

Lions Lake

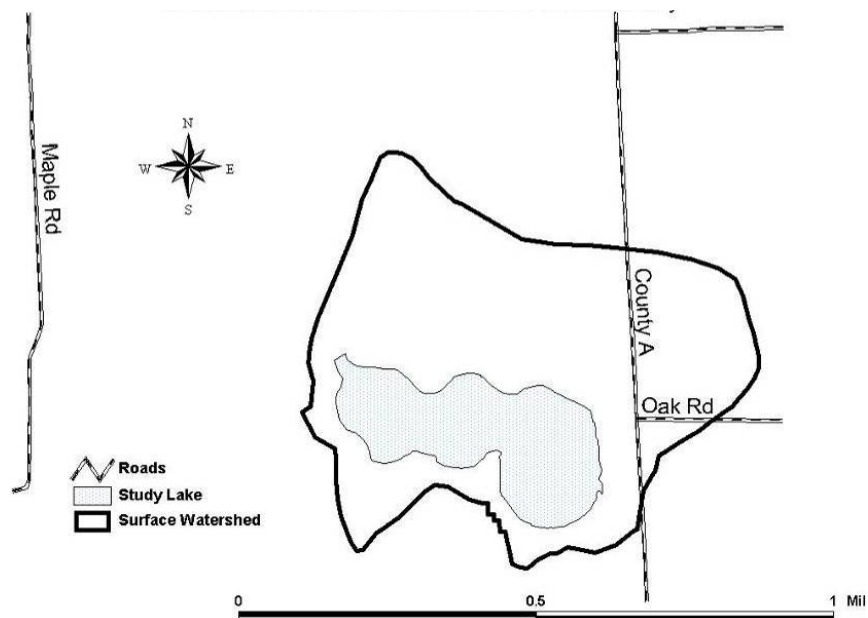
Introduction

Lions Lake is a 43 acre **groundwater drainage lake** with an estimated volume of 188 acre-feet, located in the Township of Alban, northeast of Rosholt (Figure 1). It has a maximum depth of 11 feet. The bottom is predominantly **marl**, with sand and silt also present. The length of the shoreline is 1.4 miles, and the estimated **retention time** is 1.1 years. The lake contains one navigable outlet, Bradley Creek, where a small dam maintains the water level six to eight inches above normal. The lake is named after the Wisconsin Lions Foundation which owns all the surrounding land and runs a camp for the handicapped, the only development on the lake. The camp includes cabins, campsites, dining and office facilities, a caretaker's residence, and a sand beach. Due to the unique nature of the camp, Lions is the only lake in Wisconsin that has a law protecting it from any public access purchase as long as the camp remains in operation. In addition, the Department of Natural Resources helps maintain a fishery for the benefit of campers. The lake has a history of partial winterkills which in the past resulted in a large population of bullhead. Recently, the most common fish species in Lions Lake are panfish and largemouth bass, with northern pike also present.

Land Use and Watershed

The surface **watershed** for Lions Lake is 213 acres (Figure 1). The dominant land use is forest (48%), followed by non-irrigated agriculture (14%) and shrub vegetation (10%). Non-irrigated cropland has decreased since 1948 while forestland has increased. Shrub cover has maintained near-constant levels during this period, along with transportation. Commercial and institutional usage has increased since 1948 as the Lions Camp has expanded its facilities (Figure 2 and Figure 3).

Figure 1. Lions Lake surface watershed boundary.



*Terms in bold, see glossary pp 13-18

Figure 2. Land Use in the Lions Lake surface watershed 2002.

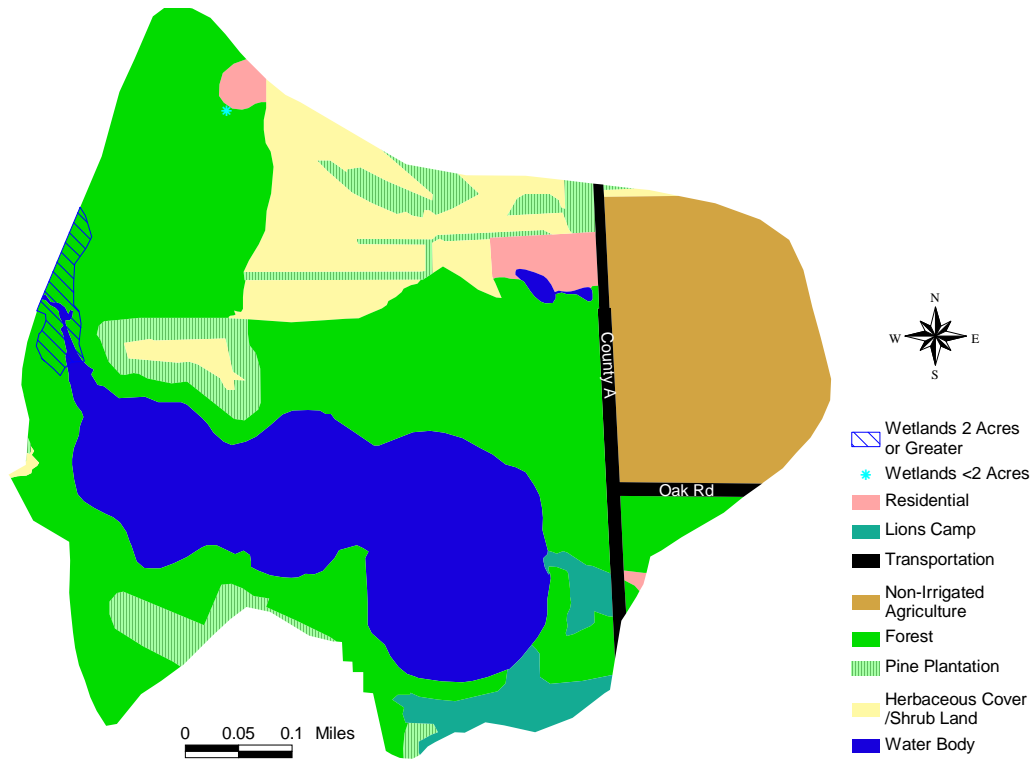
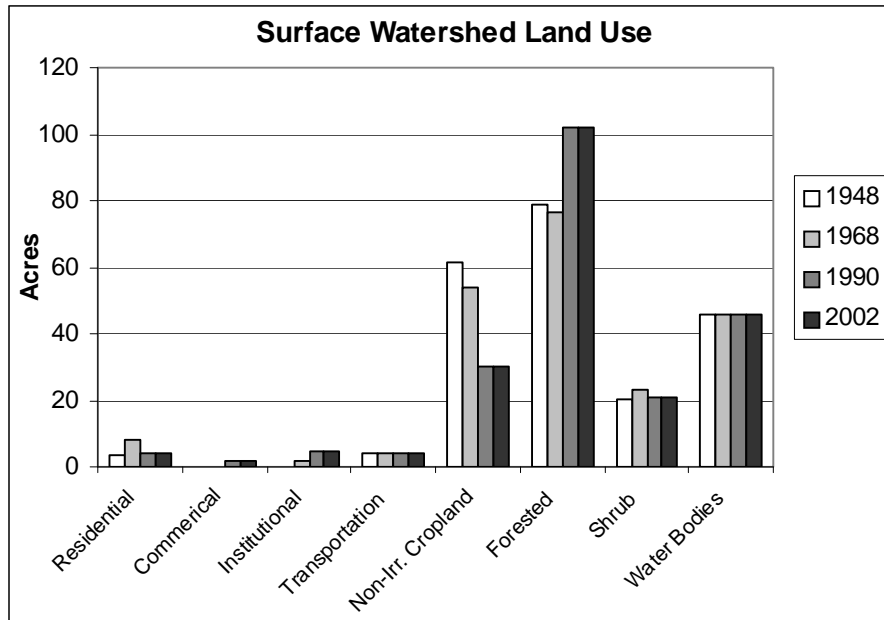


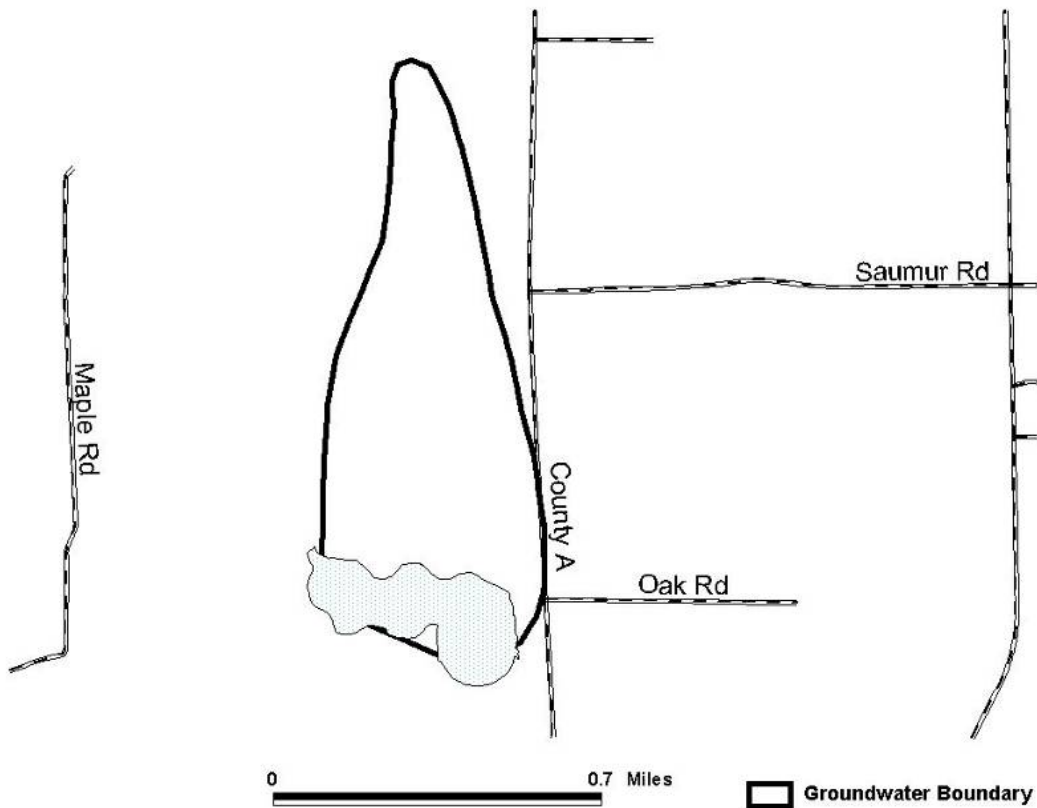
Figure 3. Land use in the Lions Lake surface watershed 1948 – 2002.



*Terms in bold, see glossary pp 13-18

The **groundwater watershed** of Lions Lake is 252 acres (Figure 4). The land use is predominantly forest (59%), followed by shrub vegetation (18%). Non-irrigated agriculture decreased substantially between 1968 and 1990. During that period forestland and shrub cover increased. Residential development has been increasing slightly since 1968 but remains a fraction of the landscape today (Figure 5 and Figure 6). An inventory of the records during 2002 indicate that there were no potentially failing septic systems based on age or former landfill sites present in either the surface or **groundwater watersheds** of Lions Lake.

Figure 4. Lions Lake groundwater watershed boundary.



*Terms in bold, see glossary pp 13-18

Figure 5. Land use in the Lions Lake groundwater watershed 2002.

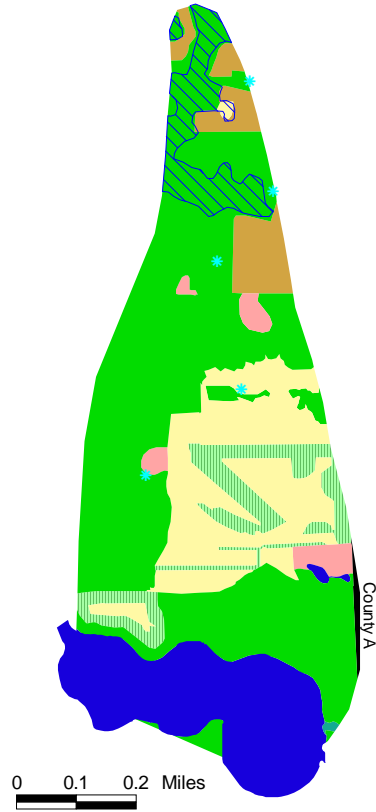
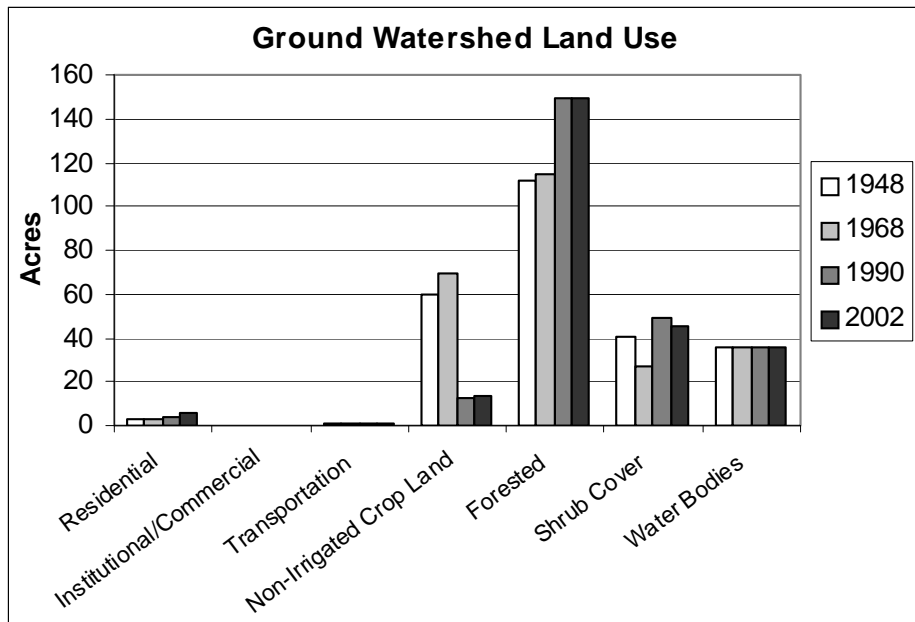


Figure 6. Land use in the Lions Lake groundwater watershed 1948-2002.

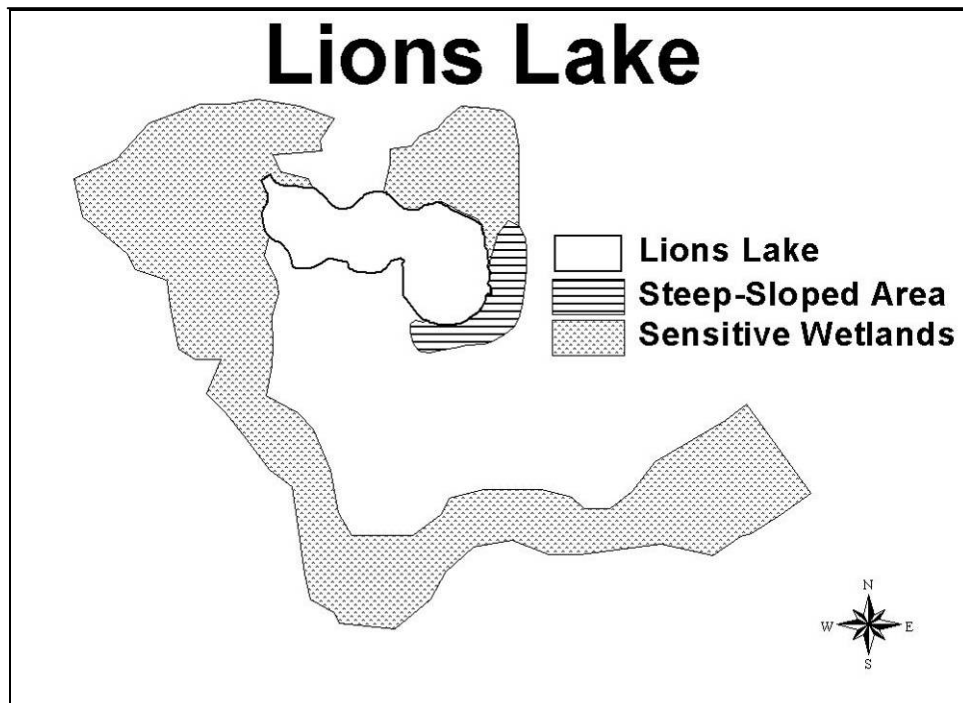


*Terms in bold, see glossary pp 13-18

Upland Sensitive Areas

The survey of upland sensitive areas was conducted to identify areas immediately around the lakeshore that are particularly valuable, or sensitive to disruption. There is a steeply sloped area on the southeast end of Lions Lake, where the camp is located, that may be prone to erosion. Also present are two large wetlands. One is adjacent to the northeast portion of the shoreline. The other, adjacent to the west side of the lake, is quite large and follows Bentley Creek as it travels south, bends around the lake, and continues east of Lions Lake (Figure 7).

Figure 7. Upland sensitive areas near Lions Lake.



Shoreline Vegetation, Reptiles, and Amphibians

Amphibians (frogs and toads) were included in this survey because with their permeable skin and biphasic lifecycle (meaning that the young live in water while adults can survive on land) they are considered excellent indicators of overall ecosystem health. Furthermore, both turtles and amphibians utilize both aquatic and terrestrial habitats and especially the shoreline interface between these two habitats, and thus are of particular relevance.

Large sections of continuous natural shoreline on lakes are ideal habitats for many frog species. Natural areas with large amounts of submergent, emergent, and floating-leaf vegetation provide protection and a place for attachment of eggs during the breeding season. The upland areas surrounding these lakes also provide important habitat as many frog species migrate to lakes and other bodies of water in the spring or fall to breed and spend the summer months foraging in the uplands. Several species also use the surrounding uplands for overwintering. The turtle species found associated with lakes are predominantly aquatic, usually departing from the water only to deposit eggs in a nest. Nests are usually on south facing slopes above the shoreline where there is open vegetation and sandy soil. The newly hatched young then find their way to the water. Thus,

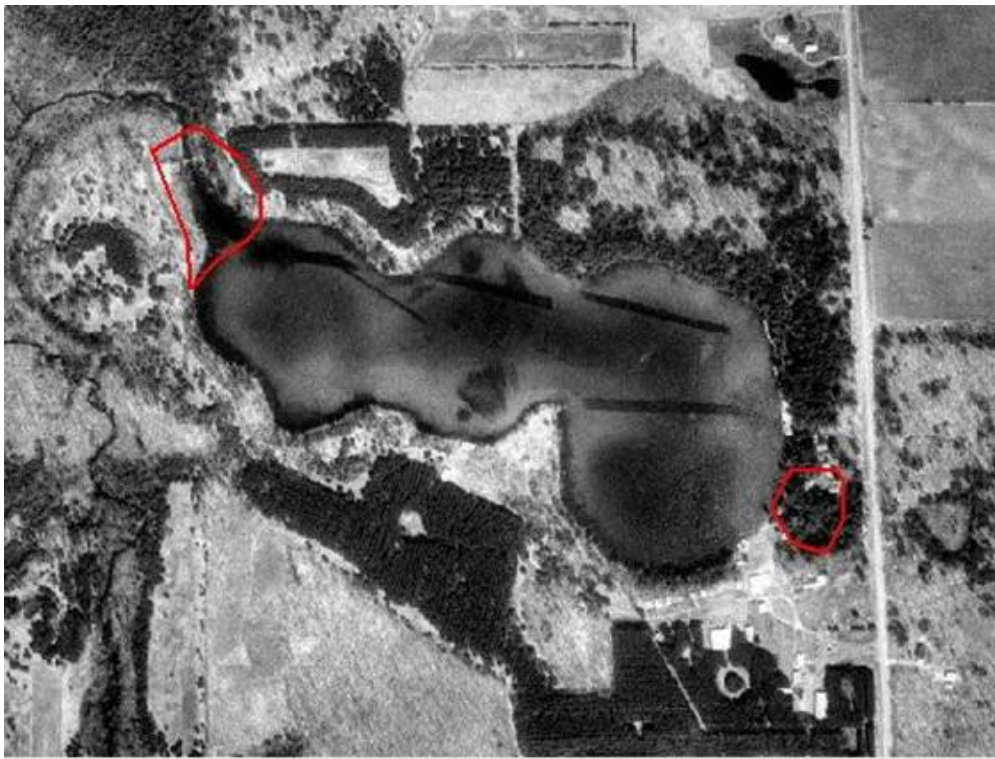
*Terms in bold, see glossary pp 13-18

both turtles and amphibian are intimately associated with lakes and the associated habitats of a **watershed**.

Three frog species were identified during the amphibian survey near Lions Lake (wood frog [*Rana sylvatica*], spring peeper [*Pseudacris crucifer*], and chorus frog [*Pseudacris triseriata*]). There are numerous areas of ideal amphibian habitat surrounding the lake (sensitive areas are identified in red in Figure 8). Some of the key features of this habitat include protected areas of marsh with large amounts of submergent, emergent, and floating-leaf vegetation as well as downed trees. The good news is that large sections of natural shoreline are present. Unfortunately, some disturbance has occurred on the southeast side of the lake.

During the reptile survey Lions Lake was found to contain two turtle species (painted turtle [*Chrysemys picta*] and snapping turtle [*Chelydra serpentina*]).

Figure 8. Regions of primary amphibian habitat around Lions Lake.



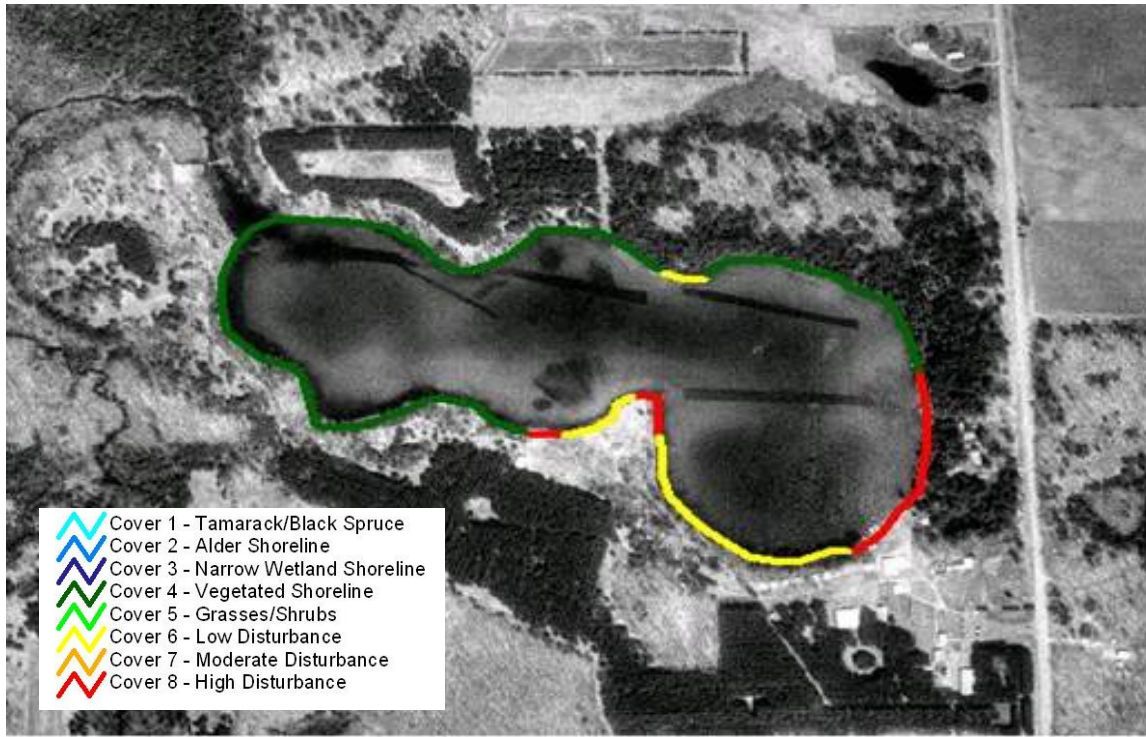
Approximately 62.3% of the Lions Lake shoreline is vegetated. Vegetated shoreline is characterized as upland areas with dense vegetation comprised of tall grasses or shrubs that lacks a rocky component. It is represented by dark green in Figure 9.

Around Lions Lake, 38% of the shoreline is considered to be disturbed. Of this area, 20.5% is considered to be a low disturbance area and 17.2% is considered highly disturbed. An area that exhibits low vegetation disturbance is defined as a location where there is an unaltered shore

*Terms in bold, see glossary pp 13-18

zone except for pier access. A highly disturbed developed area which is defined as a beach, **rip rap**, sea wall or where the shore is mowed to the water line.

Figure 9. Shoreline vegetation around Lions Lake.



Aquatic Plants

There are **33** species of aquatic and wetland **macrophytes** (**32 vascular plants** plus one **macrophytic alga**) that have been found at Lions Lake. This number is below average for Portage County lakes. The average **coefficient of conservatism (c-value)** is **4.8**, which is about average. The **floristic quality index** is **27.2**, which is below average for Portage County lakes.

The **floristic quality index** for Lions Lake places it below the median for lakes in this study, primarily because only 33 species have been recorded for the lake. This low number may in part reflect a relatively uniform lake and shore, with steep banks to the edge of the lake in most places, reducing the extent of wet shoreline habitat. Another factor in the low species number is that, except for one collection of blue-joint grass (*Calamagrostis canadensis*) made in 1963, no collections or botanical observations were made before 2003.

On the other hand, the **coefficient of conservatism (c-value)**, 4.8, is relatively high. The submersed vegetation consists of native species typical of moderately **hard water** lakes. **Marl** has been dredged from Lions Lake in the past, and a large field of **marl** lies on the upland to the north of the lake. No alien species have been found in the lake. Most of the shoreline is undeveloped and the only alien species found on the shore, reed canary-grass (*Phalaris arundinacea*), is not abundant.

*Terms in bold, see glossary pp 13-18

Current Water Quality Conditions

Water quality in lakes is assessed by measuring different characteristics including temperature, dissolved oxygen, water clarity, **chlorophyll a**, water chemistry, and the algal community. Temperature profiles measured in Lions Lake indicate that the water in Lions Lake stays mixed from top to bottom throughout the year (Figure 10). During much of the year dissolved oxygen is sufficient throughout the lake, although in late February 2004, oxygen below 5 feet depth was less than the 5 mg/L needed by many aquatic organisms (Figure 11). In years with extended periods of ice cover and/or heavy snow the volume of water with dissolved oxygen greater than 5 mg/L may become very minimal and the fishery may be subject to winter kill.

Figure 10. Profile of temperature in Lions Lake 2002-2004.

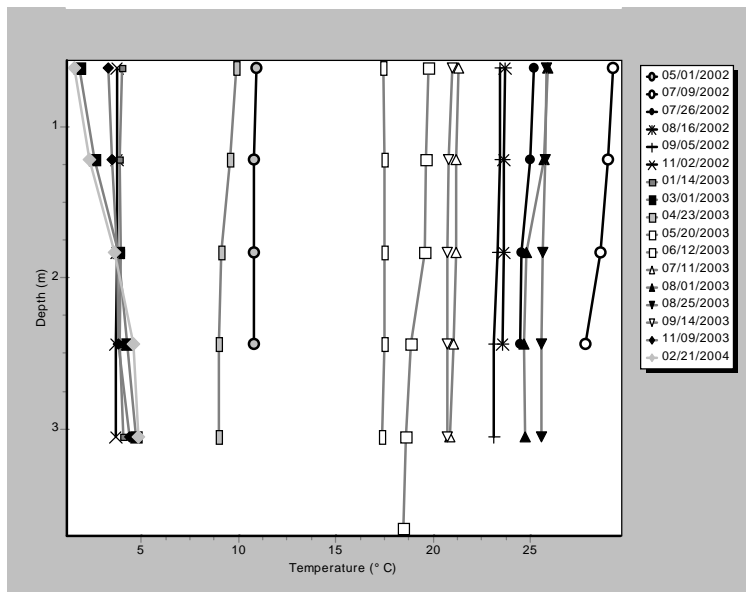
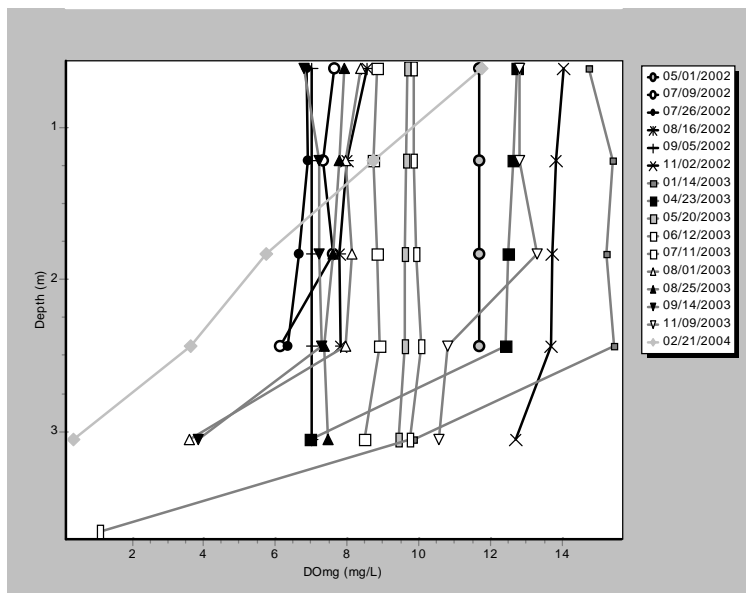


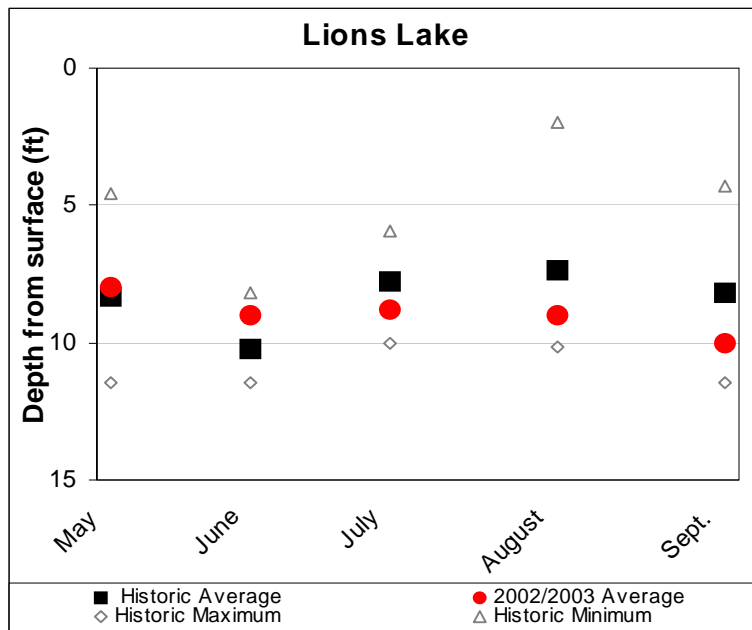
Figure 11. Profile of dissolved oxygen in Lions Lake 2002-2004.



*Terms in bold, see glossary pp 13-18

Water **clarity** is a measure of how deep light can penetrate. It is an aesthetic measure and is related to how deep **rooted aquatic plants** can grow. Water **clarity** is affected by water **color** and suspended materials in the water (**turbidity**). **Turbidity** consists of **suspended solids**, such as suspended sediments and **algae (chlorophyll a)**. **Color, turbidity, and chlorophyll a** were generally quite low. The highest **chlorophyll a** readings were in July. The water **clarity** in Lions Lake is considered fair. The average **Secchi disc** depth reading for similar lakes in Portage County is 11 feet; Lions Lake appears to have poorer **clarity**. The water **clarity** of Lions Lake during the 2002-03 growing seasons was slightly better than the historical growing season average (Figure 12). The month of September shows the best water **clarity** and the month of May the poorest. These fluctuations throughout the summer are normal as **algae** populations and **sedimentation** increase and decrease. Shallow **marl** lakes like Lions Lake are also influenced by wind disturbance of sediment.

Figure 12. Monthly average water clarity measurements in Lions Lake 2002-2003 and historic average, maximum and minimums.



Nutrients (**phosphorus** and **nitrogen**) are important measures of water quality in lakes because they are used for growth by **algae** and aquatic plants (similar to houseplants and crops). In Lions Lake all forms of nutrients were low (Table 1).

Chloride levels, and to a lesser degree **sodium** and **potassium** levels, are commonly used as an indicator of how strongly a lake is being impacted by human activity. These concentrations were all low. **Atrazine** was found in low concentrations in the lake water (0.11 and 0.15 µg/L); some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Lions Lake.

*Terms in bold, see glossary pp 13-18

Table 1. 2002-2003 water quality seasonal averages in Lions Lake.

Lions Lake	RP (ug/L)	TP (ug/L)	TN (mg/L)	NO2+NO3 (mg/L)	NH4 (mg/L)	Alkalinity (mg/L)	Total Hardness (mg/L)	Calcium Hardness (mg/L)	Color (CU)	Turbidity (NTU)	Chlorophyll a (ppm)
Spring Averages	2.3	11.7	0.78	0.06	0.06	111.0	120.5	60.0	5	1.1	<0.1
Summer Averages	3.2	18.3	1.01	0.03	0.06	113.0	121.0	58.5	9	1.2	3.5
Fall Averages	6.5	19.0	1.24	0.04	0.22	125.5	133.5	67.0	18	1.9	
Winter Averages	2.3	9.5	0.91	0.06	0.38						
2002-2004 Averages	3.5	16.2	0.99	0.04	0.16	116.5	125.0	61.8	11	1.4	3.1

TP=total **phosphorus**; RP=reactive or soluble **phosphorus**; TN=total **nitrogen**; NO2+NO3=**nitrite** and **nitrate nitrogen**; NH4=**ammonia nitrogen**

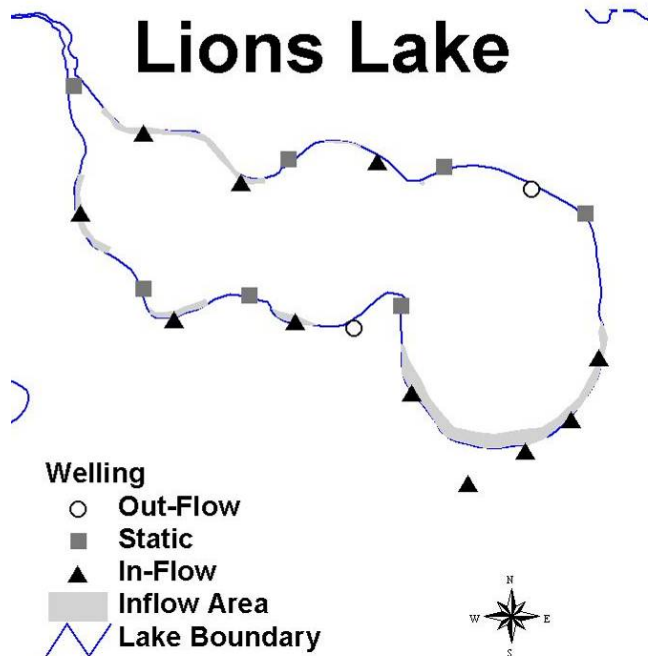
Table 2. 2002-2003 Lions Lake average water chemistry and reference value

Lions Lake	<i>Low</i>	<i>Medium</i>	<i>High</i>	Reference Values	<i>Low</i>	<i>Medium</i>	<i>High</i>
Sulfate	11.10			Sulfate	<10	10-20	>20
Chloride	0.92			Chloride	<3	3-10	>10
Potassium	0.75			Potassium*	<2.16	2.16-4.30	>4.30
Sodium	2.03			Sodium*	<2.28	2.28-5.09	>5.09

*Ranges of low, medium, high defined by taking the median values from the lake study and dividing into thirds.

Twenty mini wells were inserted into Lions lakebed to determine areas of **groundwater** inflow/no flow/outflow. Fifty-five percent of the sampling sites showed **groundwater** inflow. These sites were scattered around the lake, but were mostly focused in the southeast part of the lake (Figure 13). Samples were collected from four sites for water quality analysis. Concentrations in all samples were low. Analyses included **nitrate**, **ammonium**, reactive **phosphorus**, **chloride** and triazine (**atrazine**).

Figure 13. Locations in Lions Lake showing groundwater inflow/no flow/outflow from mini-piezometer measurements and winter observations.



*Terms in bold, see glossary pp 13-18

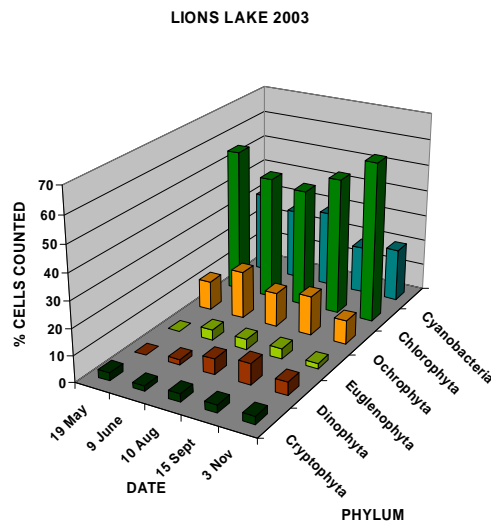
Algal Community

The algal community in Lions Lake was somewhat diverse. The dominant group was the green **algae** (Chlorophyta, 52% of all cells counted). The **blue-green algae** (Cyanobacteria, 25% of all cells counted) and the yellow-green **algae** and **diatoms** (Ochrophyta) were subdominant phyla (16% of all cells counted) (Table 3). These three phyla represented 90% of all cells counted during the 2003 sampling season. In the 2,547 cells counted during this period there were 5 genera of Cyanobacteria, 9 genera of Chlorophyta, 6 genera of Ochrophyta (including 4 **diatom** genera), 4 genera of Euglenophyta, 2 genera of Dinophyta (and 3 species), and 2 genera of Cryptophyta identified. The green **algae** (Chlorophyta) were substantial dominants in all sample periods of 2003 and never represented less than 45% of all cells counted. The Cyanobacteria were the subdominant in all sample periods with the Ochrophyta in the third most dominant position across all sample periods. The other three phyla (Dinophyta, Euglenophyta, Cryptophyta) comprised only 10% of all cells counted across all the 2003 sample periods with none of these phyla representing more than 8% of all cells counted in any one sample period (Figure 14).

Table 3. Algal phyla and mean seasonal composition in Lions Lake from May to November 2003.

LIONS LAKE						
PHYLUM	% CELLS COUNTED BY PHYLUM AND DATE					MEAN
	19 May	9 June	10 Aug	15 Sept	3 Nov	
Cyanobacteria	31	27	29	18	20	25
Chlorophyta	55	47	45	52	61	52
Ochrophyta	11	18	13	15	9	13
Euglenophyta	0	4	4	4	2	3
Dinophyta	0	2	6	8	5	4
Cryptophyta	3	2	3	3	3	3

Figure 14. Algal community composition by date in Lions Lake from May to November 2003 (total phylum cells counted divided by total cells counted).



*Terms in bold, see glossary pp 13-18

Eleven of the top 15 abundance slots belonged to the green **algae** (Figure 15). The small, nonmotile, unicellular genus *Ankistrodesmus* was the most abundant genus in all five sampling periods of 2003. Additionally, the unicellular desmid genus *Cosmarium* and the filamentous desmid genus *Desmidium* were subdominants in every sample period. The four remaining slots in the top 15 abundance ranks were occupied by the cyanobacterial genera *Coelosphaerium* or *Merismopedia* (3 times and 1 time, respectively) (Table 4).

The algal community when considered relative to the **chlorophyll, phosphorus, and nitrogen** values for Lions Lake presents a picture of an **oligotrophic** lake. The 29 genera identified during the sample periods were relatively common, and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues.

Figure 15. Algal community composition by phylum in Lions Lake from May to November 2003.

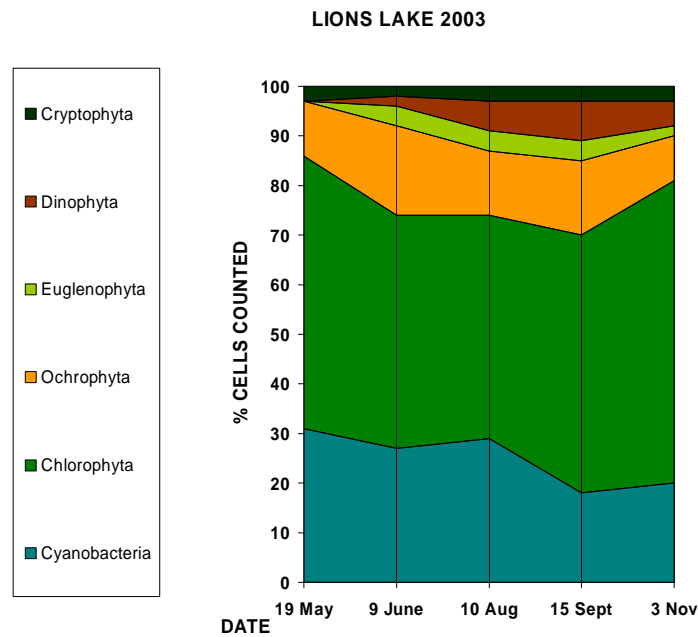


Table 4. Most common algal genera by date in Lions Lake from May to November 2003.

DATE	TOP THREE TAXA (MOST ABUNDANT, LEFT TO RIGHT)		
19 May	<i>Ankistrodesmus</i>	<i>Cosmarium</i>	<i>Coelosphaerium</i>
9 June	<i>Ankistrodesmus</i>	<i>Cosmarium</i>	<i>Coelosphaerium</i>
10 August	<i>Ankistrodesmus</i>	<i>Coelosphaerium</i>	<i>Cosmarium</i>
15 September	<i>Ankistrodesmus</i>	<i>Cosmarium</i>	<i>Desmidium</i>
3 November	<i>Ankistrodesmus</i>	<i>Cosmarium</i>	<i>Merismopedia</i>

*Terms in bold, see glossary pp 13-18

Lions Lake Study Highlights

- There is a steeply sloped area on the southeast end of Lions Lake, where the camp is located, that may be prone to erosion. Also present are two large wetlands. One is adjacent to the northeast portion of the shoreline. The other, adjacent to the west side of the lake, is quite large and follows Bentley Creek as it travels south, bends around the lake, and continues east of Lions Lake.
- Approximately 62.3% of the Lions Lake shoreline is vegetated. Thirty-eight percent of the shoreline is considered to be disturbed. Of this area, 20.5% is considered to be low disturbance and 17.2% is considered to be highly disturbed.
- The submersed vegetation consists of native species typical of moderately **hard water** lakes. **Marl** has been dredged from Lions Lake in the past, and a large field of **marl** lies on the upland to the north of the lake. No alien species have been found in the lake. Most of the shoreline is undeveloped and the only alien species found on the shore, reed canary-grass, is not abundant.
- There are numerous areas of ideal amphibian habitat surrounding the lake
- During much of the year dissolved oxygen is sufficient throughout the lake, although in late February 2004 oxygen below 5 feet depth was less than the 5 **mg/L** needed by many aquatic organisms. In years with extended periods of ice cover and/or heavy snow, the volume of water with dissolved oxygen greater than 5 **mg/L** may become very minimal, and the fishery may be subject to winter kill.
- In Lions Lake all forms of nutrients and contaminants were low. **Atrazine** was detected in the lake and **groundwater**; some toxicity studies have indicated that reproductive system abnormalities can occur in frogs at these levels. The presence of **atrazine** indicates that other agri-chemicals may also be entering Lions Lake.
- The algal community when considered relative to the **chlorophyll**, **phosphorus**, and **nitrogen** values for Lions Lake presents a picture of an **oligotrophic** lake. The 29 genera identified during the sample periods were relatively common, and none of those that reached numerical dominance in the sample counts are associated with toxins or health issues.

Glossary

Algae:

One-celled (phytoplankton) or multicellular plants either suspended in water (plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provide the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Alkalinity:

A measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. Expressed as milligrams per liter (mg/L) of calcium carbonate (CaCO₃), or as microequivalents per liter (ueq/l). 20 ueq/l = 1 mg/L of CaCO₃.

*Terms in bold, see glossary pp 13-18

Ammonia, Ammonium:

A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient. It converts rapidly to nitrate (NO₃) if oxygen is present. The conversion rate is related to water temperature. Ammonia is toxic to fish at relatively low concentrations in pH-neutral or alkaline water. Under acid conditions, non-toxic ammonium ions (NH₄⁺) form, but at high pH values the toxic ammonium hydroxide (NH₄OH) occurs. The water quality standard for fish and aquatic life is 0.02 mg/L of NH₄OH. At a pH of 7 and a temperature of 68° F (20° C), the ratio of ammonium ions to ammonium hydroxide is 250:1; at pH 8, the ratio is 26:1.

Atrazine:

The nation's most widely used weedkiller for both grassy and broadleaf weeds.

Blue-Green Algae:

Algae that are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N₂) from the air to provide their own nutrient.

Chloride (Cl-):

Chlorine in the chloride ion (Cl⁻) form has very different properties from chlorine gas (Cl₂), which is used for disinfecting. The chloride ion (Cl⁻) in lake water is commonly considered an indicator of human activity. Agricultural chemicals, human and animal wastes, and road salt are the major sources of chloride in lake water.

Chlorophyll *a*:

Green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.

Clarity:

see "Secchi disc."

Coefficient of Conservatism (c-value):

Indicates on a scale of 0 to 10 the degree to which a species can tolerate disturbance to a native plant community; a species with a c value of 10 is found only in relatively undisturbed areas of native plant community, whereas a species with a c value of 0 never grows in undisturbed areas of native plant communities. Plants with low numbers tend to occur in a wide range of more-or-less disturbed plant communities. Alien species are also assigned a c value of 0. The c values are used in this report in calculating the Floristic Quality Index for each lake.

Color:

Measured in color units that relate to a standard. A yellow-brown natural color is associated with lakes or rivers receiving wetland drainage. The average color value for Wisconsin lakes is 39 units, with the color of state lakes ranging from zero to 320 units. Color also affects light penetration and therefore the depth at which plants can grow.

*Terms in bold, see glossary pp 13-18

Concentration Units:

Express the amount of a chemical dissolved in water. The most common ways chemical data is expressed is in milligrams per liter (mg/L) and micrograms per liter (ug/L). One milligram per liter is equal to one part per million (ppm). To convert micrograms per liter (ug/L) to milligrams per liter (mg/L), divide by 1000 (e.g. 30 ug/l = 0.03 mg/L). To convert milligrams per liter (mg/L) to micrograms per liter (ug/L), multiply by 1000 (e.g. 0.5 mg/L = 500 ug/L). Microequivalents per liter (ueq/L) is also sometimes used, especially for alkalinity; it is calculated by dividing the weight of the compound by 1000 and then dividing that number into the mg/L.

Diatoms:

A major group of eukaryotic algae, which are one of the most common types of phytoplankton. Diatom communities are a popular tool for monitoring environmental conditions, past and present, and are commonly used in studies of water quality; often the brown stuff attached to rock surfaces.

Drainage Basin:

The total land area that drains toward the lake.

Drainage Lakes:

Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter retention times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Endocrine:

An integrated system of small organs that involve the release of extracellular signaling molecules known as hormones. The endocrine system is instrumental in regulating metabolism, growth, development and puberty, tissue function, and also plays a part in determining mood.

Erosion:

The lowering of the land surface by weathering, corrosion, and transportation, under the influence of gravity, wind, and running water.

Eutrophic:

Eutrophic lakes are high in nutrients and support a large biomass (all the plants and animals living in a lake). They are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow, eutrophic lakes are especially vulnerable to winterkill which can reduce the number and variety of fish. Rough fish are commonly found in eutrophic lakes.

Eutrophication:

The process by which lakes and streams are enriched by nutrients, and the resulting increase in plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Fen:

A fen is a type of wetland fed by surface and/or groundwater. Fens are characterized by their water chemistry, which is neutral or alkaline, unlike bogs, which are generally acid.

*Terms in bold, see glossary pp 13-18

Floristic Quality Index (FQI):

The FQI is a standardized method for evaluating natural plant communities by multiplying the average coefficient of conservatism (c-value) for all species by the square root of the total number of species found at that lake; an additional point is added to the index for each state-listed special concern species, two points added for a threatened species, and three points added for an endangered species. A higher floristic quality index, such as FQI=60, indicates a higher floristic quality and biological integrity and a lower level of disturbance impacts. A lower floristic quality index, such as FQI=20, indicates a lower floristic quality and biological integrity and a higher level of disturbance impacts.

Groundwater:

Water found below the land surface in pore spaces between soil particles or in cracks in rock. It moves slowly from higher to lower areas on the landscape and may provide water to a lake.

Groundwater Drainage Lake:

Often referred to a spring-fed lake, has large amounts of groundwater as its source, and a surface outlet. Areas of high groundwater inflow may be visible as springs or sand boils. Groundwater drainage lakes often have intermediate retention times with water quality dependent on groundwater quality.

Hardness, Hard Water:

The quantity of multivalent cations (cations with more than one +), primarily calcium (Ca⁺⁺) and magnesium (Mg⁺⁺) in the water expressed as milligrams per liter of CaCO₃. Amount of hardness relates to the presence of soluble minerals, especially limestone, in the lake watershed. Soft water has 60 mg/L CaCO₃ or less, moderately hard water has 61-120 mg/L CaCO₃, hard water has 121-180 mg/L CaCO₃, and very hard water has more than 180 mg/L CaCO₃.

Impoundment:

Manmade lake or reservoir usually characterized by stream inflow and always by a stream outlet. Because of nutrient and soil loss from upstream land use practices, impoundments ordinarily have higher nutrient concentrations and faster sedimentation rates than natural lakes. Their retention times are relatively short.

Littoral:

The shallow water zone near the shoreline that is home to most aquatic plants.

Macrophytes:

see "Rooted aquatic plants."

Macrophytic Algae:

Algae that resemble true plants in that they appear to have stems and leaves, and are attached to the bottom.

Marl:

White to gray accumulation on lake bottoms caused by precipitation of calcium carbonate (CaCO₃) in hard water lakes. Marl may contain many snail and clam shells, which are also calcium carbonate. While it gradually fills in lakes, marl also precipitates phosphorus, resulting in low algae populations and good water clarity. In the past, marl was recovered and used to lime agricultural fields.

Mesotrophic:

Mesotrophic lakes lie between the oligotrophic and eutrophic trophic stages. In late summer, they lose oxygen at depth, limiting cold water fish and causing phosphorus release from sediments.

mg/L:

see "Concentration units"

*Terms in bold, see glossary pp 13-18

Nitrate (NO₃⁻):

An inorganic form of nitrogen important for plant growth. Nitrogen is in this stable form when oxygen is present. Nitrate often contaminates groundwater when water originates from manure pits, fertilized fields, lawns or septic systems. High levels of nitrate-nitrogen (over 10 mg/L) are dangerous to infants and expectant mothers. A concentration of nitrate-nitrogen (NO₃-N) plus ammonium-nitrogen (NH₄-N) of 0.3 mg/L in spring will support summer algae blooms if enough phosphorus is present.

Nitrite (NO₂⁻):

A form of nitrogen that rapidly converts to nitrate (NO₃⁻) and is usually included in the NO₃⁻ analysis.

Nitrogen:

A chemical element that is an essential plant nutrient and may occur in the form of nitrate, nitrite, ammonium, or organic nitrogen in lakes.

Oligotrophic:

A trophic state in which lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large fish populations. However, oligotrophic lakes often develop a food chain capable of sustaining a very desirable fishery of large game fish.

Phosphorus:

Key nutrient influencing plant growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photosynthesis:

The process by which green plants convert carbon dioxide (CO₂) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Potassium:

A chemical element that is an essential plant nutrient and may enter lakes from runoff of agricultural fertilizers and animal wastes.

Retention Time: (Turnover Rate or Flushing Rate)

The average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention in most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.

Rip Rap (Rip-Rap):

Hard rock, commonly granite or concrete rubble recycled from construction sites, used inland on lakes, rivers, coastlines, and other waterways to prevent bank erosion. Generally rip rap is not considered good management in lakes, due to its inability to provide adequate habitat, and is no longer commonly used.

Rooted Aquatic Plants: (Macrophytes)

Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

*Terms in bold, see glossary pp 13-18

Secchi Disc (Secchi Disk):

An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Sedimentation:

Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, marl, and soil and organic matter eroded from the lake's watershed.

Seepage Lakes:

Lakes without a significant inlet or outlet, fed by rainfall and groundwater. Seepage lakes lose water through evaporation and groundwater moving on a down gradient. Lakes with little groundwater inflow tend to be naturally acidic and most susceptible to the effects of acid rain. Seepage lakes often have long retention times, and lake levels fluctuate with local groundwater levels. Water quality is affected by groundwater quality and the use of land on the shoreline.

Sodium:

A chemical element that may enter lakes from runoff of road salt, fertilizers, and human and animal wastes.

Stratification, Stratified:

The layering of water due to differences in density. Water's greatest density occurs at 39°F (4°C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 ft. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Sulfate (SO₄²⁻):

The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate (SO₄²⁻) can be reduced to sulfide (S²⁻) and hydrogen sulfide (H₂S) under low or zero oxygen conditions. Hydrogen sulfide smells like rotten eggs and harms fish. Sulfate input from acid rain is a major indicator of sulfur dioxide (SO₂) air pollution. Sulfate concentration is used as a chemical fingerprint to distinguish acid lakes acidified by acid rain from those acidified by organic acids from bogs.

Substrate:

The material found at the bottom of a lake, such as silt, mud, sand, clay, marl, gravel, etc.

Suspended Solids:

A measure of the particulate matter in a water sample, expressed in milligrams per liter. When measured on inflowing streams, it can be used to estimate the sedimentation rate of lakes or impoundments.

Turbidity:

The "cloudiness" or "murkiness" of water, caused by total suspended solids.

Vascular Plants:

Vascular plants are those plants that have tissues for conducting water, minerals, and food through the plant. Vascular plants include the ferns, clubmosses, flowering plants, and conifers.

Watershed:

The total land area that drains either surface water or groundwater toward a lake.

*Terms in bold, see glossary pp 13-18