LAKE COUNTY, ILLINOIS

CROOKED LAKE 2010 SUMMARY REPORT

PREPARED BY THE
LAKE COUNTY HEALTH DEPARTMENT
Population Health Environmental Services

Crooked Lake

Picture provided by: Don Gibbs, Crooked Lake Improvement Committee

Crooked Lake is a glacial lake located in unincorporated Lake County and Lindenhurst. The lake has a surface area of 140.0 acres and a maximum depth of 26.5 feet. Crooked Lake Homeowners associations actively manage the lake for boating, fishing, swimming, and aesthetics. There are three licensed beaches on Crooked Lake

Crooked Lake is listed as an ADID (advanced identification) wetland by the U.S. Environmental Protection Agency. This indicates that the lake and surrounding natural environments have potential to high quality aquatic resources based on water quality and hydrology values.

Crooked Lake receives water from its approximate 1260 acre watershed that includes Slough Lake and drains into Hastings Lake. The primary land uses within the Crooked Lake watershed were public and private open space, single family homes, and water. Many water quality parameters have not changed significantly since the 2006 lake study. Total phosphorus concentrations in Crooked Lake averaged 0.070 mg/L in 2010 which is a 13% increase from the 2006 concentration of 0.061 mg/L. The total phosphorus levels in 2006 and 2010 exceed the Illinois

ENVIRONMENTAL SERVICES WATER QUALITY SPECIALISTS

Kelly Deem
kdeem@lakecountyil.gov

Mike Adam
madam@lakecountyil.gov

Kathy Paap
kpaap@lakecountyil.gov

INSIDE THIS ISSUE:

SUMMARY	2
WATERSHED	2
WATER CLARITY	4
NUTRIENTS	5
TROPHIC STATE INEDEX	6
NPDES PERMITS	6
HERBICIDES	7
PLANKTON	8
BLUE-GREEN ALGAE	9
CONDUCTIVITY	10
CHLORIDES	11
AQUATIC	12
FLORISTIC	13
EURASIAN WATERMILFOIL	14
CURLYLEAF PONDWEED	15
SHORELINE	16
BATHYMETRIC	17
FISHERIES	18

CROOKED LAKE SUMMARY (CONTINUED FROM PAGE 1)

Lake Facts:

Major Watershed: Des Plaines

Sub-Watershed: North Mill Creek

Location: T46N, R10E, Section 34

Surface Area: 147.86 acres

Shoreline Length: 2.96 miles

Maximum Depth: 21.95 feet

Average Depth: 8.31 feet

Lake Volume: 1228.6 acre -feet

Watershed Area: 1253.94 acres

Lake Type: Glacial

Management Entity: Associations

Environmental Protection Agency's (IEPA) impairment level of 0.050 mg/L. Another violation of the IEPA water quality standards was documented in August (9.02) for pH greater than 9.0. Nitrogen is the other nutrient critical for algal growth. The average Total Kjeldahl nitrogen concentration fro Crooked Lake was 1.26 mg/L which was lower than the 2006 value by 29% (1.62 mg/L). A total nitrogen to total phosphorus (TN:TP) ratio of 20:1 indicates phosphorus was limiting. Also using phosphorus as an indicator, the trophic state index (TSIp) ranked Crooked Lake as eutrophic with a TSIp value of 65.3.
The 2010 average total suspended solids (TSS) concentration for Crooked Lake was 7.3 mg/L, which was less than the 2009 county median (7.9 mg/L) and a slight reduction from the 2006 value of 7.7 mg/L. Water clarity was measured by Secchi depth, with the lowest reading in September (1.36 feet) corresponding with the highest TSS concentration (14.0 mg/L). The average Secchi depth for the season was 4.28 feet which is higher than the county median (3.15 feet).

Conductivity concentrations, are correlated with chloride concentrations, the average conductivity reading for Crooked Lake was 0.8430 mS/cm, which was above the county median (0.7948 mS/cm). This was a 31% decrease from the 2006 average (1.1034 mS/cm). The chloride concentration in Crooked Lake in 2010 was 173 mg/L which is above the county median of 145 mg/L.

Plant sampling was conducted on Crooked Lake in July. Nine species of aquatic plants were present covering approximately 42% of the lake. Coontail and White Water Lily were the most two abundant species found at 25% and 10% of the sites, respectively. Curlyleaf Pondweed and Eurasian Watermilfoil were also present these species are exotic and invasive that tend to crowd out native species when left unmanaged.

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?

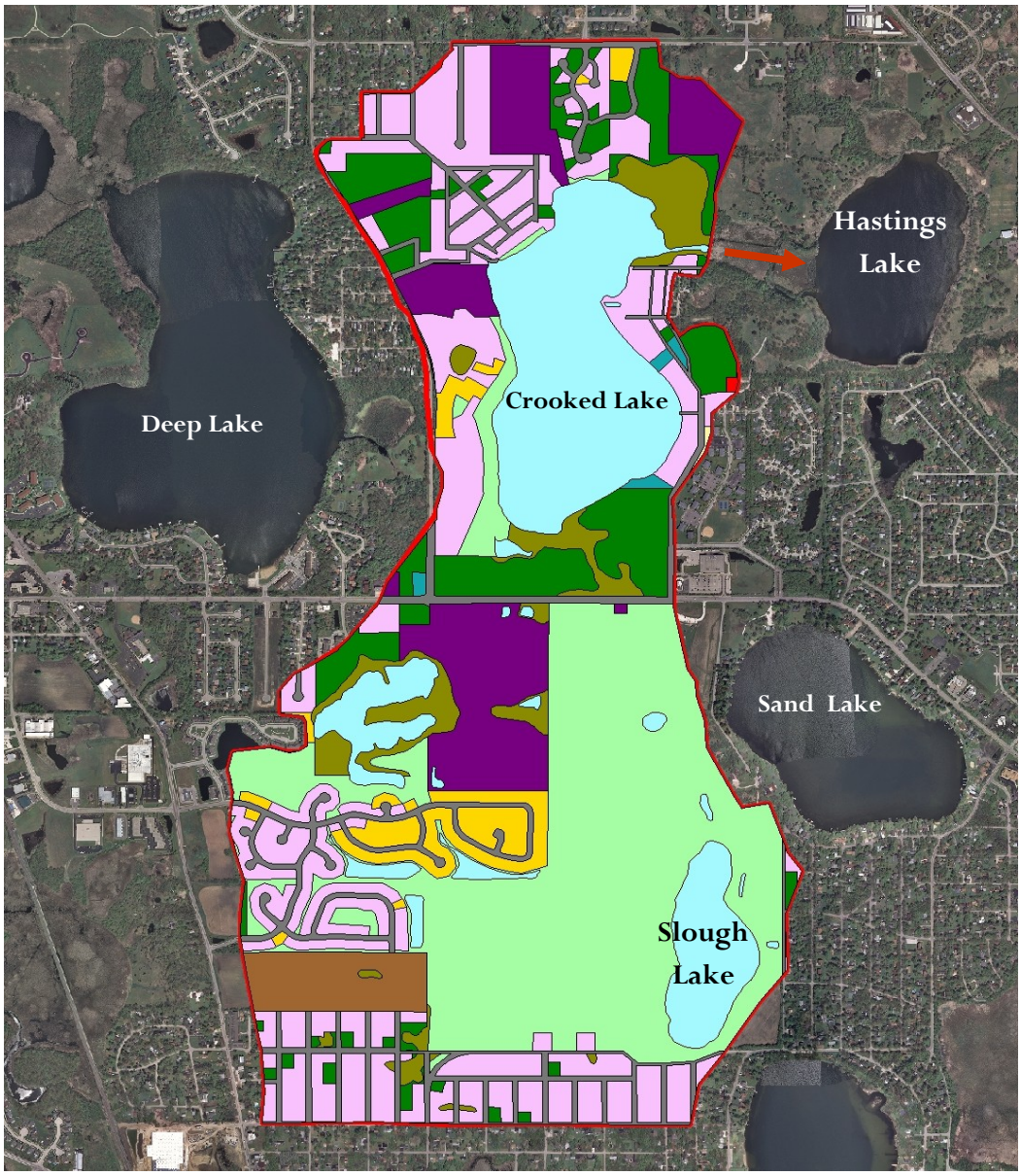
The source of a lake's water supply is very important in determining its water quality and choosing management practices to protect the lake. Crooked Lake is in the North Mill Creek watershed and receives water from Slough Lake during periods of high water from the south inlet and drains into Hastings Lake from the northwest outlet. 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. Retention time, the amount of time it takes for water entering a lake to flow out of it again was calculated to be approximately 1.66 years. The 1254 acre watershed carries storm water and pollutants into Crooked Lake. Typically water quality declines as pollutants accumulate from the top to the bottom of the watershed. However water quality actually improves as it travels downstream to Hastings Lake. Historically nutrient contamination came from the operation of the Weber duck farm on Slough Lake from the mid 1940s through the mid1980s. During normal operation, the farm had 45,000-50,000 ducks (at times up to 100,000), which lived in and around Slough Lake. These nutrients were eventually washed into Crooked Lake on a continual basis until the closure of the Duck farm.

Based on the 2010 data the current external sources affecting Crooked Lake were from the following land uses: public and private open space (27%) and single family homes (19%). The public and private space land use was a unique and valuable characteristic within a watershed as Lake County only has 13% of land preserved as open space. Based on the amount of impervious 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 two major sources of runoff for Crooked Lake were transportation (28%) and single family homes (27%). The northern wetland and southern forest and grassland areas around the lake help absorb runoff and nutrients before it enters the lake.

Crooked Lake Watershed

2010 Land use in the Crooked 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



Crooked Lake Outlet

Direction of watershed:
Slough Lake flows into Crooked Lake which enters Hasting Lake from the northwest outlet. Hastings Lake drains north into North Mill Creek and eventually the Des Plaines River, Illinois River, Mississippi River and finally the Golf of Mexico.

Lake	Slough Lake	Slough Lake	Slough Lake	Crooked Lake	Crooked Lake	Crooked Lake	Hastings Lake	Hastings Lake	Hastings Lake
Year	**2000**	**2006**	**2010**	**2001**	**2006**	**2010**	**2001**	**2006**	**2010**
Secchi (feet)	1.53	2.00	1.63	2.51	4.39	4.28	3.29	4.85	3.52
TSS (mg/L)	33.8	18.8	19.4	13.7	7.7	7.3	7.6	6.2	5.2
TP (mg/L)	0.263	0.413	0.386	0.101	0.061	0.07	0.066	0.068	0.052
Conductivity (milliSiemens/cm)	0.8659	1.5228	1.1306	0.7927	1.1034	0.8843	0.7863	1.0886	0.8491

2000 to 2010 Comparisons for epilimnetic averages for Secchi disk transparency, total suspended solids, total phosphorus, and conductivity readings in the Hastings Lake watershed (Slough Lake, Crooked Lake, and Hastings Lake).

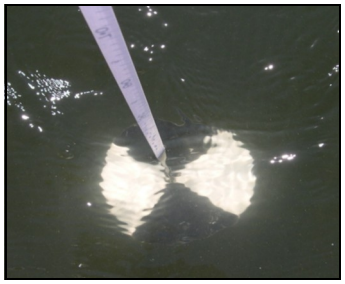
WATER CLARITY

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 2010 average water clarity in Crooked Lake was 4.28 feet; this was a 3% reduction in the lake's transparency since 2006 (4.39 feet) and is above the county median of 2.95 feet.

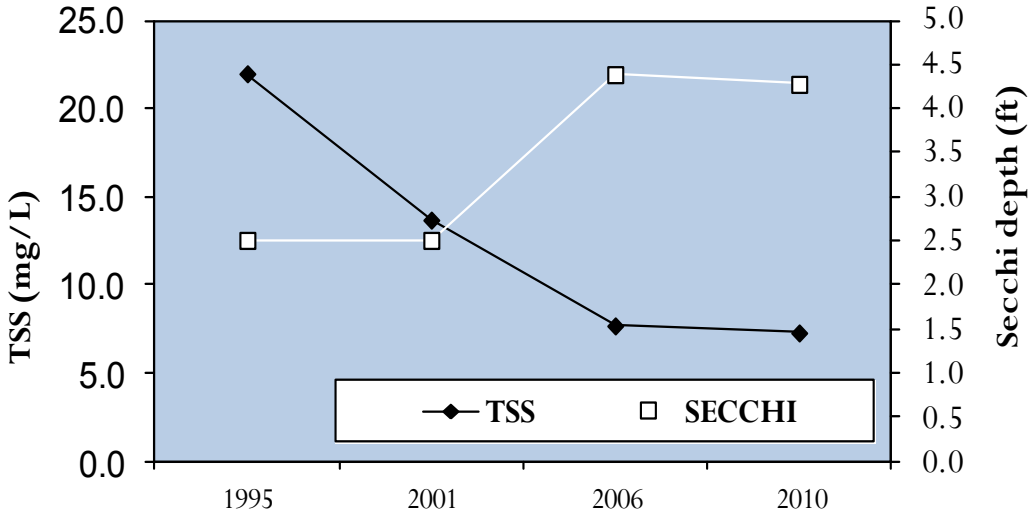


A Secchi disk is an eight-inch diameter weighted metal plate painted black and white in alternating quadrants. A calibrated rope is used to lower the disk into the water and measure the depth to which it is visible.

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).

TSS concentrations averaged 7.3 mg/L which was just below the county median of 7.9 mg/L. Since 2006 the TSS value of 7.7 mg/L has decreased by 5%. 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. Calculated nonvolatile suspended solids (NVSS) was 2.0 mg/L. This means that 27% of the TSS concentration is related to suspended inorganic particles. The other 73% can be attributed to organic particles. May had the lowest level of NVSS (0.9 mg/L and deepest Secchi disk measurement (7.25 feet), turbidity caused by algae is the most common reason for low Secchi disk readings in Crooked Lake. The lowest Secchi disk reading in 2010 occurred in September (1.36 feet) this sampling event coincided with a high density blue-green algae bloom.



Average Total Suspended Solid Concentrations and Secchi Depth in Crooked Lake 1995, 2001, 2006, and 2010.

VOLUNTEER LAKE MONITOR PROGRAM

Volunteers measure water clarity using the Secchi disk twice a month May through October. In 2010 there were **43 lakes** participating in Lake County.

If you would like more information please contact:

Kelly Deem
(847) 377-8009
kdeem@lakecountyil.gov

www.epa.state.il.us/water/vlmp/index.html

*2010 Lake County Median

Secchi depth = 2.95 feet

Secchi disk transparency is an indicator overall water quality. In general, the greater the Secchi disk depth, the clearer the water and better the water quality. High TSS values are typically correlated with poor water clarity. Over the past 15 years water clarity in Crooked Lake has improved significantly.

DATE	TSS	SECCHI
1995	22.0	2.51
2001	13.7	2.51
2006	7.7	4.39
2010	7.3	4.28

Average Total Suspended Solids (mg/L) and Secchi Depth (feet) in Crooked Lake.

NUTRIENTS-PHOSPHORUS/NITROGEN

YEAR	TP	TKN
1995	0.080	1.17
2001	0.101	1.47
2006	0.061	1.62
2010	0.070	1.26

AVERAGE TOTAL PHOSPHORUS CONCENTRATIONS AND TOTAL KJELDAHL NITROGEN CONCENTRATIONS FORCROOKED LAKE 1995-2010

***2010 Lake County Median**

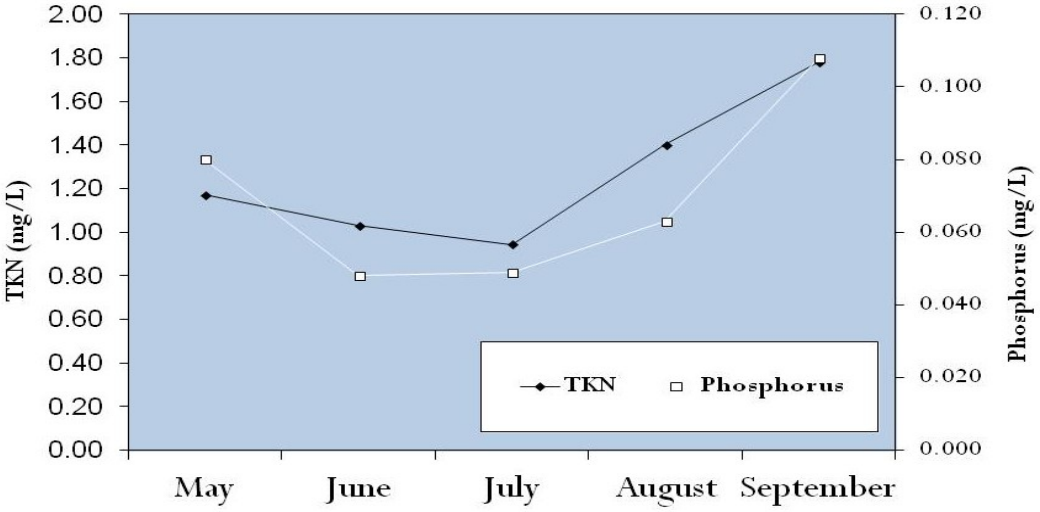
TP = 0.065 mg/L

Nutrients needed by organisms to live or grow and are typically taken in from its environment. In a lake the primary nutrients needed for aquatic plant and algal growth are phosphorus and nitrogen. In most lakes, including Crooked Lake phosphorus is the limiting nutrient, which means everything that plants and algae need to grow is available in excess: sunlight, warmth, and nitrogen. Phosphorus has a direct effect on the amount of plant and algal growth in lakes.

The 2010 average total phosphorus concentration in Crooked Lake was 0.070 mg/L this was a 13% increase from the 2006 concentration (0.061 mg/L). The Illinois Environmental Protection Agency (IEPA) lists Crooked Lake as being impaired for total phosphorus as the phosphorus concentration exceeds the impairment level of 0.050 mg/L. Concentrations above the impairment level can support high densities of algae and aquatic plants which can reduce water clarity and dissolved oxygen levels.

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 farmland and 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 2010 TKN for Crooked Lake was 1.26 mg/L, which was slightly higher than the county median of 1.18 mg/L. Summarily to 2006, TKN values increased in September. September had the highest concentration (1.78 mg/L) corresponding with the highest monthly concentration of phosphorus (0.108 mg/L) and a blue-green algae bloom in 2010.



Average Total Kjeldahl Nitrogen (TKN) and Phosphorus Concentrations in Crooked Lake 1995, 2001, 2006, and 2010.

WHAT HAS BEEN DONE TO REDUCE PHOSPHORUS LEVELS

2011- Common Carp removal, Illinois Division of Natural Resources removed 361 individuals totaling 1171 lbs.

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

July 2010- The state of Illinois passed a law to reduced the amount of phosphorus content in dishwashing and laundry detergents.

1989- Lake County Forest Preserve (LCFP) purchases Duck Farm and 350 acres surrounding Slough Lake, featuring gently sloping topography dotted with dense woodlands and expansive prairies.

WHAT YOU CAN DO TO HELP LOWER PHOSPHORUS LEVELS IN CROOKED 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 Crooked 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.

*****Sweep curbs and gutters to reduce nutrients and other organic material carried in runoff water.

TROPHIC STATE INDEX

BASED ON THE 2010 TSIP CROOKED LAKE RANKED 81ST OUT OF 162 LAKES IN LAKE COUNTY AND WAS CONSIDERED EUTROPHIC

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 lakes 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 2010, Crooked Lake was eutrophic with a TSIp value of 65.41, placing it 81st out of 162 lakes in the county.

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.

NEW PERMIT REQUIREMENTS FOR APPLYING PESTICIDES IN WATERS

FOR FULL DETAILS OF THE RULE SEE:

HTTP://WWW.EPA.STATE.IL.US/WATER/PERMITS/PESTICIDE/INDEX.HTML

Starting this October, new regulations go into 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. However, it is believed that it will be primarily aimed at commercial applicators. 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.

Aquatic Herbicides– Chelate Copper (Cutrine Ultra)

Copper salts are one of the earliest know herbicides for terrestrial and aquatic weed control. Copper sulfate which is used strictly for algae control was first used in 1904. The use of copper sulfate is appealing because it has little or no effect on flowering plants at normal use rates and there are no restrictions on the use of water following a treatment. Rollins Aquatic Solutions treated Crooked Lake once a month from May through August in 2011 with Curtine-Plus a copper chelate. A copper chelate is copper held in an organic molecule so that the formulations prevent copper from precipitating in the water. This is the key difference between chelate copper and copper sulfate both of which are commonly used to treat algae.

Another advantage to copper chelates is that they are slightly less toxic to fish than copper sulfate particularly in alkaline water. The efficiency of copper compounds are greatly affected by the carbonate alkalinity ($CaCO_3$) concentrations in the water. Crooked Lake average alkalinity concentration in 2010 was 162 mg/L. Alkalinity concentrations 50 to 250 mg/L provide effective treatments and protect fish from lethal doses of copper. Copper is a contact herbicide. Therefore, direct exposure of the algae to the compound is required. Applications in Crooked Lake occurred primarily on the south east and northern portion of the lake targeting Nostoc sp. a blue-green algae. Nostoc is a common and widespread genus with more than 200 taxa.

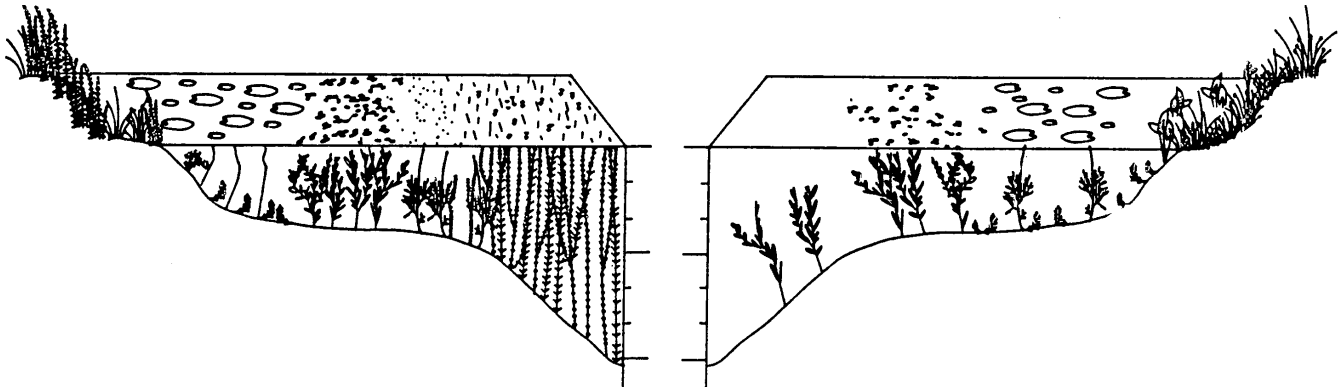
Species of Nostoc are mainly benthic, occurring in unpolluted lakes, ponds and pools, streams and rivers, and soils. Nostoc's physical composition is similar to Anabaena sp. both are made up of spherical colonies with specialized cells that can fix nitrogen (heterocyst) and survive harsh conditions (akinetes). However unlike Anabaena sp. Nostoc is not a taxa known to produce cyanotoxins and the colonies are surrounded by a gelatinous sheath. Herbicide treatments are one the many tools available to lake managers when used alone they provide a quick fix, that does not address the source of the problem, high nutrient levels.

CHEMICAL APPLICATIONS FOR ALGAE IS A **TEMPORARY** SOLUTION THAT OFTEN REQUIRES **MULTIPLE** APPLICATIONS AS THE TREATED ALGAE SINK TO THE BOTTOM TO **DECOMPOSE** (USE OXYGEN) THEY **RELEASE NUTRIENTS** THAT THE SURVIVING ALGAE USES TO **REBOUND.**

Aquatic Herbicides-Endothall (Aquathol K)

Aquathol K™ is a herbicide produced from endothall salts, this potassium salt formulation does not adversely affect fish populations when applied correctly. Aquathol K™ is a contact herbicide that causes localized injury to plant tissue where contact occurs. While this herbicide requires reasonably good distribution to be effective it is also subject to rapid microbial breakdown persisting in the water for about 15 to 16 days. This herbicide is used to reduce the populations of a broad range of aquatic leafy plants. Aquatic Solutions treatments specifically targeted the exotic aquatic plants Eurasian Watermilfoil (2010) and Curlyleaf Pondweed (2010 and 2011). This product should to be applied while the exotics are actively growing and before our native plants emerge. Sago Pondweed and Water Stargrass are plants in Crooked Lake that are also sensitive to Aquathol K™. For a healthy aquatic plant community these populations need to expand, so special care in the timing of the applications should be considered.

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



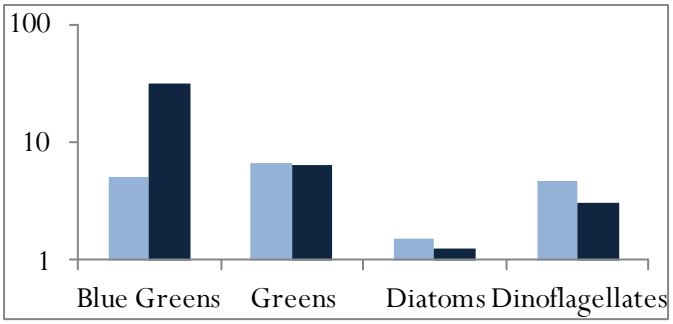
PHYTOPLANKTON

PLANKTON NET

Phytoplankton (algae) are free-floating and microscopic organisms that are distinguished from plants because they lack roots, stems and leaves. There are four distinct groups of phytoplankton found in Lake County lakes: blue-greens, greens, diatoms, and dinoflagellates/chrysophytes. Blue-greens are also known as cyanobacteria because they are the only group of bacteria that obtain their energy from photosynthesis like plants. Some of these species can be toxic. Green algae are the closest ancestors of land plants and are the most common group.

Diatoms are unique because they are encased in a cell wall made of silica that can be very ornate. Dinoflagellates and chrysophytes are almost always flagellated (able to move by flagella, a whip -like tail) and some can both photosynthesize and consume bacteria for food. A pelagic (open water) plankton sample was collected in July. Similar to Hastings Lake there was a notable increase in the *Ceratium* population although the dominant phytoplankton in 2010 was green algae. *Ceratium* are a relatively harmless group of dinoflagelletes that play an important role as both predators and prey in their environment. Blue-green algae populations dramatically decreased in 2010 this was a favorable transition for Crooked Lake as well as Hastings Lake downstream. The total volatile solids concentration (see page ?? for more information) decreased 28% from 2006 (174 mg/L) to 2010 (123 mg/L), indicating a reduction of planktonic algae in Crooked Lake. In 2006 the dominant genus was *Aphanizomenon*, a blue-green algae. In addition to having unique adaptations, *Aphanizomenon* can also produce toxins, these are known collectively as cyanotoxins (see page?? for more information). The July 2010 dominant species of phytoplankton in Crooked Lake was *Microspora* sp. an unbranched, filamentous green algae. The green algae population in 2010 is not as prevailing as the blue-green algae population in 2006, suggesting a more balance in the phytoplankton community.

PHYTOPLANKTON AN D ZOOPLANKTON IN CROOKED LAKE JULY 2010 AND 2006. USING A LOGARITHMIC SCALE



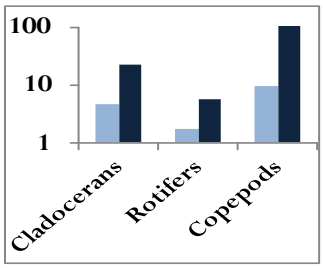
PLANKTON SAMPLE

ZOOPLANKTON

Zooplankton are small animals that occur in the water column and eat other plankton. Zooplankton are a diverse group defined on the basis of their size and function, rather than on their taxonomic affinities. Zooplankton in Crooked Lake was made up of rotifers and two crustacean groups; the cladocerans and the copepods. Rotifers are smaller and most have a crown of cilia (hair-like structure) used for movement and drawing in suspended particles to eat. Crustaceans have jointed appendages and are enclosed in an exoskeleton. Cladocerans, such as the "water flea" Daphnia species, are filter-feeders like rotifers, while the copepod group contains both filter-feeders and raptorial species.

The composition of the zooplankton community in Crooked Lake has changed significantly since 2006. While copepods remained the most abundant type of zooplankton in 2010 the overall quantity has greatly reduced. This could be influenced by the reduction in blue-green algae population as a food source. Copepods are common in a variety of aquatic habitats including lakes and oceans. They play a pivotal role in the aquatic food web as a major source of food for many larger invertebrates and larval fish. The 2010 copepod population was composed primarily of Cyclopoida. Like most copepods this species is small 0.5-2mm with a cylindrical segmented body that tapers at the end. Cylclopoids are distinguished from other copepods by having the antennae shorter than the length of the head.

CYCLOPOIDA IN CROOKED LAKE, JULY 2010



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 62% 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://dnr.wi.gov/lakes/bluegreenalgae/

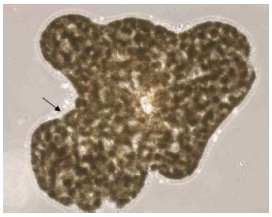
http://www.health.state.ny.us/environmental/water/drinking/bluegreenalgae.pdf

To report a blue-green algae bloom:

Lake County Health Department
Environmental Services
(8470 377-8030

Aphanizomenon

Anabaena *Sp.*



Microcystis *Sp.*

CONDUCTIVITY AND CHLORIDE

DATE	COND	Cl^-
May	0.9490	178
June	0.8990	176
July	0.8410	173
August	0.8593	165
September	0.8730	173

MONTHLY CHLORIDE CONCENTRATIONS (CL-) AND CONDUCTIVIY FOR CROOKED LAKE, 2010.

***2010 Lake County medians**

Conductivity = 0.7800 mS/cm

Chloride = 142mg/L

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.

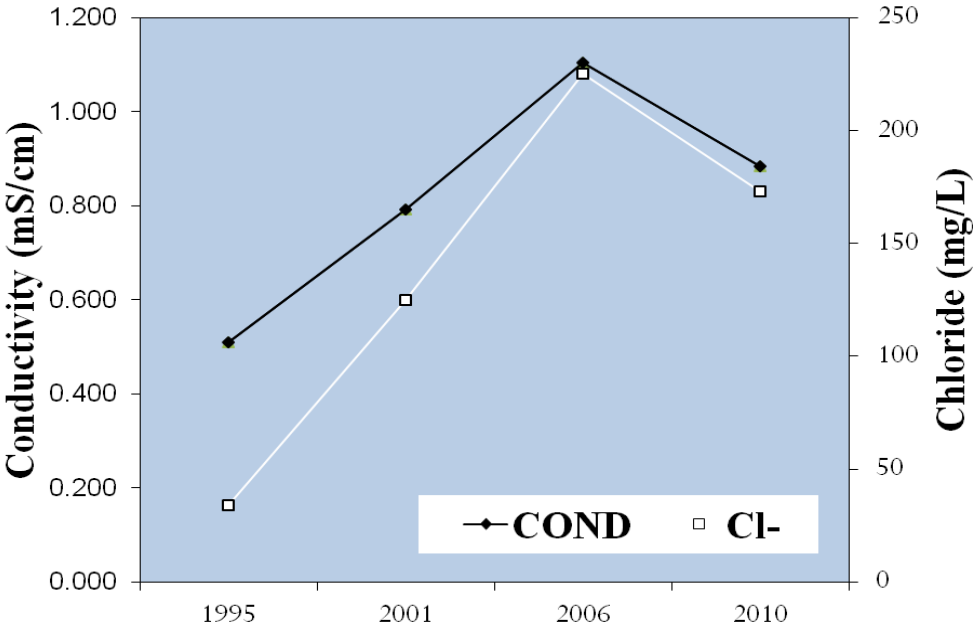
YEAR	COND	Cl^-
1995	0.5095	35*
2001	0.7927	125*
2006	1.1034	225
2010	0.8843	173

CHLORIDE CONCENTRATIONS (CL-) AND CONDUCTIVIY FOR CROOKED LAKE 1995-2010 *CALCULATED VALUES

Conductivity is a measure of a water's ability to conduct electricity , which is a measure of the water's ionic activity and content. The higher the concentration of (dissolved) ions the higher the conductivity.

Conductivity readings, which are influenced by chloride concentrations, have been increasing throughout the past decade in Lake County. Road salts used in winter road maintenance consist of the following ions sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanides which are detected when chlorides are analyzed. The 2010 average conductivity reading for Crooked Lake was 0.8843 mS/cm. This parameter was above the county median of 0.7800 mS/cm and a 20% decrease from 2006 (1.1034 mS/cm). This reduction was influenced by the weather. In 2010 there was significantly more rain events than 2006 causing some of the Cl- ions to be diluted or flushed out of the lake. Chloride concentrations averaged 173 mg/L for the season and were above the county median of 142 mg/L. The United States Environmental Protection Agency has determined that chloride concentrations higher than 230 mg/L can disrupt aquatic systems and prolonged exposure can harm aquatic species. Additionally, shifts in algal populations were associated with chloride concentrations as low as 12 mg/L. To illustrate the critical value concentration 1 teaspoon of table salt added to 5 gallons of water is equivalent to 230 mg/L.

It appears that road salt is compounding in many lakes in the county. Some lakes in the county have seen a doubling of conductivity readings in the past 10-15 years particularly lakes within watersheds that have transportation as a primary land use. Compared to lakes in undeveloped areas, lakes with residential and/or urban land uses in their watershed often have higher conductivity readings and higher Cl^- concentrations because of the use of road salts. Crooked Lake had lower chloride concentrations than Slough Lake (202 mg/L) and slightly higher than Hastings (160 mg/L) both of which are surrounded by the Lake County Forest Preserves. Chloride 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.



Average Conductivity (mS/cm) and Chloride Concentrations in Crooked Lake 1995, 2001, 2006, and 2010.

CHLORIDES: WHAT HAS BEEN DONE TO REDUCE CHLORIDE LEVELS IN LAKE LINDEN

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 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

TIPS

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.

SWIMMING BEACH MONITORING

There are three state licensed swimming beaches on Crooked Lake: Great Outdoor Camp, Oaks Subdivision, and Sedgewood Cove. They were 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, *Salemnella*, *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.

Only one bacteria related swim ban was reported at Sedgewood Cove from 2007 through 2011. Oaks Subdivision had 4 closures in 2010, while Great Outdoor Camp had one.

Left: Kerry McCaughey LCHD Lab staff uses black light technology to report E. coli beach data.

Right: Swim Bans on Crooked Lake from 2007 - 2011.

Year	Great Outdoor Camp	Oaks Subdivision	Sedgewood Cove
2011	NA	0	0
2010	1	4	0
2009	0	NA	0
2008	1	NA	1
2007	2	NA	0

TIPS

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.

AQUATIC PLANT SAMPLING

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.

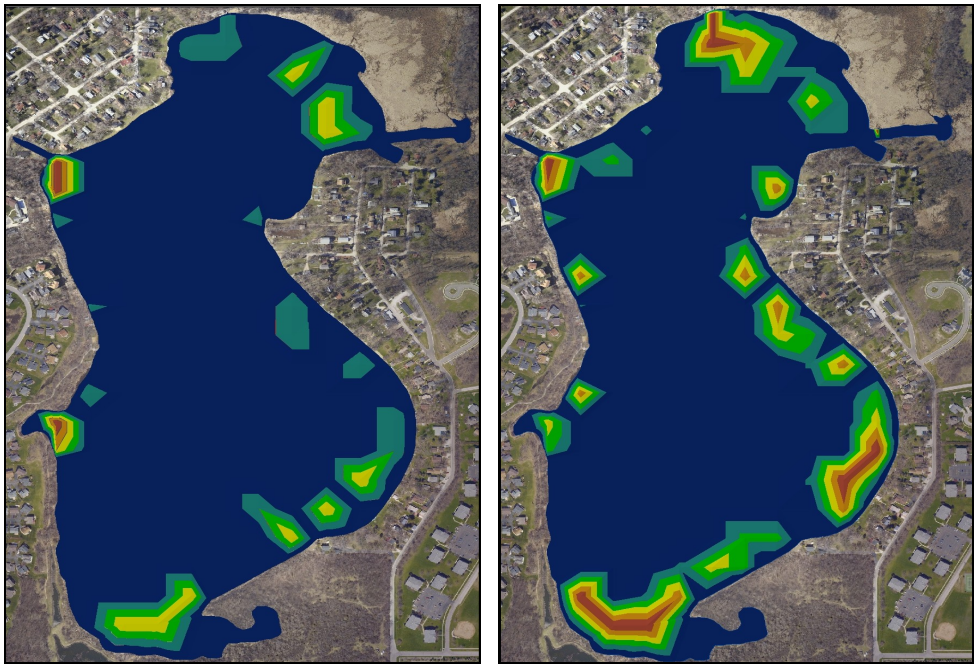
Aquatic plant sampling was conducted on Crooked Lake in July 2010. There were 157 points generated based on a computer grid system with points 60 meters apart. Aquatic plants occurred at 29 of the sites (19 % total lake coverage) that included 9 aquatic plant species, including two exotic invasive species: Curlyleaf Pondweed and Eurasian Watermilfoil. There was an increase in species diversity from 2006 with the addition of Vallisineria, Water Stargrass, and Chara (macro-algae) to the aquatic plant community. In 2010 the most common species was Coontail at 25% of the sampled sites, while Curlyleaf Pondweed (12%) and White Water Lily (10%) were the next most abundant species. Coontail is a submersed aquatic plant with coarse bushy stems and no roots, and can be found from the surface to depths of several meters. In 2010 Coontail was documented in depths ranging from 1.0 to 6.0 feet.

The overall aquatic plant density has changed significantly since 2006. This is mostly contributed to the dramatic reduction in the Eurasian Watermilfoil population. In 2006 Eurasian Watermilfoil was found at 68% of the sites sampled, in 2010 Eurasian Watermilfoil was only documented at 3% of the sampled sites. The 2010 aquatic plant community shifted as Coontail populations almost doubled from 2006 (13%).

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 Crooked Lake ranged from 12 -22ft. during the sampling season. Plants were found at a maximum depth of 6.0 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.

AQUATIC PLANT DENSITY AT 69 SITES ON HASTINGS LAKE IN JULY 2010 , MAXIMUM DEPTH THAT PLANTS WERE FOUND WAS 6.0 FEET.

Rake Density (Coverage)	# of Sites	%
No plants	40	58.0
>0 to 10%	15	21.7
>10 to 40%	11	15.9
>40 to 60%	3	4.3
>60 to 90%	0	0.0
>90%	0	0.0
Total Sites with Plants	29	42.0
Total # of Sites	69	100.0
Total Lake Coverage	157	18.5



DISTRIBUTION OF RAKE DENSITY ACROSS ALL SAMPLES SITES IN 2010 (LEFT) AND 2006 (RIGHT)

91-100% | 61-90% | 41-60% | 11-40% | 1-10% | 0%

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 average FQI for Lake County lakes from 2000-2010 was 14.4. Crooked Lake had an FQI of 14.0 ranking 81st out of 124.

Lake County Average

FQI = 14.4

Aquatic plants: where do they grow?

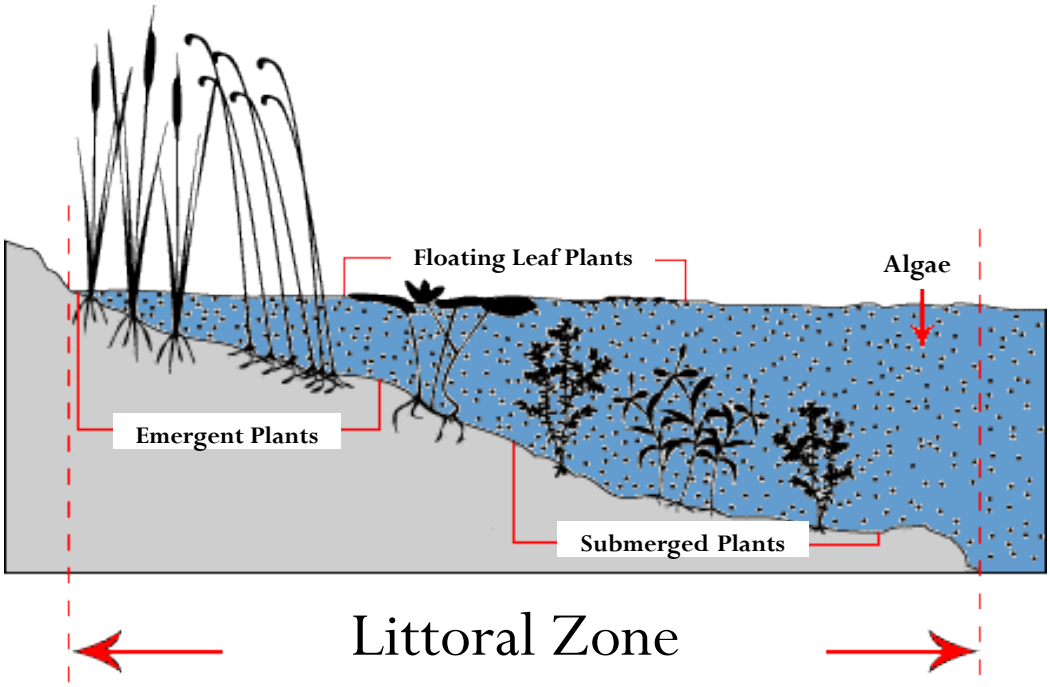
Littoral Zone– the area that aquatic plants grow in a lake.

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

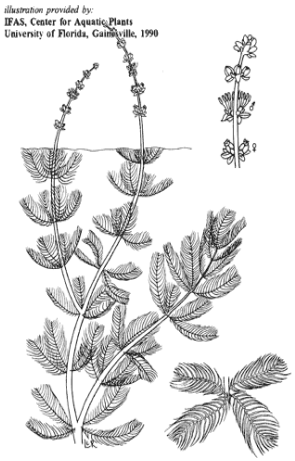
IN MANY LAKES MACROPHYTES CONTRIBUTE TO THE AESTHETICALLY PLEASING APPEARANCE OF THE SETTING AND ARE ENJOYABLE IN THEIR OWN RIGHT. BUT EVEN MORE IMPORTANT, THEY ARE AN ESSENTIAL ELEMENT IN THE LIFE SYSTEMS OF MOST LAKES.

- 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.

Excerpt: Department of Ecology, Washington state

Eurasian Watermilfoil

Illustration of Eurasian Watermilfoil

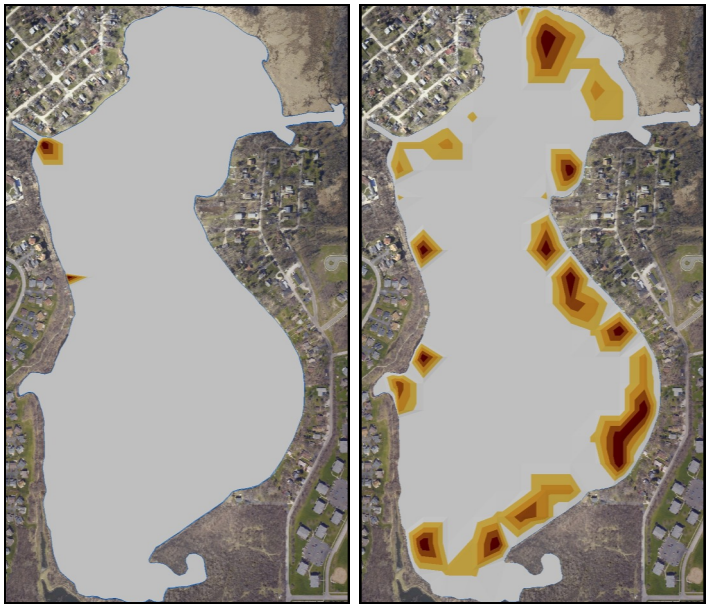


Eurasian Watermilfoil (EWM) is a feathery submerged aquatic plant that can quickly form thick mats in shallow areas of lakes and rivers in North America. These mats can interfere with swimming and entangle propellers, which hinders boating fishing, and waterfowl hunting. Heavy infestations may reduce property values. Matted milfoil can displace native aquatic plants, impacting fish and wildlife.

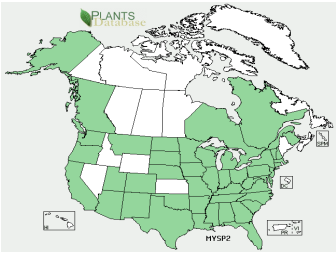
Since it was discovered in North America in the 1940's , EWM has invaded nearly every US state and at least three Canadian Provinces. Milfoil spreads when plant pieces break off and float on water currents. It can cross land to new waters by clinging to sailboats, personal watercraft, powerboats, motors, trailers, and fishing gear.

The abundance of EWM in Crooked Lake has decreased by 96% since 2006. EWM was present at most sample sites with plants. Populations were most dense in the eastern portion of the lake extending from the shoreline into the lake to a depth of 9.9 feet. In 2010 chemical applications greatly reduced the EWM populations; EWM was only documented at two sites on the western side of the lake at 1 and 1.75 feet. 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 removal of exotic aquatic species including 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 69 sites on Crooked lake in July 2010 and 2006, Maximum depth that plants were found was 1.1 and 9.9 feet, respectively.



Distribution of eurasion watermilfoil



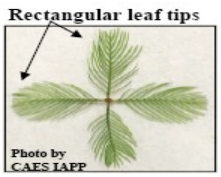
Myriophyllum spicatum Exotic*

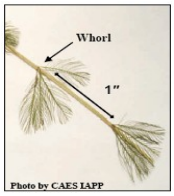
Common Names:
Eurasian watermilfoil

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 2010 in Crooked Lake the CLP population was low, plants being found at 8 sampled sites (12% of lake). This is a decrease of 48% from 2006 when CLP was documented at 23 of the sample sites. At this time the density of CLP is not causing fluctuations in nutrient availability. While populations are low in Crooked Lake action should be taken to eradicate CLP. Crooked Lake aquatic plant management plan should focus on further reduction in CLP populations in an effort to mirror the results in the reduction of EWM and increase the abundance and diversity of native aquatic plants.

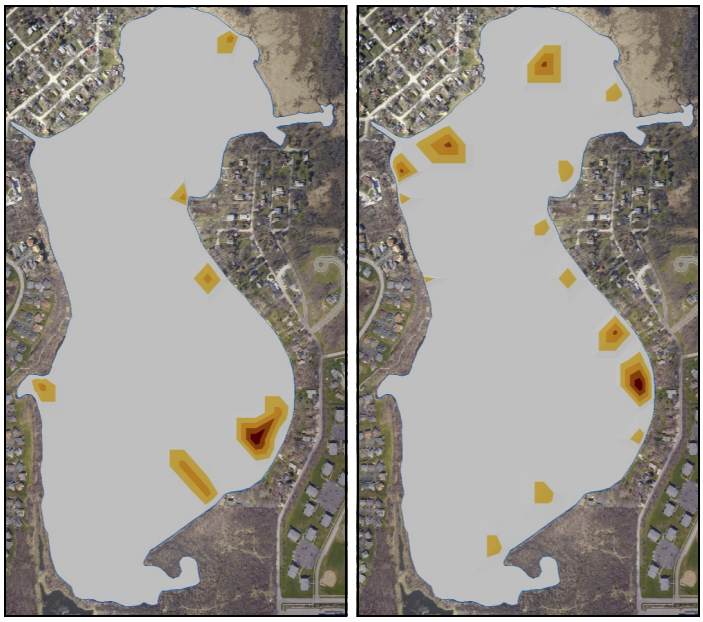
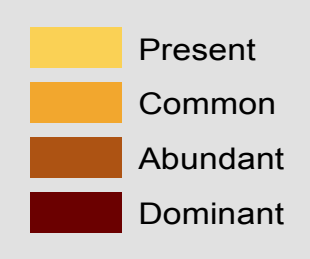


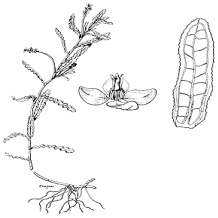
Illustration of Curlyleaf Pondweed

Curlyleaf Pondweed density at 69 sites on Crooked Lake in July 2010 and 2006, Maximum depth that plants were found was 3.5 and 6.7 feet, respectively.



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.

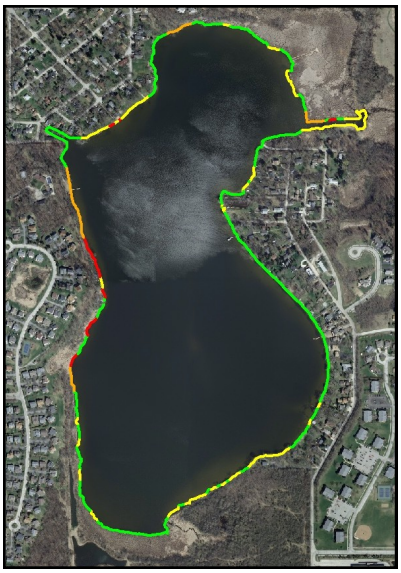
Look alikes:
None

Shoreline erosion

Permanent Staff Gage at Third 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 2010 for significant changes in erosion since 2006. Based on the 2010 assessment, there was a significant increase in shoreline erosion with approximately 43% of the shoreline having some degree of erosion. Overall, 58% of the shoreline had no erosion, 27% had slight erosion, 27% had moderate, and 6% had severe erosion. In the past shoreline erosion on Crooked Lake has been minimal. The 2010 shoreline assessment was influenced by a partial removal of a beaver dam at the northwest outlet. This action lowered the level of the lake to reflect the 1946 lake level. The areas of moderate and severe erosion were mostly located along west side of the lake near Sedgewood Cove Estates. These areas should be addressed soon; it is much easier and less costly to mitigate slightly eroding shorelines than those with more severe erosion. The areas with no erosion were typically vegetated with a variety of habitats including wetland and woodland. The benefits to Crooked Lake from these types of shoreline include a stabilized shoreline, habitat for wildlife, and the filtration of pollutants and nutrients. In 2011 the beaver rebuilt the dam, raising the lake level. Frequent alterations in the lake level is strongly discouraged, increasing/decreasing the lake level can negatively influence a variety of lake parameters including: nutrients, suspended solids, lake volume, and aquatic plants by increasing shoreline erosion.

Shoreline erosion on Crooked Lake, 2010



Monthly Water Levels in Crooked Lake, 2010 and Lake County Stormwater Management Commission Rain guage data from the Lindhurst rain gauge

2010	Level (in)	Rain (in)
May	18.25	
June	20.00	4.12
July	27.00	4.99
August	24.00	5.76
September	32.50	2.42

Lindenhurst Rain gauge

Photo: Lake County Stormwater Management Commission

Lake Water Level

Lakes with stable water levels potentially have less shoreline erosion problems. The lake level in Crooked Lake decreased monthly from May to September totally 14.25 inches. The highest water level occurred in May and the lowest level in September. The most significant decrease in lake level occurred from August to September with a decrease in lake level by 8.5 inches. Crooked Lake does not appear to be greatly influenced by rain events; even though the lake has a relatively large watershed. The wetland complex on the North and South of the lake has the ability to hold and slow storm water so that Crooked is less susceptible to storm water runoff. 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).

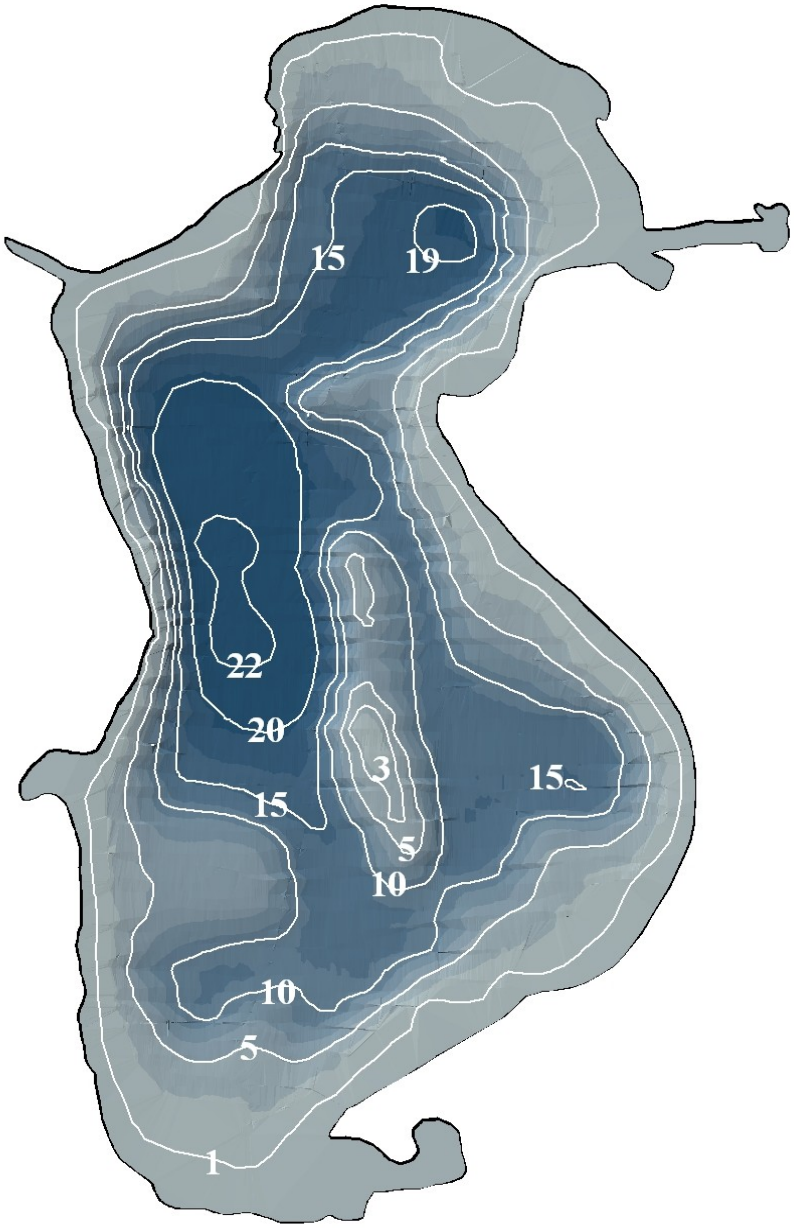
2010 BATHYMETRIC MAP

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 September, 2010 the LCHD-ES collected the field data to replace the bathymetric map created by the LCHD-ES in 1986. 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.

Elevation

- -2.439 - 0
- -4.878 - -2.439
- -7.316 - -4.878
- -9.755 - -7.316
- -12.194 - -9.755
- -14.633 - -12.194
- -17.071 - -14.633
- -19.51 - -17.071
- -21.949 - -19.51



Contour (Feet)	Area Enclosed (Acres)	Percent of total acres
0	147.86	100%
1	120.66	82%
2	106.01	72%
3	97.20	66%
4	90.80	61%
5	85.42	58%
6	79.19	54%
7	73.79	50%
8	69.01	47%
9	64.54	44%
10	60.05	41%
11	55.10	37%
12	48.73	33%
13	41.05	28%
14	35.45	24%
15	29.21	20%
16	25.91	18%
17	22.45	15%
18	18.57	13%
19	14.30	10%
20	11.15	8%
21	7.28	5%

Survey Data Collected September 29, 2011.This map is intended for water quality reference only, not intended for navigational, swimming, or driving purposes.

2010 FISH SURVEY: ILLINOIS DIVISION OF NATURAL RESOURCES

"THE SHEER NUMBER OF CARP SEEN WAS BY FAR MORE THAN OUR DIPPER COULD TRY TO COLLECT OR THE EXTRAPOLATED NUMBER REPRESENTS"

-FRANK JAKUBICEK, IDNR

In September of 2007 the Illinois Department of Natural Resources (IDNR) conducted a 60 minute daytime electrofishing survey of Crooked Lake. The survey was undertaken to assess the abundance and diversity of the fish population. The IDNR collected 217 fish representing nine fish species. Common Carp was the most abundant fish species collected at 33.6% of the catch (73 individuals) ranging in length from 16.8 to 18.9 inches. Common Carp were the only fish species subsampled due to the existing large population. IDNR biologist Frank Jakubicek noted, "Nearly all the way around the lake carp were being stunned by the electrofishing boat and the sheer number of carp seen was by far more than our dipper could try to collect or the extrapolated number represents". IDNR are making an effort to reduce Common Carp populations in Crooked Lake for the past 12 to 15 years. In that time thousands of Common Carp have been removed from the lake. In the spring of 2011 IDNR and some concerned residents removed 361 individuals totally 1171 pounds of biomass.

Yellow perch were also very abundant; their expansion indicates a better balance in the overall fishery as they contribute to the lake as predator and prey. IDNR collected 45 individuals in 2010 this is a 91% increase in the population since the 2002 survey (4 individuals). Largemouth Bass were collected at a rate of 0.45 fish per minute which was below the management goal of 1.0 fish per minute representing 12.4% (27 individuals) of the sample.

The IDNR used an index called the Proportional Stock Density (PSD) to evaluate adult abundance of Largemouth Bass in the sample. The index compares the number of fish longer than 12" (Quality size) to the number of bass longer than 8" (Stock size) and produces a value that can be used to compare samples from different years or different lakes. The PSD value basically produces a number that represents the percent of sexually mature fish in the sample to fish that survived their first winter (roughly 8" long) and are likely to survive to maturity. A balanced population has a PSD value between 40 and 60. The Crooked Lake sample had a PSD of 83, this indicates sporadic reproduction. Only two fish between 8 and 12 inches were collected indicating poor reproduction 2-3 years prior while eleven yearlings were collected indicating a successful spawn in 2009.

Following the 2010 IDNR fish survey fisheries biologist, Frank Jakubicek, concluded that overall the future fish community in Crooked Lake appears to be good. The 2010 fish population report can be viewed in its entirety in the appendix of this report. The IDNR had the following recommendations for Crooked Lake in 2010 (Page 19).

ILLINOIS DIVISION OF NATURAL RESOURCES 2010 CATCH SUMMARY FOR CROOKED LAKE

			LENGTH (In)		
SPECIES	NUMBER	PERCENT	MINIMUM	AVERAGE	MAXIMUM
LARGEMOUTH BASS	27	12.4	5.4	11.4	19
BLUEGILL	38	17.5	2.3	5.9	7.7
PUMKINSEED SUNFISH	12	5.5	4.2	4.7	5.2
GREEN SUNFISH	1	0.5	5.4	5.4	5.4
BLACK CRAPPIE	13	6	7	8.5	8.9
YELLOW BASS	7	3.2	3.9	4.8	7.2
YELLOW PERCH	45	20.7	4.4	6.7	7.7
YELLOW BULLHEAD	1	0.5	9.1	9.1	9.1
COMMON CARP	73	33.6	16.8	17.9	18.9
TOTAL=	**217**	**100**			

Crooked Lake Fishing

Crooked Lake is located within the village limits of Lindenhurst and unincorporated Lake County, with eight private access points. The lake is used for gas motor boating and fishing and managed by the Crooked Lake Improvement Committee (CLIC).

The Crooked Lake Improvement Committee is comprised of concerned Crooked Lake residents from all sides of the Lake. CLIC was started in 1996 in an effort to improve the quality of Crooked Lake through the combined efforts and resources of the various lake residents and homeowners associations.

The CLIC supplements the fish populations in Crooked Lake based on IDNR and CLIC recommendations to maintain a balanced fish community.

NO CARP!

Common Carp spawn in late May or early June, this is the best time to document their presence in a lake. Keep an eye on the northern and southern portions of the lake near the inlet and outlet of the Crooked Lake as they will splash around in the shallows.

2010 IDNR Recommendations

Recommendations:

1. Remove carp via fishing events and other creative methods.
2. Stock northern pike fingerlings (10 to 12 inch) at a rate of 3 to 5 per acre to increase their abundance quickly.
3. Stock walleye fingerlings (4 to 6 inch) at a rate of 25 to 35 per acre.
4. Manage vegetation to increase plant diversity and provide recreational access to deep water.
5. Harvest as many yellow bass (stripers) as possible.

FISHING LOGS

You can track/ detect changes in the fishery by recording catches and observations in fishing logs!

Fish Stocking in Crooked Lake 2007-2011

Year	Walleye	Yellow Perch	Largemouth Bass	Northern Pike	Channel Catfish	Black Crappie	Bluegill	Muskie
2007	600			600	500	300		
Size	7-9”			12-18”	8-11”	5-7”		
2008	700		500				1000	
Size	7-9”		5-8”				5-8”	
2009	1500/200			200				
Size	5-9”/10-12”			12-18”				
2010	500		500	200		400	400	10
Size	No information available							
2011	500		500	200		280	285	10
Size	No information available							

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

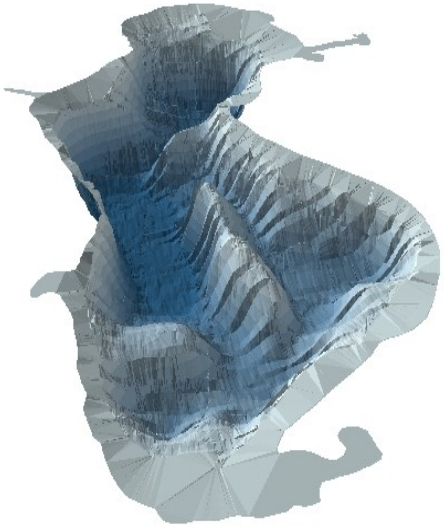
Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

LAKE RECOMMENDATIONS

Crooked Lake's water quality has improved dramatically improved over the last 15 years, total phosphorus, and total suspended solids concentrations have decreased and water clarity increased. Chlorides have steadily increased, proper application procedures and alternative methods for ice removal can be used to keep these concentrations under control. Crooked Lake aquatic plant density has significantly decreased, this is primarily contributed to the 68% reduction in Eurasian Watermilfoil.

Crooked Lake, lake's management is administered by Crooked Lake Improvement Committee. To improve the overall quality of Crooked Lake, the ES (Environmental Services) has the following recommendations:

- **Increase aquatic plant diversity, and decrease the Curlyleaf Pondweed population**
- **Participate Volunteer Lake Monitoring Program**
- **Mitigate shoreline exhibiting erosion**
- **Encourage homeowners to incorporate native plants in their landscaping through rain gardens or shoreline filter strips**
- **Install a staff gauge to monitor lake level fluctuations**
- **Use salt alternatives and proper application procedures.**
- **Reduce Common Carp populations**



A BATHYMETRIC MAP WAS CREATED FOR WATERFORD LAKE IN 2010, FOR A COPY VISIT:

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

Water quality data for Crooked Lake, 2000, 2006, and 2010

2010	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
12-May	3	185	1.17	0.186	<0.05	0.080	0.019	525	178	5.1	545	115	7.25	0.9490	8.39	8.96
9-Jun	3	167	1.03	<0.1	<0.05	0.048	<0.005	500	176	4.5	533	122	4.89	0.8990	8.54	7.25
14-Jul	3	159	0.94	<0.1	0.67	0.049	<0.005	470	173	4.9	521	123	5.75	0.8410	8.59	9.32
11-Aug	3	149	1.40	<0.1	<0.05	0.063	<0.005	479	165	8.1	510	120	2.17	0.8593	9.02	11.93
15-Sep	3	149	1.78	<0.1	<0.05	0.108	<0.005	486	173	14.0	522	137	1.36	0.8730	8.89	13.72
	Average	162	1.26	<0.117[k]	0.174[k]	0.070	<0.008[k]	492	173	7.3	526	123	4.28	0.8843	8.69	10.24

2006	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
17-May	3	183	1.81	<0.1	<0.05	0.072	<0.005	600	220	5.0	639	153	5.41	1.0980	8.33	9.90
21-Jun	3	175	1.50	<0.1	<0.05	0.062	<0.005	597	217	8.4	650	149	4.26	1.0920	8.46	11.03
19-Jul	3	172	1.55	<0.1	<0.05	0.048	<0.005	590	221	8.2	668	174	4.10	1.0780	8.59	8.19
16-Aug	3	161	1.41	<0.1	<0.05	0.041	<0.005	623	231	6.1	657	168	5.41	1.1440	8.48	7.14
20-Sep	3	155	1.83	<0.1	<0.05	0.081	<0.005	603	237	11.0	647	169	2.78	1.1050	8.30	6.10
	Average	169	1.62	<0.1	<0.05	0.061	<0.005	603	225	7.7	652	163	4.39	1.1034	8.43	8.47

2001	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
16-May	3	163	1.94	<0.1	<0.05	0.145	0.006	488	NA	17.0	536	162	2.10	0.7986	8.55	9.54
20-Jun	3	145	1.18	<0.1	<0.05	0.117	0.015	492	NA	16.0	524	169	2.69	0.7678	8.87	9.94
25-Jul	3	134	1.26	<0.1	<0.05	0.062	< 0.005	494	NA	9.4	520	154	2.66	0.7889	8.44	6.63
22-Aug	3	151	1.41	<0.1	<0.05	0.068	< 0.005	514	NA	11.0	521	168	2.98	0.7872	8.08	7.35
19-Sep	3	160	1.57	<0.1	<0.05	0.115	0.006	496	NA	15.0	540	182	2.10	0.8210	7.94	6.95
	Average	151	1.47	<0.1	<0.05	0.101	0.009[K]	497	NA	13.7	528	167	2.51	0.7927	8.38	8.08

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

Water Quality Summary Continued

2010	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
12-May	22	185	1.24	0.186	0.0	0.077	0.021	526	181	6.4	564	133	NA	0.9510	8.42	8.89
9-Jun	22	196	2.30	1.39	0.0	0.289	0.212	529	172	6.8	564	135	NA	0.9580	7.53	0.32
14-Jul	22	199	2.99	1.91	0.0	0.371	0.287	532	171	9.4	557	117	NA	0.9630	7.01	0.40
11-Aug	21	167	2.31	1.17	0.0	0.24	0.153	535	170	7.8	534	132	NA	0.9708	7.095	1.90
15-Sep	20	150	1.93	0.389	0.0	0.149	0.01	495	172	18.0	507	119	NA	0.8900	8.33	3.36
	Average	169	1.62	<0.117[k]	<0.05[k]	0.061	<0.008[k]	603	225	7.7	652	163	NA	1.1034	8.43	2.97

2006	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
17-May	19	184	1.98	0.199	<0.05	0.077	0.006	602	218	8.2	637	148	NA	1.1020	8.17	6.39
21-Jun	20	192	2.56	1.070	<0.05	0.136	0.051	616	215	7.9	681	177	NA	1.1300	7.85	0.50
19-Jul	19	184	2.23	0.750	<0.05	0.070	0.017	599	221	5.5	657	160	NA	1.0960	8.21	0.38
16-Aug	20	185	2.71	1.410	<0.05	0.145	0.061	646	229	5.2	649	151	NA	1.1900	7.14	0.09
20-Sep	18	155	1.86	0.000	<0.05	0.076	< 0.005	603	236	10.0	630	150	NA	1.1050	8.23	4.78
	Average	189	2.64	1.240	<0.05	0.141	0.056[k]	631	222	6.6	665	164	NA	0.6447	8.51	2.43

2001	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
16-May	20	168	1.49	0.164	<0.05	0.120	0.025	486	NA	12.0	534	156	NA	0.8139	7.94	4.70
20-Jun	21	172	1.20	<0.1	<0.05	0.253	0.109	526	NA	28.0	550	186	NA	0.8188	6.99	0.05
25-Jul	20	242	2.44	0.861	<0.05	0.479	0.352	558	NA	12.0	584	141	NA	0.9255	6.65	0.01
22-Aug	19	161	1.67	0.398	<0.05	0.173	0.040	506	NA	9.6	524	173	NA	0.8908	6.68	0.03
19-Sep	19	164	1.64	0.160	<0.05	0.134	0.009	498	NA	20.0	531	177	NA	0.8209	7.88	6.45
	Average	181	1.69	0.396[k]	<0.05	0.232	0.107	515	NA	16.3	545	167	NA	0.8540	7.23	2.25

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

2000 to 2010 Comparisons for epilimnetic averages for Secchi disk transparency, total suspended solids, total phosphorus, and conductivity readings in the Hastings Lake watershed (Slough Lake, Crooked Lake, and Hastings Lake).

Lake	Slough Lake	Slough Lake	Slough Lake	Crooked Lake	Crooked Lake	Crooked Lake	Hastings Lake	Hastings Lake	Hastings Lake
Year	**2000**	**2006**	**2010**	**2001**	**2006**	**2010**	**2001**	**2006**	**2010**
Secchi (feet)	1.53	2.00	1.63	2.51	4.39	4.28	3.29	4.85	3.52
TSS (mg/L)	33.8	18.8	19.4	13.7	7.7	7.3	7.6	6.2	5.2
TP (mg/L)	0.263	0.413	0.386	0.101	0.061	0.07	0.066	0.068	0.052
Conductivity (milliSiemens/cm)	0.8659	1.5228	1.1306	0.7927	1.1034	0.8843	0.7863	1.0886	0.8491

Direction of watershed: Slough Lake flows into Crooked Lake which enters Hasting Lake from the northwest outlet. Hastings Lake drains north into North Mill Creek and eventually the Des Plaines River, Illinois River, Mississippi River and finally the Gulf of Mexico.

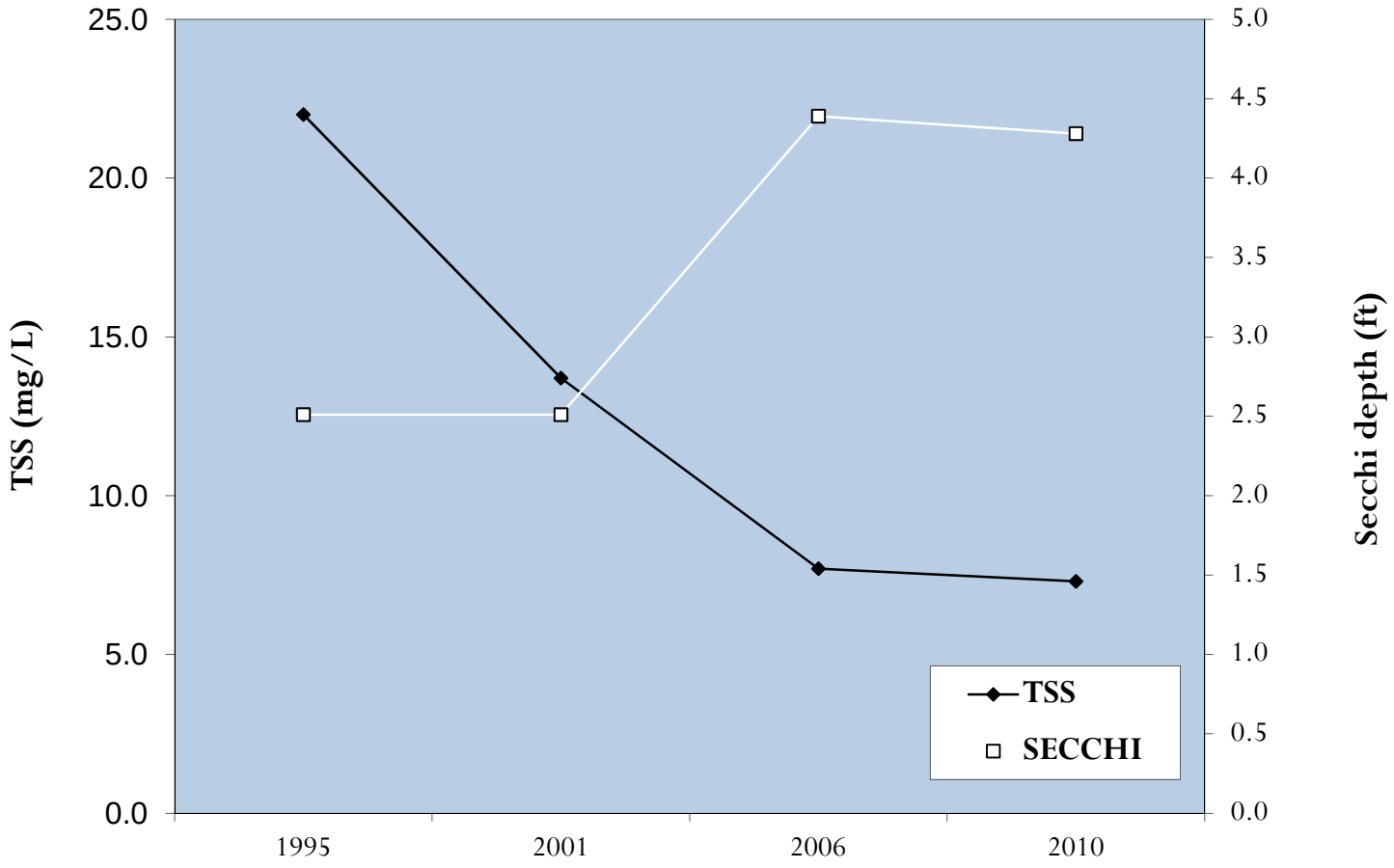
Approximate Land Use Within the Crooked Lake Watershed, 2010.

Land Use	Acreage	% of Total
Agricultural	31.62	2.5%
Disturbed Land	43.49	3.5%
Forest and Grassland	116.50	9.3%
Government and Institutional	113.52	9.1%
Multi Family	0.47	0.0%
Public and Private Open Space	338.51	27.0%
Retail/Commercial	3.95	0.3%
Single Family	243.04	19.4%
Transportation	91.69	7.3%
Utility and Waste Facilities	0.46	0.0%
Water	211.76	16.9%
Wetlands	58.92	4.7%
Total Acres	**1253.94**	**100.0%**

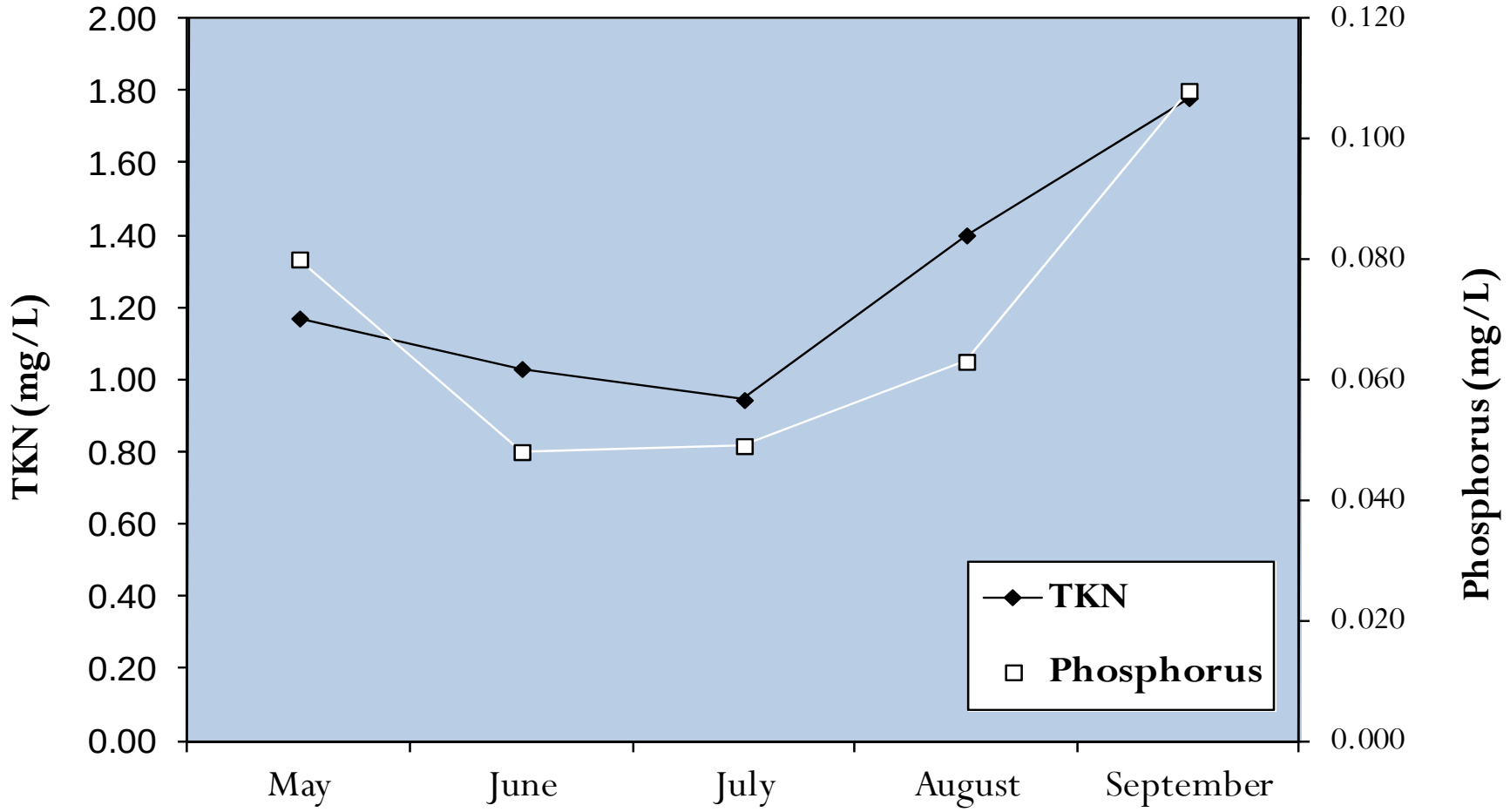
Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% Total of Estimated Runoff
Agricultural	31.62	0.05	4.3	0.6%
Disturbed Land	43.49	0.05	6.0	0.8%
Forest and Grassland	116.50	0.05	16.0	2.1%
Government and Institutional	113.52	0.50	156.1	20.7%
Multi Family	0.47	0.30	0.4	0.1%
Public and Private Open Space	338.51	0.15	139.6	18.5%
Retail/Commercial	3.95	0.85	9.2	1.2%
Single Family	243.04	0.30	200.5	26.6%
Transportation	91.69	0.85	214.3	28.4%
Utility and Waste Facilities	0.46	0.30	0.4	0.1%
Water	211.76	0.00	0.0	0.0%
Wetlands	58.92	0.05	8.1	1.1%
TOTAL	**1253.94**		**755.0**	**100.0%**

Lake volume	**1253.94**	**acre-feet**
Retention Time (years)= lake volume/runoff	**1.66**	**years**
	606.20	**days**

Secchi Depth vs. Total Suspended Solid (TSS) Concentrations in Crooked Lake, 1995, 2001, 2006, and 2010.



Total Kjeldahl Nitrogen (TKN) Vs. Phosphorus in Crooked Lake, 2010.



Lake County average TSI phosphorus (TSIp) ranking 2000-2010.

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	West Loon Lake	0.0140	42.21
6	Cedar Lake	0.0150	43.20
7	Windward Lake	0.0160	44.13
8	Sand Pond (IDNR)	0.0165	44.57
9	Fourth Lake	0.0180	45.83
10	Pulaski Pond	0.0180	45.83
11	Banana Pond	0.0200	47.35
12	Lake Kathryn	0.0200	47.35
13	Lake Minear	0.0200	47.35
14	Highland Lake	0.0202	47.49
15	Timber Lake (North)	0.0210	48.05
16	Cross Lake	0.0220	48.72
17	Dog Training Pond	0.0220	48.72
18	Sun Lake	0.0220	48.72
19	Deep Lake	0.0230	49.36
20	Lake of the Hollow	0.0230	49.36
21	Round Lake	0.0230	49.36
22	Stone Quarry Lake	0.0230	49.36
23	Druce Lake	0.0240	49.98
24	Bangs Lake	0.0250	50.57
25	Little Silver Lake	0.0250	50.57
26	Lake Leo	0.0260	51.13
27	Dugdale Lake	0.0270	51.68
28	Peterson Pond	0.0270	51.68
29	Lake Miltmore	0.0280	52.20
30	Gray's Lake	0.0300	53.20
31	Lake Fairfield	0.0300	53.20
32	Lake Catherine	0.0310	53.67
33	Lambs Farm Lake	0.0310	53.67
34	Old School Lake	0.0310	53.67
35	Sand Lake	0.0320	54.13
36	Third Lake	0.0320	54.13
37	Gages Lake	0.0340	55.00
38	Hendrick Lake	0.0340	55.00
39	Honey Lake	0.0340	55.00
40	Cranberry Lake	0.0360	55.82
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	Schreiber Lake	0.0400	57.34
46	Waterford Lake	0.0400	57.34

Lake County average TSI phosphorus (TSIp) ranking 2000-2010.

RANK	LAKE NAME	TP AVE	TSIp
47	Hook Lake	0.0410	57.70
48	Duck Lake	0.0430	58.39
49	Nielsen Pond	0.0450	59.04
50	Seven Acre Lake	0.0460	59.36
51	Turner Lake	0.0460	59.36
52	Willow Lake	0.0460	59.36
53	East Meadow Lake	0.0480	59.97
54	Lucky Lake	0.0480	59.97
55	Old Oak Lake	0.0490	60.27
56	College Trail Lake	0.0500	60.56
57	East Loon Lake	0.0520	61.13
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	Lake Naomi	0.0620	63.66
70	Lake Tranquility (S1)	0.0620	63.66
71	Liberty Lake	0.0630	63.89
72	Werhane Lake	0.0630	63.89
73	Countryside Glen Lake	0.0640	64.12
74	Davis Lake	0.0650	64.34
75	Lake Fairview	0.0650	64.34
76	Leisure Lake	0.0650	64.34
77	Wooster 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	Crooked Lake	0.0700	65.41
82	Lake Helen	0.0720	65.82
83	ADID 203	0.0730	66.02
84	Bluff Lake	0.0730	66.02
85	Spring Lake	0.0730	66.02
86	Harvey Lake	0.0770	66.79
87	Broberg Marsh	0.0780	66.97
88	Sylvan Lake	0.0790	67.16
89	Big Bear Lake	0.0810	67.52
90	Redwing Slough	0.0822	67.73
91	Petite Lake	0.0830	67.87
92	Lake Marie	0.0850	68.21

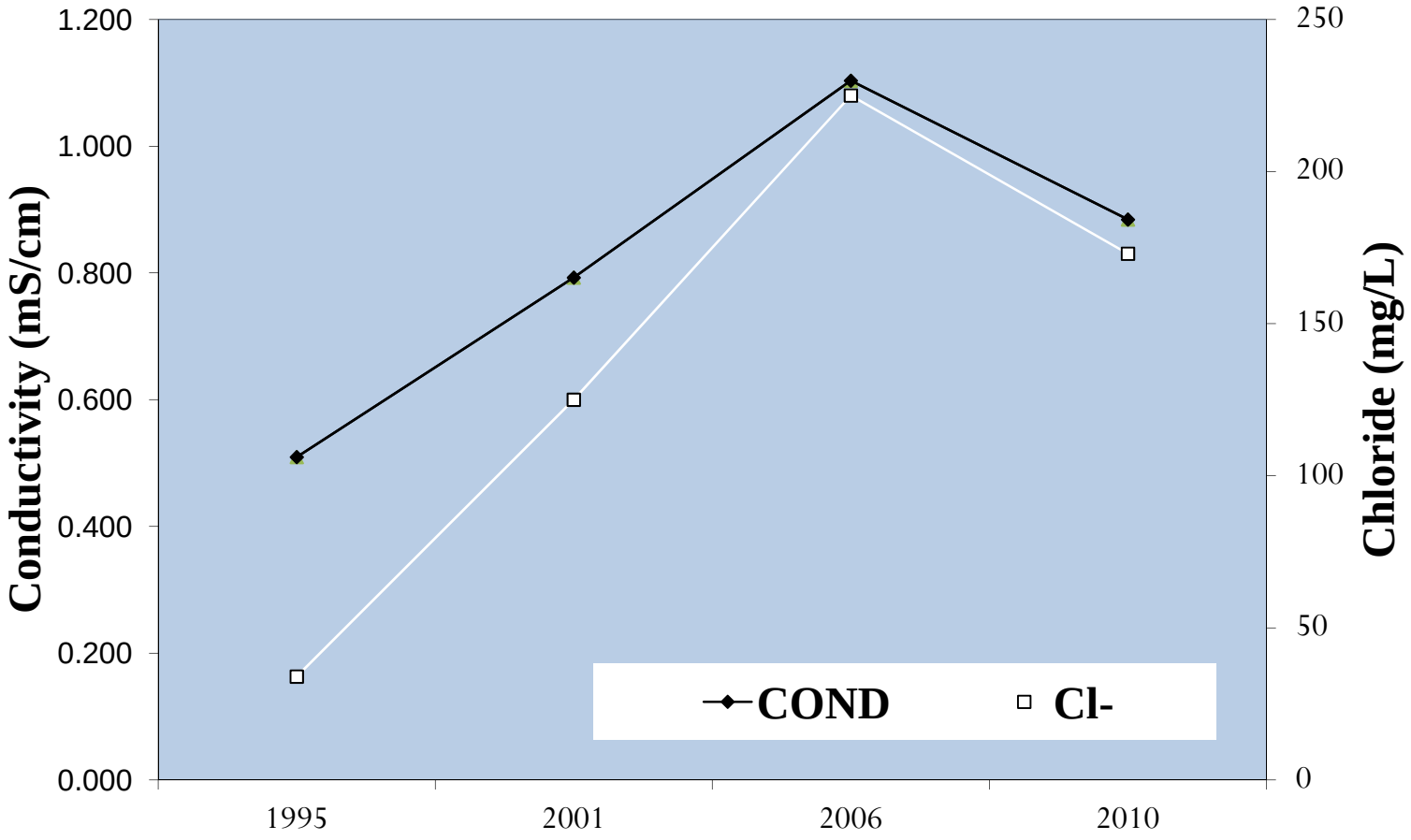
Lake County average TSI phosphorus (TSIp) ranking 2000-2010.

RANK	LAKE NAME	TP AVE	TSIp
93	Potomac Lake	0.0850	68.21
94	Timber Lake (South)	0.0850	68.21
95	White Lake	0.0862	68.42
96	Grand Ave Marsh	0.0870	68.55
97	North Churchill Lake	0.0870	68.55
98	Grandwood Park Lake	0.0880	68.71
99	McDonald Lake 1	0.0880	68.71
100	North Tower Lake	0.0880	68.71
101	Rivershire Pond 2	0.0900	69.04
102	South Churchill Lake	0.0900	69.04
103	McGreal Lake	0.0910	69.20
104	Deer Lake	0.0940	69.66
105	Dunn's Lake	0.0950	69.82
106	Eagle Lake (S1)	0.0950	69.82
107	International Mine and Chemical Lake	0.0950	69.82
108	Valley Lake	0.0950	69.82
109	Countryside Lake	0.0960	69.97
110	Fish Lake	0.0960	69.97
111	Lochanora Lake	0.0960	69.97
112	Long Lake	0.0970	70.12
113	Island Lake	0.0990	70.41
114	Woodland Lake	0.0990	70.41
115	Nippersink Lake	0.1000	70.56
116	Forest Lake	0.1020	70.84
117	Longview Meadow Lake	0.1020	70.84
118	Lake Barrington	0.1050	71.26
119	Lake Forest Pond	0.1070	71.53
120	Bittersweet Golf Course #13	0.1100	71.93
121	Fox Lake	0.1100	71.93
122	Osprey Lake	0.1110	72.06
123	Bresen Lake	0.1130	72.32
124	Round Lake Marsh North	0.1130	72.32
125	Deer Lake Meadow Lake	0.1160	72.70
126	Taylor Lake	0.1180	72.94
127	Columbus Park Lake	0.1230	73.54
128	Lake Nipperink	0.1240	73.66
129	Echo Lake	0.1250	73.77
130	Grass Lake	0.1290	74.23
131	Lake Holloway	0.1320	74.56
132	Redhead Lake	0.1410	75.51
133	Antioch Lake	0.1450	75.91
134	Slocum Lake	0.1500	76.40
135	Lakewood Marsh	0.1510	76.50
136	Pond-A-Rudy	0.1510	76.50
137	Lake Matthews	0.1520	76.59
138	Buffalo Creek Reservoir	0.1550	76.88

Lake County average TSI phosphorus (TSIp) ranking 2000-2010.

RANK	LAKE NAME	TP AVE	TSIp
139	Pistakee Lake	0.1590	77.24
140	Grassy Lake	0.1610	77.42
141	Salem Lake	0.1650	77.78
142	Half Day Pit	0.1690	78.12
143	Lake Eleanor	0.1810	79.11
144	Lake Farmington	0.1850	79.43
145	Lake Louise	0.1850	79.43
146	ADID 127	0.1890	79.74
147	Patski Pond	0.1970	80.33
148	Dog Bone Lake	0.1990	80.48
149	Summerhill Estates Lake	0.1990	80.48
150	Redwing Marsh	0.2070	81.05
151	Stockholm Lake	0.2082	81.13
152	Bishop Lake	0.2160	81.66
153	Ozaukee Lake	0.2200	81.93
154	Hidden Lake	0.2240	82.19
155	McDonald Lake 2	0.2250	82.25
156	Fischer Lake	0.2280	82.44
157	Oak Hills Lake	0.2790	85.35
158	Loch Lomond	0.2950	86.16
159	Heron Pond	0.2990	86.35
160	Fairfield Marsh	0.3260	87.60
161	ADID 182	0.3280	87.69
162	Slough Lake	0.3860	90.03
163	Flint Lake Outlet	0.5000	93.76
164	Rasmussen Lake	0.5030	93.85
165	Albert Lake, Site II, outflow	1.1894	106.26

Chloride (Cl^-) vs. Conductivity Concentrations for Crooked Lake, 1995, 2001, 2006, and 2010.



Aquatic vegetation species found at the 69 sampling sites on Crooked Lake, July 2010.
Maximum depth that plants were found was 6.0 feet.

Plant Density	Chara	Coontail	Curlyleaf Pondweed	Eurasian Watermilfoil	Sago Pondweed	Spatterdock	Valisneria	Water Stargrass	White Water Lily
Absent	67	52	61	67	63	68	68	63	62
Present	1	9	7	2	3	0	1	5	6
Common	1	6	1	0	3	1	0	1	1
Abundant	0	2	0	0	0	0	0	0	0
Dominant	0	0	0	0	0	0	0	0	0
% Plant Occurrence	2.9%	24.6%	11.6%	2.9%	8.7%	1.4%	1.4%	8.7%	10.1%

Distribution of rake density across all sampling sites

Rake Density (Coverage)	# of Sites	%
No plants	40	58.0
>0 to 10%	15	21.7
>10 to 40%	11	15.9
>40 to 60%	3	4.3
>60 to 90%	0	0.0
>90%	0	0.0
Total Sites with Plants	29	42.0
Total # of Sites	69	100.0
Total Lake Coverage	157	18.5

Lake County average Floristic Quality Index (FQI) ranking 2000-2010.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.0	40.0
2	Cranberry Lake	34.4	34.4
3	West Loon Lake	34.3	35.7
4	East Loon Lake	33.6	35.0
5	Little Silver	31.6	29.6
6	Deep Lake	31.2	29.7
7	Round Lake Marsh North	29.9	29.1
8	Bangs Lake	29.8	32.0
9	Sullivan Lake	28.5	26.9
10	Independence Grove	27.5	24.6
11	Lake Zurich	27.1	24.3
12	Sterling Lake	26.9	24.5
13	Sun Lake	26.1	24.3
14	Round Lake	25.9	23.5
15	Druce Lake	25.2	22.8
16	Honey Lake	25.1	23.3
17	Schreiber Lake	24.8	23.9
18	Fourth Lake	24.8	23.0
19	Lake of the Hollow	24.8	23.0
20	Lakewood Marsh	24.7	23.8
21	Redwing Slough	24.0	25.8
22	Deer Lake	23.5	24.4
23	Butler Lake	23.1	21.4
24	Third Lake	23	24.7
25	Duck Lake	22.9	21.1
26	Countryside Glen Lake	22.8	21.9
27	Cross Lake	22.4	24.2
28	McGreal Lake	22.1	20.2
29	Wooster Lake	21.9	23.6
30	Davis Lake	21.4	21.4
31	Broberg Marsh	21.4	20.5
32	Fish Lake	21.2	19.3
33	Redhead Lake	21.2	19.3
34	Turner Lake	21.2	18.6
35	Timber Lake (North)	20.9	23.4
36	Lake Kathryn	20.7	19.6
37	ADID 203	20.5	20.5
38	Lake Miltmore	20.3	18.4
39	Salem Lake	20.2	18.5
40	Gray's Lake	19.8	16.9
41	Old Oak Lake	19.1	18.0
42	Highland Lake	18.9	16.7
43	Forest Lake	18.0	19.0
44	Lake Helen	18.0	18.0
45	Potomac Lake	17.8	17.8
46	Bresen Lake	17.8	16.6
47	Hendrick Lake	17.7	17.7
48	Lake Barrington	17.7	16.7
49	Windward Lake	17.6	16.3
50	Diamond Lake	17.4	16.3
51	Owens Lake	17.3	16.3
52	Osprey Lake	17.3	15.5
53	Long Lake	17.2	19.0
54	Lake Tranquility (S1)	17.0	15.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2010.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
55	McDonald Lake 1	16.7	17.7
56	Island Lake	16.6	14.7
57	Lake Fairview	16.3	15.2
58	Grand Avenue Marsh	16.3	14.3
59	Lake Nippersink	16.3	14.3
60	Taylor Lake	16.3	14.3
61	White Lake	16.0	17.0
62	Dog Training Pond	15.9	14.7
63	Dog Bone Lake	15.7	15.7
64	Seven Acre Lake	15.5	17.0
65	Ames Pit	15.5	13.4
66	Heron Pond	15.1	15.1
67	Dugdale Lake	15.1	14.0
68	Eagle Lake (S1)	15.1	14.0
69	Mary Lee Lake	15.1	13.1
70	Old School Lake	15.1	13.1
71	Hastings Lake	15.0	17.0
72	North Churchill Lake	15.0	15.0
73	Bishop Lake	15.0	13.4
74	Sand Lake	14.8	12.5
75	Countryside Lake	14.7	14.7
76	Timber Lake (South)	14.7	12.7
77	Buffalo Creek Reservoir	14.3	13.1
78	Lake Carina	14.3	12.1
79	Lake Leo	14.3	12.1
80	Lambs Farm Lake	14.3	12.1
81	Crooked Lake	14.0	16.0
82	Longview Meadow Lake	13.9	13.9
83	Dunn's Lake	13.9	12.7
84	Summerhill Estates Lake	13.9	12.7
85	Lake Napa Suwe	13.9	11.7
86	Lake Minear	13.9	11.0
87	Stockholm Lake	13.5	12.1
88	Antioch Lake	13.4	11.3
89	Hook Lake	13.4	11.3
90	Lake Charles	13.4	11.3
91	Rivershire Pond 2	13.3	11.5
92	Flint Lake	13.0	11.8
93	Harvey Lake	13.0	11.8
94	McDonald Lake 2	12.5	12.5
95	Stone Quarry Lake	12.5	12.5
96	Lake Naomi	12.5	11.2
97	Pulaski Pond	12.5	11.2
98	Pond-A-Rudy	12.1	12.1
99	Loch Lomond	12.1	9.4
100	Grassy Lake	12.0	12.0
101	Lake Matthews	12.0	12.0
102	Nielsen Pond	12.0	10.7
103	Werhane Lake	12.0	9.8
104	Lake Lakeland Estates	11.5	10.0
105	Redwing Marsh	11.0	11.0
106	Tower Lake	11.0	11.0
107	West Meadow Lake	11.0	11.0
108	Big Bear Lake	11.0	9.5
109	Little Bear Lake	11.0	9.5
110	Fischer Lake	11.0	9.0
111	Grandwood Park Lake	11.0	9.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2010.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
112	Lake Holloway	10.6	10.6
113	Lake Fairfield	10.4	9.0
114	Lake Louise	10.4	9.0
115	College Trail Lake	10.0	10.0
116	Gages Lake	10.0	5.8
117	Valley Lake	9.9	9.9
118	Woodland Lake	9.9	8.1
119	Lake Christa	9.8	8.5
120	Lake Farmington	9.8	8.5
121	Lucy Lake	9.8	8.5
122	Columbus Park Lake	9.2	9.2
123	Sylvan Lake	9.2	9.2
124	Waterford Lake	9.2	9.2
125	Banana Pond	9.2	7.5
126	Leisure Lake	9.0	6.4
127	Albert Lake	8.7	7.5
128	Fairfield Marsh	8.7	7.5
129	Lake Eleanor	8.7	7.5
130	Ozaukee Lake	8.7	6.7
131	East Meadow Lake	8.5	8.5
132	South Churchill Lake	8.5	8.5
133	Lake Forest Pond	8.5	6.9
134	Peterson Pond	8.5	6.0
135	Bittersweet Golf Course #13	8.1	8.1
136	Lake Linden	8.0	8.0
137	Patski Pond	7.1	7.1
138	Rasmussen Lake	7.1	7.1
139	Slocum Lake	7.1	5.8
140	IMC Lake	7.1	5.0
141	Lucky Lake	7.0	7.0
142	Deer Lake Meadow Lake	6.4	5.2
143	ADID 127	5.0	5.0
144	Liberty Lake	5.0	5.0
145	Oak Hills Lake	5.0	5.0
146	Slough Lake	5.0	5.0
147	Sand Pond (IDNR)	5.0	3.5
148	Half Day Pit	5.0	2.9
149	Lochanora Lake	5.0	2.5
150	Echo Lake	0.0	0.0
151	Hidden Lake	0.0	0.0
152	North Tower Lake	0.0	0.0
153	St. Mary's Lake	0.0	0.0
154	Willow Lake	0.0	0.0
	Mean	**15.3**	**14.4**
	Median	**14.3**	**12.9**

Morphometric Features of Crooked Lake ~
Data From the Septemenber 29, 2010 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	147.86	100%	134.03	0 - 1	27.20	18.4%	10.9%
1	120.66	82%	113.26	1 - 2	14.65	9.9%	9.2%
2	106.01	72%	101.57	2 - 3	8.81	6.0%	8.3%
3	97.20	66%	93.98	3 - 4	6.40	4.3%	7.6%
4	90.80	61%	88.10	4 - 5	5.39	3.6%	7.2%
5	85.42	58%	82.28	5 - 6	6.22	4.2%	6.7%
6	79.19	54%	76.48	6 - 7	5.40	3.7%	6.2%
7	73.79	50%	71.39	7 - 8	4.79	3.2%	5.8%
8	69.01	47%	66.76	8 - 9	4.46	3.0%	5.4%
9	64.54	44%	62.28	9 - 10	4.50	3.0%	5.1%
10	60.05	41%	57.56	10 - 11	4.95	3.3%	4.7%
11	55.10	37%	51.88	11 - 12	6.37	4.3%	4.2%
12	48.73	33%	44.83	12 - 13	7.69	5.2%	3.6%
13	41.05	28%	38.21	13 - 14	5.60	3.8%	3.1%
14	35.45	24%	32.28	14 - 15	6.24	4.2%	2.6%
15	29.21	20%	27.54	15 - 16	3.30	2.2%	2.2%
16	25.91	18%	24.16	16 - 17	3.46	2.3%	2.0%
17	22.45	15%	20.48	17 - 18	3.88	2.6%	1.7%
18	18.57	13%	16.39	18 - 19	4.27	2.9%	1.3%
19	14.30	10%	12.69	19 - 20	3.15	2.1%	1.0%
20	11.15	8%	9.15	20 - 21	3.87	2.6%	0.7%
21	7.28	5%	3.33	21+	7.28	4.9%	0.3%
			1228.63		147.86	100%	100%

Maximum Depth of Lake: 21.95 feet
Average Depth of Lake: 8.31. feet
Volume of Lake: 1228.63 acre-feet

Area of Lake: 147.86 acres
Shoreline Length: 2.96 miles
Water elevation at 767.75 feet above mean sea level

LakeCounty
Health Department and
Community Health Center

2000 - 2010 Water Quality Parameters, Statistics Summary

	ALKoxic <=3ft00-2010	
Average	**165**	
Median	**160**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**812**	

	ALKanoxic 2000-2010	
Average	**201**	
Median	**192**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**52**	
n =	**249**	

	Condoxic <=3ft00-2010	
Average	**0.8629**	
Median	**0.7800**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5215**	
n =	**812**	

	Condanoxic 2000-2010	
Average	**1.0125**	
Median	**0.8678**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.7821**	
n =	**248**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2010	
Average	**0.489**	
Median	**0.160**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.054**	
n =	**812**	

*ND = Many lakes had non-detects (74.5%)
Only compare lakes with detectable concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2010	
Average	**2.132**	
Median	**1.360**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.345**	
n =	**249**	

*ND = 20.1% Non-detects from 32 different lakes

	pHoxic <=3ft00-2010	
Average	**8.37**	
Median	**8.36**	
Minimum	**7.07**	**Bittersweet #13**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**810**	

	pHanoxic 2000-2010	
Average	**7.33**	
Median	**7.30**	
Minimum	**6.24**	**Banana Pond**
Maximum	**9.16**	**White Lake**
STD	**0.43**	
n =	**248**	

	All Secchi 2000-2010	
Average	**4.33**	
Median	**2.95**	
Minimum	**0.25**	**McDonald Lake 2/Ozaukee Lake**
Maximum	**23.50**	**West Loon Lake**
STD	**3.66**	
n =	**758**	

LakeCounty
Health Department and
Community Health Center

2000 - 2010 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2010	
Average	**1.399**	
Median	**1.180**	
Minimum	**<0.1**	***ND**
Maximum	**10.300**	**Fairfield Marsh**
STD	**0.819**	
n =	**812**	

*ND = 3.8% Non-detects from 15 different lakes

	TKNanoxic 2000-2010	
Average	**2.866**	
Median	**2.130**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.302**	
n =	**249**	

*ND = 3.2% Non-detects from 4 different lakes

	TPoxic <=3ft00-2010	
Average	**0.099**	
Median	**0.065**	
Minimum	**<0.01**	***ND**
Maximum	**3.880**	**Albert Lake**
STD	**0.169**	
n =	**812**	

*ND = 2.2% Non-detects from 7 different lakes

	TPanoxic 2000-2010	
Average	**0.305**	
Median	**0.174**	
Minimum	**0.012**	**Independence Grove**
Maximum	**3.800**	**Taylor Lake**
STD	**0.394**	
n =	**249**	

	TSSall <=3ft00-2010	
Average	**15.6**	
Median	**8.1**	
Minimum	**<0.1**	***ND**
Maximum	**165.0**	**Fairfield Marsh**
STD	**20.8**	
n =	**812**	

*ND = 1.7% Non-detects from 10 different lakes

	TVSoxic <=3ft00-2010	
Average	**127.6**	
Median	**123.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**298.0**	**Fairfield Marsh**
STD	**39.7**	
n =	**767**	

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	**111**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**324**	
n =	**162**	

	CLoxic <=3ft00-2010	
Average	**181**	
Median	**142**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**220**	
n =	**552**	

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 2000-2010 (n=1357).

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

LCHD Environmental Services ~ 01/20/2011

LakeCounty
Health Department and
Community Health Center

Crooked Lake 2010 IEPA Ranking

TROPHIC STATUS		
Carlson's TSIp	65.3	Eutrophic

IMPAIRMENT ASSESSMENTS	
Total Phosphorus	Yes
Total Nitrogen	None
pH	Yes
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	65.3	50		
Macrophyte Impairment	Minimal	0		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**50**	0	**Full**
RECREATION USE IMPAIRMENT INDEX				
Mean Trophic State Index	65.3	65.3		
Macrophyte Impairment	Moderate	10		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**75.3**	1	**Partial**
Overall Use Index			**0.50**	**Partial**

Crooked Lake 2010 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
											0.220
51210	0.25	0.25	13.41	8.97	86.2	0.9510	8.30	373	Surface		
51210	1	1	13.54	9.39	89.7	0.9480	8.37	371	Surface	100%	
51210	2	2	13.55	9.00	86.7	0.9490	8.38	176	0.33	47%	2.26
51210	3	3	13.55	8.96	86.3	0.9490	8.39	120	1.33	32%	0.29
51210	4	4	13.55	8.92	86.0	0.9490	8.39	85	2.33	23%	0.15
51210	6	6	13.55	8.90	85.7	0.9490	8.40	52	4.33	14%	0.11
51210	8	8	13.51	8.91	85.1	0.9510	8.41	24	6.33	6%	0.12
51210	10	10	13.42	8.95	86.0	0.9520	8.41	30	8.33	8%	-0.03
51210	12	12	13.53	8.90	85.7	0.9510	8.42	19	10.33	5%	0.04
51210	14	14	13.53	8.90	85.7	0.9500	8.42	15	12.33	4%	0.02
51210	16	16	13.54	8.90	85.7	0.9500	8.42	11	14.33	3%	0.02
51210	18	18	13.54	8.89	85.6	0.9510	8.42	7	16.33	2%	0.03
51210	20	20	13.54	8.89	85.6	0.9510	8.42	6	18.33	1.5%	0.01
51210	22	22	13.54	8.89	85.6	0.9510	8.42	4	20.33	1.1%	0.01
51210	24	24	13.53	8.89	85.5	0.9510	8.41	3	22.33	0.8%	0.01
51210	26	26	13.53	5.13	45.2	0.9510	8.38	2	24.33	0.6%	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
											0.275
60910	0.25	0.25	21.26	7.45	84.2	0.912	8.45	2996.0	Surface		
60910	1	1	21.25	7.40	83.6	0.912	8.47	2929.2	Surface	100%	
60910	2	2	21.23	7.33	82.8	0.912	8.51	1165.4	0.33	40%	2.79
60910	3	3	21.22	7.25	81.9	0.899	8.54	682.2	1.33	23%	0.40
60910	4	4	21.19	7.19	81.2	0.911	8.56	503.4	2.33	17%	0.13
60910	6	6	21.15	7.13	80.4	0.911	8.58	272.3	4.33	9%	0.14
60910	8	8	21.11	7.07	79.7	0.900	8.59	274.9	6.33	9%	0.00
60910	10	10	21.00	6.81	76.6	0.901	8.58	187.3	8.33	6%	0.05
60910	12	12	19.85	3.86	42.4	0.928	8.25	57.5	10.33	2%	0.11
60910	14	14	18.87	2.33	25.2	0.934	8.06	32.5	12.33	1%	0.05

60910	16	16	17.64	1.03	10.8	0.941	7.88	18.8	14.33	1%	0.04
60910	18	18	16.32	0.53	5.5	0.947	7.74	9.8	16.33	0%	0.04
60910	20	20	15.02	0.38	3.8	0.952	7.64	5.8	18.33	0%	0.03
60910	22	22	14.26	0.32	3.2	0.958	7.53	3.1	20.33	0%	0.03
60910	24	24	13.87	0.30	2.9	0.972	7.41	2.3	22.33	0%	0.01
60910	26	26	13.68	0.28	2.7	0.986	7.28	1.4	24.33	0%	0.02

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
											0.293
71410	0.25	0.25	27.71	9.82	125.0	0.840	8.42	3174.5	Surface		
71410	1	1	27.71	9.50	121.0	0.841	8.53	3287.0	Surface	100%	
71410	2	2	27.71	9.43	120.1	0.841	8.56	1177.3	0.33	36%	3.11
71410	3	3	27.70	9.32	118.7	0.841	8.59	756.9	1.33	23%	0.33
71410	4	4	27.70	9.26	118.0	0.841	8.62	593.4	2.33	18%	0.10
71410	6	6	27.69	9.22	117.4	0.841	8.63	316.3	4.33	10%	0.15
71410	8	8	27.65	9.21	117.2	0.840	8.65	175.5	6.33	5%	0.09
71410	10	10	27.52	9.26	117.6	0.840	8.65	162.9	8.33	5%	0.01
71410	12	12	27.27	4.84	61.1	0.844	8.54	129.8	10.33	4%	0.02
71410	14	14	26.92	2.48	31.2	0.847	8.39	95.3	12.33	3%	0.03
71410	16	16	26.26	0.71	8.8	0.851	8.20	58.3	14.33	2%	0.03
71410	18	18	25.65	0.62	7.6	0.854	8.07	39.4	16.33	1.2%	0.02
71410	20	20	24.55	0.59	7.1	0.861	7.91	23.8	18.33	0.7%	0.03
71410	22	22	16.89	0.40	4.1	0.963	7.01	1.6	20.33	0.05%	0.13
71410	24	24	16.76	0.38	3.9	0.968	6.98	1.3	22.33	0.04%	0.01
71410	26	26	16.48	0.32	3.3	0.981	6.88	0.6	24.33	0.02%	0.03

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
											0.268
81110	0.25	0.35	28.41	12.4	165	0.858	9.08	771	Surface		
81110	1	0.97	28.42	12.3	164	0.858	9.08	425	Surface	100%	
81110	2	2.04	28.41	12.3	164	0.8584	9.07	279	0.37	66%	1.14
81110	3	3.02	28.29	11.9	159	0.8593	9.02	68	1.35	16%	1.05
81110	4	4.02	27.71	10.1	133	0.8621	8.86	42	2.35	10%	0.21

81110	6	6	27.41	8.65	113	0.8645	8.73	18	4.33	4%	0.20
81110	8	8.11	26.6	4.8	61.8	0.8698	8.35	6	6.44	1.4%	0.17
81110	10	10.03	26.37	3.52	45.1	0.8717	8.2	2	8.36	0.5%	0.13
81110	12	12.02	26.15	1.95	24.9	0.8745	8.01	1	10.35	0.2%	0.07
81110	14	14.02	26.12	1.21	15.5	0.8747	7.93	1	12.35	0.2%	0.00
81110	16	16.04	25.88	0.37	4.7	0.8794	7.78	1	14.37	0.2%	0.00
81110	18	18.09	25.4	0.18	2.2	0.8897	7.62	1	16.42	0.2%	0.00
81110	20	20.03	24.46	0.16	2	0.9126	7.34	1	18.36	0.2%	0.00
81110	22	22.1	21.34	0.16	1.8	1.029	6.85	0	20.43		
81110	24	23.46	19.8	0.18	2	1.116	6.73	0	21.79		

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 0.331
91510	0.25	0.25	20.98	13.8	155	0.875	8.82	2705.7	Surface		
91510	1	1	21.02	13.7	155	0.874	8.84	2392.4	Surface	100%	
91510	2	2	21.05	13.7	154	0.873	8.87	954	0.33	40%	2.79
91510	3	3	21.06	13.7	155	0.873	8.89	348.3	1.33	15%	0.76
91510	4	4	21.08	13.8	155	0.873	8.91	269.4	2.33	11%	0.11
91510	6	6	21.06	13.8	155	0.873	8.91	155.1	4.33	6%	0.13
91510	8	8	20.99	12.4	140	0.875	8.89	68.8	6.33	3%	0.13
91510	10	10	20.85	11	123	0.873	8.85	37.6	8.33	2%	0.07
91510	12	12	20.61	8.75	97.7	0.877	8.78	19.8	10.33	1%	0.06
91510	14	14	20.34	6.46	71.7	0.882	8.63	7.6	12.33	0%	0.08
91510	16	16	20.21	5.21	57.7	0.887	8.49	3.5	14.33	0%	0.05
91510	18	18	20.14	4.15	45.8	0.888	8.4	2	16.33	0%	0.03
91510	20	20	20.09	3.36	37.1	0.89	8.33	1.3	18.33	0%	0.02
91510	22	22	20.03	2.71	29.9	0.891	8.24	0.7	20.33	0%	0.03
91510	24	24	19.93	0.83	9.1	0.927	8.01	0.3	22.33	0%	0.04