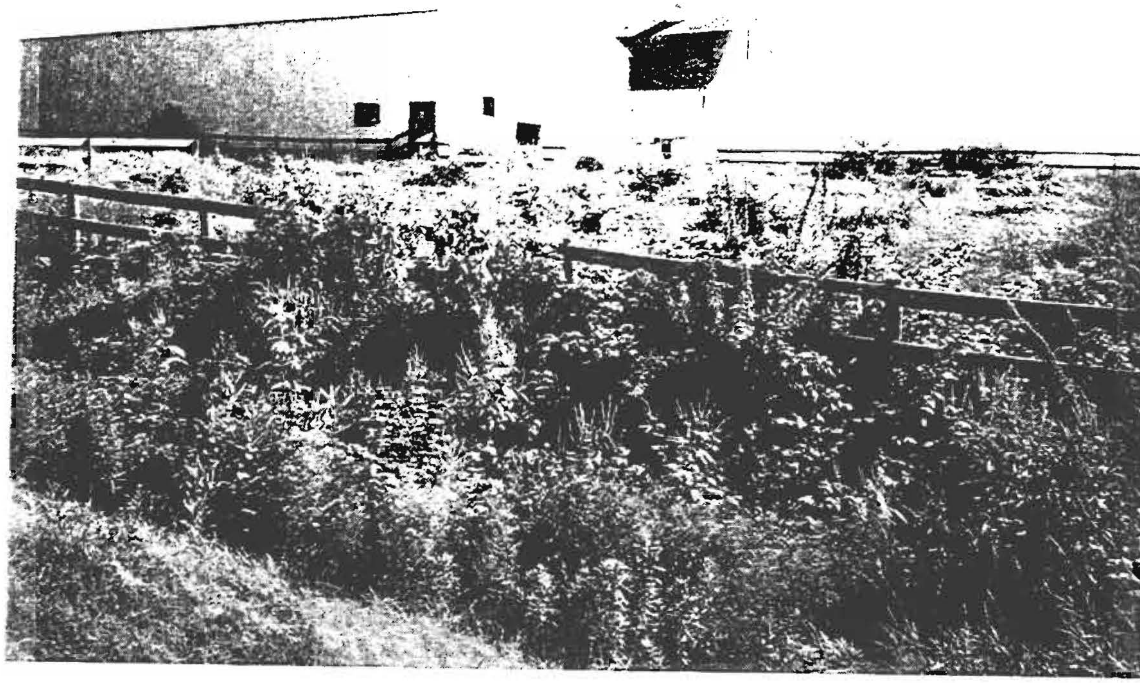


Figure 5. Row cropping in subwatershed 4. Roadside ditch drains to the lake.



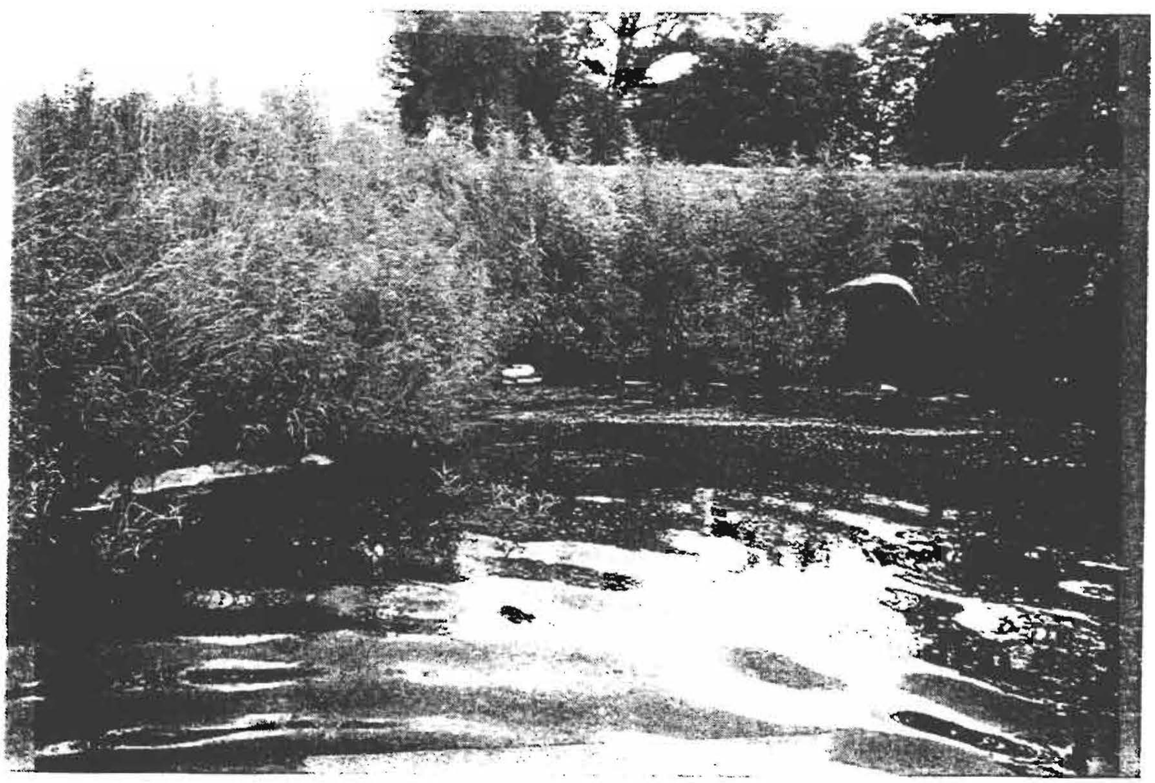


Figure 6. Temporarily idle farm in subwatershed 4 (top). Runoff from this acreage goes into Turtle Lake by way of the culvert shown in the bottom photo.

4. Stream Characteristics

Lower Turtle Lake has five streams entering the lake (Figure 7). The main stream comes from the Upper Turtle Lake outlet (Turtle Creek)(Figure 8) .

According to the Lower Turtle Lake Watershed Study by Barron County Land Conservation Department, Turtle Creek has an undisturbed streambank, there was however, evidence that at one time some of the area was pastured.

Stream flows were recorded in 1994. Turtle Creek flow was 9.9 cubic feet per second (cfs) on April 13 1994, during spring runoff. In early summer it was 4.6 cfs (recorded on June 7, 1994) and was fairly constant for the rest of the summer. The Northwest Tributary (shown in Figure 9) had a flow of about 0.1 cfs on June 7, 1994. Flows were low for the entire summer. The other tributaries also had low flows, often less than 2 gallons per second. We did not capture rain event flows, but storms in 1994 did not produce heavy rainfall (nothing over 2 inches).

Turtle Creek had a high phosphorus and total suspended sediment concentration on a June 20, 1994 date (Table 1), indicating that elevated nutrients will come into the lake with storm events.

The average phosphorus concentration of Turtle Creek from March to August, 1994 was 95.5 ppb. Water chemistry data for Turtle Creek and the other streams that enter Lower Turtle Lake are shown in Table 1.

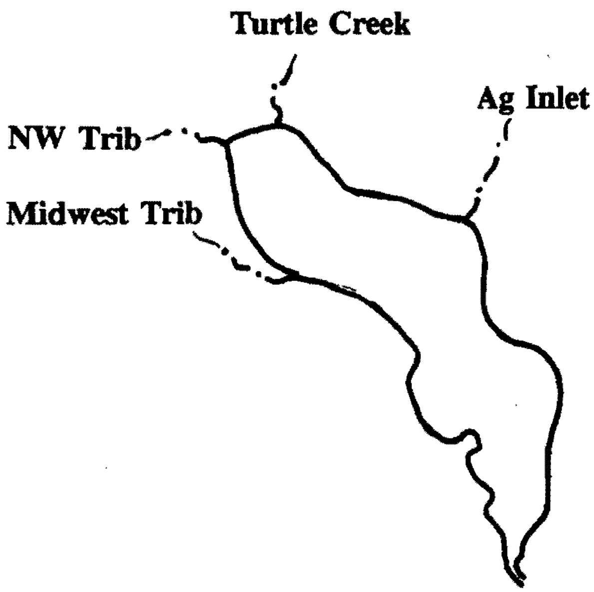


Figure 7. Tributaries to Lower Turtle Lake.

Table 1. Water Chemistry for tributary streams to Lower Turtle Lake in 1994.

Location	Date/ Source	TP (ppb)	TSS (mg/l)	Fe (mg/l)
Turtle Creek	3.5.94 1	120		
Turtle Creek	3.25.94 1	27		
Turtle Creek	4.9.94 1	14		
Turtle Creek	4.13.94 1	31	5	
Turtle Creek	6.7.94 1	50	9	0.31
Turtle Creek	6.20.94 2	500	108	4.5
Turtle Creek	7.5.94 2	51	30	10.0
Turtle Creek	7.7.94 2	48		0.2
Turtle Creek	8.3.94 1	57	4	0.27
NW Trib	4.13.94 1	340	13	
NW Trib	6.7.94 1	193	6	2.6
NW Trib	7.7.94 2	54		3.7
NW Trib	8.3.94 1	178	11	2.0
NW Trib - bottom	4.19.94 1	43		
NW Trib - rain storm	4.27.94 1	105		
Murry Cr	5.9.94 1	946		
Midwest Trib	7.7.94 2	180		1.1
Culvert from Ag Land	8.3.94 1	375		2.0

1 = collect by Blue Water Science
2 = collected by Lake District

5. Lake Characteristics

5.1. Physical/Chemical Data Emphasizing Dissolved Oxygen and Temperature

Lower Turtle Lake is 276 acres in size, with a watershed of 5,265 acres (from the Barron County LCD). The average depth of Lower Turtle Lake is 4.6 meters (15 feet) with a maximum depth of 7.3 meters (24 feet) (Table 2). A lake contour map is shown in Figure 10. Lower Turtle Lake is located in an area of Wisconsin that is dominated by agricultural land use.

The secchi disc transparency had an average summer depth of 2.6 meters (8.5 feet) in 1994. This is the highest summer average recorded since measurements have been made. Details are given in the next section.

The summer dissolved oxygen (DO) and temperature profiles for 1990, 1991, and 1994 are shown in Figure 11. The lake is weakly stratified in regard to temperature and generally has oxygen from top to bottom.

Table 2. Lower Turtle Lake Characteristics

Area (Lake): 276 acres (112 ha)
Mean depth: 15 feet (4.6 m)
Maximum depth: 24 feet (7.3 m)
Volume: 4,140 acre-feet (515 Ha-M)
Watershed area: 5,265 acres (2,131 ha)
Watershed: Lake surface ratio 19:1
Estimated average water residence time 1 year
Public accesses (#): 2
Inlets: 2 Outlets: 1

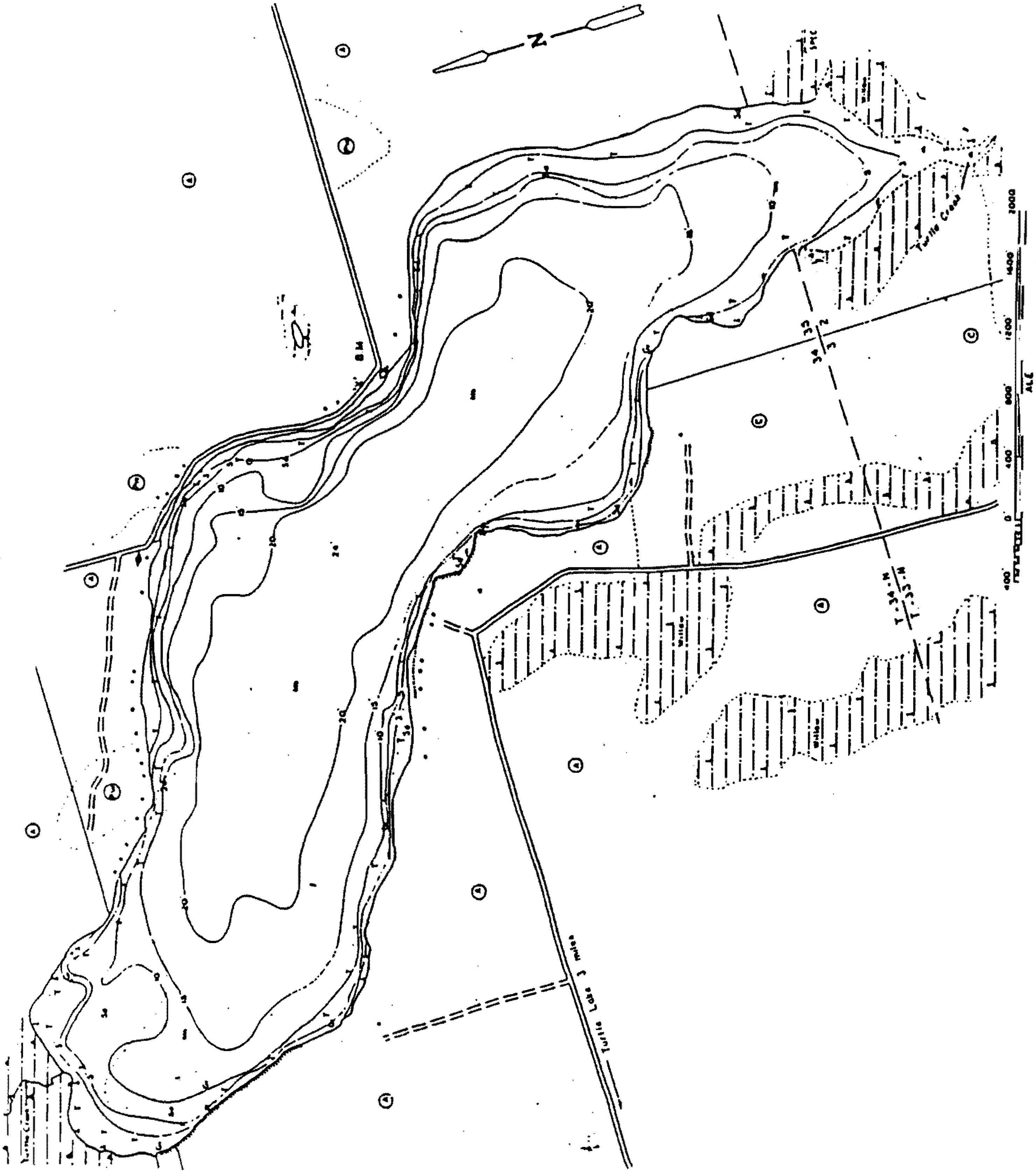


Figure 10. Lake contour map of Lower Turtle Lake, Barron County, Wisconsin.

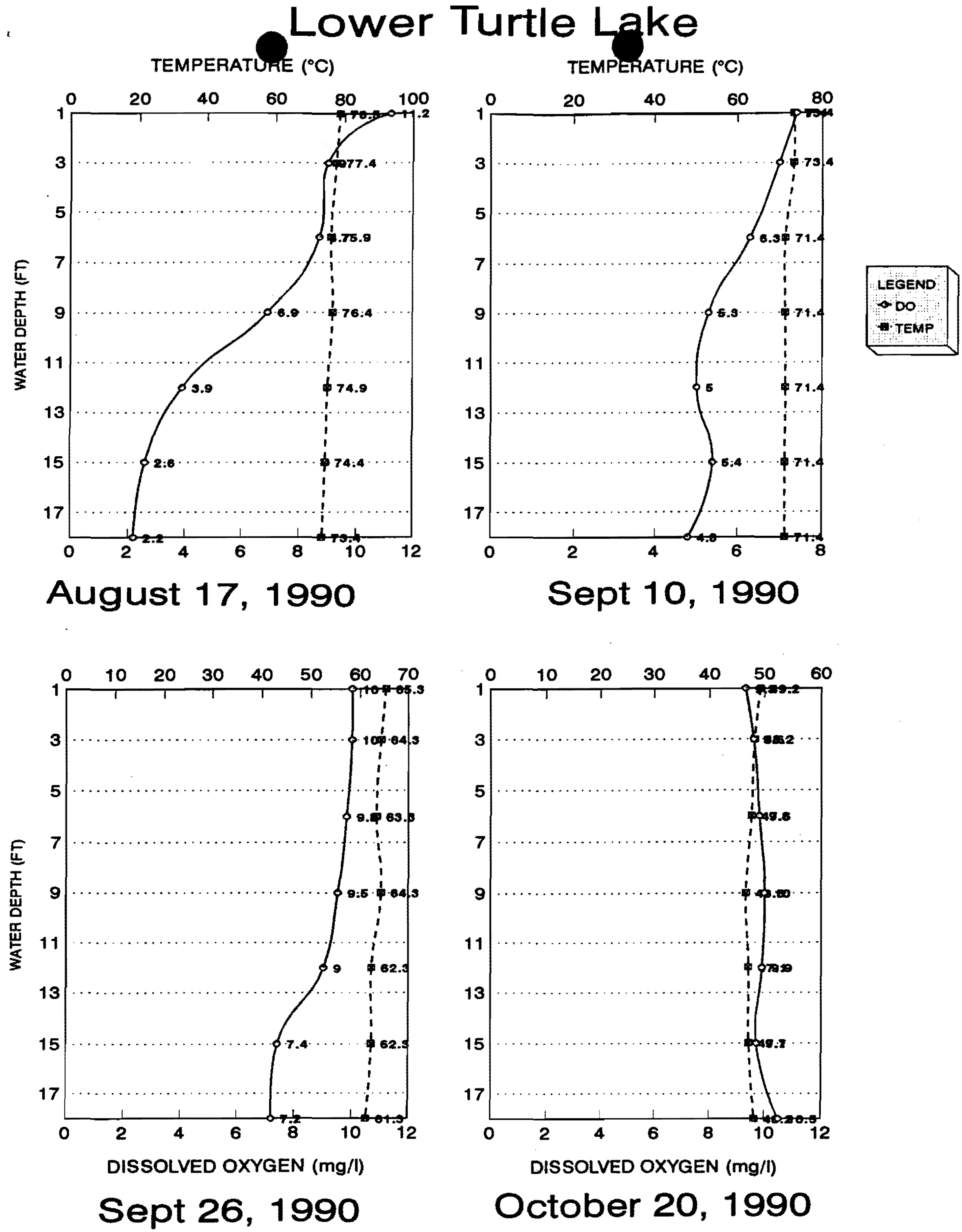


Figure 11. Dissolved oxygen/temperature profiles of Lower Turtle Lake, Wisconsin.

Lower Turtle Lake

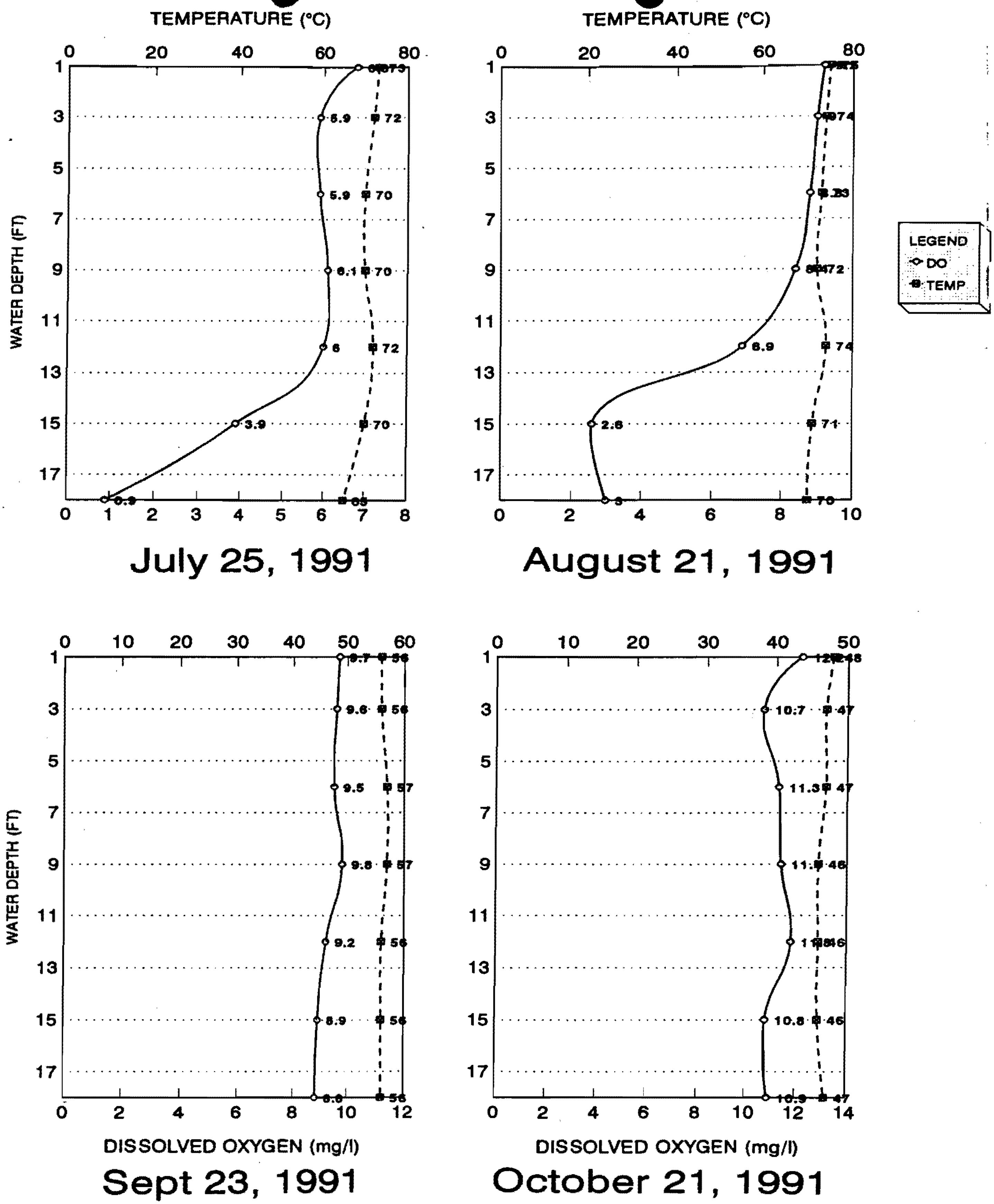


Figure 11. Continued.

Lower Turtle Lake

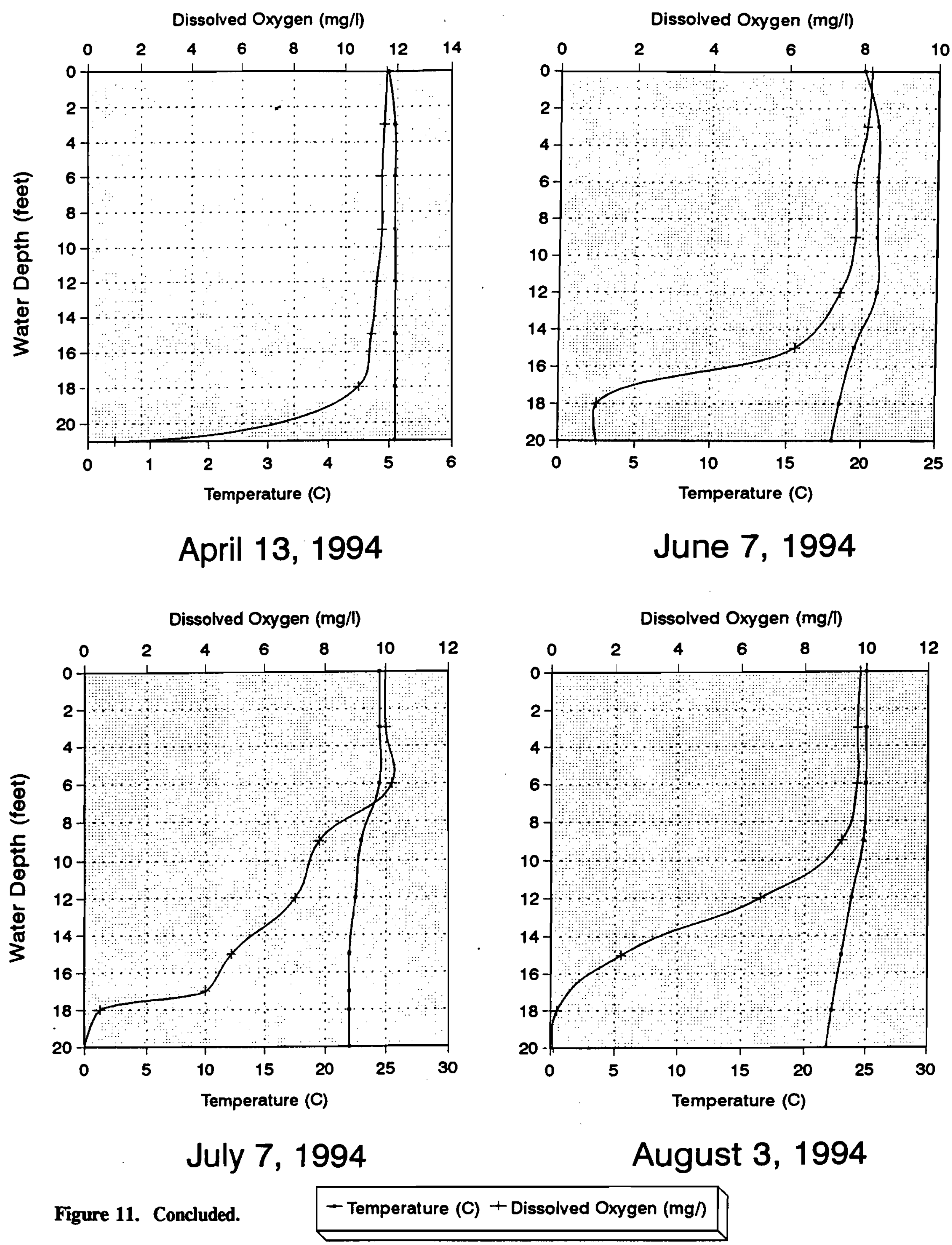


Figure 11. Concluded.

5.2. Physical/Chemistry Data Emphasizing Secchi Disc, Phosphorus, Nitrogen and Iron

Summer water chemistry data collected during 1994 included secchi disc, total phosphorus (TP), chlorophyll a (Chl a), total kjeldahl nitrogen (TKN), ammonia (NH_3), nitrate (NO_3), and conductivity (Cond) (Table 3). Samples were collected at the surface and two feet off the bottom in the deepest area of Lower Turtle Lake.

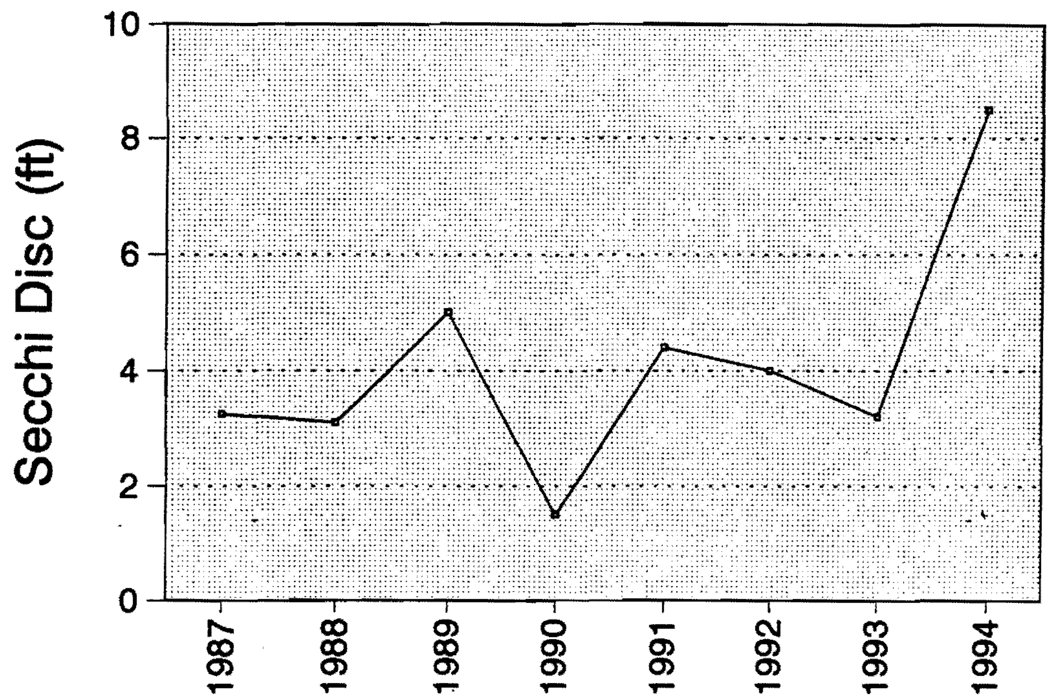
Table 3. Lake Sample results for 1994. Summer averages are June through August.

Location	Date/ Source	TP (ppb)	TKN (mg/l)	Chl a (ug/l)	Fe (mg/l)	Nitrate (mg/l)	Secchi disc (ft)
Lake - top	4.13.94 1	66	1.1	29.2	0.92	0.199	4.3
Lake - bottom	4.13.94 1	64			0.75	0.197	
Lake - top	6.6.94 2	24		3.8			
Lake - bottom	6.6.94 2	142					
Lake - top	6.7.94 1	25	0.6	4.8	0.18	0.173	12.5
Lake - bottom	6.7.94 1	42			0.37	0.088	
Lake - top	7.7.94 2	33	0.7	13	0.09	<0.007	6.0
Lake - bottom	7.7.94 2	31			0.3	<0.007	
Lake - top	7.12.94 2	43		17			
Lake - bottom	7.12.94 2	42					
Lake - top	8.3.94 1	31	0.5	12.2	0.08		7.6
Lake - bottom	8.3.94 1	54			0.2	0.015	7.0
Lake - top	8.24.94 2	25		21.1			
Lake - bottom	8.24.94 2	39					
Lake -top	10.13.94 2	31	0.5	12.2	0.08		7.6
Lake - bottom	10.13.94 2	36					
Jun-Aug Average		26	0.6	12.0	0.12	0.06	8.3

1 = Blue Water Science
2 = Lake District

Total phosphorus was high in April and the transparency was low (4.3). Through the summer phosphorus levels decreased and water transparency increased. Water clarity was the best its been since 1987 (Figure 12). Total phosphorus was higher in the bottom water than the top water in June indicating some phosphorus release from the bottom material (sediments or plants) may be occurring (Table 3 and Figure 13).

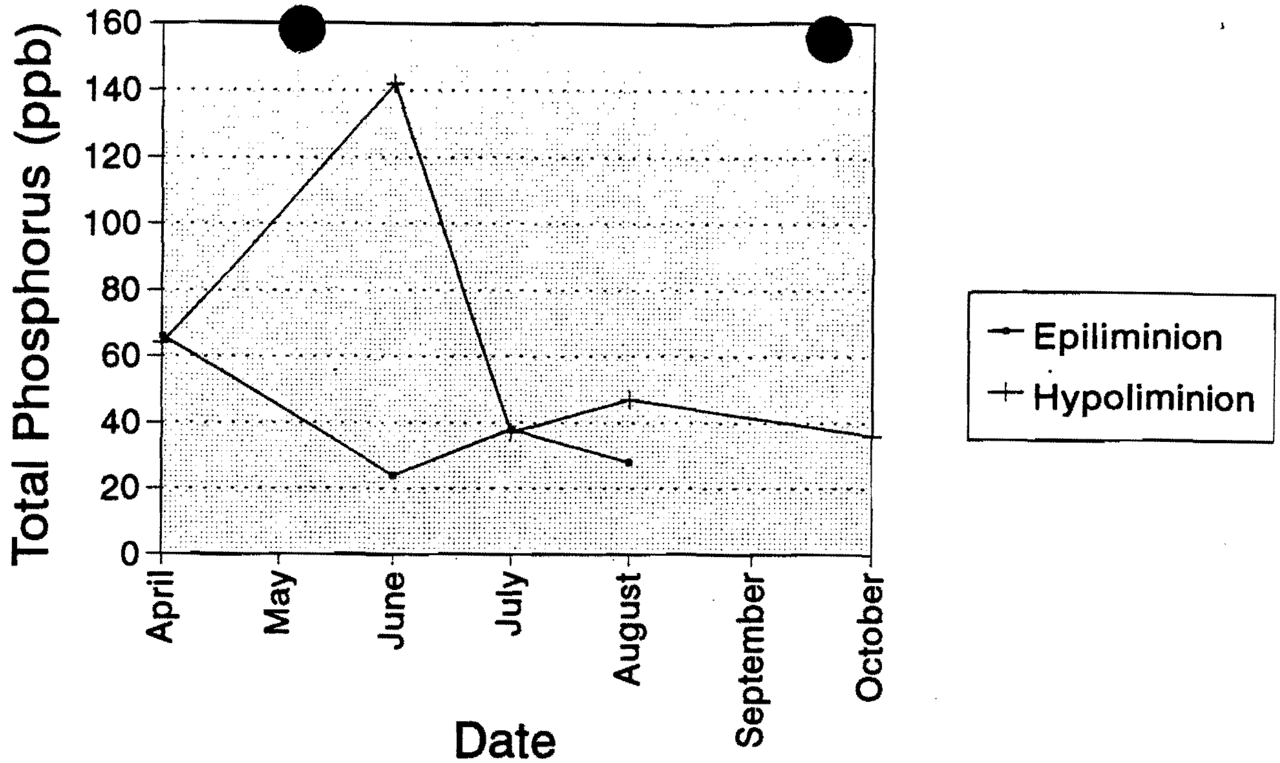
Chlorophyll a (which is a measure of the algae) was also the highest in April and was lower for the rest of the summer. Iron concentrations were high in April also, and then were low in the surface water in the summer. They were elevated in the bottom water (Table 3). Nitrogen values were typical for lakes in this area.



	1987	1988	1989	1990	1991	1992	1993	1994
Secchi Disc	3.25	3.1	5	1.5	4.4	4	3.2	8.5
Maxinum	6.3	6	5.5	4.5	7.8	5.5	6	12.5
Minimum	1.5	1.8	4.5	1.5	2.8	3.3	1.8	6

Year

Figure 12. Secchi disc transparencies from 1987 to 1994 for Lower Turtle Lake.



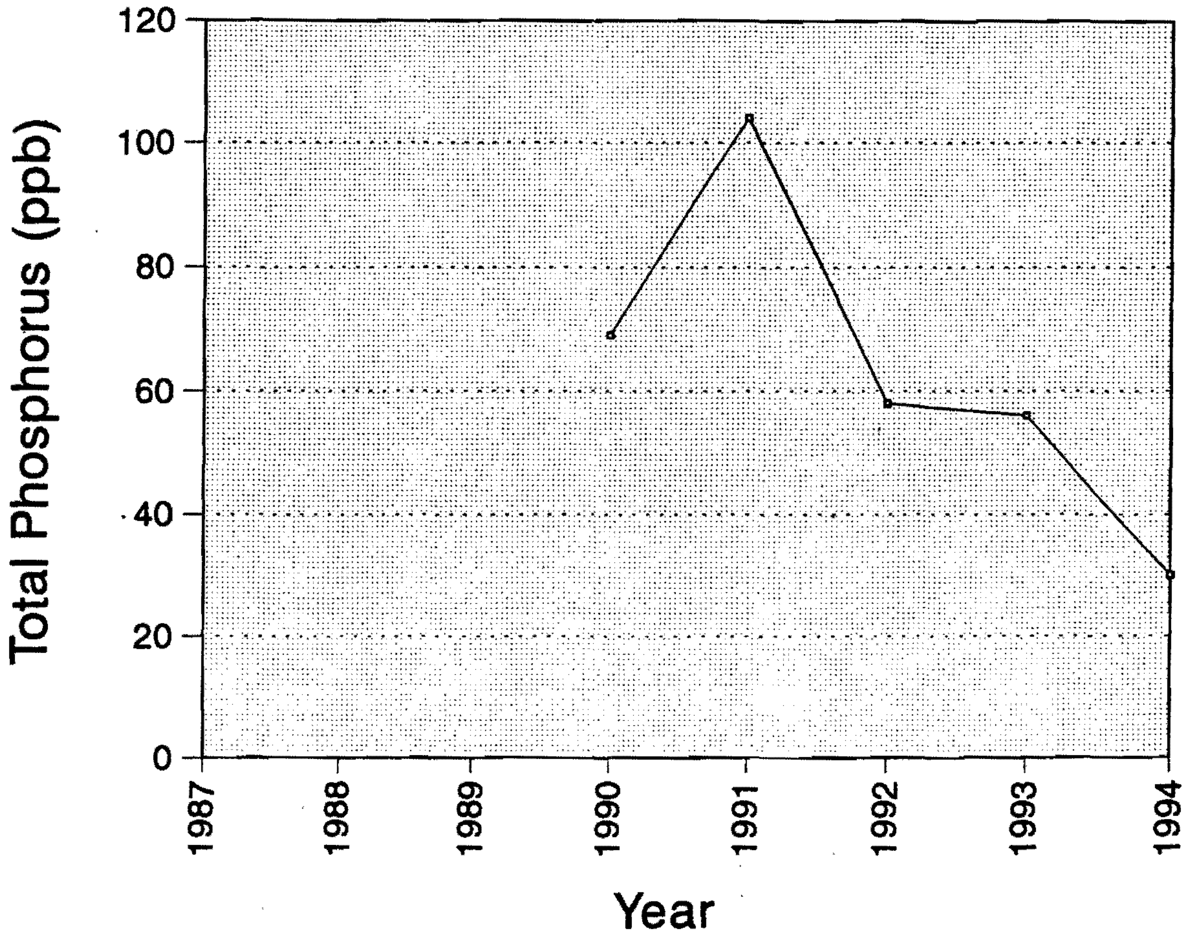


Figure 13. Phosphorus concentrations in Lower Turtle Lake. Top Graph: upper (epilimnion) and lower (hypolimnion) phosphorus concentrations for 1994. Bottom graph: average summer phosphorus concentrations since 1990.

5.3. Algae and Zooplankton

Algae: Algae samples were taken two times during the 1994 sampling summer. Phytoplankton are microscopic plants that are indicators of the amount of nutrients, mostly phosphorus, that are in the water column.

Overall numbers of algae were low. The analysis indicate that green algae are the dominant algae during the sample year of 1994 (Table 4).

Zooplankton: Zooplankton samples were collected four times during the summer of 1994.

Copepods were the dominant zooplankton in Lower Turtle Lake throughout the summer of 1994. Daphnids were found on all sampling dates and large daphnia (which are good grazers on algae) were found in April, June and July. Results of the zooplankton analysis is shown in Table 4.

Table 4. Results of zooplankton and phytoplankton analysis.

Lower Turtle Lake phytoplankton counts

Date	Species	Number/milliliter of water
6.7.94	Pediastrum	17
	Chlorococcales	276
7.7.94	Microcystis	17

Lower Turtle Lake zooplankton counts

	Daphnids						Copepods				Rotifers
Date	Big	Little	Ceriodaphnia	Bosmina	Chydorus	Total	Calanoids	Cyclopoids	Nauplii	Total	
4.13.94	6	3	0	1	0	10	1	33	30	64	0
4.13.94	6	1	0	1	1	9	0	40	31	71	0
6.7.94	10	7	0	0	0	17	0	31	17	48	1
7.7.94	3	1	0	0	0	4	1	6	46	53	0
8.3.94	0	10	1	1	1	11	2	58	0	60	0

5.4. Conductivity Survey

A conductivity survey was preformed on Lower Turtle Lake during August 1994. A conductivity survey uses a Yellow Springs Inc. specific conductance meter with the probe secured to the end of a pole. A boat moves slowly around the shoreline and he meter is watched to spot changes in specific conductance. The objective of the conductivity survey is to find possible groundwater inflows (springs) or faulty on-site wastewater treatment systems. A conductivity less than the background conductivity of the open lake indicates areas of groundwater inflow, whereas a higher conductivity, could indicate a faulty septic system.

There are a few locations around Lower Turtle Lake that need to be looked at more closely in regard to potential failing on-site systems (Figure 14). Conductivity that is different than open lake background (220 umhos/cm^2) by about 10% should be looked at more closely. There appears to be four locations around Lower Turtle Lake that could be groundwater inflows, and one location that could be a faulty septic system or a point source of pollution to the lake.

The survey setup is shown in Figure 15.

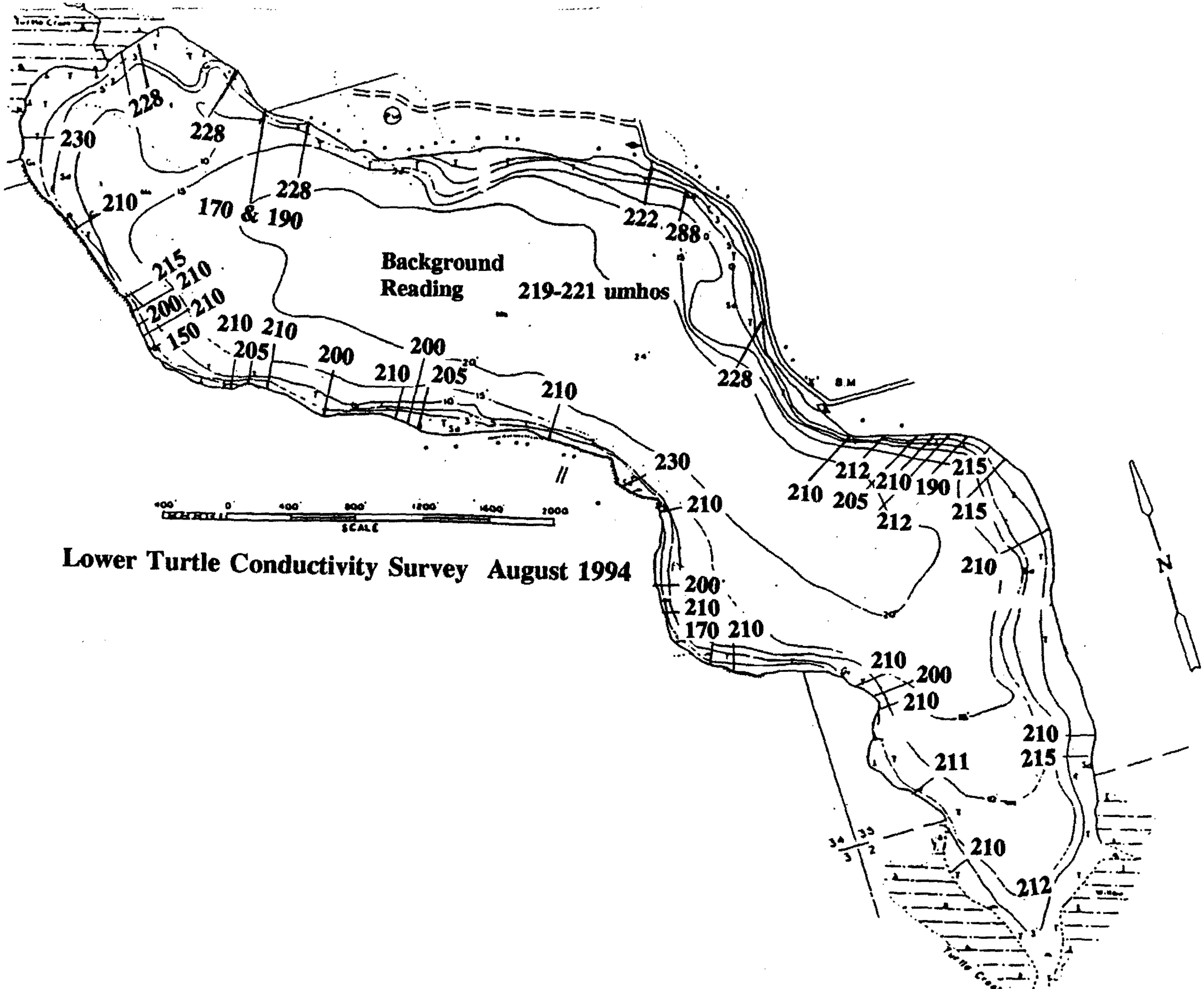


Figure 14. Conductivity survey map of Lower Turtle Lake, August 1994.

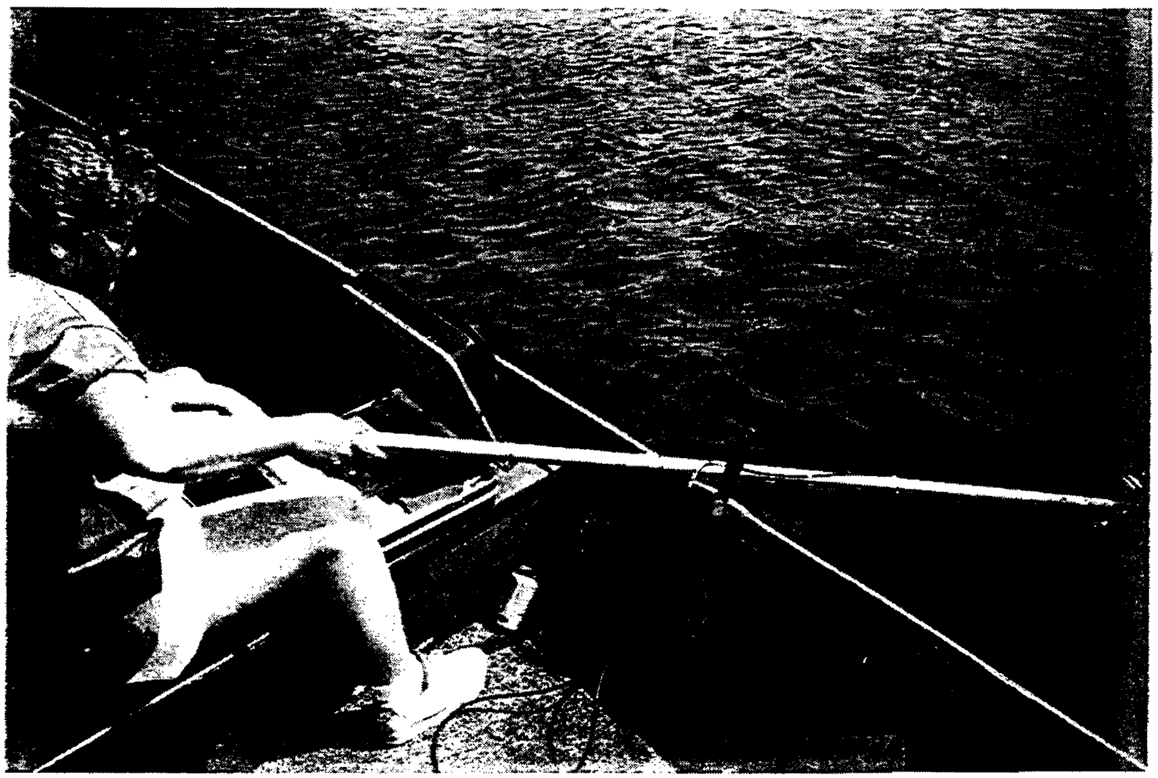


Figure 15. Septic leachate survey being conducted on Lower Turtle Lake in 1994.

5.5. Macrophytes

An aquatic plant survey was conducted on Lower Turtle Lake in July and August, 1994 and results are shown below.

Twenty-two transects (Figure 16) were run with sample points at 0-3 feet, 4-6 feet, 7-10 feet, and greater than 10 feet. Rooted plants were found in water to a depth of eight feet. Plant coverage is shown in Figure 17. Plant coverage on the bottom is roughly 31% of the bottom area. Four plant groups are represented, with no group dominating Figure 17 and Tables 6 and 7. Representative plants are shown in Figures 18 and 19.

Table 5. Species list of the aquatic plants found in Lower Turtle Lake. Seventeen species are shown below and we probably missed a couple.

Common Name	Scientific Name
Flatstem pondweed	*Potamogeton zosteriformis?*
Water celery	*Vallisneris americana*
Curlyleaf pondweed	*P. crispus*
Claspingleaf pondweed	*P. richardsonii*
Northern milfoil	*Myriophyllum exalbescens*
Coontail	*Ceratophyllum demersum*
Sago pondweed	*P. pectinatus*
Whitelily	*Nymphaea tuberosa*
Elodea	*Elodea canadensis*
Naiads	*Najas sp.*
Cattails	*Typha sp.*
Variable pondweed	*P. gramineus*
Chara	*Chara sp.*
Softstem bulrush	*Scirpus validus*
Robins pondweed	*P. robbinsii*
Arrowhead	*Sagittaria sp.*
Filamentous algae	

The most common plant the flatstem pondweed, followed by water celery and curlyleaf pondweed (Tables 6 and 7). IN 1994, there was a diverse plant community.

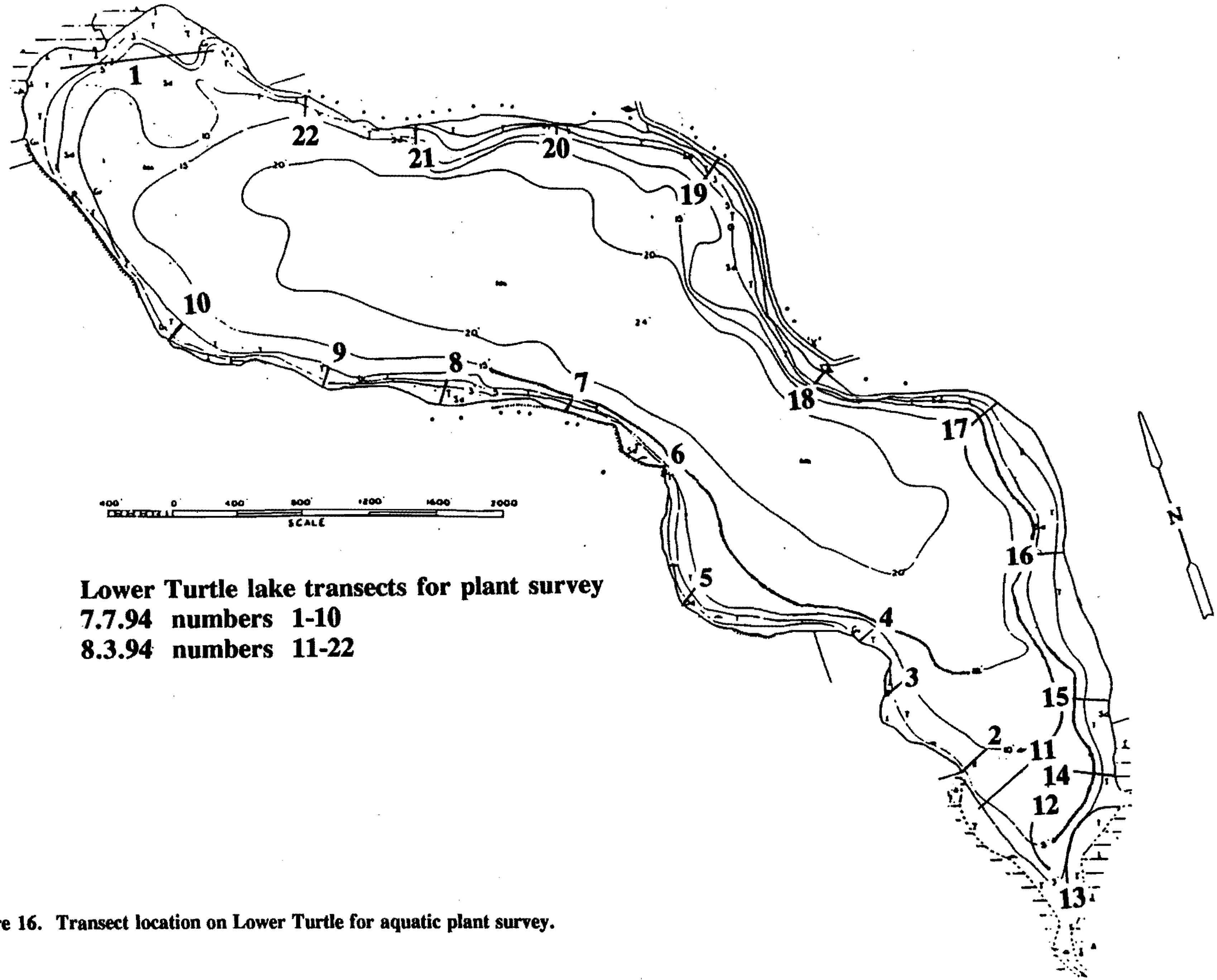


Figure 16. Transect location on Lower Turtle for aquatic plant survey.

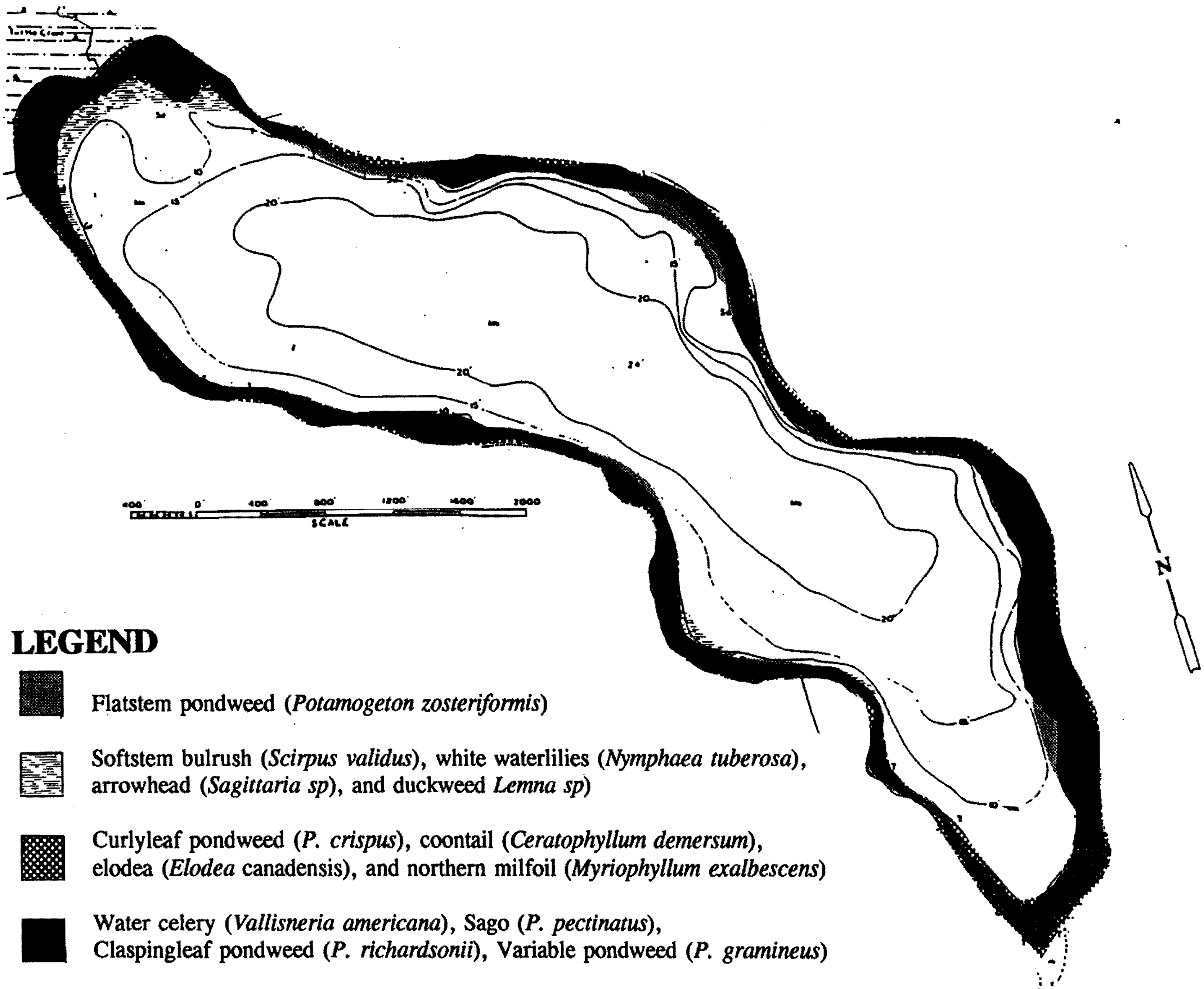


Figure 17. Aquatic pant distribution in Lower Turtle Lake, July and August, 1994.

Table 6. Summary of aquatic plant occurrence and density for Lower Turtle Lake, 1994.

	Depth 0-3			Depth 4-6			Depth 7-10			TOTALS				
											All Stations		Where plants are	
Plant Species	Occur	%Occur	Density	Occur	%Occur	Density	Occur	%Occur	Density	Occur	%Occur	Density	%Occur	Density
Flatstem	19	86	3.4	13	59	2.8	6	27	1.8	38	62	1.9	70	2.9
Water celery	16	73	2.9	12	55	3	1	6	1	29	48	1.4	54	2.9
Curlyleaf pondweed	8	36	1.7	11	50	1.8	4	24	1.5	23	38	0.7	43	1.7
Claspingleaf pondweed	9	41	1.3	4	18	1.5	1	6	2	14	23	0.3	26	1.4
Northern milfoil	8	36	1	5	23	1.4	1	6	1	14	23	0.3	26	1.1
Filamentous algae	6	27	3.4	3	14	3	1	5	2	10	16	0.5	19	3.1
Coontail	3	14	3.9	5	23	2.9	1	5	5	9	15	0.5	17	3.5
Sago	6	27	2.1	3	14	1.7	0	0	0	9	15	0.3	17	2
White lily	6	27	1.5	2	9	1	0	0	0	8	13	0.2	15	1.4
Elodea	4	18	1.3	2	9	1.8	1	6	2	7	11	0.2	13	1.6
Naiads	3	14	1	1	5	1	0	0	0	4	7	0.1	7	[illegible]
Cattails	2	9	2.5	2	9	1.8	0	0	0	4	7	0.1	7	2.2
Variable pondweed	1	5	4	1	5	4	0	0	0	2	3	0.1	4	4
Chara	1	5	1	0	0	0	0	0	0	1	2	0.02	2	1
Softstem bulrush	0	0	0	1	5	1	0	0	0	1	2	0.02	2	1
Robins pondweed	0	0	0	1	5	1	0	0	0	1	2	0.02	2	1
Arrowhead	1	5	1	0	0	0	0	0	0	1	2	0.02	2	1

Table 7. Plant densities for transects 1-11.

Lower Turtle Lake Plant Survey, 7/7/94.

	T1 (parallel to shore)										T2						T3		T4						
Species	1A	1B	1C	1D	1E	1A	1B	1C	1D	1E	2A	2B	2C	2D	2E	2F	3A	3B	4A	4B	4C	4D	4E	4F	4G
Depth (ft)	1	1	1	1	1	3	3	3	3	3	10	8	6	3	2	1	8	2	8	6	5	4	3	2	1
Sago	1			3		3																		3	
Flatstem				2	3	2	3	3	4					5		2		5			2	2	2		
Water Celery	2			2			1							1	2	2		2				3			
Curlyleaf	2	1		1	1	2			1				4	4		2		3						1	
Coontail	5	5	2	4			5	3	2																
Wh.W. Lilly	1	1		1											1	1									
Elodea	1	3	2			2						2													
Duckweed		5	5																						
Filament. Alg.		2				1						2													
Naiads				1	1																				
P. Rich				1	1				1									2					3		
S.S. Bulrsh					P																				
N. Milf.							1	1					2	1	1							1			
Var. Pndwd	1																								
Arrwhd spp.																									1

	T5				T6					T7				T8			T9					T10		T11			
Species	5A	5B	5C	5D	6A	6B	6C	6D	6E	7A	7B	7C	7D	8A	8B	8C	9A	9B	9C	9D	9E	10A	10B	11A	11B	11C	11D
Depth (ft)	7	5	3	2	8	7	5	3	1	7	5	4	2	5	3	1	8	6	5	4	2	6	4	8	6	5	3
Sago			2	3												1									2		
Flatstem	2	1	5		1	1		1	3			1	5		2	2	2	2	3	4	4	2	4		2	3	3
Water Celery		2	3	2			3	3			4	4	1	4	4	3									2	2	2
Curlyleaf			1	2												1											
Coontail																									3	3	
Wh.W. Lilly				2																							
Elodea																											
Duckweed																											
Filament. Alg.																1											2
Naiads																											
P. Rich															1												
S.S. Bulrsh																							1				
N. Milf.																		1								1	
Var. Pndwd																				4	4						
Arrwhd spp.																											

5.6. Fish

Lower Turtle Lake has one of the best walleye populations in Barron and Polk Counties, third only to Big Butternut Lake in Polk county and Upper Turtle Lake in Barron County (Table 8).

Lower Turtle Lake is currently managed as a Bass-Panfish-Northern Pike-Walleye lake. The last walleye stocking was in 1969.

In 1992 the Great Lakes Indian Fish and Wildlife Commission conducted two fish surveys on Lower Turtle Lake. One survey to determine the size of the adult walleye population, conducted in April and the other survey was to sample the natural walleye recruitment, conducted in September.

The 1992 results indicate that the adult walleye population was about 3.83 walleyes per acre (male = 2.97 walleyes/acre and female = 0.86 walleyes/acre). The size of the walleyes ranged from 7.0 to 27.49 inches in length. The fall survey sampled a total of 56 walleyes, 26 were age 0. This indicates that the walleyes have good natural recruitment in Lower Turtle Lake.

Table 8. Adult walleye population estimates for Barron and Polk County Lakes, source Richard Cornelius, WDNR, letter to George Fahley.

Lake	Adult walleye/acre
Big Butternut, Polk	4.7
Upper Turtle, Barron	4.0
Lower Turtle, Barron	3.8
Balsam, Polk	3.3
Red Cedar, Barron	2.9
Pipe, Polk	2.6
Big Round, Polk	2.0
Wapogasset, Polk	1.9
Half Moon, Polk	1.5
Beaver Dam, Polk	1.4
Silver, Barron	1.1
Sand, Barron	1.0
Bear, Barron	0.9

6. Lower Turtle Lake Phosphorus Model

Lake modeling is a tool that aids in predicting what phosphorus concentrations should be in a lake based on the amount of nutrients that comes into a lake on an annual basis. A lake model can also be used to predict what future conditions could be if changes occur in the watershed that bring in more phosphorus.

Many lake models have been written. In this report we used the Wisconsin Lake Model Spreadsheet (WLMS) which will run 10 different lake models at the same time. An example of an equation used in a lake model is the Canfield and Bachmann Model (1981). The model format is shown in Table 9.

Before the WLMS models could be run, nutrient and water budget for Lower Turtle Lake was needed. To estimate the nutrient budget, phosphorus concentrations were assigned for various land use delineations and then assuming a certain amount of runoff per year we estimated phosphorus inputs from various land uses. A summary of phosphorus export coefficients for each land use and then the total estimated phosphorus input to Lower Turtle Lake is shown in Table 10. The nutrient input table shows that agricultural land is the major nutrient contributor to Lower Turtle Lake. The variables with high uncertainty are groundwater inputs as well as septic tank inputs. Our estimates are that septic tanks inputs are relatively low.

The phosphorus model predictions and the actual observed phosphorus load are shown in Table 10 as well.

Table 9. Phosphorus models used for Lower Turtle Lake.

Canfield and Bachmann Phosphorus Model (1981)

$$TP = \frac{L}{z(0.162\ (L/z)^{0.458} + p)}$$

where:

TP (mg/m^3) = concentration of total phosphorus in the lake water

L ($mg/m^2/yr$) = annual phosphorus loading per unit of lake surface area

z (m) = mean depth of the lake

p (yr^{-1}) = hydraulic flushing rate

Model Results: Phosphorus loading was based on assuming a flow weighted mean phosphorus concentration for Turtle Creek of 60 ppb. The amount of flow was assumed to be 10 inches of runoff for the 2,465 acres of the Upper Turtle Lake watershed (2,260 acre-feet = 278.8 ha-m). The annual input of phosphorus from Upper Turtle Lake is approximately 167 kg/year.

Land use was determined using aerial photographs from the updated Barron Co. soil survey and a U.S.G.S. quad map (showing wetland areas).

The nutrient loading from on-site wastewater treatment systems was estimated based on the number of people living around Lower Turtle Lake. We assumed 100 cabins with 30% being permanent residences occupied by 2 people (60 capita - years). We also assumed that 70 residences are seasonal and are used 2 months per year with an average of 4 people (47 capita - years). A total of 107 capita - year was used in the model. This results in about 9 kilograms of phosphorus coming into Lower Turtle Lake per year from on-site systems.

The 10 models all used the same input data, but the predicted lake phosphorus concentration ranged from 30 to 87 ppb. The observed phosphorus concentration was 26 ppb. The models overestimated the lake phosphorus concentration which means that there may not be as much phosphorus going into Lower Turtle Lake as we estimated.

7. Lake Status and Trophic State Index

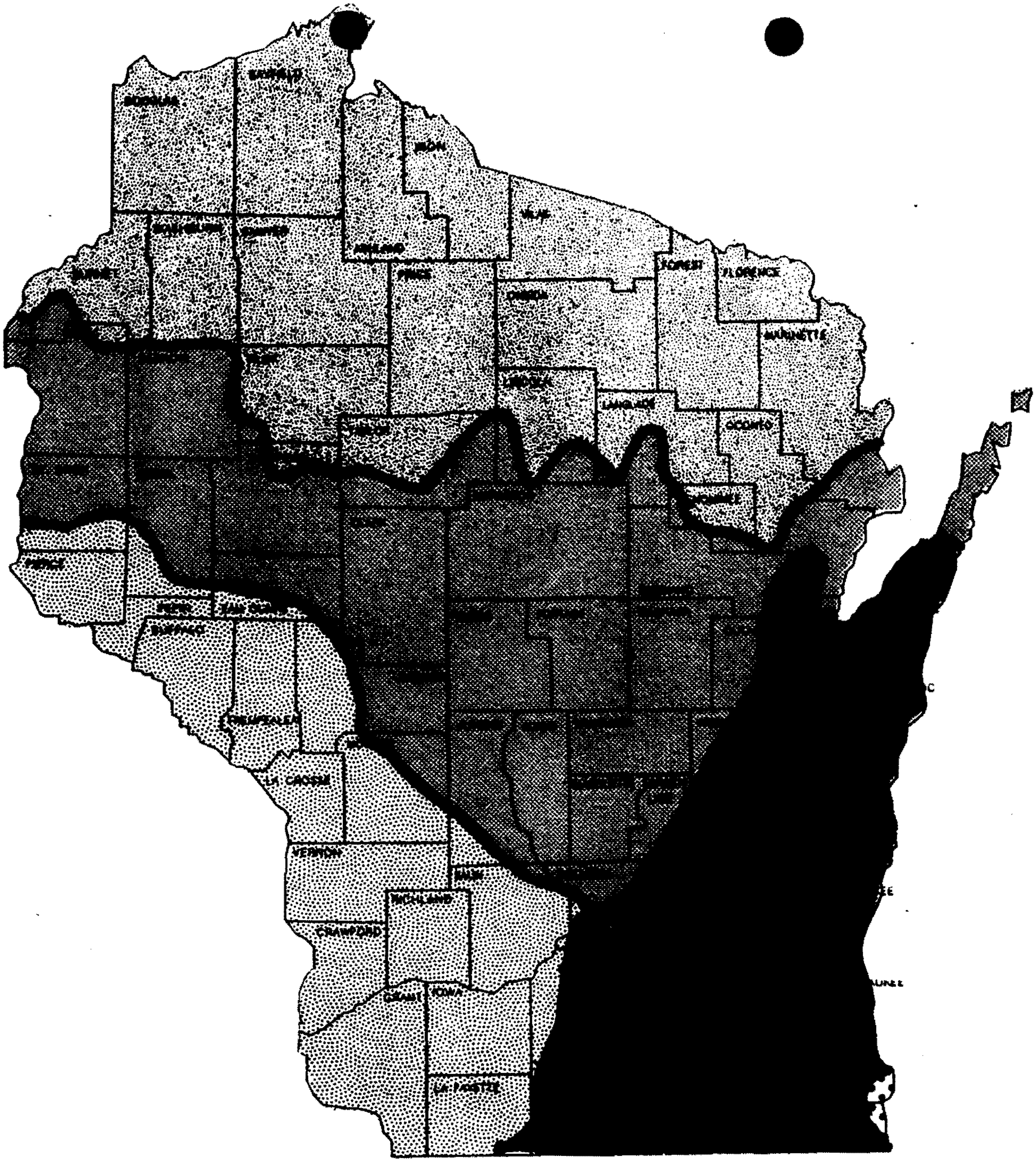
The status of Lower Turtle Lake 1994 was good. Values for phosphorus, chlorophyll and secchi depth are within North ecoregion values (Table 11).

Table 11. Summer average water quality characteristics for lakes in four ecoregions, as noted in Descriptive Characteristics of the Seven Ecoregions in Minnesota, by G. Fandrei, S. Heiskary, and S. McCollar. 1988. Minnesota Pollution Control Agency. Lower Turtle Lake is in the North Central Hardwood Forest ecoregion.

Parameter	Northern Lakes & Forests	North Central Hardwood Forests	Western Corn Belt Plains	Northern Glaciated Plains	Lower Turtle Lake
Total phosphorus ($\mu g/l$)	14-27	23-50	65-150	130-250	26
Chlorophyll a					
mean	<10	5-22	30-80	30-55	12
maximum	<15	7-37	60-140	40-90	21
Secchi disc (feet)	8-15	4.9-10.5	1.6-3.3	1.0-3.3	8.3
(meters)	2.4-4.6	1.5-3.2	0.5-1.0	0.3-1.0	2.5
Total Kjeldahl Nitrogen (mg/l)	<0.75	<0.60-1.2	1.3-2.7	1.8-2.3	0.6
Nitrite & Nitrate N (mg/l)	<0.75	<0.01	0.01-0.02	0.01-0.1	0.06
Alkalinity (mg/l)	40-140	75-150	125-165	160-260	
Color (Pt-Co units)	10-35	10-20	15-25	20-30	
pH (SU) 7.2-8.3	8.6-8.8	8.2-9.0	8.3-8.6	8.7	
Chloride (mg/l)	<2	4-10	13-22	11-18	
Total Suspended Solids (mg/l)	<1-2	2-6	7-18	10-30	
Total Suspended Inorganic Solids (mg/l)	<1-2	1-2	3-9	5-15	
Turbidity (NTU)	<2	1-2	3-8	6-17	
Conductivity (umhos/cm)	50-250	300-400	300-650	640-900	220
TN:TP Ratio	25:1-35:1	25:1-35:1	17:1-27:1	7:1-18:1	23:1

A map showing the ecoregion area and the Lower Turtle Lake location is displayed in Figure 20. Phosphorus concentrations ranged from 23-50 ppb. Lower Turtle Lake had a summer phosphorus concentrations of 26 ppb.

These comparisons indicate that in 1994 Lower Turtle Lake was within Ecoregion values and was in good shape. However, in previous years, Lower Turtle Lake was on the low end of ecoregion values, indicating it was below average in terms of water quality. At this point in time the challenge is to keep the lakes in good shape.



Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of The Upper Midwest States. U.S. EPA 600/3-88/037, Corvallis, OR.

Legend

- Northern Lakes and Forests
- North Central Hardwood Forests
- Driftless Area
- Southeastern Wisconsin Till Plains
- Central Corn Belt Plains

Figure 20. Ecoregions in Wisconsin. Lower Turtle Lake is in the North Central Hardwood Forest Ecoregion.

An important variable to watch and to control is nutrient inputs -- both phosphorus and nitrogen. If phosphorus concentrations increase above 1994 levels, nuisance algae blooms could develop, and this could cause a cascade of problems.

Likewise, construction and lake resident activities can have significant impacts on phosphorus inputs. Studies in Maine show that clearing the trees off your property, even a partial clearing can increase phosphorus inputs to the lake from the runoff. Lower Turtle Lake is vulnerable to an increase in phosphorus inputs, and therefore shoreland nutrient inputs could be significant and contribute to water quality degradation. Shoreland projects to reduce nutrient inputs are important.

Trophic State Index

The Trophic State Index (TSI) was calculated for water chemistry results and is shown in Table 12. Results indicate Lower Turtle Lake is an eutrophic lake. Although there was some variability within a lake for phosphorus, chlorophyll, and transparency values, they are fairly close.

Table 12. Summary of Trophic State Index Values

	1987	1988	1989	1990	1991	1992	1993	1994
TSIP (TP)				68	74	65	65	55
TSIC (Chl a)					56	58		54
TSIS (Secchi disc)	60	61	54	71	56	57	62	52
TSI (mean)	60	61	54	70	62	60	64	54

TSI = Trophic State Index

TSI(Chl a)(ppb or ug/L) = $36.25 + 15.5 \log_{10}$ [Chl a]
TSI(TP)(ppb or ug/L) = $60 - 33.2 \log_{10} (40.5/TP)$
TSI(Secchi)(meters) = $60-(SD \log_{10} \times 33.2)$

8. Lake Survey

One of the first projects of the Lower Turtle Lake Management District was to conduct a lake resident survey. A summary of the results are shown below in Table 13. Responses indicate the majority of residents want to live on the lake for relaxation, nature observation, and fishing. Their main concern is the nuisance levels of algae. The good ecological quality of Lower Turtle Lake is vitally important to a majority of lake residents.

Table 13. Lake survey results of lake usage and needs assessment, from the fall of 1993. About 58% responded (69 responses out of 120 surveys mailed).

I. AGE OF THE HEAD OF HOUSEHOLD

Indicate the age of the head of household by placing a check or X on the appropriate line below.

	%
20 to 29 years	1
30 to 39 years	9
40 to 40 years	16
50 to 59 years	36
60 to 69 years	30
70 to 79 years	7
80 or > years	

II. PROPERTY USAGE

Indicate with a check or X if you are a permanent resident. If you are a seasonal resident, estimate the average number of days per year by season your property is used.

a) Permanent resident	25% of responses
	Averages
b) Spring (April & May)	15.4 days
c) Summer (June, July, August)	34.6 days
d) Fall (Sept., Oct., Nov)	19.4 days
e) Winter (Dec., Jan., Feb., Mar)	9.9 days
	79.3 days total

III. SEASONAL RESIDENT WEEKEND VS WEEKDAY USAGE ESTIMATE

If a seasonal resident, estimate the percentage of the total yearly use indicated in II. that occurs on Weekends (Saturday & Sunday)

73.5% average

Table 14. Continued.

IV.	PRINCIPAL REASONS FOR PURCHASE OF LAKE PROPERTY Prioritize your reasons by writing a "1" in the blank for your most important reason, followed by "2", "3", etc. for reasons of lesser importance.	Average Rank
	a) Natural beauty and/or solitude	2.8
	b) A place to "get away" and relax	1.6
	c) A place the family can use	2.6
	d) Primarily for fishing	3.1
	e) Water recreation (swimming, boating, etc.)	3.9
	f) A place to entertain	5.6
	g) Financial investment or other financial reason	5.6
	h) To be close to the Casino	8.1
	i) Other (write in): inherited, retired here, business owner nearby	4.5
V.	PRIMARY RECREATIONAL ACTIVITIES Prioritize your activities by writing "1", "2", etc.	Average Rank
	a) Nature observation	3.3
	b) Relaxation	1.8
	c) Fishing	2.4
	d) Swimming/diving	3.9
	e) Motorized boating	3.9
	f) Non-motorized boating (canoeing, rowing)	5.1
	g) Winter sports (snowmobiling, skiing, etc)	6.3
	h) Water skiing	6.3
	i) Jet skiing	8.4
	j) Other (write in) ice fishing, paddle boating	3.5
VI.	CONCERNS REGARDING PROBLEMS OF LOWER TURTLE LAKE Prioritize your choices by writing "1", "2", etc	Average Rank
	a) Green algae in water	2.0
	b) Weed growth in lake	2.4
	c) Water levels	4.1
	d) Poor fishing	2.9
	e) Fishermen bothered by power boats	3.6
	f) Boat noise, wakes	4.2
	g) Other noise (indicate) 12 jet ski, 2 parties	5.5
	h) Unattractive shoreline	6.3
	i) Litter	6.4
	j) Harassment of wildlife	5.8
	k) Other (write in) boats/motors too large, waterskiing, jet skiing	2.3

Table 14. Concluded.

VII. OVERALL CONCERN ABOUT THE ENVIRONMENT IN, ON AND NEAR LOWER TURTLE LAKE
Mark one of the following choices.

	% of Response
a) This issue is vitally important to me	63
b) The environment is fairly important to me	33
c) The environment does not mean that much to me and I would not change what I do to improve it	3
d) This issue just does not concern me	1

9. Conclusions

Lower Turtle Lake appears to be on the threshold of clear water conditions, which is usually preferable to algae dominated systems. In 1994, Lower Turtle Lake had acceptable water clarity, with a summer average secchi disc of 8.6 feet. The reasons for this "good" year are not certain. One contributing factor was two farms that had been active were idle in 1993 and 1994. It is possible that reduced nutrient inputs from runoff produced lower algae blooms. Another related factor may be that there were no rainstorms were severe enough in 1994 to produce high levels of nutrient runoff. In years with big rainfalls (over 2 inches), high nutrient loads may move into Lower Turtle Lake with the runoff.

Based on the results of our study in 1994, it is clear that Lower Turtle Lake has the potential to have good water quality. Projects will be designed to maintain these lake conditions.

But we should also point out that Lower Turtle Lake has the potential for nuisance conditions as well. Benthic blue-green algae mats are found on the lake sediments. Occasionally, wind action or currents can dislodge the mat and it comes to the surface in pieces. Some pieces of a benthic mat were spotted by Al Moris in 1994 (Figure 21). Often, the open water algae originate from these mats. I interpret the rapid loss of nitrates in the summer of 1994 (Table 3) to be an indicator that they were being used by algae. Sometimes I have observed that when nitrates are depleted, nuisance algae blooms develop. I suspect that Lower Turtle Lake was close to having algae last year and that's why it is important to reduce phosphorus going into the lake ... to keep the nuisance algae blooms in check.

10. Recommended Projects and Programs

A list of projects has been prepared that are intended to protect the water quality of the Lower Turtle Lake. Projects are listed below:

1. Work with the Barron County Land Conservation Department on watershed projects. These projects include:
   - 1-A. Nutrient management for field crops
   - 1-B. Runoff treatment from livestock holding areas

2. Work with WDNR on stream, wetland, and lake projects. These projects include:
   - 2-A. Wetland restoration
   - 2-B. Stream management to enhance fish spawning
   - 2-C. Lake level control policy (to dam or not to dam)
   - 2-D. Install fish cribs

3. Lake residents have several projects they could implement and include:
   - 3-A. Aquascaping/native plant reestablishment.
   - 3-B. Lake shoreland projects.
   - 3-C. On-site system maintenance program.
   - 3-D. Continue a lake monitoring program.

Details of these projects are given in the following pages.

1. Work with Barron County and Conservation Department on watershed projects.

Dale Hanson (715-537-6315) is the contact at the Barron County Land Conservation Department. Based on time availability, either Dale or someone from his office could work toward implementing projects in two broad areas: runoff from agricultural fields and runoff from feedlots.

1-A. Nutrient management for field crops

● Conservation Tillage: Conservation tillage employs various types of field preparation and crop residue management. By leaving corn stalks in the field, erosion off the field is reduced.

> Action 1: Work with producers to demonstrate economic benefits of conservation tillage as well as soil protection benefits.

● Buffer strip acquisition. A buffer strip is a piece of vegetated land that is 16 to 100 feet wide that is located between farm fields and a stream or lake. The vegetated land filters out sediments and reduces the amount of nutrients washing into streams or into Lower Turtle Lake.

> Action 1: Identify critical erosion prone areas. If conventional BMP's are not judged to be effective, or if volunteer compliance is not feasible, then negotiations should start in order to purchase critical property for use as a buffer strip to protect the lake and streams.
>
> Action 2: Design an environmental corridor for maximum wildlife value as well as water quality protection.

● Manure Management. Because several farms have livestock, manure is a by product. This is a resource to producers and they can get phosphorus and nitrogen credit when it is applied to their land. However, if it is overapplied, excess nutrients will runoff the fields and into receiving water bodies.

> Action 1: Work with farmers to set up a nutrient management plan for manure application.
>
> Action 2: Cost share soil testing to determine the proper rates and timing of manure application.

1-B. Runoff treatment from livestock holding areas

A feedlot is a combination of lots and/or buildings where animals are confined for feeding, breeding, raising or holding. Usually manure accumulates and vegetative cover cannot be maintained. Pastures are not considered feedlots. Runoff from a feedlot can be a significant source of phosphorus and nitrogen because animals are concentrated and waste products accumulate. In some cases runoff carries high concentrations of nutrients toward a lake. This is especially critical if the feedlot is close to a lake and there is not much of a buffer zone (vegetation or other material) to filter out the pollutants.

In the Lower Turtle Lake watershed there are several feedlots that could be improved. This alternative outlines procedures that could be implemented to reduce nutrient runoff from these feedlots.

<u>Step 1</u>

Eaves shall be added to existing barns or cattle sheds. The eaves on the barn shall be attached to a downspout that drains into a tile that will remove the roof water to a site so that none of the roof water will be running through the feedlot.

<u>Step 2</u>

The feedbunks shall be moved to a location where runoff can be routed through a vegetated buffer. The new location for the feed bunks should be set so that overland flow is diverted around the feedlot.

<u>Step 3</u>

The feedlot are could be reduced in size. The portion of the feedlot that is being taken out of feedlot use should be seeded down to the permanent meadow. A starter crop could be used when seeding down this area to help prevent any erosion from taking place until the permanent vegetation gets established. This permanent vegetation shall be periodically hayed to insure new growth of vegetation that will help to uptake nutrients. This project could be carried out as soon as the lot is dry enough to prepare a permanent cover crop to be seeded. No livestock shall be allowed to graze in this area so that erosion and compaction problems can be avoided.

2. Work with WDNR on stream, wetland, and lake projects

Rick Cornelius (715-537-5046) is the WDNR fish manager for Lower Turtle Lake. Personal from RIck's office on other DNR offices could assist the Lower Turtle Lake Management District in implementing a program for wetland restoration, stream management, and fish management.

2-A. Wetland restoration

The idea is that various wetlands in the Lower Turtle Lake watershed may be able to remove some phosphorus from runoff. There are several locations where wetlands could be restored. For long-term phosphorus removal by wetlands, the soils are the key. During the summer growth cycle in wetlands, plants remove phosphorus, but come fall, these same plants release phosphorus. Several studies have shown that the best way to check the amount of phosphorus that wetlands can remove is to check the type of wetland soil; because some soils are better than others for removing phosphorus.

The strategy for Lower Turtle Lake is to test wetland soils to see what their phosphorous removal efficiency is. If it is good, then all that needs to be done is to restore the wetland. However, if the wetland soils are lacking certain critical ingredients that are needed for phosphorus removal, a phosphorus trap will be considered. A phosphorus trap is a combination of limestone and iron compounds that will aid in removing excess phosphorus from wetland runoff.

For long-term phosphorous removal in wetland settings geochemical uptake of phosphorus is more efficient than biological uptake. The problem with biological uptake is that it is short term, in autumn, senescence of plant biomass and subsequent winter freezing releases a variety of phosphorus compounds from plant tissue; this phosphorus then moves into the lake. Subsequent phosphorus transport from a wetland in November or in April to a lake can still produce problems in July and August. Geochemical phosphorus removal is desirable because phosphorus is fixed by a variety of chemical processes (absorption, coprecipitation, van der Wahls forces, etc.), that retain phosphorus and eventually results in mineralization. Some wetlands work better than others for geochemical phosphorus removal. Two factors are the amount of clay in the wetland soil and if the wetland is flooded and can maintain a fairly constant pool elevation.

<u>Action 1:</u> Individual wetlands should be surveyed to evaluate soil types and vegetation. This could be performed by the WDNR, the Barron County LCD or Blue Water Science.

<u>Action 2:</u> The beaver dam that was described in the Barron County LCD report and included in this report (page 10) may have important water quality benefits, as well as wildlife benefits. Action should be taken to maintain this beaver dam, by maintaining an active beaver lodge in this area. This is the most cost effective way to keep water damned at this time (and beavers don't need WDNR permits either), but not a long-term solution to water impoundment.

<u>Action 3:</u> The Lake Management District should look at existing wetland restoration programs that could possibly fund a water level control structure for this wetland. The Wisconsin DNR has a grant program that could help. Details are given at the end of this section.

2-B. Stream management to enhance fish spawning

Turtle Creek is a perennial stream that comes from the outlet of Turtle Lake. The northwest tributary is an ephemeral stream that runs in the spring and has a flow less than 0.1 cfs in mid summer in average years. Both streams have the potential to host spring spawning fish runs.

The best way to enhance fish stream spawning is to have goon water quality coming down the stream. Watershed projects should promote good stream water quality.

In addition, based on time availability of the WDNR, a stream habitat survey could be conducted. If needed, in-stream habitat could be constructed to enhance fish spawning (probably for walleyes or white suckers).

2-C. Lake level control policy

Decisions regarding the control of lake levels are often divided. Some will want higher lake levels and others will want lower levels. Currently, Lower Turtle Lake does not have an official dam, lake level is probably controlled by the sill (Creek bottom) at the County bridge over the Lower Turtle Creek outlet (Figure 22, bottom picture). In some years, beavers will construct a dam, and it will have to be removed (like in 1994 -- Figure 22).

My evaluation is that a dam would have little impact on lake water quality, either positive or negative. Therefore I would not recommend installing a dam. Additional information on WDNR requirements for installing a dam are shown after Figure 22.

The approximate cost for a sheet pile structure, with a spillway would be between $30,000 to $50,000. I think a better investment would be to spend money on projects that improves water coming into Lower Turtle Lake rather than on water going out of the lake.

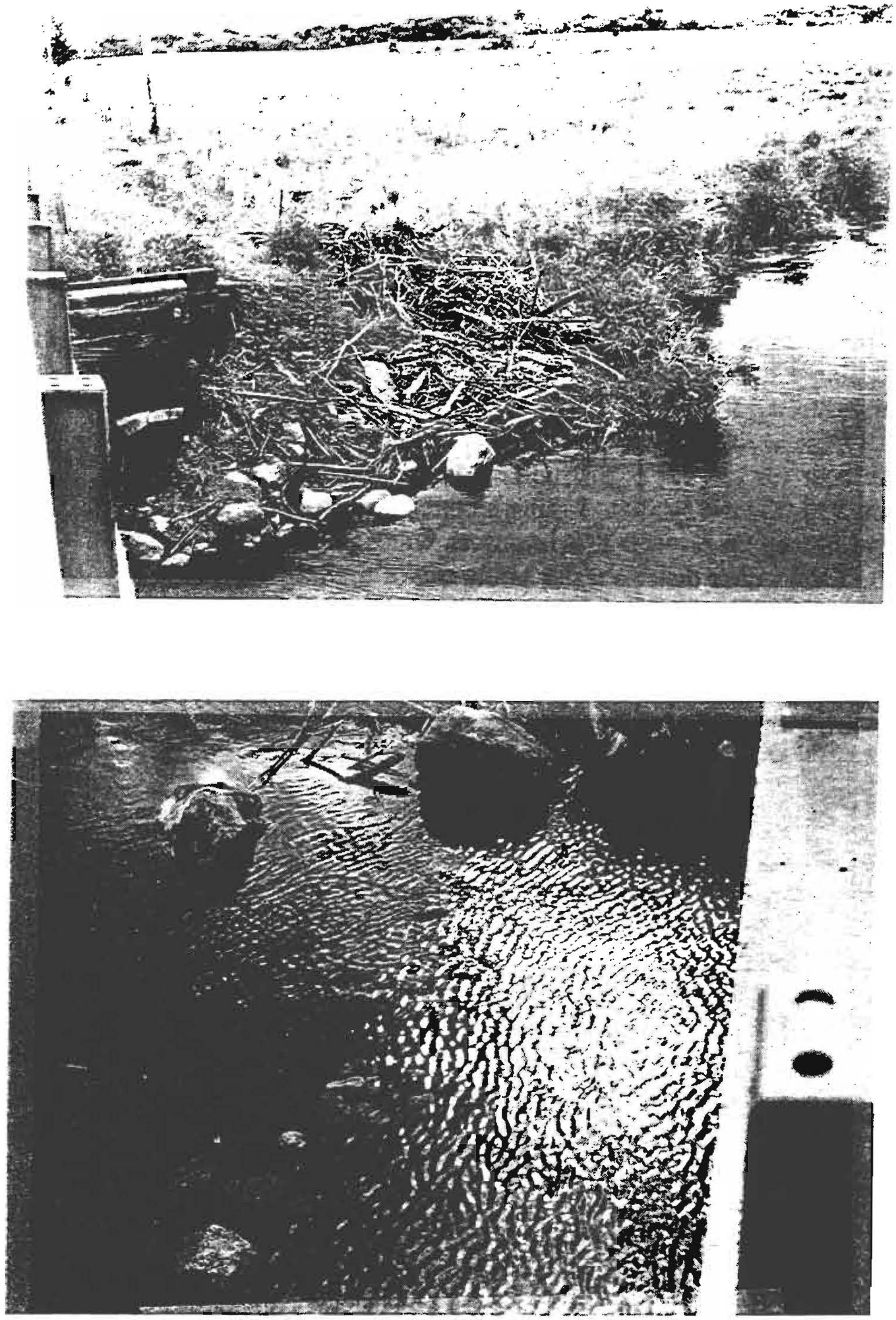


Figure 22. Outlet stream of Lower Turtle Lake. Top: debris removal from under the dam - coming from a beaver dam. Bottom: a water level control structure would only hold back one to two feet of water. It is not recommended at this time.

3. Lake residents have several projects they could implement.

3-A. Aquascaping/Native Plant Reestablishment.
For long term success of a lake improvement project, its essential that Lower Turtle Lake maintains a diverse aquatic plant community. Often, a seed bank is already present in a lake, and disturbed areas will be recolonized naturally. When this does not occur, transplanting desirable submerged aquatic plants as may be the solution. This process is called aquascaping. The species being considered are chara, northern watermilfoil and various Potamogeton pondweeds that are native to the area.

At this time there is a diverse plant community and planting plants is not necessary. It is an idea that could be used if plants start disappearing.

3-B. Lake Shoreland Projects.
Activities associated with lakeshore development can impact a lake in many ways. As cabin or home construction increases around a lake, lawns are installed and fertilized. Wetlands may have been filled in the past thus removing some natural filtering action. Rooftops, driveways, sidewalks, and roads increase impervious surfaces. Impervious surfaces are surfaces that prevent runoff from infiltrating into the soil. When runoff doesn't infiltrate the amount of runoff increases, and this water picks up extra nutrients and sediments and delivers them to the lake. Another factor is when the runoff doesn't infiltrate into the soil, it is not very well filtered in the surface runoff.

So development around a lake can increase nutrient and sediment inputs to a lake compared to undeveloped conditions. However, cabin owners can implement some projects to minimize adverse impacts on their lake. Little things can be done and although they may seem trivial, everything is cumulative. For example, if each cabin owner could reduce phosphorous inputs to the lake by 1 pound/year, that may not sound like much. But look at it from the perspective of 30 or 40 cabin owners over 10 years. That represents 400 pounds of phosphorous that has not reached the lake.

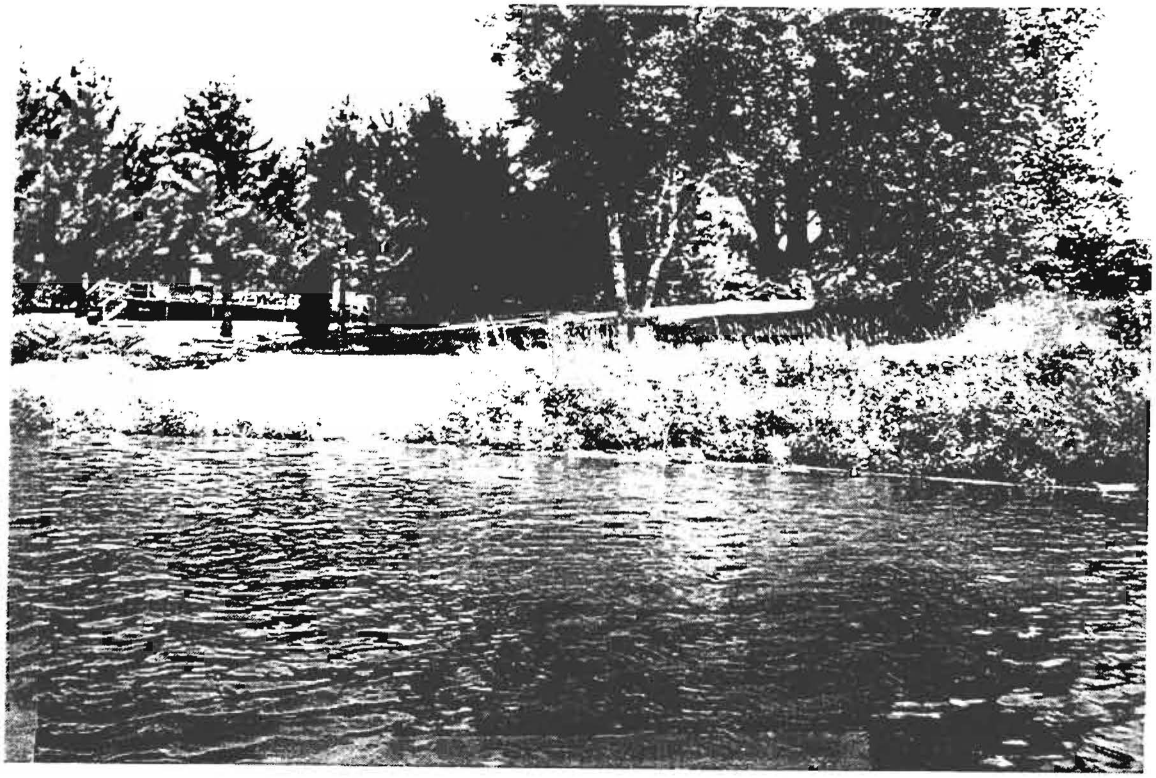
Lakescaping for wildlife
The careful planting of selected land plants and aquatic plants can improve water quality by reducing nutrients that run into the lake (land plants) and by taking up nutrients and by stabilizing bottom sediments (aquatic plants). Examples of typical plants are shown in the fact sheets that will be available to Lake Management District members. Another benefit is planned landscaping can enhance wildlife by creating refuges and food sources for water fowl and aquatic animals. The combination of landscaping and aquascaping is appropriate for wetlands, streams, and lakes. For this project we are encouraging the use of vegetative buffers to help reduce erosion and nutrient inputs to the lakes (see Figure 23 for an example).

Some benefits of this approach are:

- Erosion can be a problem nearly anywhere in the watershed. It is especially critical adjacent to a water body because sediment delivery rates are so high. Landscaping upland areas may not only reduce soil erosion, but may reduce the use of fertilizer as well.

- Transplanting native terrestrial plants also aids in reestablishing native plants that have disappeared from the area. One of the objectives of this project is to see if homeowners can reestablish native vegetation in their nearshore areas.

Several Fact Sheets have been prepared and are presented in next several pages that give instructions on planting upland plants.



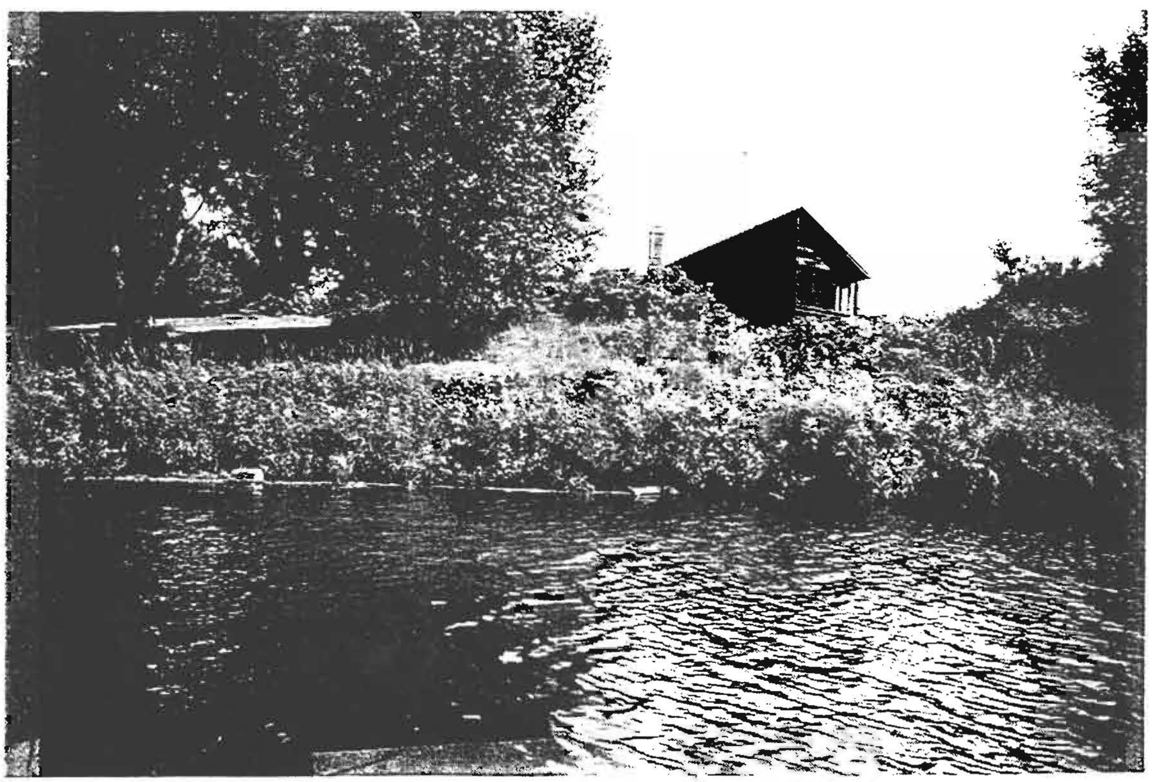


Figure 23. Natural buffer strips (as shown here on Lower Turtle) help filter out nutrients before they get to the lake.