LAKE COUNTY, ILLINOIS

2011 SAND LAKE SUMMARY REPORT

PREPARED BY THE ENVIRONMENTAL SERVICES

LAKE COUNTY HEALTH DEPARTMENT

POPULATION HEALTH ENVIRONMENTAL SERVICES

Sand Lake, March 2011

Sand Lake is a glacial lake, created over 10,000 years ago by receding glaciers, located partially in the Village of Lindenhurst and partially in unincorporated Lake Villa Township. The lake has a surface area of 100.0 acres and mean and maximum depths of 8.6 and 31.2 feet, respectively. Sand Lake is managed by the Sand Lake Property Owners Association (SLPOA) and Lake Villa Township. Access is open to residents of Lake Villa Township through the Lake Villa Township Beach, Park and Boat Launch (with the purchase of a key). The general public can access the lake through the Lake County Forest Preserve District parcel on the northwest side of the lake. The lake's main uses are boating, swimming and fishing.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature, and water clarity were measured and the plant community was assessed each month from May-September 2011. Most water quality parameters have slightly increased since the 2004

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LAKE FACTS

Major Watershed:
Des Plaines

Sub-Watershed:
Mill Creek

Surface Area:
99.98 acres

Shoreline Length:
1.59 miles

Maximum Depth:
31.2 feet

Average Depth:
8.6 feet

Lake Volume:
857.0 acre-feet

Watershed Area:
209.61 acres

Lake Type:
Glacial

Management Entity:
Sand Lake Property Owners Association (SLPOA) and Lake Villa Township

Current Uses:
swimming, fishing, gas powered boating

LAKE SUMMARY (CONTINUED)

lake study. Total phosphorus in Sand Lake averaged 0.038 mg/L which is a 5% increase from the 2004 concentration of 0.032 mg/L and significantly below the Illinois Environmental Protection Agency impairment concentration of 0.050 mg/L. Nitrogen is the other nutrient critical for algal growth. The average Total Kjeldahl nitrogen concentration for Sand Lake was 1.23 mg/L, which was higher than the 2011 county median of 1.18 mg/L and the 2004 concentration by 24% (1.23 mg/L). A total nitrogen to total phosphorus (TN:TP) ratio of 33:1 indicates phosphorus was the nutrient limiting aquatic plant and algae growth in Sand Lake. Also using phosphorus as an indicator, the trophic state index (TSIp) ranked Sand Lake as eutrophic with a TSIp value of 56.5, ranking Sand Lake 40th out of 171 lakes in Lake County.

The 2011 average total suspended solids (TSS) concentration for Sand Lake was 5.0 mg/L, which was less than the county median (8.6 mg/L) and a 33% increase from the 2004 average of 3.3 mg/L. Water clarity was measured by Secchi depth, with the lowest reading in August (0.90 feet) corresponding to the highest TSS concentration (12 mg/L). The average Secchi depth for the season was 7.48 feet, which was also higher than the county median (2.95 feet).

Conductivity concentrations, are correlated with chloride concentrations, the average conductivity reading for Sand Lake in 2011 was 0.6652 mS/cm, which was below the county median (0.7821 mS/cm). This was a 6% increase from the 2004 average (0.6248 mg/L). The chloride concentration in Sand Lake in 2011 was 129 mg/L which was below the county median of 145 mg/L.

Aquatic plant sampling was conducted on Sand Lake in July. Five species of submerged aquatic plants and one macro-algae were present covering 67% of the lake bottom. There was a significant increase in Coontail since 2004. Both Coontail and Eurasian Watermilfoil were abundant. The two exotic species found in the lake were Eurasian Watermilfoil and Curlyleaf Pondweed; these species are invasive and tend to crowd out native species.

WATERSHED

Everyone lives in a watershed! A watershed is an area of land where surface water from rain and melting snow meet at a point, such as a lake or stream.

Which watershed do you live in?

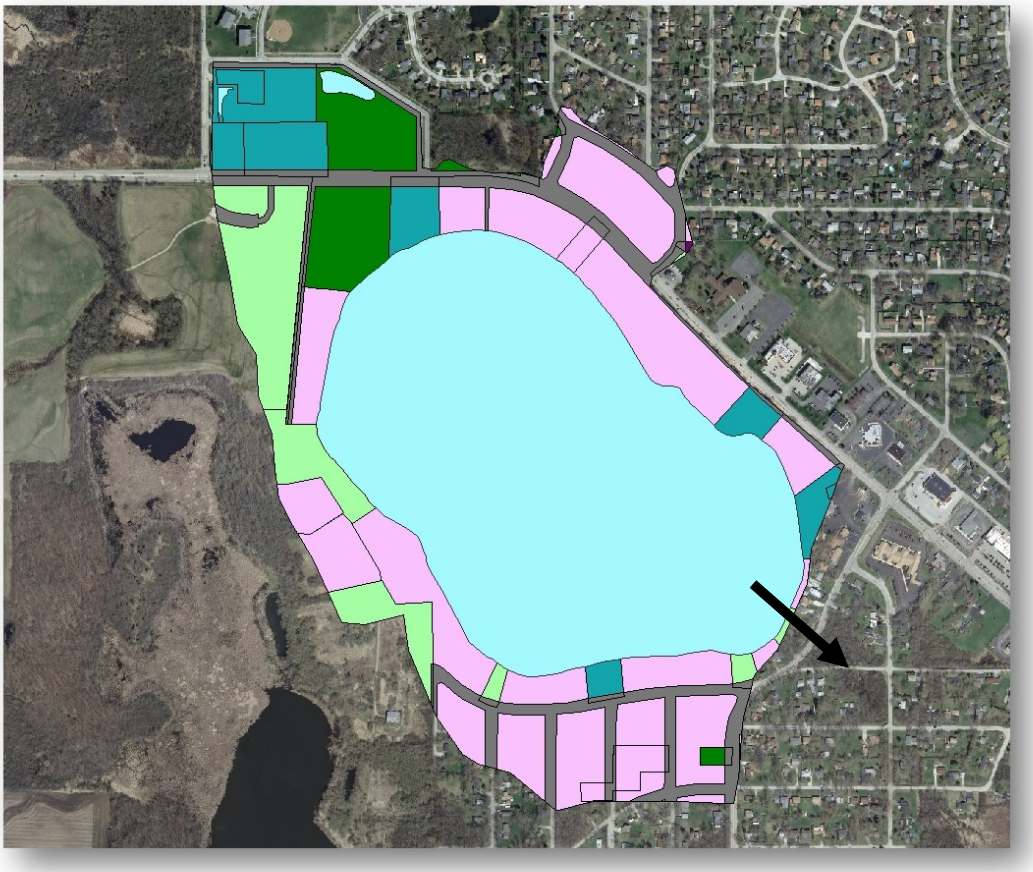
The source of a lake's water supply is very important in determining its water quality and choosing management practices to protect the lake. A watershed is an area of land where surface water from rain and melting snow meet at a point, such as a lake or stream. The watershed of Sand Lake encompasses approximately 209.6 acres, draining large residential areas to the south and north of the lake. The size of the watershed feeding the lake relative to the lakes size is also an important factor in determining the amount of pollutants in the lake. The watershed to lake surface area ratio of 2:1 is very small. This is positive in that it may help lessen serious water quality problems that often accompany lakes with a higher ratio. The outlet of Sand Lake is located on the southeast side of the lake. Water exits Sand Lake over a spillway on the north end and flows under Grand Avenue before eventually entering Mill Creek and then the Des Plaines River. Retention time, the amount of time it takes for water entering a lake to flow out of it again, was calculated to be approximately 6.33 years. Based on the 2011 data, the current external sources affecting Sand Lake were from the following land uses: water (46%) single family homes (24%), and transportation (9%). Based on the amount of impervious

Sand Lake Watershed (continued)

surfaces each land use contributes varied amounts of runoff. Because impervious surfaces (parking lots, roads, buildings, compacted soil) do not allow rain to infiltrate into the ground, more runoff is generated than in the undeveloped condition. The major sources of runoff for Sand Lake were single family homes (39%), and transportation (35%) and retail/commercial (25%). Controlling water that runs from the land's surface into the lake is important for drainage lakes. Due to the large amount of residential area in the Sand Lake, watershed, residents should be mindful of their impacts to the lake.

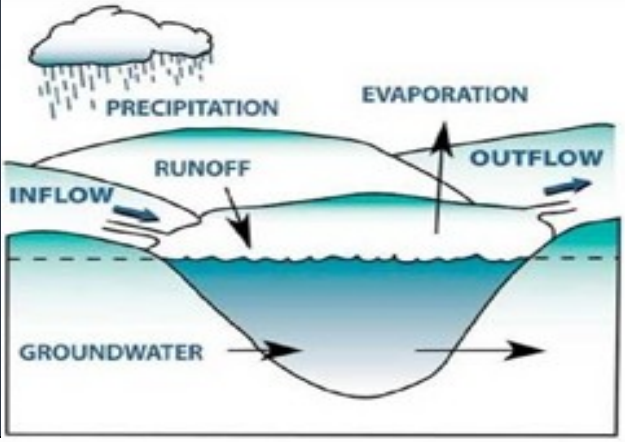
2011 Land Use in the Sand Lake Watershed

- Water
- Disturbed Land
- Transportation
- Agricultural
- Government and Institutional
- Wetlands
- Utility and Waste Facilities
- Single Family
- Office
- Retail/Commercial
- Industrial
- Multi Family
- Forest and Grassland
- Public and Private Open Space



Sand Lake Outlet

Direction of watershed:
Water drains into Sand Lake from the delineated land. Water exits Sand Lake over a spillway on the north end and flows under Grand Avenue before eventually entering Mill Creek and then the Des



DRAINAGE LAKE

A LAKE FED BY STREAMS, GROUNDWATER, PRECIPITATION AND RUNOFF AND DRAINED BY A STREAM

VOLUNTEER LAKE MONITORING PROGRAM

The VLMP was established in 1981 to gather information on Illinois inland lakes, and to provide an educational program for citizens. The primary measurement by volunteers is the secchi depth (water clarity). Other observations such as water color, suspended algae and sediment, aquatic plants and odor are also recorded. The sampling season is May through October with measurements taken twice a month. In 2011 there were **42 lakes** participating in Lake County.

For more information visit: www.epa.state.il.us/water/vlmp/index.html

SECCHI DISK AVERAGES FROM VLMP AND LCHD RECORDS FOR SAND LAKE 1986—2011.

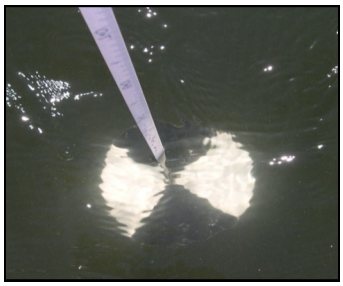
- VLMP
- LCHD
- LAKE COUNTY 2011 MEDIAN 2.95 FEET

WATER CLARITY

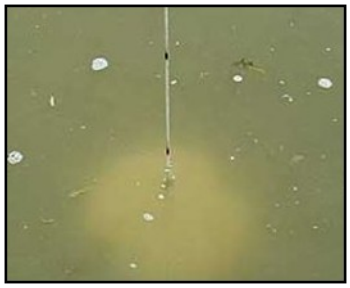
Water clarity is an indicator of water quality related to chemical and physical properties.

Measurements taken with a Secchi disk indicate the light penetration into a body of water. Algae, microscopic animals, water color, eroded soil, and resuspended bottom sediment are factors that interfere with light penetration and reduce water transparency.

The 2011 average water clarity in Sand Lake was 7.48 feet; this was a 4% decrease in the lake's transparency since 2004 (7.80 feet) and the water clarity was above the county median of 2.95 feet.

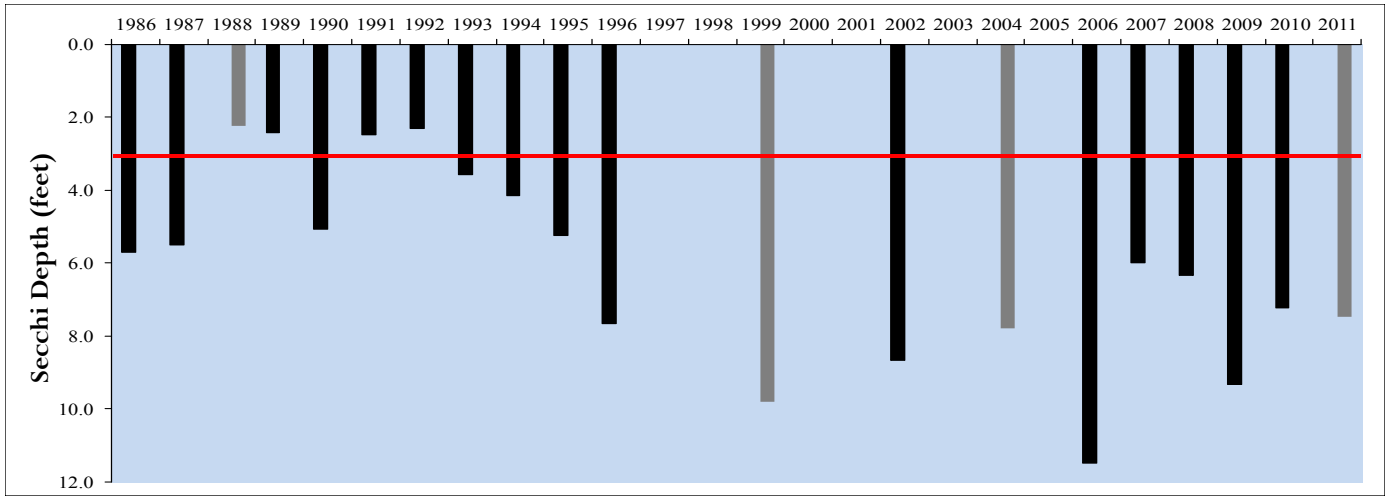


A Secchi disk is an eight-inch diameter weighted metal plate painted black and white in alternating quadrants. A calibrated rope is used to lower the disc into the water and measure the depth to which it is visible.



WATER CLARITY-VOLUNTEER LAKE MONITOR PROGRAM

Additional water clarity measurements were taken in Sand Lake through participation in the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program (VLMP). Sand Lake resident Michael Plishka has participated in the program since 2006. Sand Lake also had historical VLMP data from 1986. Participation in the VLMP program has provided Sand Lake with annual baseline data that can be used to determine long-term water quality trends and support current lake management decision making. The average VLMP Secchi disk depth from 2010 was 7.25 feet. Annual VLMP readings have varied from 2.23 feet 1992 to 11.50 feet in 2006. The volunteers on Sand Lake have provided data that is vital for the continued monitoring and management of this lake. The LCHD-ES would like to thank them for their efforts and recommend continued involvement in the future.



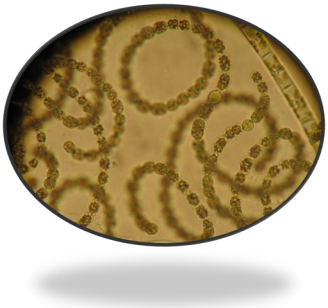
TOTAL SUSPENDED SOLIDS

Another measure of water clarity is turbidity, which is caused by particles of matter rather than dissolved organic compounds. Suspended particles dissipate light, which affects the depth at which plants can grow. The total suspended solid (TSS) parameter (turbidity) is composed of nonvolatile suspended solids (NVSS), non -organic clay or sediment materials, and volatile suspended solids (TVS) (algae and other organic matter).

2011 TSS concentrations in Sand Lake averaged 5.0 mg/L which was below the county median of 8.6 mg/L, but 34% higher than the 2004 average concentration of 3.3 mg/L.

High TSS values are typically correlated with poor water clarity (Secchi disk depth) and can be detrimental to many aspects of the lake ecosystem including the plant and fish communities. The lowest Secchi depth recorded in 2011 occurred in August (0.90 feet) corresponding with the highest 2011 TSS concentration (12.0 mg/L).

Calculated nonvolatile suspended solids (NVSS) was <1 mg/L. This means that the majority of the TSS concentration in 2011 can be attributed to organic particles, such as algae. Turbidity caused by algae reduced the water clarity in Sand Lake. Algae blooms were documented throughout the sampling season. As summer progressed planktonic algae (free-floating) blooms increased primarily consisting of blue-green algae. In August the TVS concentration was 140 mg/L, which is above the county median (122 mg/L). A dense blue-green algae bloom consisting primarily of the genus *Anabaena* sp. had occurred; causing the whole lake to be "*closed* "due to harmful algae blooms



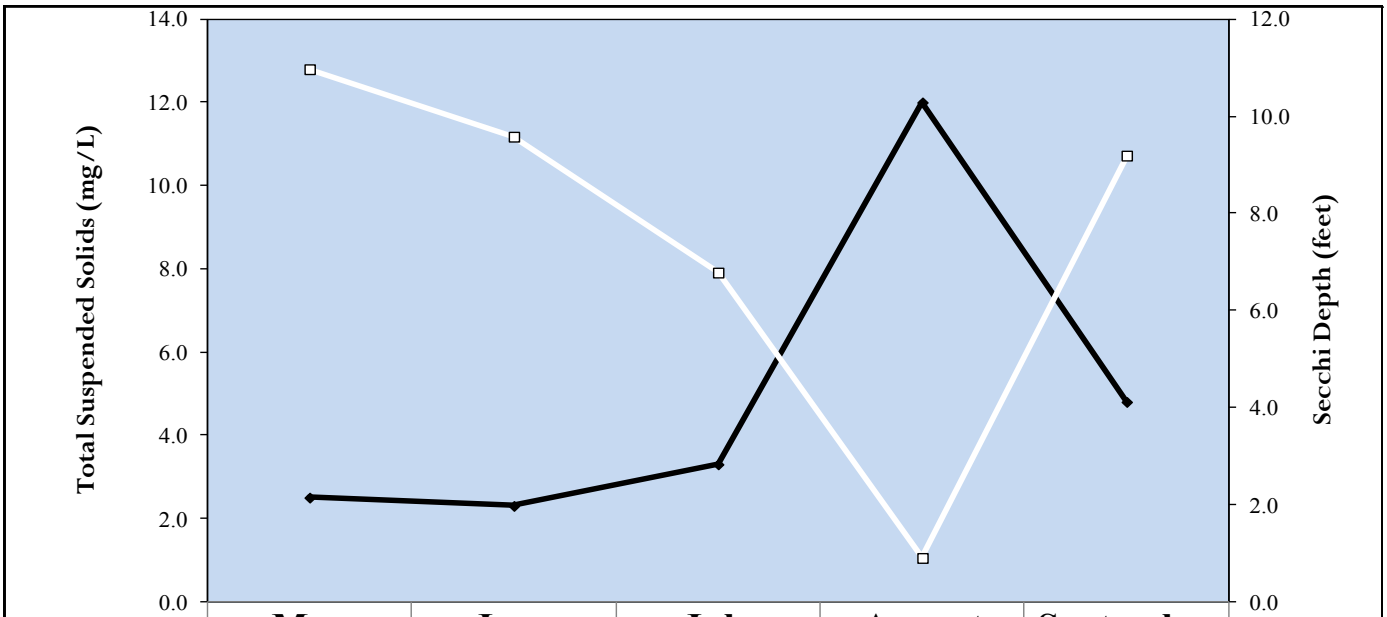
Blue-green Algae

***Anabaena* sp.**

***2011 Lake County Median TSS = 8.6 mg/L**

Monthly Total Suspended Solid Concentrations and Secchi Depth in Sand Lake, 2011.

TSS (mg/L) **Secchi Depth (feet)**



	May	June	July	August	September
TSS	2.5	2.3	3.3	12	4.8
SECCHI	10.97	9.58	6.78	0.9	9.19

NUTRIENTS

WHAT HAS BEEN DONE TO REDUCE PHOSPHORUS LEVELS IN SAND LAKE

January 2009- Lindenhurst passed an ordinance prohibiting the use of lawn fertilizers containing phosphorus

July 2010- The State of Illinois passed a law to reduce the amount of phosphorus content in dishwashing and laundry detergents

July 2010- The State of Illinois passed another law restricting the use of lawn fertilizers containing phosphorus by commercial applicators.

WHAT YOU CAN DO TO HELP LOWER PHOSPHORUS LEVELS IN SAND LAKE

*Do not throw leaves, grass clippings, pet waste, other organic debris into the street or driveway. Runoff carries these through storm sewers, directly to Sand Lake.

*Build a rain garden to filter run-off from roofs, driveways, streets. This allows the phosphorus to be bound to the soil so it does not reach surface waters.

*Sweep up fertilizer that is spilled or inadvertently applied to hard surface areas, do not hose it away.

Organisms take nutrients in from their environment. In a lake, the primary nutrients needed for aquatic plant and algal growth are phosphorus and nitrogen. In most lakes, phosphorus is the limiting nutrient, which means everything that plants and algae need to grow is available in excess: sunlight, warmth, and nitrogen. In Sand Lake, the limiting nutrient was phosphorus, which has a direct effect on how much aquatic plants and algae can grow in lakes.

The 2011 average total phosphorus concentration in Sand Lake was 0.038 mg/L this was a 5% increase from the 2004 concentration (0.034 mg/L) and below the 2011 county median of 0.066 mg/L. Lakes with concentrations exceeding 0.050 mg/L can support high densities of algae and aquatic plants, which can reduce water clarity and dissolved oxygen levels and are considered impaired by the IEPA.

Phosphorus originates from a variety of sources, many of which are related to human activities which include: human and animal waste, soil erosion, detergents, septic systems, common carp, and runoff from lawns.

Nitrogen is the other nutrient critical for algal growth. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen, and is typically bound up in algal and plant cells. The average 2011 TKN for Sand Lake was 1.23mg/L, which was above the county median of 1.18 mg/L and a 23% increase from the 2004 concentration (0.93 mg/L).

TROPHIC STATE INDEX

Another way to look at phosphorus levels and how they affect lake productivity is to use a Trophic State Index (TSI) based on phosphorus (TSIp). TSIp values are commonly used to classify and compare lake productivity levels (trophic state). A lake's response to additional phosphorus is an accelerated rate of eutrophication. Eutrophication is a natural process where lakes become increasingly enriched with nutrients. Lakes start out with clear water and few aquatic plants and over time become more enriched with nutrients and vegetation, until the lake becomes a wetland. This process takes thousands of years. However, human activities that supply lakes with additional phosphorus that drives eutrophication is speeding up this process significantly. The TSIp index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich, productive). In 2011, Sand Lake was eutrophic with a TSIp value of 56.5. Based on the TSIp, Sand Lake ranked 40th out of 171 lakes studied by the LCHD-ES from 2000-2011.

OLIGOTROPHIC:

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.

MESOTROPHIC:

Lakes lie between the oligotrophic and eutrophic stages. Devoid of oxygen in late summer, their hypolimnions limit cold water fish and cause phosphorus cycling from sediments.

EUTROPHIC:

Lakes are high in nutrients, 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.

Blue-green Algae: the facts

Blue-green algae, also known as cyanobacteria, are not a true algae but are in fact closely related to bacteria. Similar to bacteria in structure, these simple organisms are credited for first using chlorophyll to make food from sunlight and for boosting oxygen in the Earth's early atmosphere. Today this organism forms an important role at the base of the food chain in our lakes; however they also pose a potential harmful health effect as they reach nuisance and noxious populations due to the high nutrient loads in our lakes.

Blue-green algae are naturally present in lakes and streams in low numbers. Blue-green algae can become abundant in warm, shallow, undisturbed surface water that receives ample sunlight. Under some conditions the algae becomes so abundant that they can form floating rafts or scums on the surface of the water. Both true algae and blue-green have similar growth requirements including sunlight, warmth, and nutrients (phosphorus and nitrogen). However, an oversupply of nutrients, especially phosphorus, will often result in excessive growth of blue-green algae because they possess certain adaptations that enable them to out compete true algae. One of these adaptations is positive buoyancy; blue-greens contain gas vesicles that allow them to rise to the lake surface during calm conditions to take advantage of sunlight. The second adaptation of some blue-green algae is the ability to fix nitrogen from the atmosphere when nitrogen supplies are low. This is especially useful in Lake County where the majority of the lakes have high levels of phosphorus. This means that in lakes with high phosphorus there is not enough nitrogen, thus the need for this adaptation.

In addition to having unique adaptations, some blue-green algae can also produce toxins, these are known collectively as cyanotoxins. Not all blue-green algae produce harmful conditions. The three primary genera in our area that are responsible are *Anabaena, Aphanizomenon, and Microcystis*.

Algal toxins could pose a health risk to people and animals when they are exposed to the toxins in large quantities. Health effects could occur when surface scums or water containing high levels of blue-green algal toxins are swallowed, come in contact with the skin or when airborne droplets containing toxins are inhaled while swimming, bathing, or showering. Lake County residents get their drinking water from Lake Michigan and ground water; both of which have minimal levels of nutrients and algae cells, unlike our inland lakes. Direct contact or breathing airborne droplets containing high levels of blue-green algal toxins during swimming or showering can cause irritation of the skin, eyes, nose and throat and inflammation in the respiratory tract. To protect yourself against exposure do not swim, boat, etc. in water that looks like "pea soup," green or blue paint, or that has a scum layer or puffy blobs floating on the surface.

There is no quick or easy way to control blue-green algae. Chemical treatments can control blue-green algae temporarily, but repeated applications are often necessary. It is best to treat blue-green algae when populations are low. Treating large populations can cause large amounts of toxins to be released at once. Reducing the amount of nutrients in the lake or pond will eventually reduce the frequency and intensity of the blooms. It is not understood when or why blue-green algae release toxins. If you suspect that you are experiencing symptoms related to exposure to blue-green algae such as stomach cramps, diarrhea, vomiting, headache, fever, muscle weakness, or difficulty breathing contact your doctor or the poison control center. For more information or to report a blue-green algae bloom, contact the Lake County Health Department Environmental Services (847) 377-8030.

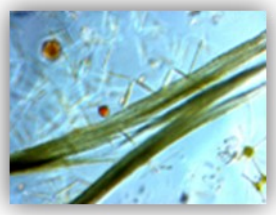
For more information on Blue-green algae.

http://www.epa.state.il.us/water/surface-water/blue-green-algae.html

http://dnr.wi.gov/lakes/bluegreenalgae/

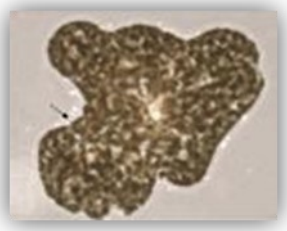
To report a blue-green algae bloom:

Lake County Health Department
Environmental Services
(8470 377-8030



Aphanizomenon *Sp.*

Anabaena *Sp.*



Microcystis *Sp.*

CONDUCTIVITY AND CHLORIDE

Another parameter measured during 2011 that is important in comparing data from year to year is conductivity. Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways. In 2011, Sand Lake average conductivity was 0.6652 mS/cm. This value was below the county median of 0.7821 mS/cm and 6% increase from the 2004 value 0.6248 mS/cm. One of the most common dissolved solids is road salt used in winter road deicing. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. Sand Lake 2011 average chloride concentration was 129 mg/L. These values are influenced by the winter road maintenance of highway 132.

The United States Environmental Protection Agency has determined that chloride concentrations higher than 230 mg/L can disrupt aquatic systems. Chlorides tend to accumulate within a watershed as these ions do not break down and are not utilized by plants or animals. High chloride concentrations may make it difficult for many of our native species to survive. However, many of our invasive species, such as Eurasian Watermilfoil, Cattail and Common Reed, are tolerant to high chloride concentrations.

THE CRITICAL VALUE FOR CHLORIDES IN AQUATIC SYSTEMS IS 230 MG/L.

230 mg/L = 1 teaspoon of salt added to 5 gallons of water.

ICE FACTS

1. De-icers melt snow and ice. They provide no traction on top of snow and ice.
2. Anti-icing prevents the bond from forming between pavement and ice.
3. De-icing works best if you plow/shovel before applying material.
4. Pick the right material for the pavement temperatures.
5. Sand only works on top of snow as traction. It provides no melting.
6. Anti-icing chemicals must be applied prior to snow fall.
7. NaCl (Road Salt) does not work on cold days, less than 15° F.

WHAT HAS BEEN DONE TO REDUCE CHLORIDE LEVELS IN SAND LAKE

Village of Lindenhurst Public Works:

Uses an environmentally friendly alternative to salt a liquid by-product consisting of salt brine mix (70%), beet juice (20%) (beet by-product) and calcium chloride (10%). This product will be mixed with the salt on the trucks to create an oatmeal like substance, and then applied to the streets.

This liquid has several advantages:

1. Beet juice adds moisture to help salt work better.
2. Lowers the working temperature of salt to around 20 degrees (below zero).
3. Creates a composition that sticks to the pavement versus dry salt that can bounce off of the pavement.
4. Reduces salt use by 20%.
5. Environmentally friendly product.

Lake County Division of Transportation:

Is enhancing efficiency of snow removal, and going green through innovation and technology. Global positioning systems (GPS) on snow plows are providing real-time tracking of these vehicles, as well as the application of salt and de-ice materials. The data is then used to better coordinate and target services, saving on salt and gas.

Effectiveness of Salt as a Deicing Agent Based on Pavement Temperature °F

Pavement Temp. °F	One Pound of Salt (NaCL) melts	Melt Times
30°	46.3 lbs of ice	5 min.
25°	14.4 lbs of ice	10 min.
20°	8.6 lbs of ice	20 min
15°	6.3 lbs of ice	1 hour
10°	4.9 lbs of ice	Dry salt is ineffective and will blow away before it melts the ice

Swimming Beach Monitoring

There is one state licensed swimming beach on Sand Lake at the South Township Park. The beach was sampled for the bacteria Eschericia coli (E. coli) levels every two weeks, from mid May to the end of August, by the LCHD-ES in 2011. The water samples are tested for E. coli bacteria, which are found in the intestines of warm-blooded animals. While not all strains of E. coli are the same, certain strains can make humans sick if ingested in high enough concentrations. If water samples come back high for E. coli (>235 E. coli/100 ml), the management body for the bathing beach is notified and a sign is posted indicating the swim ban. E. coli is used as an indicator organism, meaning that high concentrations of E. coli might suggest the presence of harmful pathogens such as, Salmonella, Giardia, etc.

There are many ways E.coli can end up in a swimming beach. Heavy rainfall and strong wind associated with storms can cause the water to become cloudy with sediment from the lake bottom. Stormwater from rain can also wash in other particles from lawns, streets, and buildings. This sediment and stormwater may contain high concentrations of E. coli. Another source of E. coli contamination is the feces of gulls, geese, and other wildlife.

From 2004 through 2011 there were a total of 8 beach closures at South Township Park. Three closures occurred in 2008, and two in 2007 and 2006, and only 1 occurring in 2011.

Kerry McCaughey LCHD Lab staff uses black light technology to report E. coli

Swim Bans on South Township Park, Sand Lake from 2004 - 2011.

2011	2010	2009	2008	2007	2006	2005	2004
1	0	0	3	2	2	0	0

Practicing common sense and good hygiene will go a long way in preventing illness from swimming beaches.

- If you are sick, do NOT swim.
- Do NOT drink the water while swimming.
- Avoid swimming during heavy algae blooms.
- Keep geese off the beach.
- Children who are not toilet trained should wear tight-fitting rubber or plastic pants.
- Take a shower before entering the water, and have kids take frequent bathroom breaks.
- Wash your hands after exiting the lake.

Stop Aquatic Hitchhikers

This new law provides that no person may place, operate, transport on a highway, or take off with a vehicle, seaplane, watercraft, or other object of any kind in waters of the State if it has any aquatic plants or aquatic animals attached to the exterior.

These "hitchhikers" are often invasive species that harm native plants and animals.

STOP AQUATIC HITCHHIKERS!™

Bathymetric Map

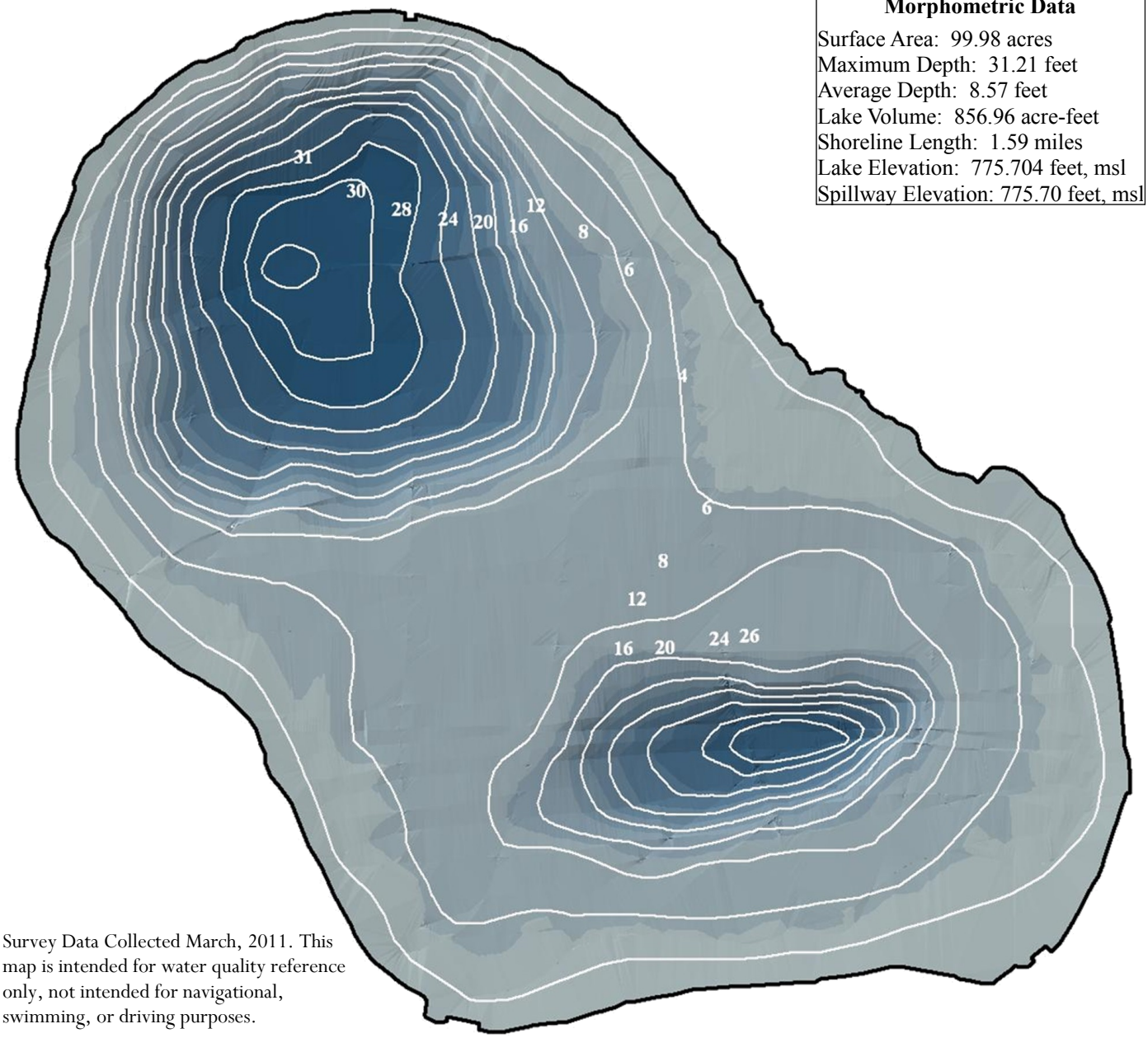
Elevation
-3.467 - 0
-6.934 - -3.467
-10.4 - -6.934
-13.867 - -10.4
-17.334 - -13.867
-20.801 - -17.334
-24.267 - -20.801
-27.734 - -24.267
-31.201 - -27.734

A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information about the physical features of the lake such as depth, surface area, and volume. This information is particularly important when intensive management techniques such as chemical treatments for plant or algae control, dredging, fish stocking or habitat enhancement are part of the lake's overall management plan.

In March 2011 the LCHD-ES collected the field data to replace the bathymetric map created by the LCHD-ES in 1998. Field data was collected using Biosonics equipment along with a Trimble GPS unit with sub-foot accuracy. Once collected, the data was analyzed and imported into ArcGis for further analysis. In ArcGis, the contours were drawn and the volume was calculated.

Morphometric Data

Surface Area: 99.98 acres
Maximum Depth: 31.21 feet
Average Depth: 8.57 feet
Lake Volume: 856.96 acre-feet
Shoreline Length: 1.59 miles
Lake Elevation: 775.704 feet, msl
Spillway Elevation: 775.70 feet, msl



Survey Data Collected March, 2011. This map is intended for water quality reference only, not intended for navigational, swimming, or driving purposes.

New Permit Requirements for Applying Pesticides in Waters

New regulations are now in effect that will significantly affect how pesticides are used in Illinois waters. A National Pollutant Discharge Elimination System (NPDES) permit will now be required to apply any type of pesticides over or into waters of the State. In Illinois, the permitting process will be administrated through the Illinois Environmental Protection Agency (IEPA).

Who has to get a permit? According to the language in the permit, anyone who qualifies as an "operator", which is defined as: "any person, persons, group, or entity in control over the financing for, or over the decision to perform pest control activities, or applying pesticides that will result in a discharge to waters of the State". Homeowner associations or even individuals may need to get a permit. Regardless of the size of treatment, a permit will be needed. If the treatment area or total annual area exceeds certain thresholds then additional requirements will be required such as a Pesticide Discharge Management Plan and an annual report. The thresholds vary depending on type of treatment. For weed and algae control, the threshold is 80 acres of treatment or 80 linear miles along the water's edge. The threshold is an annual total, so for example, algaecides applied to five acres four times during the year, would meet this 80 acre threshold requirement.

Anyone or any group planning to treat their pond or lake with pesticide this year should take into account these new requirements.

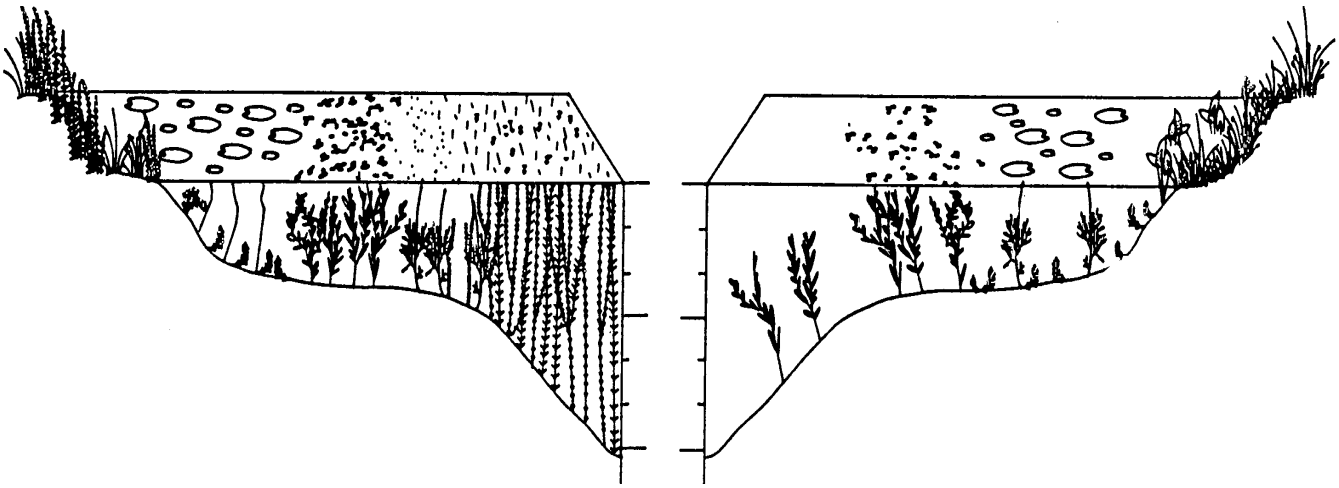
For full details of the rule see:

http://www.epa.state.il.us/water/permits/pesticide/index.html

Aquatic Herbicides-2, 4-D

In 2011 a total of 14.71 acres were treated with liquid and granular forms of 2,4D to reduce exotic Eurasian Watermilfoil populations. 2, 4D is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian Watermilfoil and other broad-leaved species. Both the granular and liquid formulations can be effective for spot treatment of Eurasian Watermilfoil. 2,4-D has been shown to be selective to Eurasian Watermilfoil when used at the labeled rate, leaving native aquatic species relatively unaffected. Coontail is a native plant in Sand Lake that is also susceptible to 2,4-D. For a healthy aquatic plant community native plant populations need to expand, so special care in the timing of the applications should be considered. This product should be applied while the exotics are actively growing and before our native plants emerge.

A KEY TO A HEALTHY LAKE IS A WELL-BALANCED AQUATIC PLANT POPULATION



AQUATIC PLANTS

The tips of the braches are crowded with leaves giving it a "Coontail" resemblance.

COONTAIL
CERATOPHYLLUM DEMERSUM
OVERWINTERS AS A EVERGREEN PLANT, IT PROVIDES IMPORTANT HABITAT TO MANY INVERTEBRATES OVERWINTERS AS AN EVERGREEN AND PROVIDES FISH WITH YEAR ROUND HABITAT.

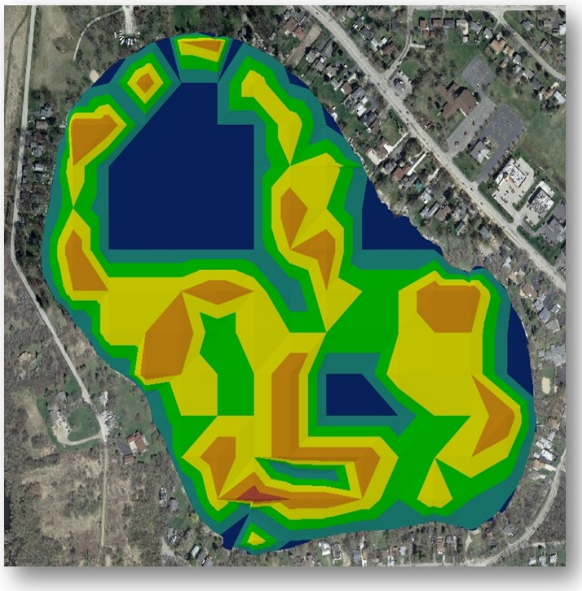
Plants growing in our lakes, ponds, and streams are called macrophytes. These aquatic plants appear in many shapes and sizes. Some have leaves that float on the water surface, while others grow completely underwater. In moderation, aquatic plants are aesthetically pleasing and desirable environmentally. Their presence is natural and normal in lakes.

Aquatic plant sampling was conducted on Sand Lake in July 2011. There were 111 points generated based on a computer grid system with points 60 meters apart. Aquatic plants occurred at 74 of the sites (67 % total lake coverage) that included 6 aquatic plant species, including two exotic invasive species: Curlyleaf Pondweed and Eurasian Watermilfoil and one macro-algae, Chara. There was decrease in species diversity from 2004 with the loss of Small Pondweed and Water Stargrass in the aquatic plant community. In 2011 the most common species was Eurasian Watermilfoil and Coontail at 50% and 46% of the sampled sites, respectively while Curlyleaf Pondweed (14%) and Sago Pondweed (6%) were the next most abundant species. The overall aquatic plant density has changed since 2004. This is mostly contributed to the significant increase in the Coontail population. In 2004 Eurasian Watermilfoil was found at 67% of the samples sites in July. The 2011 Coontail population has significantly expanded from 2004, when lake occurrence was 2%. Coontail is a submersed aquatic plant with coarse, bushy stems and no roots. Lacking true roots, the plants may drift between a variety of depths during the growing season. Coontial overwinters as an evergreen plant, providing habitat to invertebrates and fish year round.

The diversity and extent of plant populations can be influenced by a variety of factors. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow. When the light level in the water column falls below 1% of the surface light level, plants can no longer grow. The 1% light level in Sand Lake ranged from 8-22ft. during the sampling season. Plants were found at a maximum depth of 9.3 feet. A healthy aquatic plant population is critical to good lake health. Aquatic vegetation provides important wildlife habitat and food sources. Additionally, aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available resources.

Rake Density (Coverage)	# of Sites	%
No plants	22	19.8
>0 to 10%	4	3.6
>10 to 40%	21	18.9
>40 to 60%	26	23.4
>60 to 90%	22	19.8
>90%	1	0.9
Total Sites with Plants	74	66.7
Total # of Sites	111	100.0

DISTRIBUTION OF RAKE DENSITY ACROSS ALL SAMPLES SITES IN 2011



FLORISTIC QUALITY INDEX

Floristic quality index (FQI) is an assessment tool designed to evaluate the closeness the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts. Each aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). This is done for every floating and submersed plant species found in the lake. An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The median FQI for Lake County lakes from 2000 -2011 was 14.3. Sand Lake had an FQI of 10.4 ranking 118th out of 158.

Lake County Average

FQI = 14.3

AQUATIC PLANTS: WHERE DO THEY GROW?

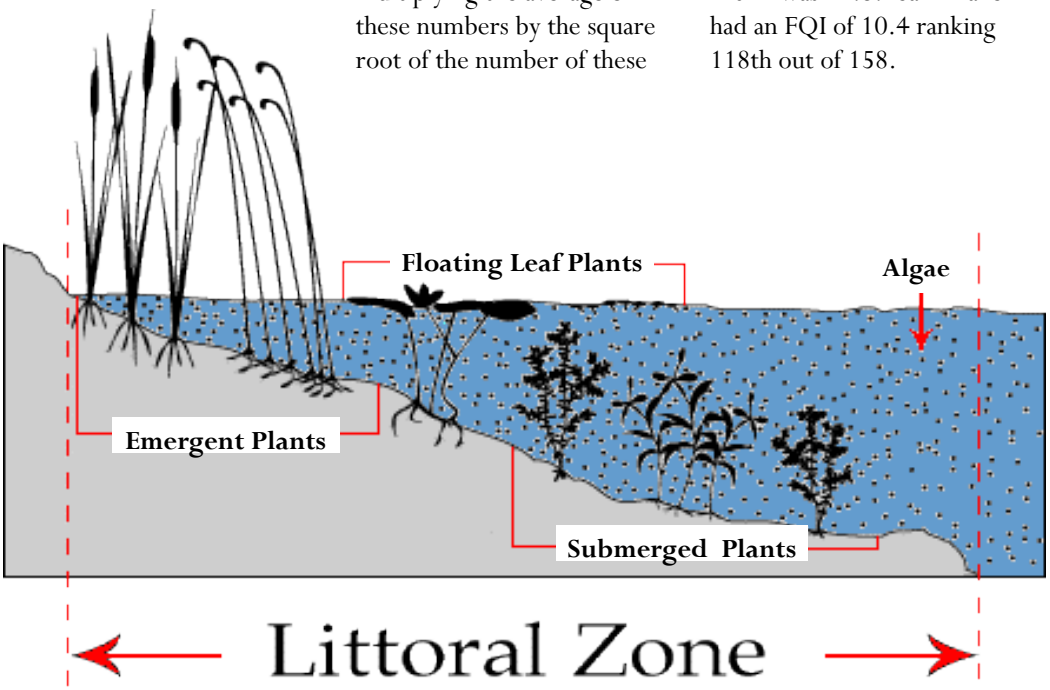
Littoral Zone– the area that aquatic plants grow in a lake.

Algae– have no true roots, stems, or leaves and range in size from tiny, one-celled organisms to large, multicelled plant-like organisms.

Submerged Plants– have stems and leaves that grow entirely underwater, although some may also have floating leaves.

Floating-leaf Plants– are often rooted in the lake bottom, but their leaves and flowers flat on the water surface.

Emergent Plants– are rooted in the lake bottom, but their leaves and stems extend out of the water.



Source: Minnesota Department of Natural Resources

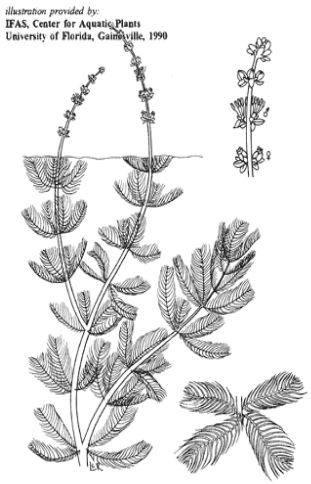
IN MANY LAKES MACROPHYTES CONTRIBUTE TO THE AESTHETICALLY PLEASING APPEARANCE OF THE SETTING AND ARE ENJOYABLE IN THEIR OWN RIGHT. BUT EVEN MORE IMPORTANT, THEY ARE AN ESSENTIAL ELEMENT IN THE LIFE SYSTEMS OF MOST LAKES.

- Macrophyte leaves and stems provide a habitat or home for small attached plants and animals. Some are microscopic in size and some are larger. These attached organisms are valuable as food for animals higher in the food chain, such as fish and birds.
- Many types of small organisms live in the sediment. There are insects that spend the immature stages of life in the sediments, leaving when they become adults. Decomposing plant life provides part of the food supply for these sediment-dwelling organisms and the emerging insects, in turn, are food for fish.
- The submerged portions of macrophytes provide shelter and cover for small or young fish from larger fish that would feed on them.
- Types of plants that extend above the water can provide cover for waterfowl and their young, and many plants can serve directly as food for certain types of waterfowl.
- Aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available nutrients.

Excerpt: Department of Ecology, Washington state

Eurasian Watermilfoil

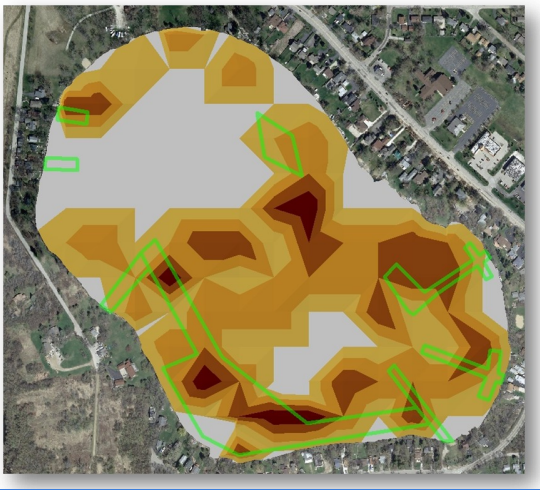
Illustration of Eurasian Watermilfoil



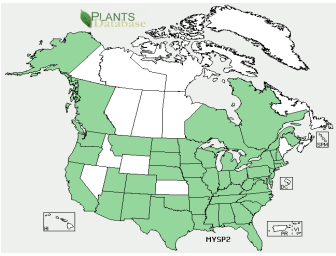
Eurasian Watermilfoil (EWM) is a feathery submerged aquatic plant that can quickly form thick mats in shallow areas of lakes and rivers in North America. These mats can interfere with swimming and entangle propellers, which hinders boating fishing, and waterfowl hunting. Matted milfoil can displace native aquatic plants, impacting fish and wildlife. Since it was discovered in North America in the 1940's, EWM has invaded nearly every US state and at least three Canadian Provinces. Milfoil spreads when plant pieces break off and float on water currents. It can cross land to new waters by clinging to sailboats, personal watercraft, powerboats, motors, trailers, and fishing gear.

The abundance of EWM in Sand Lake has decreased by 17% since 2004. EWM was present at half of the sample sites. Populations were most dense in the southwest portion of the lake and at depths between three to five feet. In 2011 chemical applications were used to reduce EWM populations in recreational portions of the lake. An aquatic plant management plan is critical to maintaining the health of the lake and a balanced aquatic plant community. The plan should be based on the management goals of the lake and involve usage issues, habitat maintenance/ restoration, and limitations of the lake. The primary focus of the plan must include the control of exotic aquatic species including EWM and Curlyleaf Pondweed. Follow up is critical to achieve long-term success. A good aquatic plant management plan considers both the short and long-term needs of the lake.

Erasian watermilfoil density at 111 sites on Sand lake in July, 2011, Maximum depth that plants were found was 9.3 feet.



Distribution of eurasion watermilfoil



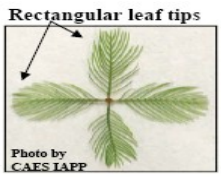
Myriophyllum spicatum Exotic*

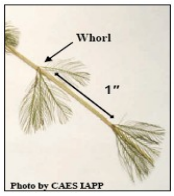
Common Names:
Eurasian watermilfoil

Origin: EXOTIC
Europe and Asia. Found throughout Lake County and Illinois

Importance:
This invasive plant spreads rapidly, crowding out native species, clogging waterways, and blocking sunlight and oxygen from underlying waters.

Look alikes:
Northern watermilfoil
Which has fewer than 12 leaflet pairs per leaf, and generally has stouter stems.





Key Features:

Stem: Long, often abundantly branced stems form a reddish or olive-green surface mat in summer.

Leaf: Leaves are rectangular with ≥12 pairs of leaflets per leaf and are dissected giving a feathery appearance, arranged in a whorl, whorls are 1 inch apart.

Flower: Small pinkish male flowers that occur on reddish spikes, female flowers lack petals and sepals and 4 lobed pistil.

Curlyleaf Pondweed

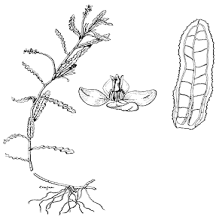
Curlyleaf Pondweed (CLP) is an invasive aquatic perennial that is native to Eurasia, Africa, and Australia. It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant. The leaves are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. This aquatic plant has an unusual life history. Unlike our native pondweeds it begins growing in the early spring. CLP has even been documented growing under the ice in lakes! The plant then reaches maturity in mid summer typically June in Lake County when our natives are starting to emerge. CLP becomes invasive in some areas because of its adaptations for low light tolerance and low water temperatures which allow the plant to get a head start and outcompete native plants in the spring. In mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Large populations of CLP also can cause changes in nutrient availability. In midsummer, CLP plants usually die back which is typically followed by an increase in phosphorus availability that may fuel nuisance algal blooms. CLP can form dense mats that may interfere with boating and other recreational uses. In July 2011 in Sand Lake CLP was common, plants being found at 16 sampled sites (14% of lake). This is a slight increase from 2004 when CLP was found at 13% of the sampled sites. At this time the density of CLP is not causing fluctuations in nutrient availability. The Sand Lake aquatic plant management plan should prioritize the reduction in CLP populations in an effort to increase the abundance and diversity of native aquatic plants.

Illustration of Curlyleaf Pondweed

Curlyleaf Pondweed density at 111 sites on Sand Lake in July 2011, Maximum depth that plants were found was 9.3 feet,

Potamogeton crispus *Exotic**

Turion



Key Features:

Stem: are flattened, branched, can form dense stands in water up to 15 feet deep.

Leaf: alternate all submersed, oblong, stiff, translucent leaves have distinctly wavy edges with fine teeth and 3 main veins.

Flower: tiny, with 4 petal-like lobes. In spikes 1-3cm long on stalks up to 7cm long. (May see turions which over winters as a hard, brown, bur-like bud with crowded, small holly-like leaves).

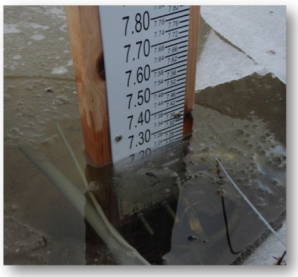
Common Names:
Curly leaf pondweed

Origin: Exotic*
Asia, Africa, and Europe Found throughout Lake County and Illinois

Importance:
Invasive: has a tolerance for low light and water temperatures that allow the plant to get a head start on native plants. By mid summer when most aquatic plants are growing, curlyleaf plants are dying off. Which may result in a critical loss of dissolved oxygen and an increase in nutrients.

Look alikes:
none

Shoreline



Example of a permanent Staff Gage

Erosion	2011	2004
None	56	87
Slight	29	4
Moderate	3	4
Severe	12	4
	100	100

% Shoreline erosion on Sand Lake

Erosion is the natural process of weathering and transport of solids (sediment, soil, rock and other particles) in the natural environment. It usually occurs due to transport by wind, water, or ice; by down-slope creep of soil and other material under the force of gravity; or by living organisms, such as burrowing animals. However this process has been increased dramatically by human land use, especially industrial agriculture, deforestation, and urban sprawl.

The shoreline was reassessed in 2011 for significant changes in erosion since 2004. Based on the 2011 assessment, there was a significant increase in shoreline erosion with approximately 44% of the shoreline having some degree of erosion. Overall, 56% of the shoreline had no erosion, 29% had slight erosion, 3% had moderate, and 12% had severe erosion. In the past shoreline erosion on Sand Lake has been minimal. The areas of moderate and severe erosion were mostly located along the along the northern shoreline near highway 132. These areas should be addressed soon; it is much easier and less costly to mitigate slightly eroding shorelines than those with more severe erosion. Very few homeowners have installed buffer strips of emergent vegetation along their shorelines. Buffers are excellent features for providing erosion control and wildlife habitat and for reducing sediment and nutrient load to the lake. It is recommended that these emergent types of buffer strips, as well as upland buffer strips, be installed along as many shorelines as possible. Upland buffers can even be installed above rip rap or seawalled shorelines to help filter non-point runoff before it enters the lake.

Photo: rain gage, Lake County Stormwater Management Commission

Lake Level

Lakes with stable water levels potentially have less shoreline erosion problems. Small fluctuations in lake levels were observed during the 2011 sampling season. Data from the Stormwater Management Commission's Sand Lake rain gauge was correlated to rain events and lake levels increases. Over the sample period May to September the lake level decreased 0.75 inches. The highest water level occurred in June and the lowest level in August. Sand Lake does not appear to be greatly influenced by rain events. The relatively small watershed and large lake size helps reduce fluctuations in lake level. In order to accurately monitor water levels it is recommended that a staff gauge be installed and levels measured and recorded frequently (daily or weekly).

LakeCounty
Health Department and
Community Health Center

ENVIRONMENTAL SERVICES

Senior Biologist: Mike Adam

madam@lakecountyil.gov

Population Health Services
500 W. Winchester Road
Libertyville, Illinois 60048-1331

Phone: 847-377-8030
Fax: 847-984-5622

For more information visit us at:

http://www.lakecountyil.gov/Health/want/BeachLakeInfo.htm

Protecting the quality of our lakes is an increasing concern of Lake County residents. Each lake is a valuable resource that must be properly managed if it is to be enjoyed by future generations. To assist with this endeavor, Population Health Environmental Services provides technical expertise essential to the management and protection of Lake County surface waters.

Environmental Service's goal is to monitor the quality of the county's surface water in order to:

- Maintain or improve water quality and alleviate nuisance conditions
- Promote healthy and safe lake conditions
- Protect and improve ecological diversity

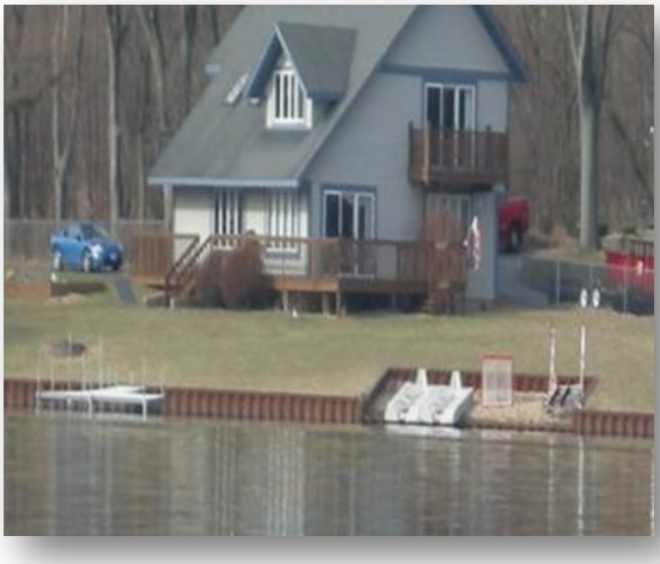
Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

LAKE RECOMMENDATIONS

Sand Lake's water quality had notable increases in TKN and TSS concentrations since the last survey. This was largely influenced by the blue-green algae blooms that occurred in 2011. The aquatic plant community showed a decrease in the amount of Eurasian Watermilfoil but also a decrease in aquatic plant diversity present in the lake. The increase in shoreline erosion was significant and should be specifically addressed in future management plans.

Sand Lake's, management is administered by the Sand Lake Property Owners Association (SLPOA) in cooperation with Lake Villa Township. To improve the overall quality of Sand Lake, the ES (Environmental Services) has the following recommendations:

- **Mitigate shorelines exhibiting erosion**
- **Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips**
- **Adjust Eurasian Watermilfoil management plan as populations change**
- **Decrease Curlyleaf Pondweed populations**
- **Continue Participation in Volunteer Lake Monitoring Program**
- **Participate in the Clean Waters Clean Boats Program**
- **Install a staff gage to monitor lake level fluctuations**
- **Assess current fish population**



Water quality data for Sand Lake, 2004, and 2011

2011	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
11-May	3	135	1.07	<0.1	<0.05	0.028	<0.005	126	NA	2.5	393	94	10.97	0.6696	9.03	11.72
15-Jun	3	134	0.99	<0.1	<0.05	0.033	<0.005	127	NA	2.3	421	111	9.58	0.6559	8.52	8.34
13-Jul	3	120	1.02	<0.1	<0.05	0.033	<0.005	135	NA	3.3	424	128	6.78	0.6377	8.78	9.53
10-Aug	3	105	2.00	<0.1	<0.05	0.050	<0.005	128	NA	12	407	140	0.90	0.6038	9.16	4.33
14-Sep	3	124	1.08	<0.1	<0.05	0.044	0.005	131	NA	4.8	401	95	9.19	0.7592	8.94	9.37
	Average	124	1.23	<0.1	<0.05	0.038	<0.005	129	NA	5.0	409	114	7.48	0.6652	8.89	8.66

2004	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
5-May	3	160	0.93	<0.1	<0.05	0.037	<0.005	NA	324	1.7	396	133	10.83	0.6606	8.54	10.31
2-Jun	3	139	1.00	<0.1	<0.05	0.026	<0.005	NA	374	2.2	377	108	8.46	0.6223	8.5	9.04
7-Jul	3	121	0.80	<0.1	<0.05	0.026	<0.005	NA	358	5.2	367	116	4.99	0.5878	8.89	8.01
4-Aug	3	126	0.98	<0.1	<0.05	0.034	0.007	NA	364	3.5	370	117	7.42	0.6126	8.62	7.43
8-Sep	3	139	0.96	<0.1	<0.05	0.035	<0.005	NA	356	3.7	410	142	7.32	0.6407	8.88	7.62
	Average	137	0.93	<0.1	<0.05	0.032	0.007k	NA	355	3.3	384	123	7.80	0.6248	8.69	8.48

Glossary

ALK = Alkalinity, mg/L $CaCC_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chloride, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi disk depth, ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Prior to 2006 only Nitrate - nitrogen was analyzed

2011	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
11-May	28	138	1.16	0.364	0.058	0.029	0.008	129	NA	1.4	420	118	NA	0.6758	7.60	5.13
15-Jun	28	137	1.27	0.432	<0.05	0.046	0.024	127	NA	1.2	411.0	111	NA	0.6557	7.43	0.25
13-Jul	29	161	2.66	1.790	<0.05	0.256	0.155	127	NA	4	430	111	NA	0.6691	7.01	0.23
10-Aug	29	180	3.38	2.440	<0.05	0.304	0.223	127	NA	4.8	437	104	NA	0.7213	6.94	0.22
14-Sep	28	193	4.8	4.260	<0.05	0.264	0.182	127	NA	4.6	438	203	NA	0.8587	6.93	0.27
	Average	162	2.65	1.857	0.058k	0.180	0.118	127	NA	3.2	427	129	NA	0.7161	7.18	1.22

2004	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl^-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
5-May	26	164	1.25	0.207	<0.05	0.051	0.005	NA	350	3.8	402	117	NA	0.6742	7.37	0.93
2-Jun	29	177	2.45	1.270	<0.05	0.091	0.034	NA	376	7.2	421	125	NA	0.6912	7.05	0.00
7-Jul	27	189	3.06	2.090	<0.05	0.145	0.076	NA	360	6.7	431	118	NA	0.7123	6.84	0.06
4-Aug	28	201	3.6	2.320	<0.05	0.152	0.08	NA	374	6	421	123	NA	0.7436	6.47	0.07
8-Sep	27	210	3.76	2.820	<0.05	0.095	0.04	NA	406	4.5	433	118	NA	0.7394	7.06	0.12
	Average	188	2.82	1.741	<0.05	0.107	0.047	NA	373	5.6	422	120	NA	0.7121	6.96	0.24

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chloride, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi disk depth, ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Prior to 2006 only Nitrate - nitrogen was analyzed

Sand Lake Illinois Evironmental Protection Ranking

TROPHIC STATUS		
Carlson's TSIp	56.5	Eutrophic

IMPAIRMENT ASSESSMENTS	
Total Phosphorus	None
Total Nitrogen	None
pH	None
Low DO	None
Total Dissolved Solids	None
Total Supended Solids	None
Aquatic Plants-Native	None
Non-Native Aquatic Plants	None
Non-Native Animals	None

AQUATIC LIFE USE IMPAIRMENT INDEX	**Weighting Criteria**	**Points**	**Overall Use Support Points**	**Degree of Support**
Mean Trophic State	56.5	40		
Macrophyte Impairment	Minimal	0		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**40**	0	**Full**

RECREATION USE IMPAIRMENT INDEX				
Mean Trophic State Index	56.5	56.5		
Macrophyte Impairment	Moderate	10		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**66.5**	1	**Partial**

Overall Use Index			**0.50**	**Partial**

Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Indpendence Grove	0.0130	41.14
4	Lake Zurich	0.0135	41.68
5	Druce Lake	0.0140	42.00
6	West Loon	0.0152	43.00
7	Windward Lake	0.0160	44.13
8	Sand Pond (IDNR)	0.0165	44.57
9	Cedar Lake	0.0170	45.00
10	Pulaski Pond	0.0180	45.83
11	Gages Lake	0.0200	47.00
12	Banana Pond	0.0200	47.35
13	Lake Kathryn	0.0200	47.35
14	Lake Minear	0.0200	47.35
15	Highland Lake	0.0202	47.49
16	Lake Miltmore	0.0210	48.00
17	Timber Lake (North)	0.0210	48.05
18	Cross Lake	0.0220	48.72
19	Dog Training Pond	0.0220	48.72
20	Sun Lake	0.0220	48.72
21	Cranberry Lake	0.0230	49.00
22	Deep Lake	0.0230	49.36
23	Lake of the Hollow	0.0230	49.36
24	Round Lake	0.0230	49.36
25	Stone Quarry Lake	0.0230	49.36
26	Little Silver Lake	0.0250	50.57
27	Bangs Lake	0.0260	51.00
28	Lake Leo	0.0260	51.13
29	Dugdale Lake	0.0270	51.68
30	Peterson Pond	0.0270	51.68
31	Fourth Lake	0.0360	53.00
32	Lake Fairfield	0.0300	53.20
33	Third Lake	0.0300	53.33
34	Lake Catherine	0.0310	53.67
35	Lambs Farm Lake	0.0310	53.67
36	Old School Lake	0.0310	53.67
37	Grays Lake	0.0310	54.00
38	Hendrick Lake	0.0340	55.00
39	Honey Lake	0.0340	55.00
40	**Sand Lake**	**0.0380**	**56.00**
41	Diamond Lake	0.0370	56.22
42	Sullivan Lake	0.0370	56.22
43	Channel Lake	0.0380	56.60
44	Ames Pit	0.0390	56.98
45	East Loon	0.0400	57.00
46	Schreiber Lake	0.0400	57.34

Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
47	Waterford Lake	0.0400	57.34
48	Hook Lake	0.0410	57.70
49	Duck Lake	0.0430	58.39
50	Nielsen Pond	0.0450	59.04
51	Seven Acre Lake	0.0460	59.36
52	Turner Lake	0.0460	59.36
53	Willow Lake	0.0460	59.36
54	East Meadow Lake	0.0480	59.97
55	Lucky Lake	0.0480	59.97
56	Old Oak Lake	0.0490	60.27
57	College Trail Lake	0.0500	60.56
58	Hastings Lake	0.0520	61.13
59	Lake Lakeland Estates	0.0520	61.13
60	Butler Lake	0.0530	61.40
61	West Meadow Lake	0.0530	61.40
62	Little Bear Lake	0.0550	61.94
63	Lucy Lake	0.0550	61.94
64	Lake Linden	0.0570	62.45
65	Lake Napa Suwe	0.0570	62.45
66	Lake Charles	0.0580	62.70
67	Lake Christa	0.0580	62.70
68	Owens Lake	0.0580	62.70
69	Briarcrest Pond	0.0580	63.00
70	Lake Naomi	0.0620	63.66
71	Lake Tranquility (S1)	0.0620	63.66
72	Liberty Lake	0.0630	63.89
73	Werhane Lake	0.0630	63.89
74	Countryside Glen Lake	0.0640	64.12
75	Davis Lake	0.0650	64.34
76	Lake Fairview	0.0650	64.34
77	Leisure Lake	0.0650	64.34
78	Tower Lake	0.0660	64.56
79	St. Mary's Lake	0.0670	64.78
80	Mary Lee Lake	0.0680	65.00
81	Wooster Lake	0.0690	65.00
82	Crooked Lake	0.0700	65.41
83	Lake Helen	0.0720	65.82
84	Grandwood Park Lake	0.0720	66.00
85	ADID 203	0.0730	66.02
86	Bluff Lake	0.0730	66.02
87	Spring Lake	0.0730	66.02
88	Harvey Lake	0.0770	66.79
89	Broberg Marsh	0.0780	66.97
90	Countryside Lake	0.0780	67.00
91	Sylvan Lake	0.0790	67.16
92	Big Bear Lake	0.0810	67.52

Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
93	Redwing Slough	0.0822	67.73
94	Petite Lake	0.0830	67.87
95	Forest Lake	0.0820	68.00
96	Lake Marie	0.0850	68.21
97	Potomac Lake	0.0850	68.21
98	Timber Lake (South)	0.0850	68.21
99	White Lake	0.0862	68.42
100	Grand Ave Marsh	0.0870	68.55
101	North Churchill Lake	0.0870	68.55
102	McDonald Lake 1	0.0880	68.71
103	North Tower Lake	0.0880	68.71
104	Long Lake	0.0850	69.00
105	Rivershire Pond 2	0.0900	69.04
106	South Churchill Lake	0.0900	69.04
107	McGreal Lake	0.0910	69.20
108	Deer Lake	0.0940	69.66
109	Dunn's Lake	0.0950	69.82
110	Eagle Lake (S1)	0.0950	69.82
111	International Mine and Chemical Lake	0.0950	69.82
112	Valley Lake	0.0950	69.82
113	Fish Lake	0.0960	69.97
114	Lochanora Lake	0.0960	69.97
115	Island Lake	0.0990	70.41
116	Woodland Lake	0.0990	70.41
117	Nippersink Lake	0.1000	70.56
118	Longview Meadow Lake	0.1020	70.84
119	Lake Barrington	0.1050	71.26
120	Lake Forest Pond	0.1070	71.53
121	Bittersweet Golf Course #13	0.1100	71.93
122	Fox Lake	0.1100	71.93
123	Middlefork Savannah Outlet 1	0.1120	72.00
124	Osprey Lake	0.1110	72.06
125	Bresen Lake	0.1130	72.32
126	Round Lake Marsh North	0.1130	72.32
127	Deer Lake Meadow Lake	0.1160	72.70
128	Taylor Lake	0.1180	72.94
129	Columbus Park Lake	0.1230	73.54
130	Lake Nipperink	0.1240	73.66
131	Echo Lake	0.1250	73.77
132	Grass Lake	0.1290	74.23
133	Lake Holloway	0.1320	74.56
134	Redhead Lake	0.1410	75.51
135	Antioch Lake	0.1450	75.91
136	Slocum Lake	0.1500	76.40
137	Lakewood Marsh	0.1510	76.50
138	Pond-A-Rudy	0.1510	76.50

Lake County average TSI phosphorus (TSIp) ranking 2000-2011.

RANK	LAKE NAME	TP AVE	TSIp
139	Lake Matthews	0.1520	76.59
140	Buffalo Creek Reservoir	0.1550	76.88
141	Middlefork Savannah Outlet 2	0.1590	77.00
142	Pistakee Lake	0.1590	77.24
143	Grassy Lake	0.1610	77.42
144	Salem Lake	0.1650	77.78
145	Half Day Pit	0.1690	78.12
146	Lake Eleanor	0.1810	79.11
147	Lake Farmington	0.1850	79.43
148	Lake Louise	0.1850	79.43
149	ADID 127	0.1890	79.74
150	Patski Pond	0.1970	80.33
151	Dog Bone Lake	0.1990	80.48
152	Summerhill Estates Lake	0.1990	80.48
153	Redwing Marsh	0.2070	81.05
154	Stockholm Lake	0.2082	81.13
155	Bishop Lake	0.2160	81.66
156	Ozaukee Lake	0.2200	81.93
157	Hidden Lake	0.2240	82.19
158	McDonald Lake 2	0.2250	82.28
159	Fischer Lake	0.2280	82.44
160	Oak Hills Lake	0.2790	85.35
161	Loch Lomond	0.2950	86.16
162	Heron Pond	0.2990	86.35
163	Rollins Savannah 1	0.3070	87.00
164	Fairfield Marsh	0.3260	87.60
165	ADID 182	0.3280	87.69
166	Slough Lake	0.3860	90.03
167	Flint Lake Outlet	0.5000	93.76
168	Rasmussen Lake	0.5030	93.85
169	Rollins Savannah 2	0.5870	96.00
170	Albert Lake, Site II, outflow	1.1894	106.26
171	Almond Marsh	1.9510	113.00

Aquatic plant density at 111 sites on Sand Lake in July 2011.
Maximum depth that plants were found was 9.3 feet.

Plant Density	Chara	Coontail	Curlyleaf Pondweed	Eurasian Watermilfoil	Sago Pondweed	Spatterdock
Absent	95	45	80	41	89	95
Present	0	7	11	11	4	0
Common	1	15	5	24	2	1
Abundant	0	24	0	15	1	0
Dominant	0	5	0	5	0	0
% Plant Occurrence	0.9%	45.9%	14.4%	49.5%	6.3%	0.9%

Distribution of rake density across all sampling sites

Rake Density (Coverage)	# of Sites	%
No plants	22	19.8
>0 to 10%	4	3.6
>10 to 40%	21	18.9
>40 to 60%	26	23.4
>60 to 90%	22	19.8
>90%	1	0.9
Total Sites with Plants	74	66.7
Total # of Sites	111	100.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.4	37.0
2	East Loon Lake	37	35.6
3	West Loon Lake	33.7	32.3
4	Little Silver	31.6	29.6
5	Deep Lake	31.2	29.7
6	Round Lake Marsh North	29.9	29.1
7	Cranberry Lake	28.9	28.0
8	Sullivan Lake	28.5	26.9
9	Independence Grove	27.5	24.6
10	Fourth Lake	27.1	24.7
11	Lake Zurich	27.1	24.3
12	Bangs Lake	26.9	25.2
13	Sterling Lake	26.9	24.5
14	Sun Lake	26.1	24.3
15	Round Lake	25.9	23.5
16	Honey Lake	25.1	23.3
17	Lake of the Hollow	24.8	23.0
18	Schreiber Lake	24.8	23.9
19	Lakewood Marsh	24.7	23.8
20	Redwing Slough	24.0	25.8
21	Deer Lake	23.5	24.4
22	Butler Lake	23.1	21.4
23	Duck Lake	22.9	21.1
24	Countryside Glen Lake	22.8	21.9
25	Cross Lake	22.4	24.2
26	McGreal Lake	22.1	20.2
27	Druce Lake	21.8	19.1
28	Third Lake	21.7	13.2
29	Broberg Marsh	21.4	20.5
30	Davis Lake	21.4	21.4
31	Fish Lake	21.2	19.3
32	Redhead Lake	21.2	19.3
33	Turner Lake	21.2	18.6
34	Wooster Lake	21.1	19.4
35	Timber Lake (North)	20.9	23.4
36	Lake Kathryn	20.7	19.6
37	ADID 203	20.5	20.5
38	Salem Lake	20.2	18.5
39	Old Oak Lake	19.1	18.0
40	Grandwood Park Lake	19.0	17.2
41	Highland Lake	18.9	16.7
42	Lake Miltmore	18.7	16.8
43	Lake Helen	18.0	18.0
44	Bresen Lake	17.8	16.6
45	Potomac Lake	17.8	17.8
46	Hendrick Lake	17.7	17.7
47	Lake Barrington	17.7	16.7
48	Long Lake	17.7	15.8
49	Rollins Savannah 2	17.7	17.7
50	Windward Lake	17.6	16.3
51	Diamond Lake	17.4	16.3
52	Almond Marsh	17.3	16.3
53	Osprey Lake	17.3	15.5
54	Owens Lake	17.3	16.3

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
55	Forest Lake	17.0	15.9
56	Lake Tranquility (S1)	17.0	15.0
57	McDonald Lake 1	16.7	17.7
58	Island Lake	16.6	14.7
59	Countryside Lake	16.3	15.2
60	Grand Avenue Marsh	16.3	14.3
61	Lake Fairview	16.3	15.2
62	Lake Nippersink	16.3	14.3
63	Taylor Lake	16.3	14.3
64	Grays Lake	16.1	16.1
65	White Lake	16.0	17.0
66	Dog Training Pond	15.9	14.7
67	Dog Bone Lake	15.7	15.7
68	Ames Pit	15.5	13.4
69	Seven Acre Lake	15.5	17.0
70	Dugdale Lake	15.1	14.0
71	Eagle Lake (S1)	15.1	14.0
72	Heron Pond	15.1	15.1
73	Mary Lee Lake	15.1	13.1
74	Old School Lake	15.1	13.1
75	Bishop Lake	15	13.4
76	Hastings Lake	15.0	17.0
77	North Churchill Lake	15.0	15.0
78	Timber Lake (South)	14.7	12.7
79	Buffalo Creek Reservoir	14.3	13.1
80	Lake Carina	14.3	12.1
81	Lake Leo	14.3	12.1
82	Lambs Farm Lake	14.3	12.1
83	Crooked Lake	14.0	16.0
84	Dunn's Lake	13.9	12.7
85	Lake Minear	13.9	11.0
86	Lake Napa Suwe	13.9	11.7
87	Longview Meadow Lake	13.9	13.9
88	Summerhill Estates Lake	13.9	12.7
89	Stockholm Lake	13.5	12.1
90	Antioch Lake	13.4	11.3
91	Hook Lake	13.4	11.3
92	Lake Charles	13.4	11.3
93	Rivershire Pond 2	13.3	11.5
94	Flint Lake	13.0	11.8
95	Harvey Lake	13.0	11.8
96	Briarcrest Pond	12.5	11.2
97	Gages Lake	12.5	10.2
98	Lake Naomi	12.5	11.2
99	McDonald Lake 2	12.5	12.5
100	Pulaski Pond	12.5	11.2
101	Rollins Savannah 1	12.5	12.5
102	Stone Quarry Lake	12.5	12.5
103	Loch Lomond	12.1	9.4
104	Pond-A-Rudy	12.1	12.1
105	Grassy Lake	12.0	12.0
106	Lake Matthews	12.0	12.0
107	Nielsen Pond	12.0	10.7
108	Werhane Lake	12.0	9.8
109	Lake Lakeland Estates	11.5	10.0
110	Big Bear Lake	11.0	9.5
111	Fischer Lake	11.0	9.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
112	Little Bear Lake	11.0	9.5
113	Redwing Marsh	11	11.0
114	Tower Lake	11.0	11.0
115	West Meadow Lake	11.0	11.0
116	Lake Holloway	10.6	10.6
117	Lake Fairfield	10.4	9.0
118	Lake Louise	10.4	9.0
119	**Sand Lake**	**10.4**	**8.0**
120	College Trail Lake	10.0	10.0
121	Valley Lake	9.9	9.9
122	Woodland Lake	9.9	8.1
123	Lake Christa	9.8	8.5
124	Lake Farmington	9.8	8.5
125	Lucy Lake	9.8	8.5
126	Banana Pond	9.2	7.5
127	Columbus Park Lake	9.2	9.2
128	Sylvan Lake	9.2	9.2
129	Waterford Lake	9.2	9.2
130	Leisure Lake	9.0	6.4
131	Albert Lake	8.7	7.5
132	Fairfield Marsh	8.7	7.5
133	Lake Eleanor	8.7	7.5
134	Ozaukee Lake	8.7	6.7
135	East Meadow Lake	8.5	8.5
136	Lake Forest Pond	8.5	6.9
137	Peterson Pond	8.5	6.0
138	South Churchill Lake	8.5	8.5
139	Bittersweet Golf Course #13	8.1	8.1
140	Lake Linden	8.0	8.0
141	IMC Lake	7.1	5.0
142	Patski Pond	7.1	7.1
143	Rasmussen Lake	7.1	7.1
144	Slocum Lake	7.1	5.8
145	Lucky Lake	7.0	7.0
146	Deer Lake Meadow Lake	6.4	5.2
147	ADID 127	5.0	5.0
148	Half Day Pit	5.0	2.9
149	Liberty Lake	5.0	5.0
150	Lochanora Lake	5.0	2.5
151	Oak Hills Lake	5.0	5.0
152	Sand Pond (IDNR)	5.0	3.5
153	Slough Lake	5.0	5.0
154	Echo Lake	0.0	0.0
155	Hidden Lake	0.0	0.0
156	North Tower Lake	0.0	0.0
157	St. Mary's Lake	0.0	0.0
158	Willow Lake	0.0	0.0
	Mean	**15.2**	**14.1**
	Median	**14.3**	**13.1**

Morphometric Features of Sand Lake ~
Data From the March 2011 Bathymetric Survey, LCHD Environmental Services

Contour (Feet)	Area Enclosed (Acres)	Percent of total acres	Volume (Acre-feet)	Depth Zone (Feet)	Area (Acres)	Percent (Depth zone to total acres)	Percent (Acre-feet to Total Volume)
0	99.98	100%	96.73	0 - 1	6.46	6.5%	11.3%
1	93.52	94%	90.36	1 - 2	6.30	6.3%	10.5%
2	87.23	87%	83.00	2 - 3	8.38	8.4%	9.7%
3	78.85	79%	72.15	3 - 4	13.20	13.2%	8.4%
4	65.65	66%	58.48	4 - 5	14.04	14.0%	6.8%
5	51.60	52%	46.02	5 - 6	10.95	10.9%	5.4%
6	40.65	41%	36.86	6 - 7	7.46	7.5%	4.3%
7	33.20	33%	31.64	7 - 8	3.10	3.1%	3.7%
8	30.10	30%	28.94	8 - 9	2.30	2.3%	3.4%
9	27.80	28%	26.93	9 - 10	1.73	1.7%	3.1%
10	26.07	26%	25.37	10 - 11	1.40	1.4%	3.0%
11	24.67	25%	24.04	11 - 12	1.25	1.3%	2.8%
12	23.42	23%	22.83	12 - 13	1.17	1.2%	2.7%
13	22.25	22%	21.68	13 - 14	1.12	1.1%	2.5%
14	21.13	21%	20.56	14 - 15	1.13	1.1%	2.4%
15	20.00	20%	19.42	15 - 16	1.15	1.1%	2.3%
16	18.85	19%	18.26	16 - 17	1.17	1.2%	2.1%
17	17.68	18%	17.09	17 - 18	1.18	1.2%	2.0%
18	16.50	17%	15.90	18 - 19	1.20	1.2%	1.9%
19	15.30	15%	14.70	19 - 20	1.19	1.2%	1.7%
20	14.11	14%	13.53	20 - 21	1.15	1.2%	1.6%
21	12.96	13%	12.39	21 - 22	1.13	1.1%	1.4%
22	11.83	12%	11.27	22 - 23	1.11	1.1%	1.3%
23	10.72	11%	10.18	23 - 24	1.06	1.1%	1.2%
24	9.66	10%	9.10	24 - 25	1.10	1.1%	1.1%
25	8.55	9%	7.99	25 - 26	1.10	1.1%	0.9%
26	7.45	7%	6.90	26 - 27	1.08	1.1%	0.8%
27	6.37	6%	5.79	27 - 28	1.14	1.1%	0.7%
28	5.23	5%	4.56	28 - 29	1.32	1.3%	0.5%
29	3.91	4%	3.07	29 - 30	1.61	1.6%	0.4%
30	2.31	2%	1.02	30 - 31	2.15	2.1%	0.1%
31	0.16	0.2%	0.19	31+	0.16	0.2%	0.02%
			856.96		99.98	100%	100%

Maximum Depth of Lake: 31.21 feet
Average Depth of Lake: 8.57 feet
Volume of Lake: 856.96 acre-feet

Area of Lake: 99.98 acres
Shoreline Length: 1.59 miles
Water elevation at 775.704 feet above mean sea level
Spillway elevation: 775.70 feet above mean sea level

LakeCounty
Health Department and
Community Health Center

Sand Lake 2011 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 0.23
51111	0.5	0.240	19.69	10.94	123.6	0.0010	9.05	4213.0	Surface		
51111	1	1.040	17.94	11.52	125.9	0.6726	9.05	3718.0	Surface	100%	
51111	2	2.000	17.59	11.70	126.9	0.6693	9.05	1550.0	0.330	42%	2.65
51111	3	2.980	17.33	11.72	126.5	0.6696	9.03	565.0	1.310	15%	0.77
51111	4	3.980	16.82	11.67	124.6	0.6708	8.99	928.0	2.310	25%	-0.21
51111	6	6.040	16.35	11.47	121.3	0.6707	8.95	635.0	4.370	17%	0.09
51111	8	8.020	15.84	11.41	119.4	0.6716	8.93	228.0	6.350	6%	0.16
51111	10	10.000	15.15	11.41	117.6	0.6711	8.92	179.0	8.330	4.8%	0.03
51111	12	12.020	14.37	11.30	114.5	0.6699	8.88	149.0	10.350	4.0%	0.02
51111	14	14.010	13.93	10.82	108.6	0.6708	8.82	122.0	12.340	3.3%	0.02
51111	16	16.020	13.58	10.49	104.5	0.6699	8.75	93.0	14.350	2.5%	0.02
51111	18	17.980	12.84	9.97	97.7	0.6705	8.64	89.0	16.310	2.4%	0.00
51111	20	19.970	11.74	8.99	85.9	0.6697	8.43	63.0	18.300	1.7%	0.02
51111	22	22.010	10.44	8.23	76.3	0.6719	8.16	46.0	20.340	1.2%	0.02
51111	24	24.020	9.25	7.28	65.6	0.6740	7.91	35.0	22.350	0.9%	0.01
51111	26	26.040	8.57	6.65	59.0	0.6747	7.77	26.0	24.370	0.7%	0.01
51111	28	27.990	8.06	5.13	44.9	0.6758	7.60	20.0	26.320	0.5%	0.01
51111	30	29.980	7.86	3.98	34.7	0.6798	7.48	15.0	28.310	0.4%	0.01

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 0.23
61511	0.5	0.52	20.52	8.38	97	0.656	8.48	2036	Surface		
61511	1	1.09	20.53	8.38	96.9	0.656	8.51	1802	Surface	100%	
61511	2	2.05	20.54	8.36	96.8	0.6559	8.51	634	0.380	35%	2.75
61511	3	3.01	20.53	8.34	96.6	0.6559	8.52	330	1.340	18%	0.49
61511	4	3.99	20.53	8.34	96.5	0.6567	8.52	195	2.320	11%	0.23
61511	6	6.04	20.53	8.33	96.4	0.656	8.52	144	4.370	8%	0.07
61511	8	8.05	20.51	8.33	96.4	0.6562	8.51	92	6.380	5%	0.07
61511	10	10.03	20.49	8.29	95.8	0.6568	8.5	71	8.360	4%	0.03
61511	12	12.05	20.43	8.17	94.4	0.6582	8.46	44	10.380	2%	0.05
61511	14	14.04	18.7	6.18	69	0.6471	8.39	28	12.370	2%	0.04

61511	16	16.04	16.47	4.6	49	0.6454	8.3	19	14.370	1%	0.03
61511	18	17.98	14.79	3.36	34.5	0.6466	8.02	14	16.310	1%	0.02
61511	20	20.04	13.54	1.99	19.9	0.6506	7.8	9	18.370	0%	0.02
61511	22	22.05	12.77	0.78	7.7	0.6517	7.61	8	20.380	0.4%	0.01
61511	24	24	12.15	0.33	3.2	0.6541	7.52	6	22.330	0.3%	0.01
61511	26	26.11	11.82	0.26	2.5	0.6547	7.48	4	24.440	0.2%	0.02
61511	28	28.07	11.49	0.25	2.4	0.6557	7.43	4	26.400	0.2%	0.00
61511	30	30.06	10.66	0.25	2.3	0.6628	7.35	2	28.390	0.1%	0.02
61511	32	31.66	10.18	0.24	2.2	0.674	7.16	2	29.990	0.1%	0.00

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 0.20
7132011	0.5	0.32	27.49	9.53	123.9	0.6378	9.1	2062	Surface		
7132011	1	1.02	27.52	9.54	124	0.6376	9.09	4490	Surface	100%	
7132011	2	2.03	27.51	9.55	124.1	0.6379	9.11	2750	0.360	61%	1.36
7132011	3	3.02	27.52	9.53	123.9	0.6377	9.11	1689	1.350	38%	0.36
7132011	4	4	27.52	9.6	124.8	0.6376	9.11	259	2.330	6%	0.80
7132011	6	6.04	27.53	9.57	124.4	0.6376	9.11	851	4.370	19%	-0.27
7132011	8	8.02	27.52	9.5	123.5	0.6374	9.1	591	6.350	13%	0.06
7132011	10	9.99	25.6	5.45	68.5	0.6511	8.59	334	8.320	7%	0.07
7132011	12	11.99	22.61	2.68	31.9	0.655	8.04	180	10.320	4%	0.06
7132011	14	14.02	20.67	1.23	14	0.6531	7.8	41	12.350	1%	0.12
7132011	16	15.97	19.1	0.35	3.9	0.652	7.67	90	14.300	2.0%	-0.05
7132011	18	17.97	17.09	0.23	2.4	0.6465	7.61	54	16.300	1.2%	0.03
7132011	20	20.03	15.39	0.22	2.3	0.6442	7.54	29	18.360	0.6%	0.03
7132011	22	22.04	13.95	0.22	2.2	0.6444	7.38	15	20.370	0.3%	0.03
7132011	24	24.02	12.58	0.21	2.1	0.6494	7.26	6	22.350	0.13%	0.04
7132011	26	26.01	11.66	0.22	2	0.6553	7.18	2	24.340		
7132011	28	27.99	11.08	0.22	2	0.665	7.05	1	26.320		
7132011	30	30.12	10.71	0.22	2	0.6725	6.98	0	28.450		

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient 1.31
81011	0.5	0.310	25.80	5.36	68.2	0.6032	9.21	3714.0	Surface		
81011	1	1.100	25.89	5.32	67.7	0.6028	9.21	527.0	Surface	100%	

81011	2	1.880	25.83	4.96	63.2	0.6030	9.19	203.0	0.210	39%	4.54
81011	3	3.090	25.65	4.33	54.9	0.6038	9.16	26.0	1.420	5%	1.45
81011	4	4.050	25.66	4.13	52.3	0.6041	9.15	16.0	2.380	3%	0.20
81011	6	5.950	25.50	3.61	45.7	0.6047	9.11	10.0	4.280	2%	0.11
81011	8	8.100	25.44	3.57	45.0	0.6051	9.12	2.0	6.430	0.4%	0.25
81011	10	9.970	25.32	3.34	42.1	0.6034	9.08	0.0	8.300		
81011	12	11.960	24.91	2.13	26.6	0.6142	8.82	0.0	10.290		
81011	14	14.000	22.71	0.42	5.0	0.6753	7.90	0.0	12.330		
81011	16	15.970	20.73	0.22	2.5	0.6752	7.75	0.0	14.300		
81011	18	17.990	17.99	0.21	2.3	0.6667	7.66	0.0	16.320		
81011	20	20.010	16.25	0.21	2.2	0.6667	7.58	0.0	18.340		
81011	22	22.080	14.67	0.22	2.2	0.6677	7.47	0.0	20.410		
81011	24	24.000	13.27	0.23	2.3	0.6731	7.31	0.0	22.330		
81011	26	26.120	12.15	0.22	2.1	0.6822	7.14	0.0	24.450		
81011	28	27.980	11.38	0.22	2.1	0.7079	6.96	0.0	26.310		

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmissio Average	Extinction Coefficient 0.31
91411	0.5	0.6	21.55	9.44	110	0.7594	8.94	353	Surface		
91411	1	1.03	21.55	9.46	110.2	0.7594	8.95	518	Surface	100%	
91411	2	2.09	21.56	9.43	109.9	0.7593	8.95	188	0.420	36%	2.41
91411	3	3.15	21.56	9.37	109.2	0.7592	8.94	85	1.480	16%	0.54
91411	4	4	21.55	9.25	107.8	0.7592	8.93	67	2.330	13%	0.10
91411	6	6.04	21.56	9.22	107.5	0.7592	8.94	45	4.370	9%	0.09
91411	8	7.95	21.55	9.33	108.7	0.7593	8.94	32	6.280	6%	0.05
91411	10	9.93	21.56	9.31	108.5	0.7591	8.93	19	8.260	4%	0.06
91411	12	11.77	21.4	7.05	81.9	0.7604	8.7	13	10.100	3%	0.04
91411	14	13.92	20.95	3.96	45.6	0.7625	8.34	8	12.250	2%	0.04
91411	16	16.05	20.58	1.61	18.4	0.7653	8.03	5	14.380	1%	0.03
91411	18	17.92	19.85	0.52	5.9	0.7718	7.85	4	16.250	1%	0.01
91411	20	20.040	17.13	0.33	3.5	0.7943	7.59	3.0	18.370	1%	0.02
91411	22	22.060	15.31	0.30	3.1	0.7984	7.40	1.0	20.390		
91411	24	23.970	13.58	0.31	3.0	0.8087	7.25	1.0	22.300		
91411	26	25.960	12.58	0.29	2.8	0.8251	7.13	0.0	24.290		
91411	28	28.010	11.78	0.27	2.6	0.8587	6.93	0.0	26.340		
91411	30	30.110	11.38	0.27	2.5	0.8893	6.80	1.0	28.440		
91411	32	31.330	11.32	0.27	2.5	0.9000	6.74	0.0	29.660		

2000 - 2011 Water Quality Parameters, Statistics Summary

	ALKoxic <=3ft00-2011	
Average	**165**	
Median	**160**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**842**	

	ALKanoxic 2000-2011	
Average	**199**	
Median	**190**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**52**	
n =	**241**	

	Condoxic <=3ft00-2011	
Average	**0.8642**	
Median	**0.7821**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5273**	
n =	**841**	

	Condanoxic 2000-2011	
Average	**0.9953**	
Median	**0.8320**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.7929**	
n =	**241**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2011	
Average	**0.516**	
Median	**0.198**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.059**	
n =	**841**	

*ND = Many lakes had non-detects (75.0%)
Only compare lakes with detectable concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2011	
Average	**2.135**	
Median	**1.360**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.405**	
n =	**241**	

*ND = 22.0% Non-detects from 34 different lakes

	pHoxic <=3ft00-2011	
Average	**8.35**	
Median	**8.35**	
Minimum	**7.07**	**Bittersweet #13**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**840**	

	pHanoxic 2000-2011	
Average	**7.31**	
Median	**7.27**	
Minimum	**6.24**	**Banana Pond**
Maximum	**9.16**	**White Lake**
STD	**0.42**	
n =	**241**	

	All Secchi 2000-2011	
Average	**4.39**	
Median	**2.95**	
Minimum	**0.25**	**McDonald 2/Ozaukee/Rollins 2**
Maximum	**20.34**	**Lake Carina**
STD	**3.43**	
n =	**767**	

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2000 - 2011 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2011	
Average	**1.511**	
Median	**1.180**	
Minimum	**<0.1**	***ND**
Maximum	**41.200**	**Almond Marsh**
STD	**1.740**	
n =	**842**	

*ND = 3.6% Non-detects from 14 different lakes

	TKNanoxic 2000-2011	
Average	**2.823**	
Median	**2.120**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.345**	
n =	**241**	

*ND = 2.9% Non-detects from 4 different lakes

	TPoxic <=3ft00-2011	
Average	**0.114**	
Median	**0.066**	
Minimum	**<0.01**	***ND**
Maximum	**7.270**	**Almond Marsh**
STD	**0.307**	
n =	**842**	

*ND = 2.1% Non-detects from 7 different lakes

	TPanoxic 2000-2011	
Average	**0.313**	
Median	**0.181**	
Minimum	**0.012**	**Independence Grove**
Maximum	**3.800**	**Taylor Lake**
STD	**0.404**	
n =	**241**	

	TSSall <=3ft00-2011	
Average	**16.6**	
Median	**8.6**	
Minimum	**<0.1**	***ND**
Maximum	**220.0**	**Rollins 2**
STD	**23.4**	
n =	**848**	

*ND = 0.9% Non-detects from 8 different lakes

	TVSoxic <=3ft00-2011	
Average	**127.2**	
Median	**122.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**1090.0**	**Almond Marsh**
STD	**53.0**	
n =	**797**	

No 2002 IEPA Chain Lakes

	TDSoxic <=3ft00-2004	
Average	**470**	
Median	**454**	
Minimum	**150**	**Lake Kathryn, White**
Maximum	**1340**	**IMC**
STD	**169**	
n =	**745**	

No 2002 IEPA Chain Lakes.

	CLanoxic <=3ft00-2010	
Average	**193**	
Median	**128**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**313**	
n =	**174**	

	CLoxic <=3ft00-2011	
Average	**183**	
Median	**145**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**212**	
n =	**638**	

Anoxic conditions are defined <=1 mg/l D.O.
pH Units are equal to the -Log of [H] ion activity
Conductivity units are in MilliSiemens/cm
Secchi Disk depth units are in feet
All others are in mg/L

Minimums and maximums are based on data from all lakes from 2000-2011 (n=1398).

Average, median and STD are based on data from the most recent water quality sampling year for each lake.

LCHD Environmental Services ~ 12/12/2011

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