North End of Lower Turtle Lake in 2004

Lake Management Plan for Lower Turtle Lake, Barron County, Wisconsin

December 2005

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with contributions from Wisconsin Department of Natural Resources and the Lower Turtle Lake Association

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Comprehensive Lake Management Plan for
Lower Turtle Lake, Barron County Wisconsin

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1. Introduction and Project Setting

Lower Turtle Lake is located in Barron County, Wisconsin (Figure 1). Lower Turtle Lake characteristics are shown in Table 1.

The objectives of this study were to characterize existing lake conditions and to make recommendations to protect and improve the lake environment where feasible.

Table 1. Lake statistics.

	Lower Turtle Lake
Size (acres)	276
Mean depth (ft)	15
Maximum depth (ft)	24

Figure 1. Lower Turtle Lake is located in Barron County, Wisconsin.

2. Glaciers and Soils

Lower Turtle Lake was formed approximately 10,000 years ago during the last glacial retreat of the Superior Lobe (Figure 2). The soils deposited by the Superior Lobe glacier were primarily sands and loamy-sands. Beneath these soils, at depths of about 50-350 feet, is Precambrian bedrock that is over one billion years old. The bedrock is referred to as the North American shield.

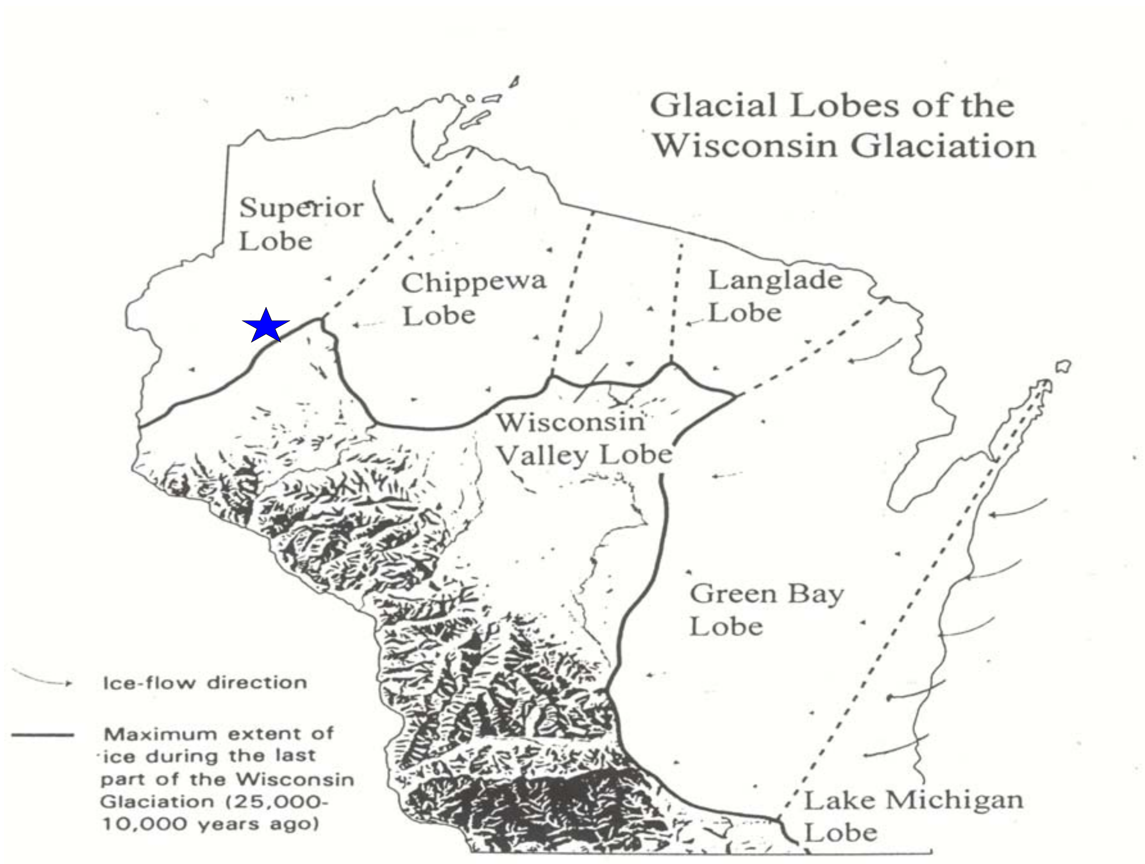


Figure 2. Glacial lobes of the Wisconsin glaciation. Lower Turtle Lake is located in the Superior lobe.

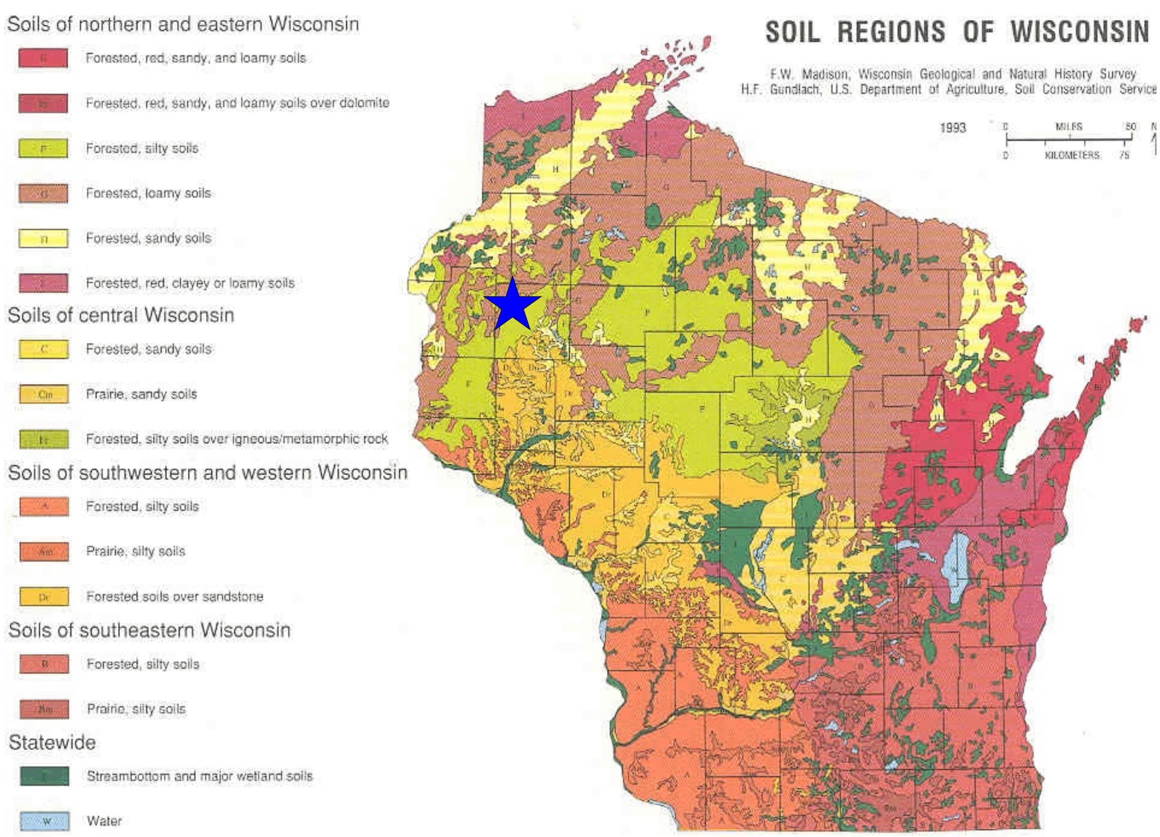


Figure 3. Lower Turtle Lake is located within a soils group characterized as forested loamy soils.

3. Watershed Features

3.1. Drainage Area and Land Use of Lower Turtle Lake

In previous studies, the Barron County Soil and Water Conservation Department prepared watershed maps and determined the land use breakdown for the watershed.

Drainage area to Lower Turtle Lake is 5,530 acres (does not include the lake area) and the delineation is shown in Figure 4.

Lower Turtle Lake and its watershed are located within 8 sections of land in Almena Township of Barron County. Lower Turtle Lake as well as its watershed lies from northwest to southeast. That, combined with the shape of Lower Turtle Lake and its proximity to the terminal moraine, suggests that Lower Turtle Lake was formed by glacial melt water.

Land use within the watershed is shown in Table 2. Cropland is the dominant land use.

Table 2. Land use in Lower Turtle Lake direct watershed.

	Acres
Lower Turtle Drainage	3,065
Upper Turtle Drainage	2,465
Total Watershed Area (not including Lower Turtle Lake area)	5,530

The watershed to lake ratio of Lower Turtle Lake is twenty to one. This is a factor that contributes to the frequency and severity of algae blooms in Lower Turtle Lake. Lower Turtle Lake has enjoyed fairly good water quality and fishery, however, to ensure that is continues for years to come conservation measures in the watershed and on the lakeshore of Lower Turtle Lake should be considered.

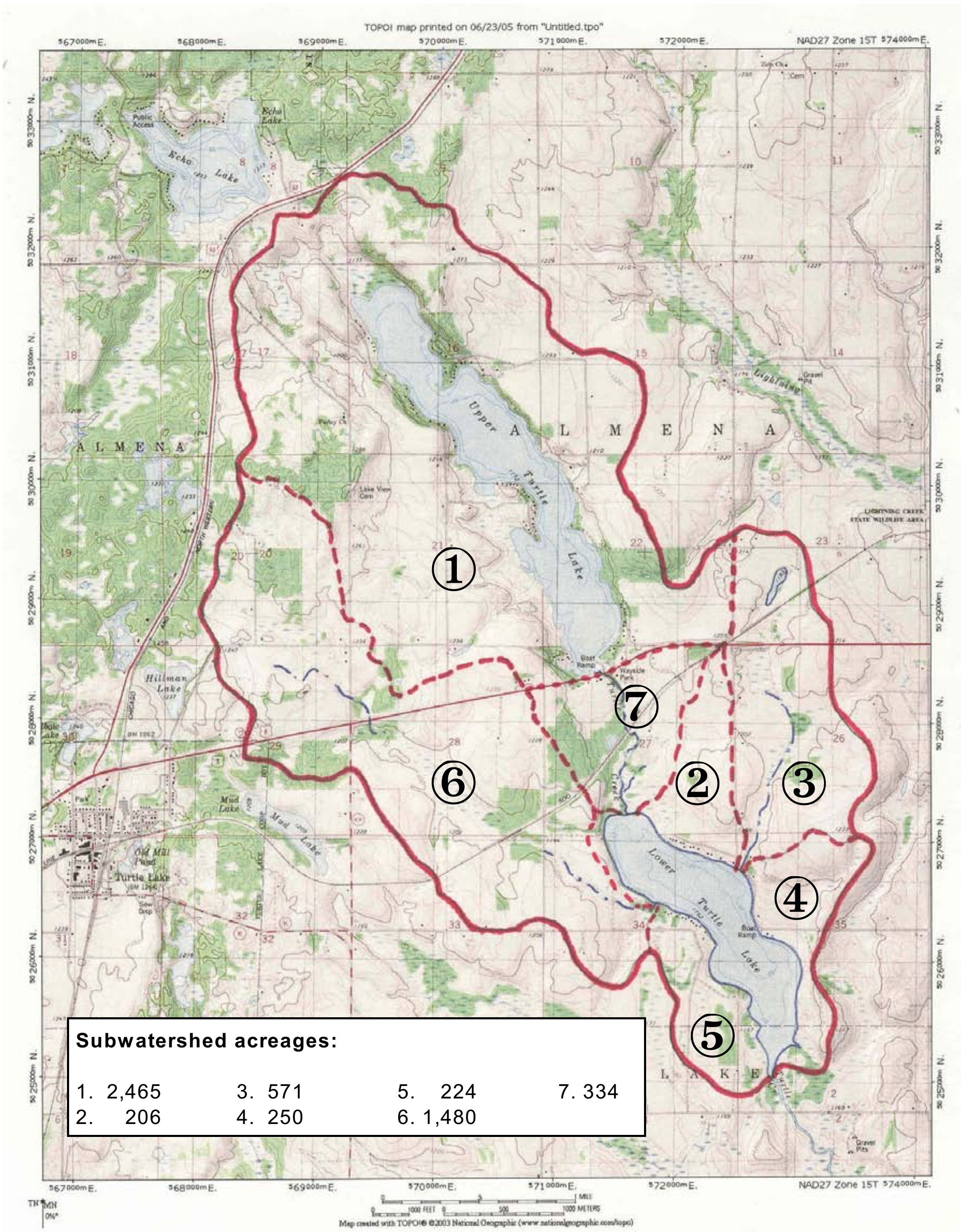


Figure 4. Watershed area for Lower Turtle Lake.

3.2. Source of Water and Nutrients to Lower Turtle

Water: Source of water to Lower Turtle Lake is from a combination of surface runoff, rainfall, and groundwater. The amount of water flowing into and out of Lower Turtle Lake is estimated to be about 5.7 cubic feet per second. Flows were estimated based on runoff amounts listed for Barron County in the Wisconsin Spreadsheet Lake Model (Table 3).

Table 3. Average annual water flow into Lower Turtle Lake.

Drainage area (acre)	5,530
Average yearly runoff for Barron County (feet)	0.81
Total water inflow (acre-feet)	4,479

***4,479 acre-feet would be enough water to fill a 4,000 foot deep swimming pool the size of a football field. It would also be enough drinking water to supply a town of 35,000 for a year.**

Although this is a lot of water coming into Lower Turtle Lake, the volume of Lower Turtle Lake is 4,140 acre-feet. If Lower Turtle Lake completely dried up, it would take about 1 year to fill.

Nutrients (prepared by Dale Hanson, Barron Co): The primary source of phosphorus from the watershed of Lower Turtle Lake is agricultural runoff. Work by the Barron County Soil and Water Conservation Department has found slightly over half of the watershed is cropland. In 2002, 60% of that cropland was row crops. It is recommended that when farmers grow row crops, the following three practices be used: conservation tillage, including either no-till or reduced till, grass waterways, and nutrient management. Contour farming also is a valuable tool, however most of the topography of the Lower Turtle watershed does not lend itself to contour farming.

According to the Barron County Soil Erosion Transect Survey, in the area of Lower Turtle Lake, conservation tillage is used with some of the row crops, but there is definite room for improvement. According to the survey, 27% of the corn, 43% of the soybeans and 10% of the small grains are grown with conservation tillage. Given the runoff from cropland is the primary concern, the Soil & Water Conservation Department recommends that the Lower Turtle Lake Association promote the increased use of reduced tilled and no-till, grass waterways and nutrient management in their watershed to protect and enhance the water quality of Lower Turtle Lake.

Nutrients Carried into the Lake with Streams: A major source of nutrients to Lower Turtle Lake is from inflowing streams that carry in phosphorus along with suspended sediments off of agricultural as well as other types of land use. Stream sample results for 2004 are listed in Table 4.

Table 4. Stream monitoring results for phosphorus (in ppb) for Lower Turtle in 2004 with a comparison to 1994 results. Four watershed sites were monitored and the 3rd Street Site, the heaviest flow, was sampled most frequently.

	3rd Street	12 ½ Ave	4th Street next to Road	Upper Turtle outflow	Turtle Creek (Lower Turtle inflow from Upper Turtle)	NW Trib
May 24, 2004	78	67	349	21	--	--
June 5, 2004	112	130	--	28	22	--
June 19, 2004	242	--	--	15	26	--
July 23, 2004	308	--	--	12	43	--
March 5, 1994	--	--	--	--	120	--
March 25, 1994	--	--	--	--	27	--
April 9, 1994	--	--	--	--	14	--
April 13, 2004	--	--	--	--	31	340
June 7, 1994	--	--	--	--	50	193
June 20, 1994	--	--	--	--	500*	--
July 5, 1994	--	--	--	--	51	--
July 7, 1994	180	--	--	--	48	54
August 3, 1994	--	--	375	--	57	178

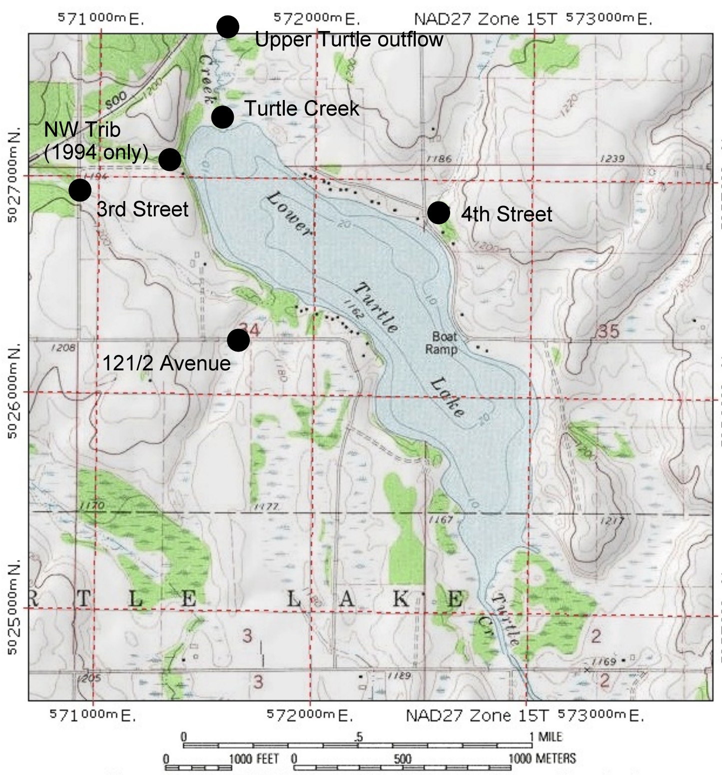


Figure 5. Site map of stream sample locations.

Figure 6. (top) Culverts leaving Upper Turtle Lake that feed the stream that flows into Lower Turtle Lake.
(bottom) A stretch of the stream that leaves Upper Turtle Lake. This stream does not appear to be a large nutrient source for Lower Turtle Lake.

3.3. Shoreland Inventory

The shoreland area encompasses three components: the upland fringe, the shoreline, and shallow water area by the shore. A photographic inventory of Lower Turtle Lake shoreline was conducted on July 23, 2004. The objectives of the survey were to characterize existing shoreland conditions which will serve as a benchmark for future comparisons.

For each photograph we looked at the shoreline and the upland condition. Our criteria for natural conditions were the presence of 50% native vegetation in the understory and at least 50% natural vegetation along the shoreline in a strip at least 15 feet deep. We evaluated shorelines and uplands at the 75% natural level as well (Figure 7 illustrates the methodology).

A summary of the inventory results is shown in Table 5. Based on our subjective criteria over 40% of the parcels in Lower Turtle Lake shoreland area meet the natural ranking criteria for shorelines and upland areas. This is about average compared to other lakes found in the Northern Wisconsin data set. In the next five to ten years proactive volunteer native landscaping could improve the natural aspects of some of parcels.

Table 5. Summary of shoreline buffer and upland conditions in the shoreland area of Lower Turtle Lake. Approximately 127 parcels were examined.

	Natural Shoreline Condition		Natural Upland Condition		Undevel. Photo Parcels	Shoreline Structure Present	
	>50%	>75%	>50%	>75%		riprap	wall
LOWER TURTLE LAKE TOTALS (no. of parcels = 127)	82% (104)	71% (90)	43% (54)	29% (37)	9% (12)	6% (8)	0% (0)

A comparison of Lower Turtle Lake's shoreland conditions to other lakes in Minnesota and Wisconsin is shown in Table 6 and in Figure 8.

Figure 7. Both of the pictures are from Lower Turtle Lake. [top] This parcel would rate as having a shoreline with a buffer greater than 50% of the lot width and an understory with greater than 50% natural cover.
[bottom] These parcels would not qualify as having a natural shoreline buffer greater than 50% of the lot width. Also the understory in the upland area would be rated as having less than 50% natural cover.

Table 6. Summary of shoreland inventories from Lower Turtle Lake and 20 other lakes in Minnesota and Wisconsin.

Lake	Eco-region	Date of Survey	Total Number of Parcels (#)	Undevel. Parcels % (#)	Natural Upland Condition > 50% % (#)	Natural Upland Condition >75% % (#)	Natural Shoreline Condition > 50% % (#)	Natural Shoreline Condition >75% % (#)	Parcels with Erosion % (#)	Parcels with Shoreline Revetment % (#)
NORTHWOODS LAKES										
Ballard chain Vilas Co, WI	LF	7.23.99	110	--	98 (108)	96 (106)	96 (106)	95 (105)	--	0
Pike Chain Price & Vilas Co, WI	LF	2001	722	380	92 (633)	87 (626)	95 (684)	91 (654)	--	5 (34)
Bear Oneida Co, WI	LF	6.8.99	115	6 (7)	93 (107)	78 (90)	84 (97)	77 (89)	1 (1)	8 (9)
Van Vliet Vilas Co, WI	LF	6.04	100	20 (20)	93 (93)	65 (65)	82 (82)	68 (68)	8 (8)	11 (11)
Big Bear Lake Burnett Co, WI	LF	9.11.02	87	13 (11)	82 (71)	62 (54)	86 (75)	76 (66)	0	9 (8)
Van Vliet Vilas Co, WI	LF	6.04	100	18 (18)	92 (92)	48 (48)	71 (71)	50 (50)	6 (6)	13 (13)
Nancy Lake Washburn Co, WI	LF	9.21.00	217	19 (41)	77 (167)	65 (141)	80 (174)	72 (156)		5 (11)
Plum Lake Vilas Co, WI	LF	7.26.01	225	13 (30)	75 (169)	58 (130)	81 (182)	708(158)	--	9(4)
Big Bearskin Oneida Co, WI	LF	8.10.99	130	--	73 (95)	63 (82)	80 (104)	67 (87)	--	0
COUNTRY LAKES										
North Pipe Lake Polk Co, WI	CHF	8.03	80	45 (36)	100 (80)	96 (77)	94 (75)	91 (73)	0	1 (1)
Upper Turtle Lake Baron Co, WI	CHF	7.23-24.02	309	28 (85)	72 (224)	58 (178)	76 (234)	68 (209)	0	20 (63)
Lower Turtle Barron Co, WI	CHF	7.23.04	127	9 (12)	43 (54)	29 (37)	82 (104)	71 (90)	1 (1)	6 (8)
Pipe Lake Polk Co, WI	CHF	8.03	217	8 (17)	67 (144)	50 (108)	63 (137)	56 (121)	0	22 (48)
Comfort Chisago Co, MN	CHF	10.9-11.2.98	100	--	62 (62)	--	50 (50)	--	--	12 (12)
Lake Volney Le Sueur Co, MN	CHF	9.21.02	79	25 (20)	54 (43)	42 (33)	56 (44)	47 (37)	0	30 (24)
Rush Lake Chisago Co, MN	CHF	9.16.00	524	11 (58)	48 (253)	28 (147)	51 (267)	38 (201)	1 (3)	18 (92)
West Rush Lake, Chisago Co, MN	CHF	9.16.00	332	12 (40)	52 (171)	31 (103)	55 (184)	43 (142)	1 (2)	15 (50)
East Rush Lake, Chisago Co, MN	CHF	9.16.00	192	9 (18)	43 (82)	23 (44)	43 (83)	31 (59)	1 (1)	22 (42)
Big Round Lake, Polk Co, WI	CHF	8.03	74	14 (10)	27 (20)	24 (18)	39 (29)	34 (25)	1 (1)	14 (10)
Green Lake Kandiyohi Co, MN	CHF	9.19.01	721	1 (9)	20 (146)	12 (88)	19 (140)	14 (100)	0	62 (446)
Diamond Lake Kandiyohi Co, MN	CHF	8.13 & 14.02	344	2 (7)	13 (44)	11 (39)	16 (56)	12 (42)	1 (5)	49 (168)

Lake	Eco-region	Date of Survey	Total Number of Parcels (#)	Undevel. Parcels % (#)	Natural Upland Condition		Natural Shoreline Condition		Parcels with Erosion % (#)	Parcels with Shoreline Revetment % (#)
					> 50% % (#)	>75% % (#)	> 50% % (#)	>75% % (#)		
METROPOLITAN LAKES										
Ravine Lake Washington Co, MN	CHF	7.19.01	9	100 (9)	100 (9)	100 (9)	100 (9)	100 (9)	0	0
Pike Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	9	56 (5)	100 (9)	100 (9)	100(9)	100 (9)	0	0
Powers City of Woodbury, MN	CHF	1998	30	90 (27)	90 (27)	90 (27)	97 (29)	97 (29)	0	0
Lake Edward, City of Maple Grove, MN	CHF	9.30 - 10.12.99	34	12 (4)	91 (31)	88 (30)	76 (26)	71 (24)	6 (2)	3 (1)
Rice Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	137	33 (45)	71 (97)	64 (87)	81 (111)	74 (102)	0	19 (25)
Lee Lake Dakota Co, MN	CHF	5.31.02	30	37 (11)	73 (22)	50 (15)	77 (23)	67 (20)	0 (0)	10 (3)
Fish Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	170	7 (12)	74 (126)	44 (75)	57 (97)	41 (70)	1 (1)	20 (34)
Alimagnet Lake Dakota Co, MN	CHF	8.6.03	108	37 (40)	54 (58)	47 (51)	69 (75)	61 (66)	0	16 (17)
Eagle Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	90	14 (13)	64 (58)	52 (47)	47 (42)	41 (37)	0	35 (32)
Cedar Island Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	93	5 (5)	62 (58)	35 (33)	55 (51)	39 (36)	0	22 (21)
Orchard Lake Dakota Co, MN	CHF	9.17.01	109	4 (4)	47 (51)	30 (33)	53 (58)	32 (35)	0	54 (59)
Lac Lavon Dakota County, MN	CHF	9.9.03	110	7 (8)	54 (59)	44 (48)	42 (46)	30 (33)	0	8 (9)
Upper Prior Scott Co, MN	CHF	9.30- 10.12.99	366	10 (37)	51 (187)	36 (132)	35 (128)	31 (113)	4 (15)	46 (168)
Weaver Lake, City of Maple Grove, MN	CHF	9.30 - 10.12.99	111	5 (5)	47 (52)	28 (31)	44 (49)	29 (32)	0	14 (16)
Lower Prior Scott Co, MN	CHF	9.24- 30.99	691	10 (66)	36 (249)	24 (166)	22 (152)	17 (117)	5 (35)	54 (373)
Maple Grove Lake Summary, MN	CHF	9.30 - 10.12.99	644	14 (89)	67 (431)	48 (312)	60 (385)	48 (310)	1 (3)	20 (129)

* CHF = Central Hardwood Forest Ecoregion
** LF = Lake and Forests Ecoregion

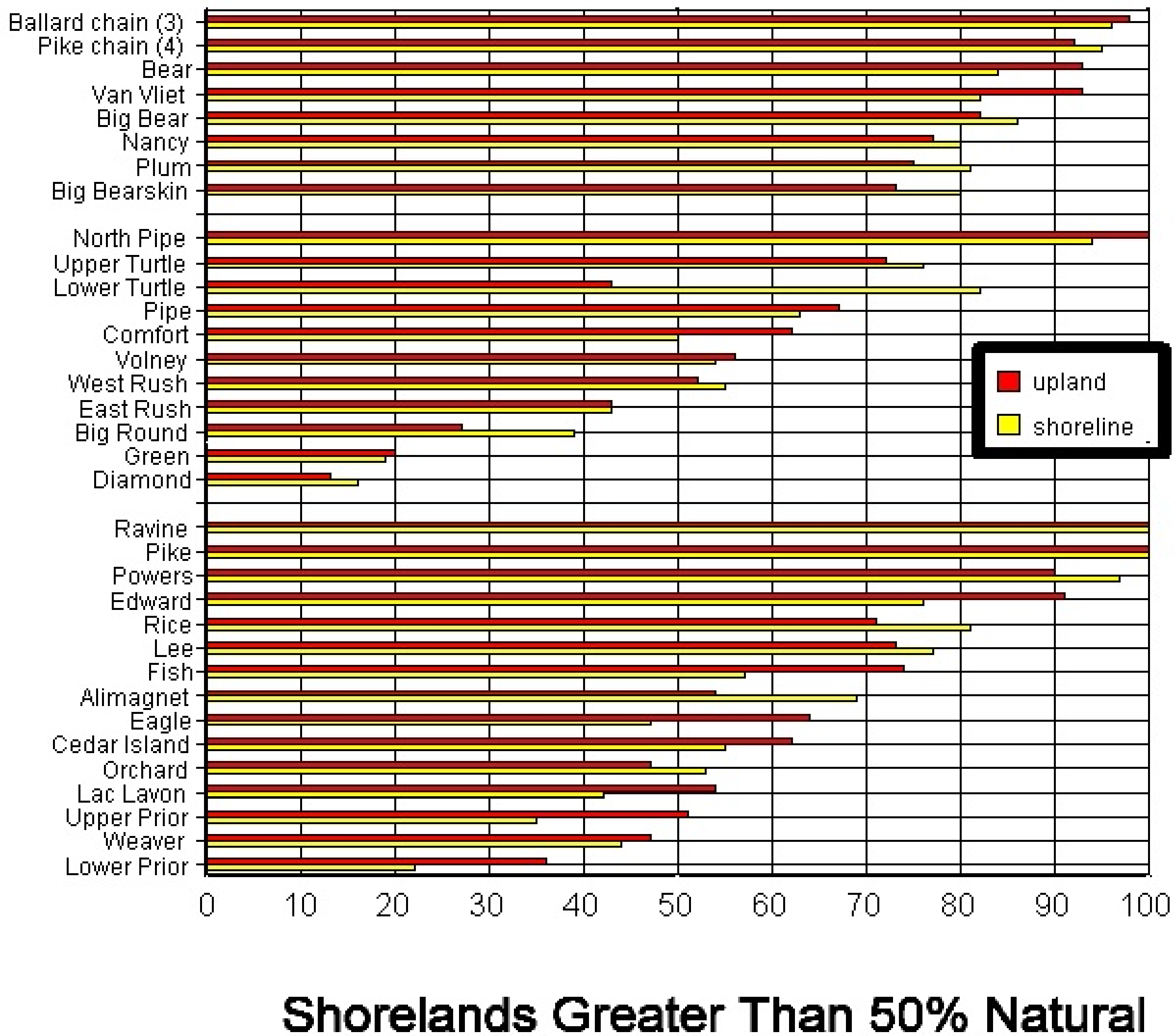


Figure 8. A summary of shoreland inventory results for lakes using an evaluation based on shoreland photographs. For each lake the percentage of shoreline and upland conditions with greater than 50% natural conditions is shown. The first tier of lakes are located in northern Wisconsin which are 4 to 5 hours from a major metropolitan area. The middle tier of lakes are about an hour's drive from the Twin Cities, and are considered to be "country" lakes. The lower tier of lakes are in the Twin City Metropolitan area and are categorized as urban lakes. Several lakes of the "urban" lakes have most of their shoreland owned by the city and there is a high percentage of natural conditions.

Lower Turtle Lake is considered a country lake for this inventory. Natural shoreland conditions for Lower Turtle Lake are about average to slightly above average compared to the other country lakes.

3.4. Groundwater and On-site Wastewater Treatment Systems

In 1994, Blue Water Science performed a groundwater study in the shallow water around Lower Turtle Lake. Groundwater inflow was evaluated indirectly by measuring lake water conductivity in the shallow nearshore area. The objective was to see if there was any change in conductivity. An increase or decrease in conductivity could indicate the inflow of groundwater. The groundwater could be coming from natural flows or from septic tank drainfields.

Specific conductance or conductivity is a measure of dissolved salts in the water. The unit of measurement is microSiemans/cm^2 or micro umhos/cm^2 . . . both are used. The saltier the water the higher the conductivity. For example oceans have higher conductivity than fresh water. For the conductivity survey on Lower Turtle Lake, in 1994, we used a YSI (Yellow Springs Instruments) probe attached to the end of an eight-foot pole. The survey used two people. One person held the probe under the surface of the water and recorded the reading off of a conductivity meter while the other person maneuvered the boat around the perimeter of Lower Turtle Lake.

Results are shown in Figure 9. The background or base conductivity was 218-220 umhos/cm. Several areas around Lower Turtle Lake had readings above background. The elevated conductivity readings could be an indicator of septic tank effluent inputs. However, just because a conductivity reading is elevated, it does not mean it is a phosphorus source. Additional testing is necessary. Results suggest that Lower Turtle Lake may be receiving groundwater inflows in several areas (Figure 9). It is not surprising that springs are found in Lower Turtle Lake. This was an active glacial area is the past and often leads to subsurface groundwater inflows.

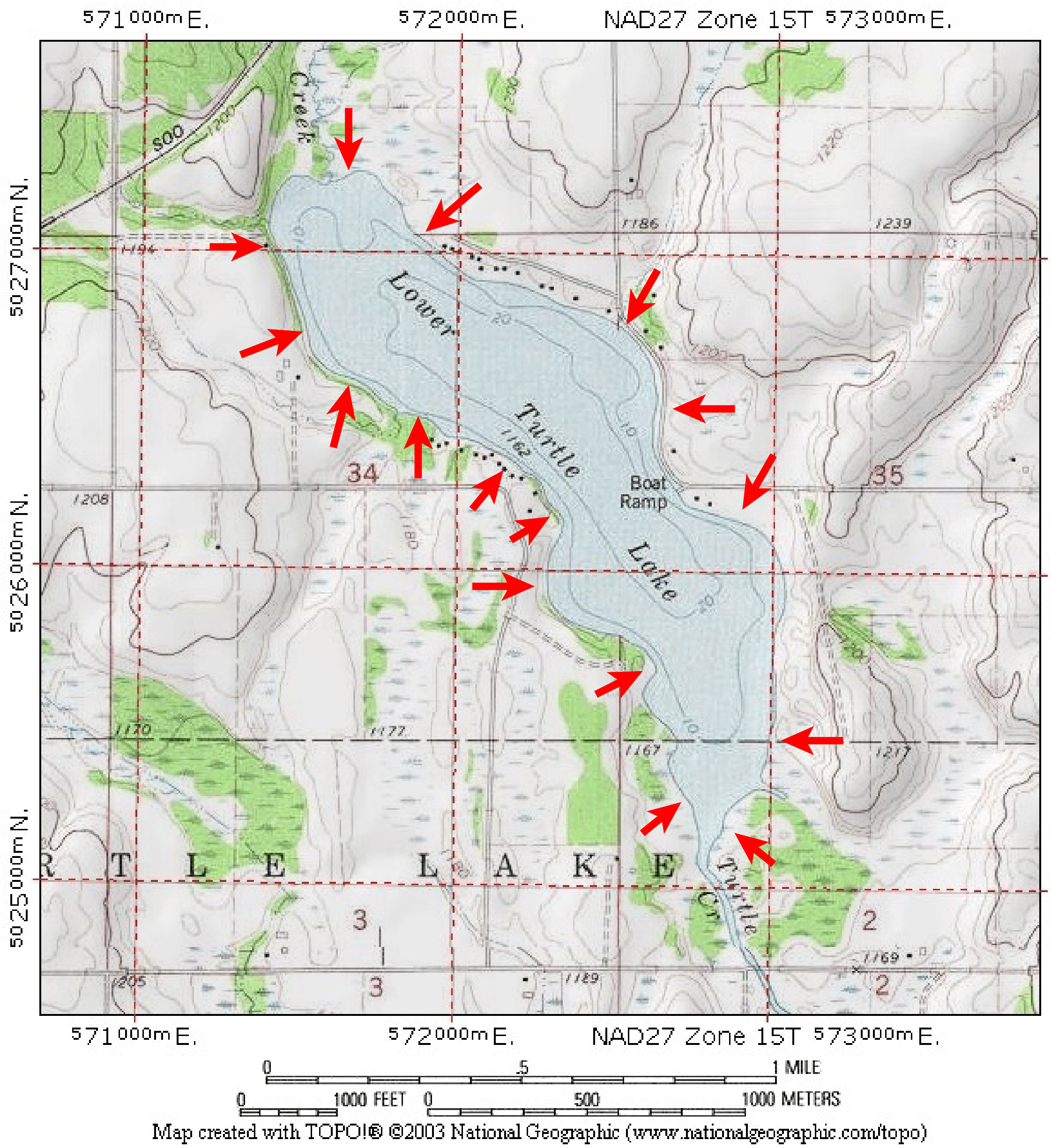


Figure 9. Lower Turtle Lake conductivity survey, August 1994. Red arrows indicate areas of potential groundwater inflow (source: Blue Water Science, 1994. Lower Turtle Lake Management Plan).

Onsite Systems Status: Onsite systems appear to be in fairly good condition based on the conductivity survey results, the surrounding soils, and the setback of the cabins and homes. A conventional onsite system is shown in Figure 10. With proper maintenance (such as employing a proper pumping schedule) onsite systems are an excellent wastewater treatment option. The challenge is to maintain systems in good working condition.

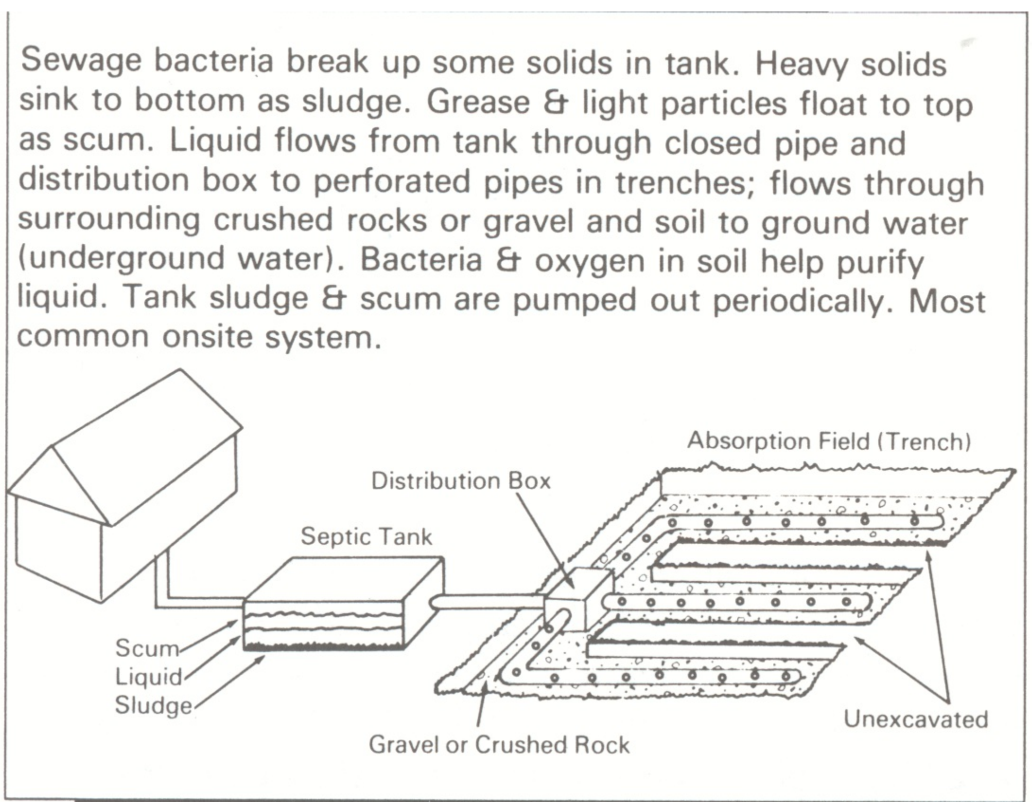


Figure 10. Typical onsite wastewater treatment system found in the Lower Turtle Lake watershed.

4. Lake Features

4.1. Lake Map and Lake Statistics

Lower Turtle Lake is approximately 276 acres in size, with a watershed of 5,530 acres. The average depth of Lower Turtle Lake is 4.6 meters (15 feet) with a maximum depth of 7.3 meters (24 feet) (Table 7). A lake contour map is shown in Figure 11. Lower Turtle Lake is located in an area of Wisconsin that is dominated by forests, wetlands, and agricultural lands.

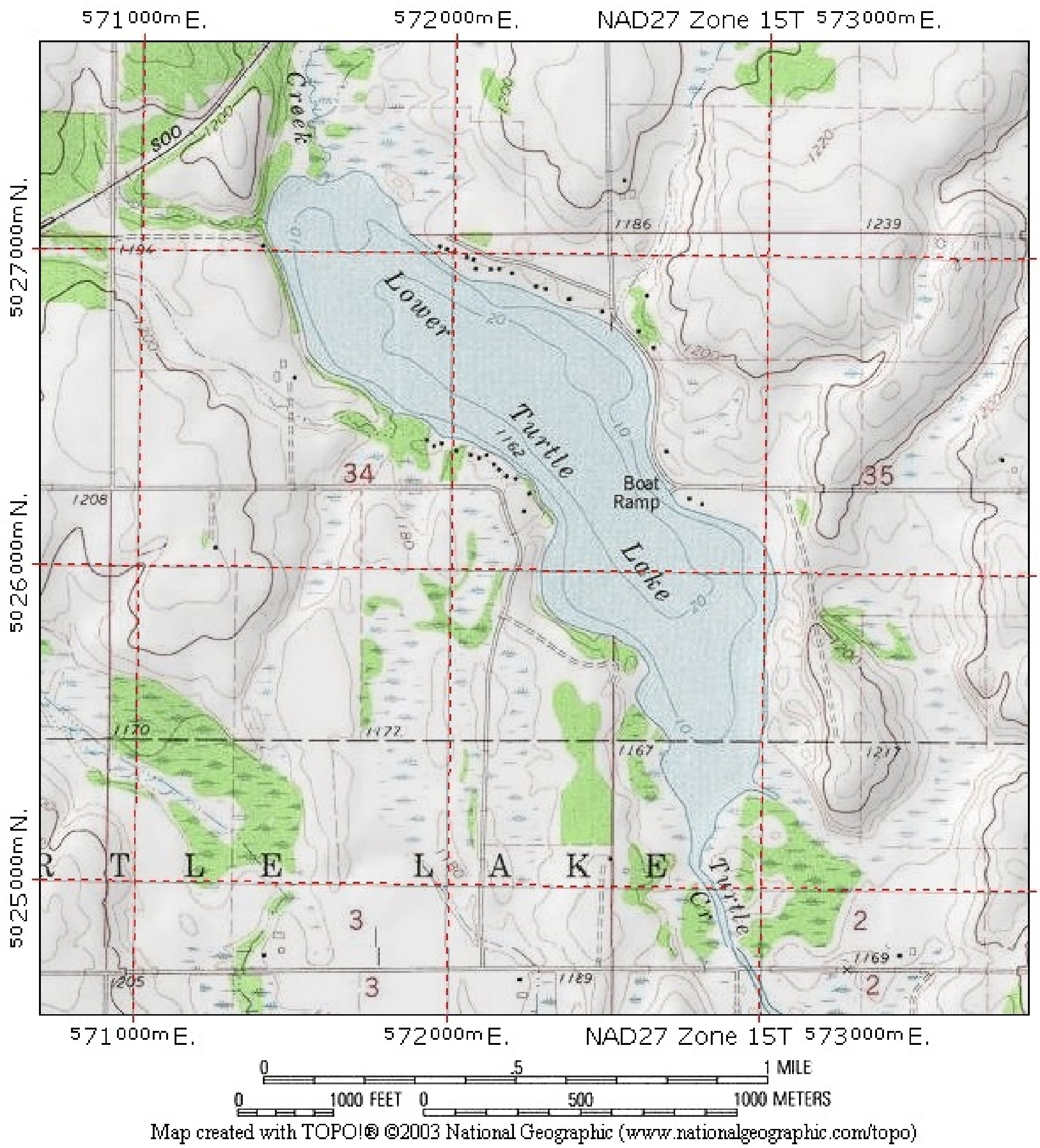


Figure 11. Lower Turtle Lake contour map.

Table 7. 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 (not including lake area):	5,530 acres (2,239 ha)
Watershed: Lake surface ratio	20 :1
Public accesses (#):	2
Inlets: 2	Outlets: 1 (Turtle Creek)

Figure 12. In the southern end of Lower Turtle, aquatic plants were growing close to the lake surface in June, 2004.

4.2. Dissolved Oxygen and Temperature

The summer dissolved oxygen and temperature profiles are shown in Figure 13.

A profile was obtained in May and July of 2004. By examining the profiles, one can learn a great deal about the condition of a lake and the habitat that is available for aquatic life.

The July profile show that the lake was thermally stratified. **Thermally stratified** means that the water column of the lake is segregated into different layers of water based on their temperature. Just as hot air rises because it is less dense than cold air, water near the surface that is warmed by the sun is less dense than the cooler water below it and it “floats” forming a layer called the *epilimnion*, or *mixed layer*. The water in the epilimnion is frequently mixed by the wind, so it is usually the same temperature and is saturated with oxygen.

Below this layer of warm, oxygenated surface water is a region called the *metalimnion*, or *thermocline* where water temperatures decrease precipitously with depth. Water in this layer is isolated from gas exchange with the atmosphere. The oxygen content of this layer usually declines with depth in a manner similar to the decrease in water temperature.

Below the thermocline is the layer of cold, dense water called the *hypolimnion*. This layer is completely cut off from exchange with the atmosphere and light levels are very low. So, once the lake stratifies in the summer, oxygen concentrations in the hypolimnion progressively decline due to the decomposition of plant and animal matter and respiration of benthic (bottom-dwelling) organisms.

The July profile indicates that the epilimnion extended to a depth of about 15 ft, and that oxygen was present throughout the lake.

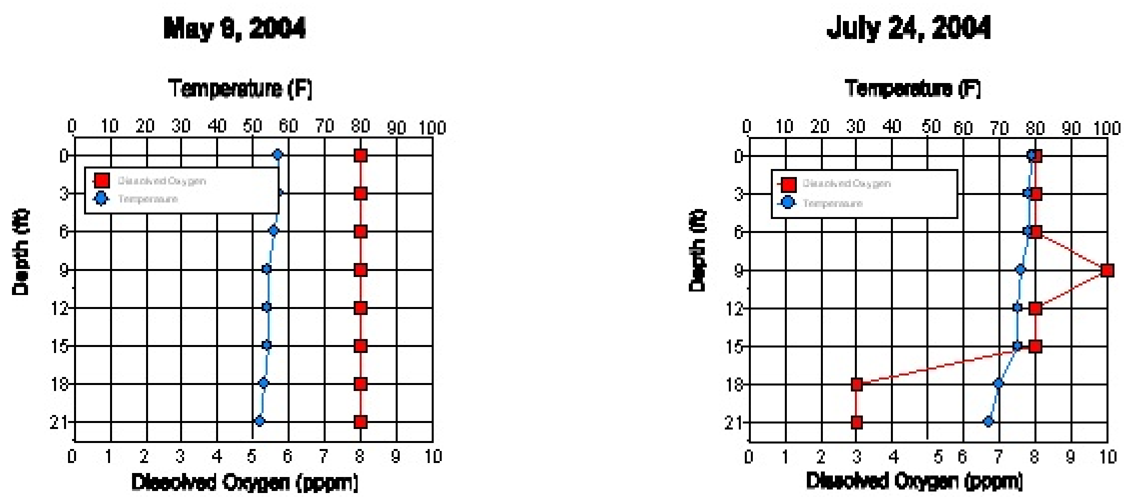


Figure 13. Dissolved oxygen (DO)/temperature profiles for May (left) and July (right) in 2004. Dissolved oxygen data are shown with squares and temperature with circles.

4.3. Lake Water Quality Summary

Summer water chemistry data collected during 2004 included secchi disc, total phosphorus (TP), and chlorophyll a (Chl a) (Table 8). Samples were collected at the surface. On the July 23 date total phosphorus was higher in the bottom water than the top water indicating some phosphorus release from the bottom material (sediments or plants) may be occurring, but it is minor. Overall, the three water quality indicators (Secchi disc, total phosphorus, and chlorophyll a) in 2004 indicate Lower Turtle is eutrophic, meaning it is nutrient enriched.

Table 8. Summer monitoring results for Lower Turtle Lake in 2004.

	Secchi Disc (ft)	Total Phosphorus (ppb)	Chlorophyll a (ppb)
April 28	19.5	51	--
May 9	8	34	--
June 26	4.5	84	13.5
July 23	4.1	40 (top) 64 (bottom)	--
July 24	4.5	55	17.4
August 22	3	85	66.9
October 10	3	67	44.4
Average (May - August)	4.9	65	33

Table 9. Historical seasonal (May - September) average lake monitoring results for Lower Turtle. The number in parenthesis is the number of data points used to calculate the seasonal average. Data are from the Wisconsin Self-Help Monitoring Program except for 1994.

	Secchi Disc (ft)	Total Phosphorus (ppb)	Chl a (ppb)
1994*	8.3 (3)	26.0 (6)	12.0 (6)
1995	5.1 (10)	63.8 (3)	20.5 (2)
1996	4.9 (9)	36.3 (3)	22.7 (3)
1997	5.5 (6)	31.7 (3)	19.7 (3)
1998	--	70.0 (1)	40.0 (1)
1999	4.8 (3)	47.7 (3)	24.7 (3)
2000	4.2 (3)	84.5 (3)	35.0 (3)
2001	4.0 (3)	51.8 (4)	28.6 (3)
2002	8.5 (1)	33.0 (1)	8.0 (1)
2003	4.7 (5)	46.7 (3)	29.8 (3)
2004	4.9 (4)	64.5 (3)	32.6 (4)

*(Planning Grant Study, McComas 1994)

4.3.1. Secchi Disc Transparency

Water clarity is commonly measured with a Secchi disc. A typical seasonal pattern shows good clarity in May with a drop off in July and August (Figure 14). This is a typical pattern for lakes like Turtle Lake. Since 1994, the seasonal average water clarity has been around 5 feet except for two years when it was higher. It is not clear why the clarity was better in 1994 and 2002.

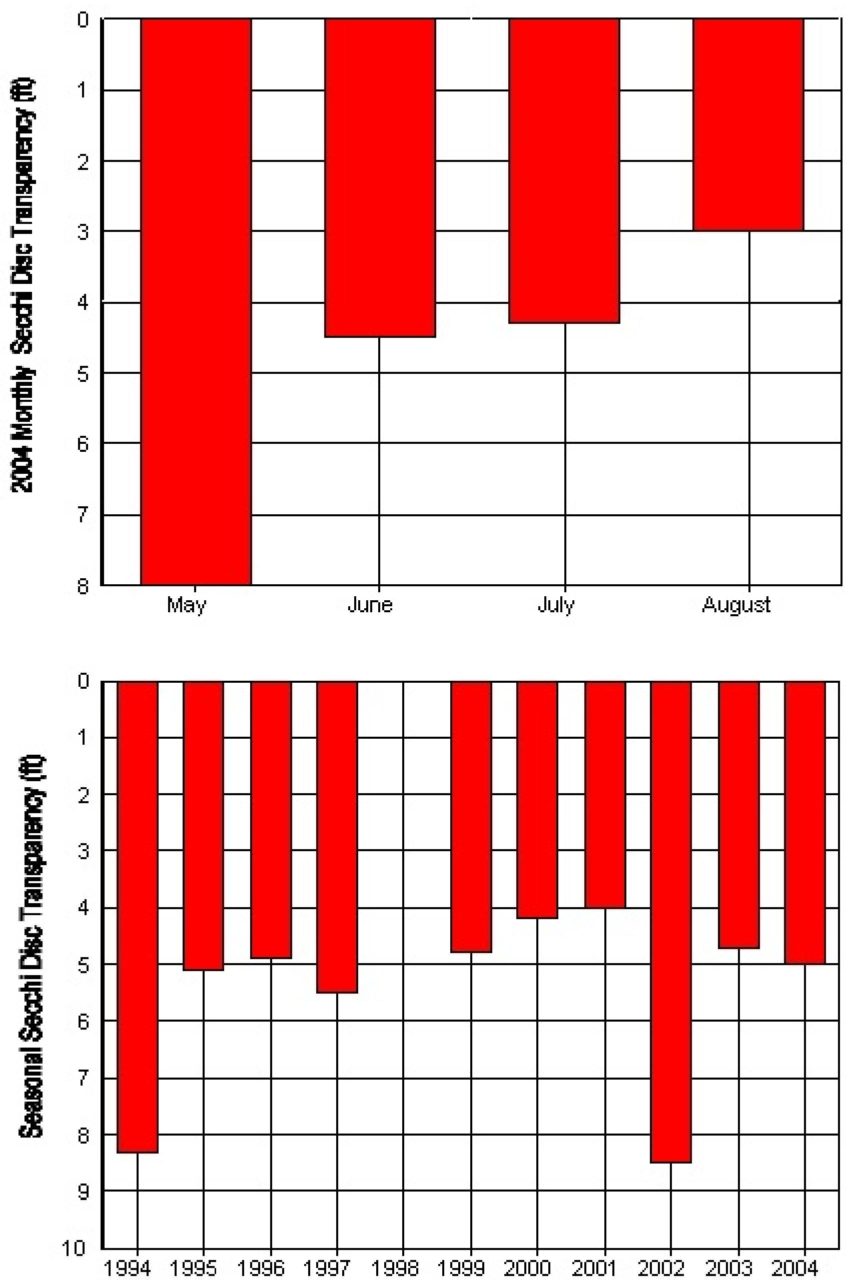
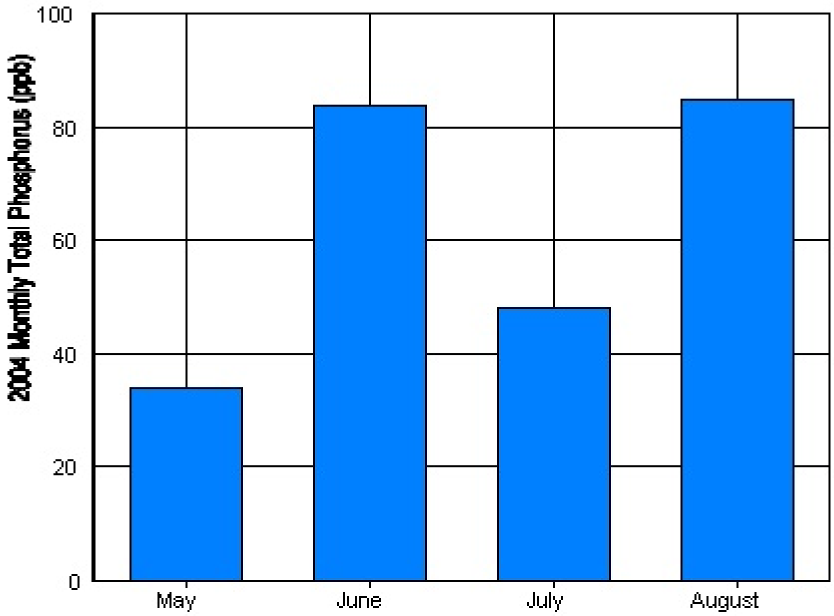


Figure 14. [top] Monthly summer Secchi disc readings for Lower Turtle Lake in 2004. [bottom] Seasonal average Secchi disc readings from 1994-2004.

4.3.2. Total Phosphorus

Phosphorus is the nutrient more often associated with stimulating nuisance algae growth. Lake phosphorus concentrations from 1994 through 2004 are shown in Figure 15. Phosphorus concentrations in Lower Turtle Lake are high enough that by the end of the summer they produce moderate algae blooms.



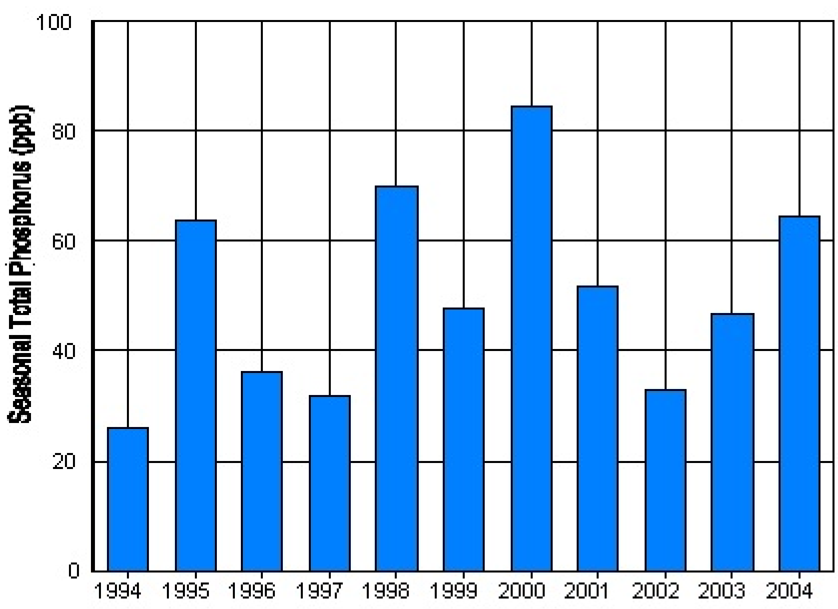


Figure 15. [top] Monthly summer total phosphorus readings for Lower Turtle Lake in 2004. [bottom] Seasonal total phosphorus concentrations from 1994-2004.

4.3.3. Chlorophyll and Algae

Algae are small green plants, often consisting of single cells or grouped together in filaments (strings of cells). Algae blooms occur in Lower Turtle Lake nearly every summer. Algae are commonly characterized by measuring the chlorophyll content in lake water. In June and July chlorophyll was low and then increased in August. This is a common pattern for lakes like Lower Turtle Lake. Chlorophyll results from 1994 - 2004 are shown in Figure 16. Except for 2002, seasonal chlorophyll levels are elevated.

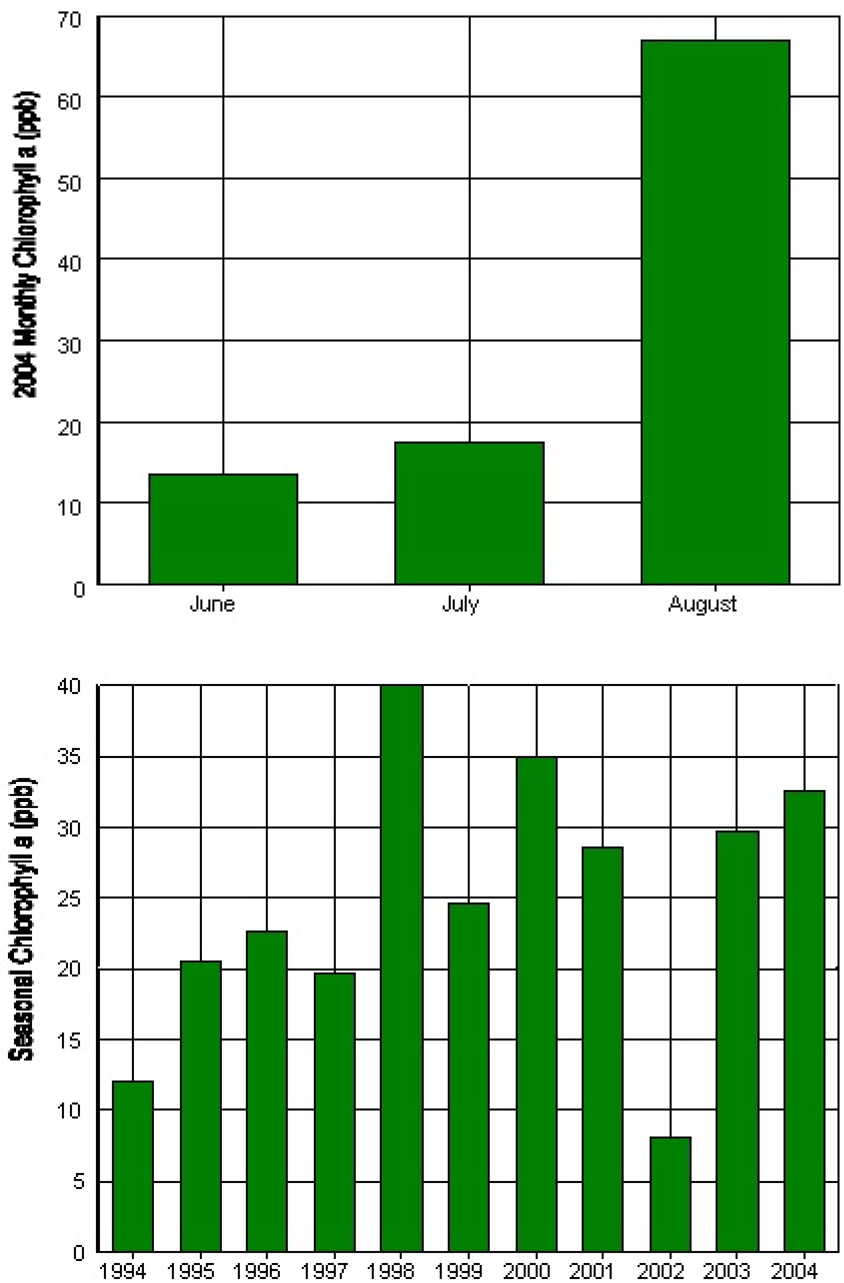


Figure 16. [top] Monthly summer chlorophyll a readings for Lower Turtle Lake in 2004. [bottom] Seasonal chlorophyll a concentrations from 1994-2004.

4.4. Zooplankton and Other Invertebrates

Zooplankton are small crustacean-like animals that can feed on algae. Examples of algae and zooplankton from Lower Turtle Lake are shown in Figure 17. Algae are dominated by "good" algae, generally non-bloom forming species. The zooplankton community is typical for lakes in Northern Wisconsin. In the photos below, images are magnified 150 times.

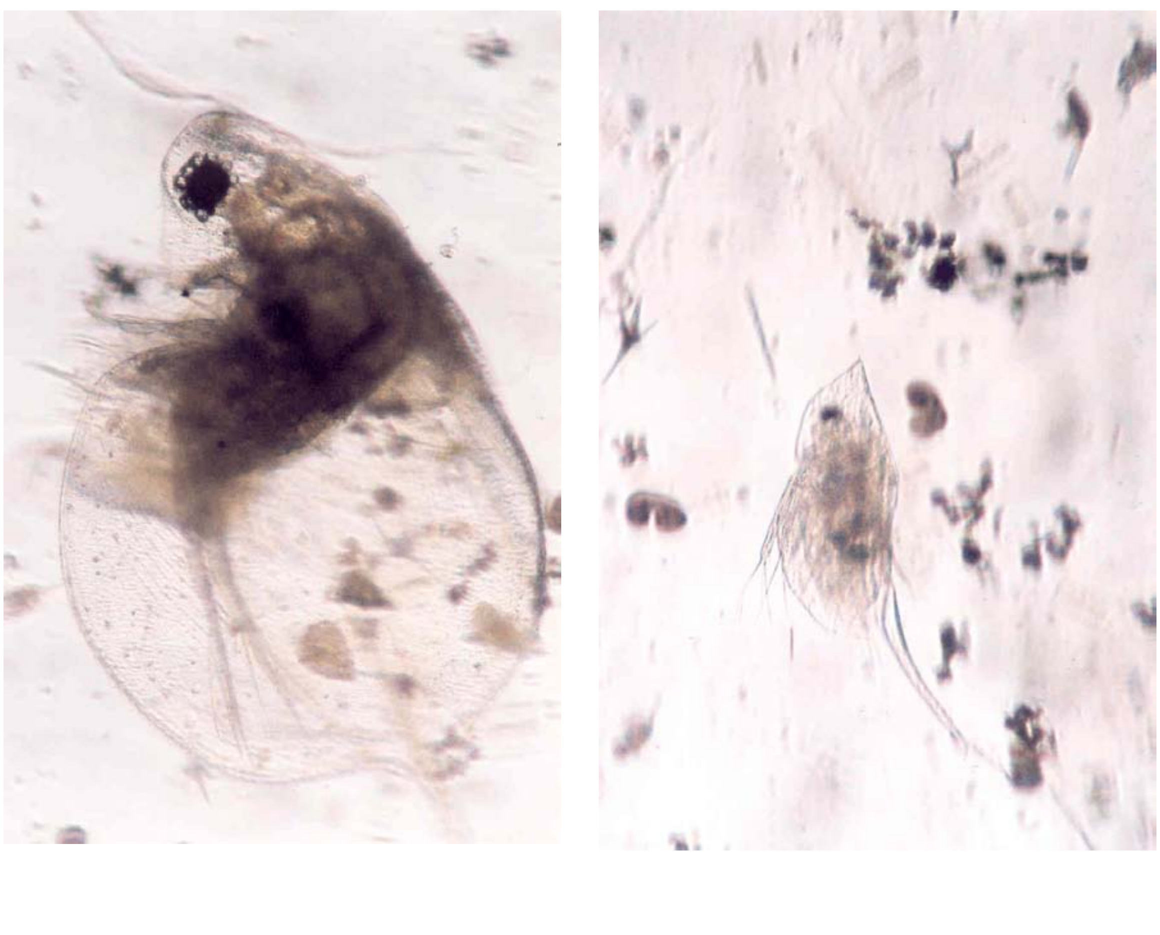


Figure 17. Two examples of zooplankton species from Lower Turtle Lake in 2004. The animal on the left is *Daphnia*, a relatively large zooplankton (1-2 mm in length) that feeds on algae. The animal on the right is a smaller daphnia.

Zooplankton were sampled in 2004 results are shown in Table 10 and Figure 18.

Table 10. Zooplankton counts for 2004.

Date	6.19.04*	7.23.04
Net Tow Depth (ft)	12	15
Big	1	4
Little	0	1
Ceriodaphnia	0	0
Bosmina	0	0
Chydorus	4	27
Total Cladocerans	**5**	**32**
Calonoids	0	9
Cyclophoids	1	15
Nauplii	0	43
Total Copepods	**1**	**67**
Rotifers	**0**	**45**
TOTAL	**6**	**144**

*sample may not have been preserved well

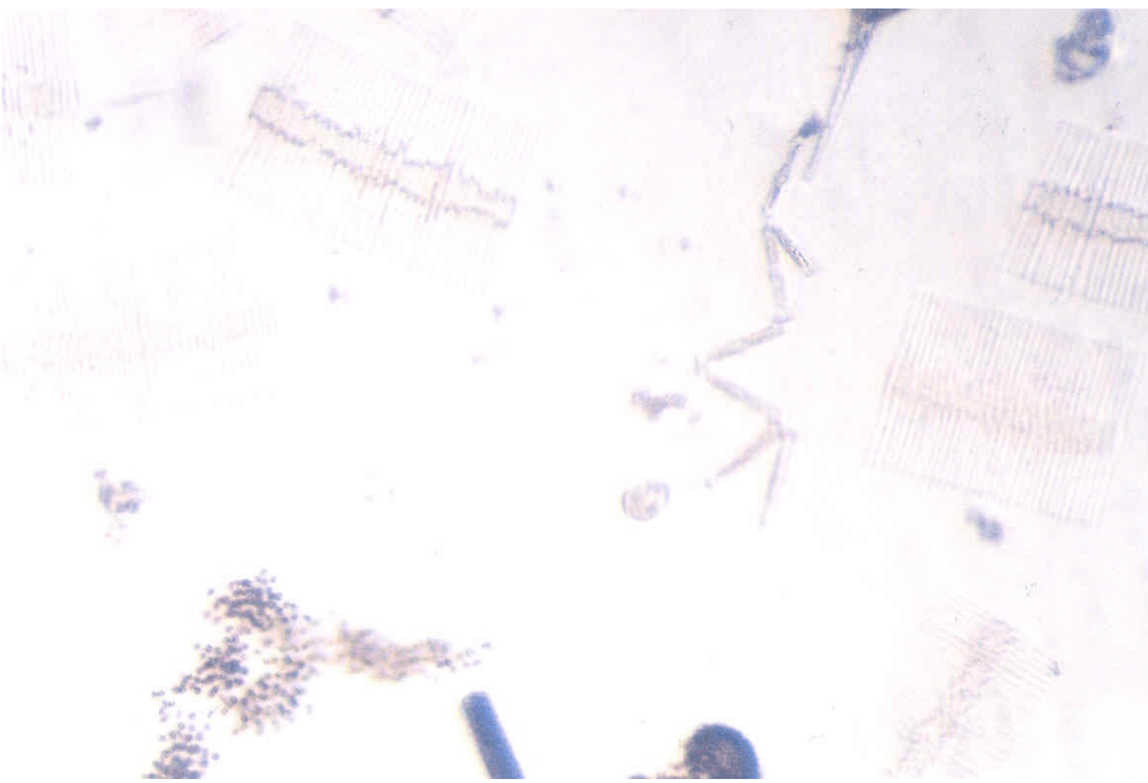


Figure 18. The algal conditions in Lower Turtle Lake on July 23, 2004 consisted of circular algae (*Microcystis*)(lower left) and diatoms (upper right).

4.5. Aquatic plant status

Aquatic plants are very important to lakes. They act as nurseries for small fish, refuges for larger fish, and they help to keep the water clear. Currently Lower Turtle Lake has a fair diversity of aquatic plants.

The coverage of aquatic plants over the lake bottom for Lower Turtle Lake is shown in Figure 19. Summary of plant statistics is shown in Tables 11 and 12 and details for individual transects for the plant survey are found in Table 13.

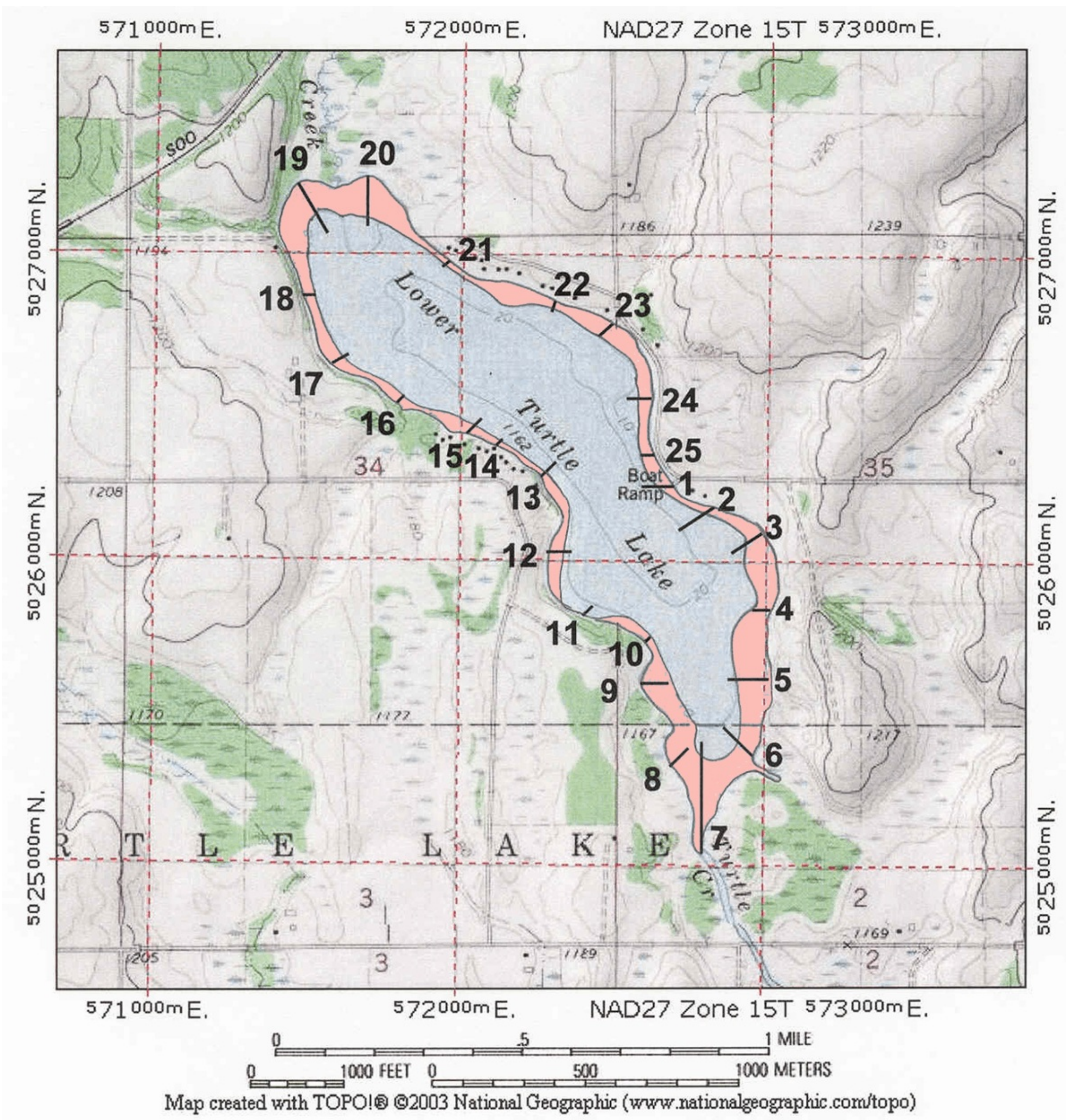


Figure 19. Lower Turtle Lake aquatic plant coverage based on the 2004 survey conducted by Blue Water Science.

A summary of aquatic plant statistics is shown in Table 11. The frequency of aquatic plant occurrence and their density is shown in Table 12.

Table 11. Aquatic plant survey summary.

	All Stations
Number of submerged aquatic plant species found	13
Most common plant	flatstem pondweed
Rarest plant	naiads and chara
Maximum depth of plant growth	8 feet

Figure 20. Curlyleaf pondweed, June 5, 2004.

Table 12. Lower Turtle Lake aquatic plant occurrences and densities for the July 23, 2004 survey based on 25 transects and 3 depths, for a total of 75 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	Depth 0-3 feet (n=25)			Depth 4-6 feet (n=25)			Depth 7-10 feet (n=25)			All Stations (n=75)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Bulrush - hardstem (*Scirpus acutus*)	1	4	2	1	4	1	--	--	--	2	3	1.5
Cattails (*Typha sp*)	1	4	1	1	4	0.5	--	--	--	2	3	0.8
Duckweed (*Lemna sp*)	1	4	1	--	--	--	--	--	--	1	1	1
Spatterdock (*Nuphar variegatum*)	1	4	2	1	4	2	--	--	--	2	3	2
White waterlily (*Nymphaea sp*)	10	40	1.9	9	36	0.9	--	--	--	19	25	1.4
Coontail (*Ceratophyllum demersum*)	6	24	1.5	15	60	1.5	8	32	1.2	29	39	1.4
Chara (*Chara sp*)	1	4	1	1	4	0.5	--	--	--	2	3	0.8
Elodea (*Elodea canadensis*)	4	16	1.1	5	20	0.7	--	--	--	9	12	0.9
Northern watermilfoil (*Myriophyllum sibiricum*)	7	28	1.3	13	52	0.9	3	12	1.2	23	31	1
Naiads (*Najas sp*)	1	4	0.8	1	4	0.3	--	--	--	2	3	0.9
Curlyleaf pondweed (*Potamogeton crispus*)	1	4	1	2	8	0.4	2	8	1	5	7	0.8
Floatingleaf pondweed (*P. natans*)	2	8	1.5	1	4	1.5	--	--	--	3	4	1.5
Claspingleaf pondweed (*P. richardsonii*)	6	24	1.5	6	24	1.3	--	--	--	12	16	1.4
Stringy pondweed (*P. pusillus*)	5	20	1.4	5	20	0.9	--	--	--	10	13	1.1
Flatstem pondweed (*P. zosteriformis*)	13	52	2.2	18	72	3.1	11	44	1.8	42	56	2.5
Sago pondweed (*Stuckenia pectinata*)	11	44	1.3	10	40	0.9	--	--	--	21	28	1.1
Water celery (*Vallisneria americana*)	12	48	1.3	18	72	1.1	3	12	1.7	33	44	1.2
Water stargrass (*Zosterella dubia*)	9	36	1.6	12	48	1	--	--	--	21	28	1.2
Filamentous algae	4	16	2	6	24	1	--	--	--	10	13	1.4

Table 13. Individual transect data for Lower Turtle Lake on July 23, 2004.

	T1			T2			T3			T4			T5			T6			T7		
	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10
Bulrush - hardstem																					
Cattails																					
Duckweed																					
Spatterdock																					
White waterlily				1															5	1	
Coontail	1					1									1		1.8			2.3	
Chara																					
Elodea										1	1									0.3	
Northern watermilfoil			0.5							1	1			0.5						0.3	
Naiads																					
Curlyleaf pondweed																	0.5			0.3	
Floatingleaf pondweed																					
Claspingleaf pondweed	1	1					1	1		1	1										
Stringy pondweed																					
Flatstem pondweed	1		1		3	4	1	1				2	2	3	3					0.7	
Sago pondweed	1	1			1		1	1					1	0.5							
Water celery	0.5	1			1		2	2		2	2	2	2	1.5	1						
Water stargrass										2	2										
Filamentous algae																				0.3	

	T8			T9			T10			T11			T12			T13			T14		
	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10
Bulrush - hardstem				2	1																
Cattails				1	0.5																
Duckweed																					
Spatterdock																					
White waterlily	3	1		2	1		1	1					3	1.5					1	0.5	
Coontail		1.3	1		0.3	0.3								2			0.5				
Chara																1	0.5				
Elodea	2	1																			
Northern watermilfoil					0.5											1	1				
Naiads													0.5	0.3							
Curlyleaf pondweed																					
Floatingleaf pondweed																					
Claspingleaf pondweed							2	2													
Stringy pondweed																1	0.5		2	1	
Flatstem pondweed	4	2.7		2	2.5				0.5					1.5		2	1	1	2	2	
Sago pondweed													2	1							
Water celery	0.5	0.2		1	0.5		1	1						0.5			0.5		1	2	
Water stargrass					1		0.5	0.5					2	1		2	1		2	1	
Filamentous algae	2	0.7											2	1							

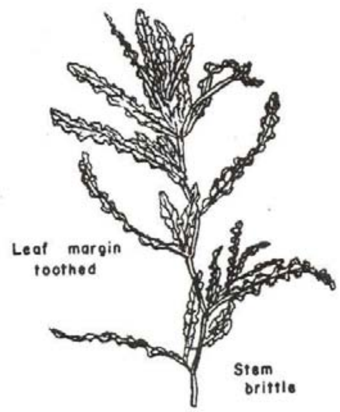
Table 13. Individual transect data concluded.

	T15			T16			T17			T18			T19			T20			T21		
	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10
Bulrush - hardstem																					
Cattails																					
Duckweed													1								
Spatterdock				2	2																
White waterlily				1	0.5		1	0.5					1	1							
Coontail				1	1	2	1	1.5			1			2	1	2	2		3	2.5	
Chara																					
Elodea				1	1																
Northern watermilfoil						2	2	2		2	1			2			0.7		1	1	
Naiads										1											
Curlyleaf pondweed						1															
Floatingleaf pondweed							1	1.5					2								
Claspingleaf pondweed	3	1.5																			
Stringy pondweed		0.5		2	2								1								
Flatstem pondweed	3	3	2			1		1.5		2	2				2	3	1		2	1.5	
Sago pondweed	2	1		1	1		1	0.5					1								
Water celery	1	0.5								2	1			2						1	
Water stargrass								1.5		2	1					2	1		1	0.5	
Filamentous algae	2	1												2		2	0.7				

	T22			T23			T24			T25		
	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10	0 - 3	4 - 6	7 - 10
Bulrush - hardstem												
Cattails												
Duckweed												
Spatterdock												
White waterlily												
Coontail		0.7		1	2	1		1				2
Chara												
Elodea	0.5	0.2										
Northern watermilfoil		0.3					1	0.5		1	0.5	1
Naiads												
Curlyleaf pondweed				1		1						
Floatingleaf pondweed												
Claspingleaf pondweed				1							1.3	
Stringy pondweed	1	0.3										
Flatstem pondweed	4	2.7			1	1	1	2.5			0.3	2
Sago pondweed				1			1	0.5		2	1.3	
Water celery		1.3		1			2	1			0.7	2
Water stargrass	1	0.7						0.5				
Filamentous algae												

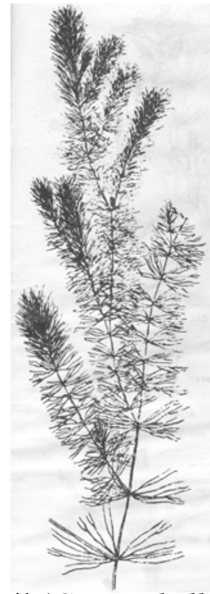
Common Plants in Lower Turtle Lake

Curlyleaf pondweed



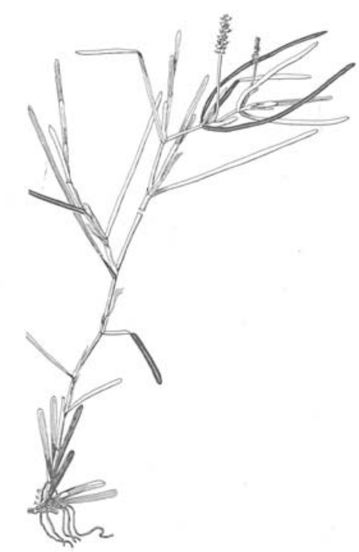
Curlyleaf pondweed (*Potamogeton crispus*) is an exotic plant found in Lower Turtle Lake.

Coontail



Coontail (*Ceratophyllum demersum*) is found in all water depths.

Flatstem Pondweed

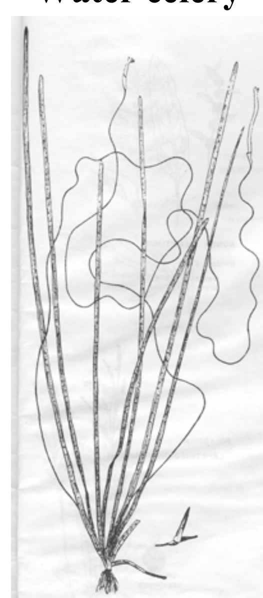


Flatstem pondweed (*Potamogeton zosteriformis*) is dominant in all water depths

Northern watermilfoil

Northern watermilfoil (*Myriophyllum sibiricum*) is found in water depths to 8 feet.

Water celery



Water celery (*Vallisneria americana*) is found in water depths to 8 feet.

Distribution and Density of Curlyleaf Pondweed, a Non-Native Plant

A curlyleaf distribution map was prepared based on an inspection of Lower Turtle Lake in May and June of 2004. Curlyleaf is fairly widespread through the lake, but presents nuisance growth conditions primarily in the southern end of the lake, encompassing about 20 acres of nuisance growth (Figure 21).

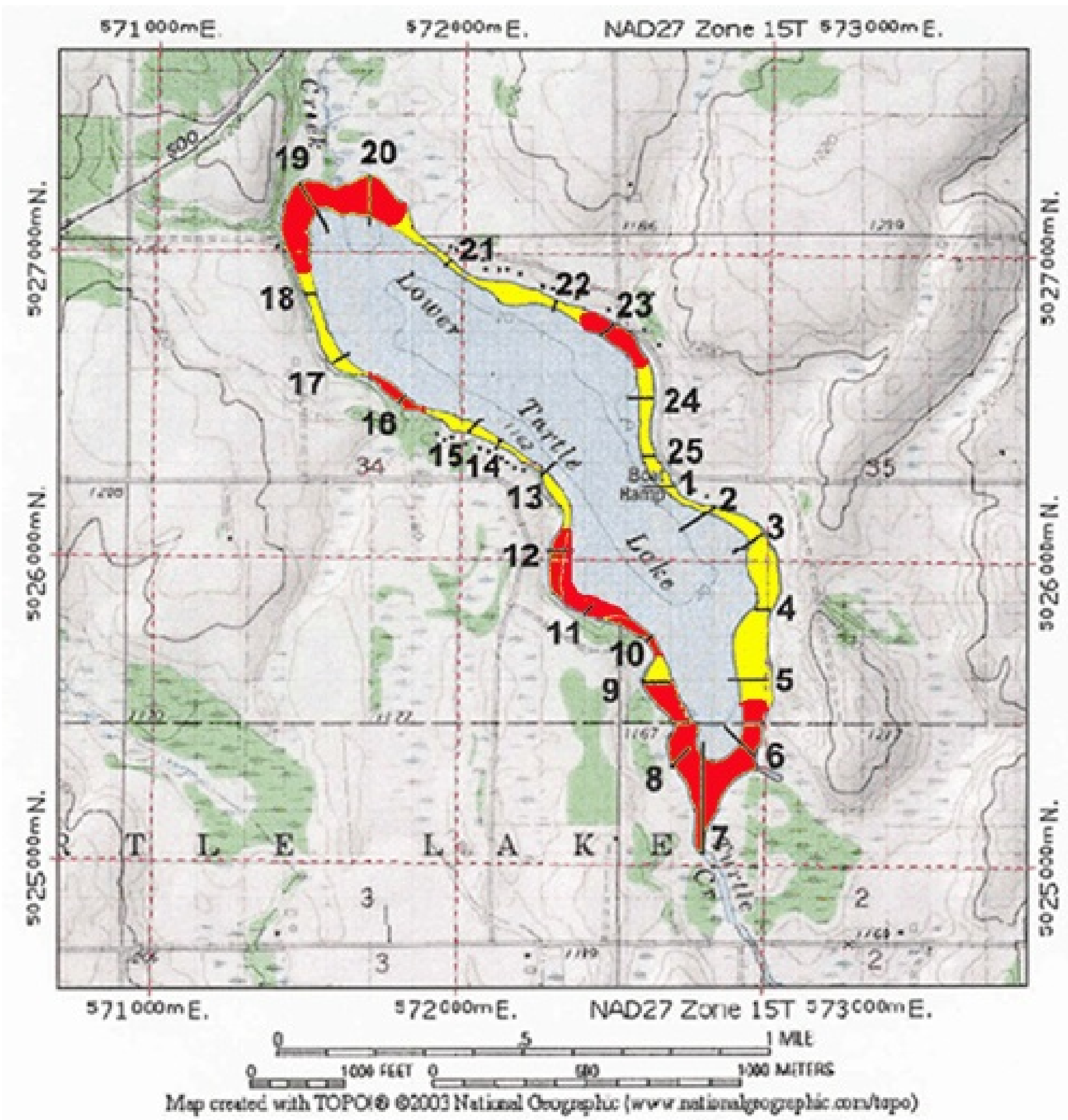


Figure 21. Lower Turtle Lake curlyleaf pondweed coverage based on the 2004 survey conducted by Blue Water Science.

Comparison of 1994 and 2004 Plant Surveys

The abundance of submerged native aquatic plants appears to be increasing in Lower Turtle Lake compared to the last aquatic plant survey from 1994. Aquatic plant species that appear to have increased since 1994 include: coontail, northern watermilfoil, stringy pondweed, sago pondweed, and water stargrass. The occurrence of curlyleaf pondweed was less in 2004 compared to 1994.

1994 (July 7 and August 3)

Lower Turtle Lake aquatic plant occurrences and densities for the July 7 and August 3, 1994 survey based on 22 transects and 3 depths, for a total of 61 stations. (Survey conducted by Blue Water Science).

	Depth 0-3 feet (n=22)		Depth 4-6 feet (n=22)		Depth 7-10 feet (n=17)		All Stations (n=61)	
	Occur	% Occur	Occur	% Occur	Occur	% Occur	Occur	% Occur
Arrowhead (*Sagittaria sp*)	1	5	--	--	--	--	1	2
Bulrush - softstem (*Scirpus validus*)	--	--	1	5	--	--	1	2
Cattails (*Typha sp*)	2	9	2	9	--	--	4	7
White waterlily (*Nymphaea sp*)	6	27	2	9	--	--	8	13
Coontail (*Ceratophyllum demersum*)	3	14	5	23	1	5	9	15
Chara (*Chara sp*)	1	5	--	--	--	--	1	2
Elodea (*Elodea canadensis*)	4	18	2	9	1	6	7	11
Northern watermilfoil (*Myriophyllum sibiricum*)	8	36	5	23	1	6	14	23
Naiads (*Najas sp*)	3	14	1	5	--	--	4	7
Curlyleaf pondweed (*Potamogeton crispus*)	8	36	11	50	4	24	23	38
Variable pondweed (*P. gramineus*)	1	5	1	5	--	--	2	3
Claspingleaf pondweed (*P. richardsonii*)	9	41	4	18	1	6	14	23
Robbins pondweed (*P. Robbinsii*)	--	--	1	5	--	--	1	2
Flatstem pondweed (*P. zosteriformis*)	19	86	13	59	6	35	38	62
Sago pondweed (*Stuckenia pectinata*)	6	27	3	14	--	--	9	15
Water celery (*Vallisneria americana*)	16	73	12	55	1	6	29	48
Filamentous algae	6	27	3	14	1	5	10	16
Total Number of Submerged Plant Species	11	--	11	--	7	--	12	--

2004 (July 23)

Lower Turtle Lake aquatic plant occurrences and densities for the July 23, 2004 survey based on 25 transects and 3 depths, for a total of 75 stations. (Survey conducted by Blue Water Science).

	Depth 0-3 feet (n=25)		Depth 4-6 feet (n=25)		Depth 7-10 feet (n=25)		All Stations (n=75)	
	Occur	% Occur	Occur	% Occur	Occur	% Occur	Occur	% Occur
Bulrush - hardstem (*Scirpus acutus*)	1	4	1	4	--	--	2	3
Cattails (*Typha sp*)	1	4	1	4	--	--	2	3
Duckweed (*Lemna sp*)	1	4	--	--	--	--	1	1
Spatterdock (*Nuphar variegatum*)	1	4	1	4	--	--	2	3
White waterlily (*Nymphaea sp*)	10	40	9	36	--	--	19	25
Coontail (*Ceratophyllum demersum*)	6	24	15	60	8	32	29	39
Chara (*Chara sp*)	1	4	1	4	--	--	2	3
Elodea (*Elodea canadensis*)	4	16	5	20	--	--	9	12
Northern watermilfoil (*Myriophyllum sibiricum*)	7	28	13	52	3	12	23	31
Naiads (*Najas sp*)	1	4	1	4	--	--	2	3
Curlyleaf pondweed (*Potamogeton crispus*)	1	4	2	8	2	8	5	7
Floatingleaf pondweed (*P. natans*)	2	8	1	4	--	--	3	4
Claspingleaf pondweed (*P. richardsonii*)	6	24	6	24	--	--	12	16
Stringy pondweed (*P. pusillus*)	5	20	5	20	--	--	10	13
Flatstem pondweed (*P. zosteriformis*)	13	52	18	72	11	44	42	56
Sago pondweed (*Stuckenia pectinata*)	11	44	10	40	--	--	21	28
Water celery (*Vallisneria americana*)	12	48	18	72	3	12	33	44
Water stargrass (*Zosterella dubia*)	9	36	12	48	--	--	21	28
Filamentous algae	4	16	6	24	--	--	10	13
Total Number of Submerged Plant Species	13	--	13	--	5	--	13	--

4.6. Fishery Status (prepared by WDNR)

The fishery status has been summarized by the WDNR.

Fish surveys indicate that natural reproduction is adequate to sustain the fishery, and that no stocking is presently necessary. Lower Turtle Lake is known as a good fishing lake. Walleyes and northern pike are common, and some years walleye fishing is very good. Panfish are common with a good size distribution. Carp are common, but are not a serious problem.

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).

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

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

Lake	Adult Walleyes/Acre
Big Butternut, Polk	4.7
Upper Turtle, Barron	4.0
Lower Turtle, Barron	3.8
Balson, 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

Fish Stocked

Year	Species	Strain	Age Class	Avg Length (inches)	Number of Fish Stocked
2000	Walleye	Unspecified	small fingerlings	1.5	13,800
2002	Walleye	Mississippi headwaters	small fingerlings	1.3	430
2002	Walleye	Mississippi headwaters	small fingerling	1.4	430

5. Lake and Watershed Assessment

5.1. Sources of Nutrients to Lower Turtle Lake

The watershed area that drains to Lower Turtle Lake is dominated by drainage from Upper Turtle Lake and by agricultural acreage.

Questions have been raised by lake users about the water quality coming into Lower Turtle Lake. Special efforts were conducted to explore the watershed of Lower Turtle Lake. Results of stream testing indicate water coming into Lower Turtle Lake from Upper Turtle Lake is not polluted. However, a large subwatershed to the west (Subwatershed 3, p. 5) is a significant source of phosphorus.

Total watershed phosphorus inputs have been estimated at 1,000 - 1,500 pounds of phosphorus per year based on a lake model that used the existing lake phosphorus concentration ranging between 47 ppb (2003) and 65 ppb (2004) and then back calculated to find how much phosphorus it would take to produce that lake concentration.

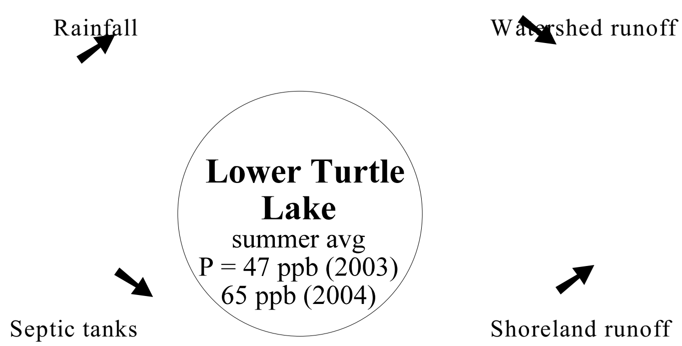


Figure 22. Sources of phosphorus (P) that feed into Lower Turtle Lake are shown above. It is estimated that approximately 1,000 - 1,500 pounds of phosphorus enter Lower Turtle Lake on an annual basis.

5.2. Lower Turtle Lake Status

The water quality status of Lower Turtle Lake is fair and probably could be graded in the range of a C-. Values for phosphorus, chlorophyll and Secchi depth are generally outside of ecoregion values (Table 14).

An ecoregion is a geographic region in the State that has similar geology, soils, and land use. Lower Turtle Lake is on the border between two ecoregions. The two ecoregions are the North Central Hardwood Forest and the Northern Lakes and Forests ecoregions (Figure 23). Lakes in this area of the state have some of the best water quality values in the State. A range of ecoregion values for lakes in the two ecoregions along with actual Lower Turtle Lake data are shown in Table 14.

Table 14. Summer average quality characteristics for lakes in the North Central Hardwood Forest ecoregion, as noted in Description Characteristics of the Seven Ecoregions in Minnesota, by G. Fandrei, S. McCollar. 1988. Minnesota Pollution Control Agency.

Parameter	North Central Hardwood Forest	Lower Turtle (2004)	Lower Turtle (2003)
Total phosphorus (ug/l) - top	23 - 50	64.5	47
Chlorophyll (ug/l)	5 - 22	32.6	30
Chlorophyll - max (ug/l)	7 - 37	66.9	--
Secchi disc (ft)	4.9 - 10.5	5	4.7
Conductivity (umhos/cm)	300 - 400	220	--

These comparisons indicate that the water quality of Lower Turtle Lake could probably be better. The challenge is to prevent excessive nutrients from entering Lower Turtle Lake – from both agricultural and shoreland sources.

An important component to watch and control is nutrient inputs -- especially phosphorus. When phosphorus concentrations are 40 ppb or above, nuisance algae blooms can develop, and this causes a cascade of problems.

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. Shoreland projects such as maintaining shoreline vegetative buffers to reduce nutrient inputs are important. Also, agricultural land use management practices will help to control excessive phosphorus inputs to Lower Turtle Lake.

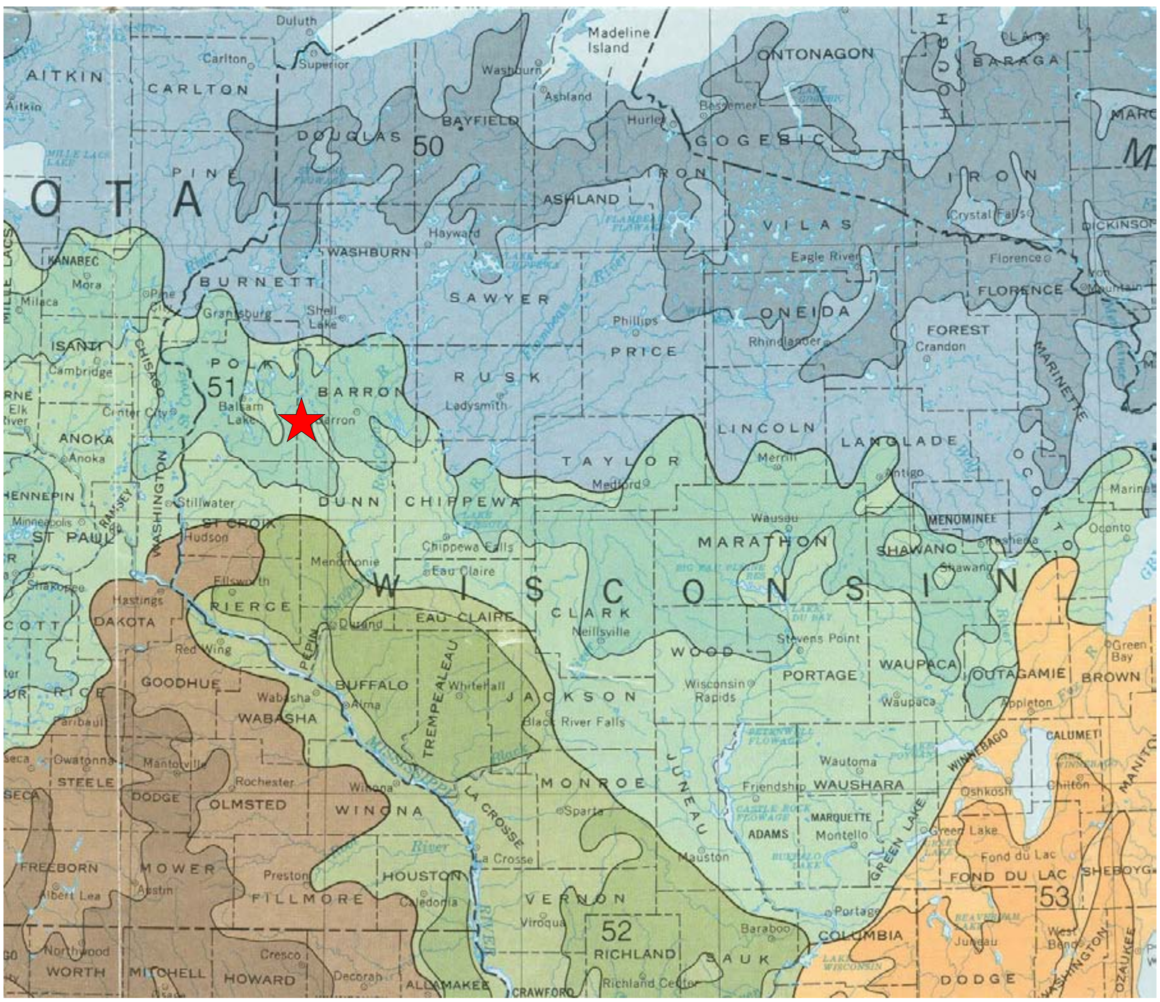


Figure 23. Ecoregion map for Wisconsin. Areas that are labeled with a "50" are bluish and are within the Northern Lakes and Forest Ecoregion. Areas labels with a "51" are blue-green and are in the Central Hardwood Forest Ecoregion. Lower Turtle Lake, located in northwestern Barron County is officially in the Central Hardwood Forest Ecoregion but close to the Northern Lakes and Forest Ecoregion.

5.3. Comparison to Ecoregion Values

Water quality in Lower Turtle Lake is slightly below average compared with other lakes located in the Central Hardwood Forest ecoregion. The large watershed, moderate soil fertility and agricultural land use account for the water quality observed in the lake.

Lake phosphorus models were run using this information. It is estimated that between 1,000 - 1,500 pounds of phosphorus enter Lower Turtle Lake on an annual basis. Results of the model predictions are summarized in Figure 24. It is predicted that Lower Turtle Lake could maintain a phosphorus concentration of around 40 ppb, and should also have slightly better summer water clarity.

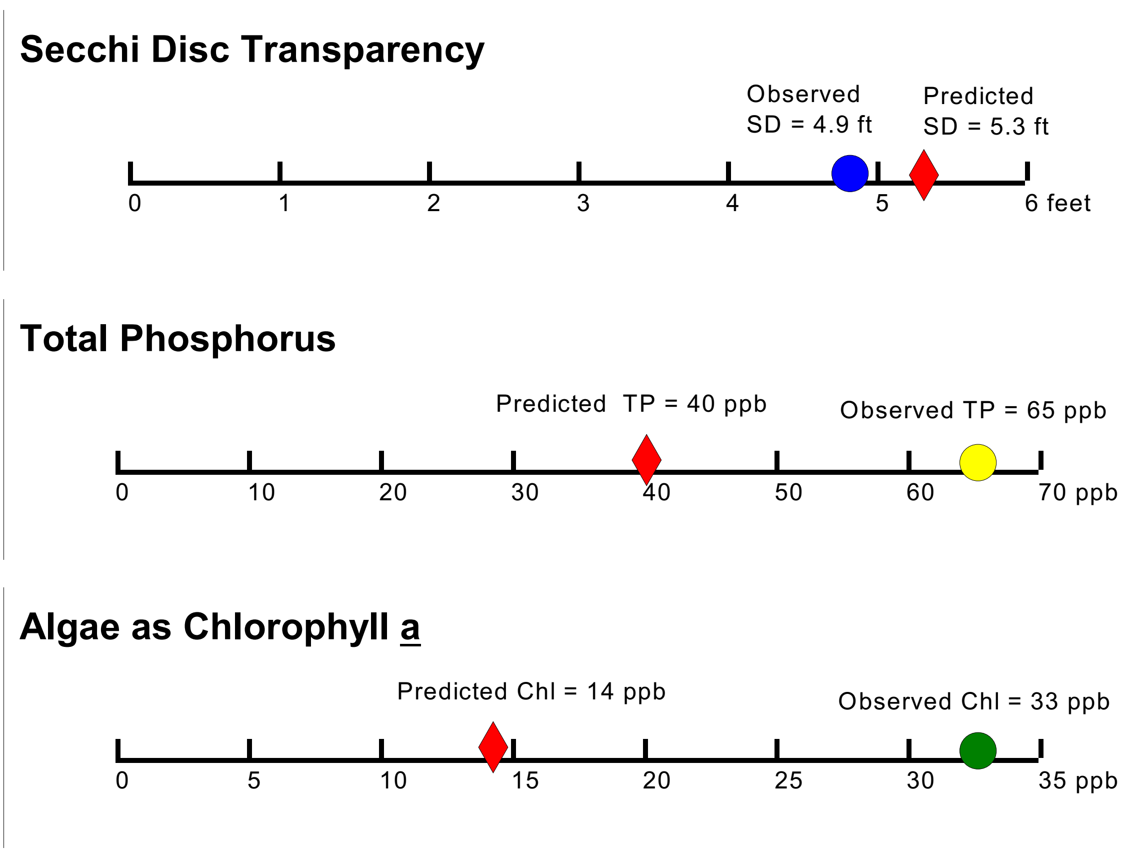


Figure 24. Comparison of water clarity, total phosphorus, and chlorophyll conditions for Lower Turtle Lake in 2004 to predicted conditions for a lake the size of Turtle Lake situated in the Central Hardwood Forest (CHF).

5.4. Major Findings of This Study

- Lower Turtle Lake water quality has the potential to be slightly improved.
- Half of the watershed area of Lower Turtle is from drainage through Upper Turtle and water inflow from Upper Turtle is good quality.
- A major tributary stream inflow that crosses 3rd Street is the major watershed phosphorus contributor to Lower Turtle Lake.
- Phosphorus contributions from lake sediments and from curlyleaf pondweed die back are factors, but not primary phosphorus contributors.
- Curlyleaf pondweed grows to the surface causing nuisance recreational conditions on about 20 acres.
- Both watershed and in-lake phosphorus sources have to be reduced in order to achieve clearer water.
- Working with Barron County Land and Water Department will help address watershed nutrient sources.
- Control of nuisance curlyleaf pondweed will help to slightly reduce internal phosphorus loading.

Figure 25. Some agricultural land to the north of Lower Turtle Lake is idle these days. The largest phosphorus contribution to Lower Turtle Lake comes from the western subwatersheds.

6. Lake Project Ideas for Protecting the Lake Environment (which includes water quality and wildlife)

Project ideas for Lower Turtle Lake are geared toward long-term improvement as well as protection of water quality.

A list of projects has seven main components:

1. Watershed projects.
2. On-site system maintenance.
3. Landscaping projects.
4. Aquatic plant projects.
5. Ongoing education program.
6. Watershed and lake monitoring program.

Details for these projects areas are given in the next few pages.

Project 1. Watershed Projects

Two goals are:

- Protect the natural character of the watershed which helps maintain good runoff water quality.
- Educate waterfront property owners and agricultural producers on the value of good landscaping practices.

Barron County Soil and Water Conservation Department recommends that when farmers grow row crops, the following three practices be used: conservation tillage, including either no-till or reduced till, grass waterways, and nutrient management. Contour farming also is a valuable tool, however most of the topography of the Lower Turtle watershed does not lend itself to contour farming.

According to the Barron County Soil Erosion Transect Survey, in the area of Lower Turtle Lake, conservation tillage is used with some of the row crops, but there is definite room for improvement. According to the survey, 27% of the corn, 43% of the soybeans and 10% of the small grains are grown with conservation tillage. Given the runoff from cropland is the primary concern, the Soil & Water Conservation Department recommends that the Lower Turtle Lake Association promotes the increased use of reduced tilled and no-till, grass waterways and nutrient management in their watershed to protect and enhance the water quality of Lower Turtle Lake.

Figure 26. This stream at the 3rd Street culvert delivers high phosphorus loads to Lower Turtle Lake.

Project 2. On-site System Maintenance

The septic tank/soil absorption field has been one of the most popular forms of on-site wastewater treatment for years. When soil conditions are proper and the system is well maintained, this is a very good system for wastewater treatment. The on-site system is the dominant type of wastewater treatment found around Lower Turtle Lake today.

However, problems can develop if the on-site system has not been designed properly or well-maintained. Around Lower Turtle Lake there are probably some on-site systems that need maintenance and upgrades. At the same time, it is good practice to ensure that systems that are functioning adequately now will continue to do so in the future.

This project calls for an organized program to be developed that makes homeowners aware of all they can do to maintain their on-site systems.

A description of possible activities associated with the on-site maintenance program are described below:

- **Workshop**
  A workshop should be scheduled for Lower Turtle Lake Watershed residents to demonstrate the installation of a conforming septic system and the proper care and maintenance of a septic tank and septic system.

- **Septic Tank Pumping Campaign**
  Barron County could work with the Lower Turtle Lake Association in a coordinated campaign effort to get every septic tank associated with a permanent residence pumped 2-3 years and seasonal systems pumped 4-6 years in the shoreland area to help reduce phosphorous loading to the septic system drainfield.

- **Ordinance Implementation**
  Work to implement and then get enforcement of a county ordinance, where septic systems must be "evaluated" at the time a property is transferred. The seller would obtain a septic system evaluation from Barron County at the time of property transfer. The evaluation would determine if the septic system was "failing", "non-conforming", or "conforming". A "failing" septic system includes septic systems that discharge onto the ground surface, discharges into tiles and surface waters, and systems found to be contaminating a well. The county would require a "failing" system to be brought into compliance with the Barron County ordinance within 90 days of property transfer. .

Through these county property transfer requirements a percentage of the septic systems that are not failing but are "non-conforming" would be upgraded to "conforming" if a prospective buyer was applying for a mortgage. This is because the potential buyer's lending institution in some cases will not approve the buyer's loan request because the property to be purchased does not have a conforming septic system. The county's evaluation report would state whether or not the evaluated septic system is "conforming" or "non-conforming".

Project 3. Landscaping Projects

Controls are in place at the county level to guide new shoreland development. However for existing properties, it is important to either maintain or to improve the natural vegetative buffer.

The shoreland area is valuable for promoting a natural lake environment and a natural lake experience for lake users. The shoreland is defined as the upland area about 300 to 1,000 feet back from the shoreline, and out into the lake to about the end of your dock (Figure 27). A shoreland with native vegetation offers more wildlife and water quality benefits than a lawn that extends to the lake's edge. A summary of attributes and functions of native plants in the shoreland area is shown in Table 15.

Figure 27. Cross section of the lake shoreland habitat.

Table 15. Attributes and functions of native plants in the shoreland area (Source: Henderson and others, 1999. Lakescaping for Wildlife and Water Quality. MnDNR)).

Important functions of plants in and around lakes

Submergent and emergent plants

- Plants produce leaves and stems (carbohydrates) that fuel an immense food web.
- Aquatic plants produce oxygen through photosynthesis. The oxygen is released into lake water.
- Submerged and emergent plants provide underwater cover for fish, amphibians, birds, insects, and many other organisms.
- Underwater plants provide a surface for algae and bacteria to adhere to. These important microorganisms break down polluting nutrients and chemicals in lake water and are an important source of food for organisms higher in the food chain.
- Emergent plants break the energy of waves with their multitude of flexible stems, lessening the water's impact on bank and thus preventing erosion.
- Plants stabilize bottom sediments, which otherwise can be resuspended by currents and wave action. This reduces turbidity and nutrient cycling in the lake.

Shoreline and upland plants

- Shoreline and upland plants provide food and cover for a variety of birds, amphibians, insects, and mammals above the water.
- The extensive root systems of shoreline plants stabilize lake-bank soils against pounding waves.
- Plants growing on upland slopes that reach down to lake hold soil in place against the eroding forces of water running over the ground, and help to keep lake water clean.
- Upland plants absorb nutrients, like phosphorus and nitrogen, found in fertilizers and animal waste, which in excessive concentrations are lake pollutants.

Improving Upland Native Landscape Conditions: In the glacial lake states, three broad vegetative groups occur: pine forests with a variety of ground cover species including shrubs and sedges: hardwood forests with a variety of understory species, including ferns: and tallgrass prairie with a variety of grasses as well as bur oaks and willow trees. Residences around Lower Turtle Lake are in the hardwood forest group.

Reestablishing native conditions in the shoreland area not only improves stormwater runoff quality, it also attracts a variety of wildlife and waterfowl to the shoreland area. Benefits multiply when other neighbors naturalize because the effects are cumulative and significant for water quality and wildlife habitat.

When installing native vegetation close to the shoreline residents are actually installing a buffer. A buffer is a strip of native vegetation wide-enough to produce water quality and wildlife improvements. Much of the natural vegetative buffer has been lost in shoreland areas with development where lawns have been extended right down to the shore.

Lawns are not necessarily bad for a lake. However they can be over fertilized and then runoff carries phosphorus to the lake. Also, lawns function as a low grade open prairie, with poor cover for wildlife and a food supply that is generally poor, except for geese who may find it attractive. Replacing lawn areas with native landscaping projects reduces the need for fertilizer, reduces the time it takes to mow, increases the natural beauty of a shoreland area, and attracts wildlife.

Lawns do not make very good upland buffers. With runoff, short grass blades bend and do not serve as a very effective filter. Tall grass that remains upright with runoff is a better filter. Kentucky bluegrass (which actually is an exotic grass) is shallow-rooted and does not protect soil near shorelines as well as deep-rooted native prairie grasses, shrubs, or other perennials. Grass up to the shoreline offers poor cover, so predators visit other hiding areas more frequently reducing the prey food base and limiting predator populations in the long run. Also with short ground cover, ground temperatures increase in summer, evapotranspiration increases and results in drying conditions, reducing habitat for frogs and shoreline dependent animals.

Buffer Strip Considerations: A functional upland buffer should be at least 15 feet deep. With this you start getting water quality and wildlife habitat benefits. But a 25 foot deep buffer is recommended. In the past, before lakeshore development, buffers ringed the entire lake. For lakeshore residents it is recommended the length of the buffer extend for 75% of the shoreline, although 50% would produce buffer benefits.

A buffer strip can address two problem areas right away. Geese are shy about walking through tall grass because of the threat of predators. There will always be a few who charge right through but it is a deterrent for most of them. Also, muskrats shouldn't be a problem. They may burrow into the bank, but generally not more then 10 feet. With a buffer going back 15 to 25 feet, you won't be mowing over their dens. An occasional den shouldn't produce muskrat densities that limit desirable aquatic vegetation.

Several types of buffers can be installed or propagated that offer nutrient removal as well as wildlife benefits. Examples include:

- **Tall grass, sedge, flower buffer:** Provides nesting cover for mallards, blue-winged teal and Canada geese. Provides above ground nesting habitat for sedge wrens, common yellow throat and others.
- **Shrub and brush buffer:** Provides nesting habitat for lakeside songbirds such as yellow warblers, common yellowthroat, swamp sparrows, and flycatchers. It also provides significant cover during migration.
- **Forested buffers:** Provides habitat for nesting warblers and yellow-throated vireo, Diamond herons, woodducks, hocked mergansers, and others. Upland birds such as red-winged blackbirds, orioles, and woodpeckers use the forest edge for nesting and feeding habitat.

Even standing dead trees, which are referred to as snags, have a critical role. When they are left standing they serve as perching sites for kingfishers and provide nesting sites for herons, egrets, eagles, and ospreys. In the midwest over 40 bird species and 25 mammal species use snags. To be useful, they should be at least 15 feet tall and 6-inches in diameter.

The initial step for lake residents to get started is to simply make a commitment to try something. Just what the final commitment is evolves as they go through a selection process. The next step in the process is to conduct a site inventory. On a map with lot boundaries, house and buildings, driveway, turf areas, trees, shrubs, and other features are drawn. If there is a chance, the property is checked during a rainstorm. Look for sources of runoff and even flag the routes. Find out where the water from the roof goes, and see if there are temporary ponding and infiltration areas. Are the paths down to the lake eroding? Then the next step is to consider a planting approach.

Native Landscaping for Buffers: Three Approaches: Native landscaping efforts can be put into three categories:

1. Naturalization
2. Accelerated Naturalization
3. Reconstruction

1. Naturalization: With this approach, the resident is going to allow an area to go natural. Whatever is present in the seedbank is what will grow. If they want to install a buffer along the shoreline, let a band of vegetation grow at least 15 feet deep from the shoreline back and preferably 25 feet or deeper. Just by not mowing will do the trick. Residents can check how it looks at the end of the summer. It will take up to three years for flowers and native grasses to grow up and be noticed. Residents can also select other spots on their property to "naturalize".

2. Accelerated Naturalization: After developing a plant list of species from the area, residents may want to mimic some features right away. They can lay out a planting scheme and plant right into existing vegetation. Several Minnesota nurseries can supply native plant stock and seeds. The nurseries can also help select plants and offer planting tips. Wildflowers can be interspersed with wild grasses and sedges. Mulch around the new seedlings. With this approach lake residents can accelerate the naturalization process.

3. Reconstruction: To reestablish a native landscape with the resident's input and vision, another option is to reconstruct the site with all new plants. Again plant selection should be based on plants growing in the area. Site preparation is a key factor. Residents will want to eliminate invasive weeds and eliminate turf. This can be done with either herbicides or by laying down newsprint or other types of paper followed by 4 to 6 inches of hardwood mulch. Plantings are made through the mulch. This is the most expensive of the three native landscaping categories. Residents can do the reconstruction all at once, or phase it in over 3 to 5 years. This allows them to budget annually and continue evolving the plan as time goes by.

Also mixing and matching the level-of-effort categories allows planting flexibility. Maybe a homeowner employs naturalization along the sides of the lot and reconstruction for half of the shoreline and accelerated naturalization for the other half. Examples of the three approaches are shown in Figure 28.

1. Naturalization: The easiest way to implement a natural shoreline setting is to select an area and leave it grow back naturally.

2. Accelerated Naturalization: To accelerate the naturalization, plant shrubs, wild flowers, or grasses into a shoreland area.

3. Restoration: This involves removing existing vegetation through the use of paper mats and/or mulching and planting a variety of native grasses, flowers, and shrubs into the shoreland area.

Figure 28. Examples of three shoreland management options.

Project 4. Aquatic Plant Projects

A high priority lake protection recommendation is to maintain healthy native aquatic plant communities in Lower Turtle Lake. Currently, Lower Turtle Lake has a variety of emergent and submergent aquatic plant growth. Aquatic plants are vital for helping sustain clear water conditions and contribute to fish habitat.

The challenge is to maintain and/or protect submerged aquatic plants in Lower Turtle Lake. Several plant improvement ideas are given below:

- Conduct a lake soil fertility survey to determine if soils can support plant growth. Sample areas with plants and areas without plants. If soil fertility is similar, then something other than nutrients are inhibiting plant growth.

- Maintaining good shoreland conditions can promote improved plant distribution.

- In the south end of Lower Turtle, some small-scale aquatic plant removal in the form of creating channels to open water could be implemented. Only the minimum amount of plants should be removed to improve navigation. Plants in this end of the lake are important fish habitat.

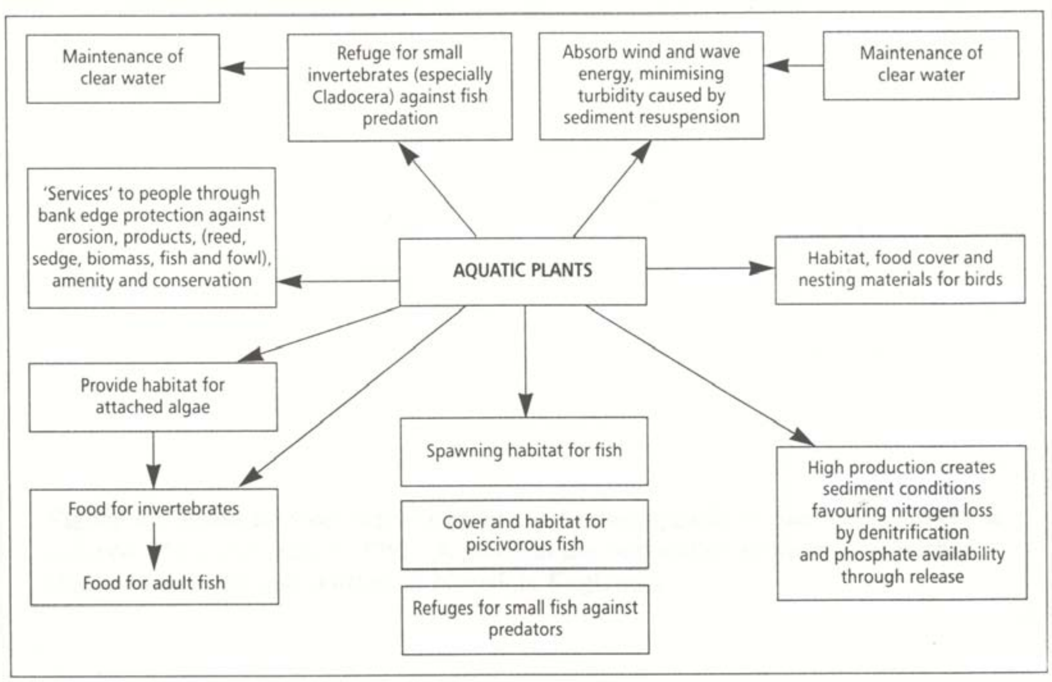


Figure 29. Links between aquatic plants and other organisms, including ourselves (source: Moss and others. 1996. A guide to the restoration of nutrient-enriched shallow lakes. Broads Authority Norwich, England).

Figure 30. Small-scale removal efforts are one option for controlling nuisance growth of curlyelaf pondweed. The use of a herbicide, Aquathol K, is another option.

Project 5. Ongoing Education Program

Lake residents get an important amount of lake protection information from the lake newsletter. Each issue should offer tips on lake protection techniques. There is abundant material available. An example of an informational piece is shown below.

Reduce Waste *If not you, who?*

YOUR LAWN AND THE ENVIRONMENT

New phosphorus lawn fertilizer law aims to protect Minnesota lakes and rivers

Minnesota has recently passed a law that restricts the use of lawn fertilizers containing phosphorus, the primary nutrient that turns lakes green with algae.

New Phosphorus Law

Starting January 1, 2004, **fertilizers containing phosphorus cannot be used on lawns in the Twin Cities metro area** (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington counties). Greater Minnesota is restricted to lawn fertilizers with 3 percent or less phosphate content (with fertilizer, phosphorus is measured as *phosphate*). Look for the middle number on a bag of fertilizer. For the metro area, it should be zero (0) and in Greater Minnesota it should be three (3).

Keep fertilizer off paved surfaces: It's illegal to spread any fertilizer on hard surfaces such as streets, sidewalks, and driveways. Rain can wash the fertilizer into nearby storm drains or road ditches, eventually getting into a lake or river near you. If you accidentally spill or spread fertilizer on a hard surface, clean it up immediately.

Exemptions

Fertilizers containing phosphorus may be used on lawns if a soil test indicates that it is needed or if you are establishing a new lawn.

These restrictions do not apply to fertilizers used for agricultural crops, flower and vegetable gardening, or on golf courses by trained staff.

Will phosphorus-free fertilizer keep my lawn healthy?

While phosphorus is necessary to grow healthy lawns, soils in many parts of Minnesota already have an adequate amount. In these instances, adding more phosphorus in fertilizer is not needed and will not benefit your lawn. Healthy lawns can be maintained with phosphorus-free fertilizers.

DO THE GREEN THING: FERTILIZE RESPONSIBLY Many garden centers and hardware stores now carry phosphorus-free lawn fertilizers.

THE PROBLEM: TOO GREEN

GREEN AND MUCKY Excess algae and weed growth is a major problem in many Minnesota lakes and waterways.

MORE PHOSPHORUS, LESS FISH Too much algae lowers oxygen levels and darkens the water. This can have a devastating effect on fish populations.

What to look for

On any bag or box of fertilizer, there is a string of three numbers. The middle number indicates phosphorus content and should read "0" in the Twin Cities seven-county metropolitan area, and "3" or less in Greater Minnesota.

What can you do to protect water quality?

Fertilizers, leaves, grass clippings, eroded soil, and animal waste are all sources of phosphorus. When they are swept or washed into the nearest street or storm drain, they end up in your local lake or river. You can do your part to protect water quality by doing the following:

- Follow Minnesota's new phosphorus lawn fertilizer law.
- Keep leaves and lawn clippings out of your gutters, streets, and ditches.
- Clean lawn and garden equipment on the grass, not on hard surfaces. Never wash or blow soil or grass clippings into the street.
- Pick up pet waste promptly. Pet waste can contain harmful bacteria as well as nutrients. Never drop pet waste in the street or ditches.

- Control soil erosion around your house. When left bare, soil is easily washed away with rain, carrying phosphorus with it. Soil erosion can be prevented by keeping soil covered with vegetation or mulch.

Sweep it up Grass clippings and leaves left on streets and sidewalks are a major source of phosphorus.

To obtain additional copies of this fact sheet

contact Office of Environmental Assistance's **Education Clearinghouse** at 1-800-877-6300, 651-215-0232 or e-mail: clearinghouse@moea.state.mn.us.

Find out what you need: Test your soil

A soil test is a good idea, especially if you are concerned that your lawn may need phosphorus.

Instructions on soil testing are available through the University of Minnesota Extension Service's INFO-U by calling 612-624-2200 (metro) or 1-800-525-8636 and requesting message 468.

Soil testing information can also be obtained through the Internet by visiting **www.extension.umn.edu** and searching for "Lawn Soil Testing."

A list of laboratories certified for soil testing by the Minnesota Department of Agriculture can be found at **www.mda.state.mn.us/appd/soilabs.htm**.

Visit **www.reduce.org** for lots of ideas about reducing waste and toxic chemicals in your day-to-day life.

reduce.org

For more information on lawn care

- The **Yard & Garden Line** is the University of Minnesota Extension Service's one-stop telephone link to information about plants and insects in the home landscape. Call 612-624-4771, or (toll free) 1-888-624-4771 in Greater Minnesota.
- University of Minnesota **Extension Service's web site:** www.extension.umn.edu. From the home page click on "Garden" then on "Lawns."
- University of Minnesota Extension Service - **Sustainable Urban Landscape Information Series** (SULIS): www.sustland.umn.edu. From the home page, click on "Maintenance" then on "Lawn care."
- **Minnesota Department of Agriculture:** www.mda.state.mn.us. From the home page, click on "Water & Land," then on "Lawn Care & Water Quality."

Minnesota Department of Agriculture | Metro WaterShed Partners | University of Minnesota Extension Service | Minnesota Office of Environmental Assistance

Project 6. Watershed and Lake Monitoring Program

A lake monitoring program is outlined in Table 16. It is designed to be flexible to accommodate the volunteer work force and a fluctuating budget.

Table 16. Lower Turtle Lake Water Quality Monitoring Program

Category	Level	Alternative	Labor Needed	Cost/Year
A. Dissolved oxygen	1	Check dissolved oxygen in Lower Turtle Lake every two weeks in January, February, and March depending on winter conditions.	Moderate	$0
	2	Check dissolved oxygen in Lower Turtle Lake every one to two weeks in December, January, February, and March, depending on winter conditions and collect phosphorus samples.	Moderate	$0
B. Water clarity	1	Secchi disc taken at spring and fall turnover.	Low	$0
	2	Secchi disc monitoring once per month May - October.	Low-moderate	$0
	3	Secchi disc monitoring twice per month, May - October.	Moderate	$0
C. Water chemistry	1	Spring and fall turnover samples are collected and sent to UW-Stevens Point. Selected parameters for analysis include: TP and chlorophyll.	Low	$200
	2	Spring and fall turnover samples are collected and sent to UW-Steven Point. Standard package of parameters is analyzed.	Low	$600
	3	Sample for phosphorus and chlorophyll once per month from May - September (surface water only).	Low-moderate	$300
	4	Sample for phosphorus and chlorophyll twice per month from May - October.	Moderate	$600
	5	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N once per month (May-October)	Moderate	$960
	6	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N twice per month (May-October).	Moderate	$1,920
D. Special samples or surveys	1	Special samples: suspended solids, BOD, chloride, turbidity, sampling bottom water, and other parameters as appropriate. Aquatic plant surveys, etc.	--	$100-$3,000

UW-Stevens Point Lab Analysis Costs:

Total phosphorus	$12.00	Total suspended solids	$8.00
Chlorophyll a	$20.00	Total volatile solids	$8.00
Kjeldahl-N	$12.00	Dissolved solids	$8.00
Nitrate/Nitrite-N	$10.00	Turbidity	$6.00
Ammonia-N	$10.00	BOD	$20.00

A recommended program consists of Level B2 and Level C3 annually. An aquatic plant survey (Level D1) should be conducted every three years.