LAKE COUNTY, ILLINOIS

2010 HASTINGS LAKE REPORT

PREPARED BY THE

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Hastings Lake March 2007

Picture provided by: Lake County Forest Preserves

Hastings Lake is a glacial lake located in unincorporated Lake County within Lake Villa Township. The lake has a surface area of 74.06 acres and a maximum depth of 25.7 feet based on the 2008 morphometric survey. The Lake County Forest Preserve District owns the lake bottom and manages the lake for recreation and restoration. The 268 acre preserve features open fields, dense woodlands and wetlands. Visitors can utilize the lake and preserve for aesthetics, trails, and shoreline fishing. Future public access improvements and amenities include potential recreational opportunities focused around the lake, and restoration efforts for the site's wetlands and woodlands.

Hastings 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 have high quality aquatic resources based on water quality and hydrology values.

Hastings Lake receives water from its approximate 1791 acre watershed and drains into North Mill Creek which enters Rasmussen Lake. The primary land use within the

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SPECIAL POINTS OF INTEREST:

- *Impaired for Phosphorus*
- *Exotic Plants*
- *Lake County Forest Preserve Land Acquisition and Conceptual Master Plan*
- *Applications of Environmentally Friendly Salt Alternatives*

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LakeCounty
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HASTINGS LAKE SUMMARY (CONTINUED FROM PAGE 1)

Lake Facts:

Major Watershed: Des Plaines River

Sub-Watershed: North Mill Creek

Location: T46N, R10E, Section 35

Surface Area: 75.0 acres

Shoreline Length: 1.5 miles

Maximum Depth: 25.7 feet

Average Depth: 9.5 feet

Lake Volume: 709.3 acre-feet

Watershed Area: 2129 acres

Lake Type: Glacial

Management Entity: Lake County Forest Preserve

Current Uses: hiking, fishing, and aesthetics

Historical Uses: YMCA Camp

Hastings Lake watershed was single family housing and public and private open space.

Many water quality parameters have improved since the LCHD 2006 lake study. Total phosphorus in Hastings Lake in 2010 averaged 0.052 mg/L which is a 31% decrease from the 2006 concentration of 0.068 mg/L and only slightly above the Illinois Environmental Protection Agency impairment rate of 0.050 mg/L. Nitrogen is the other nutrient critical for algal growth. The average Total Kjeldahl nitrogen concentration for Hastings Lake was 1.18 mg/L, which was equal to the 2010 county median of 1.18 mg/L and lower than the 2006 concentration by 51% (1.78 mg/L). A total nitrogen to total phosphorus (TN:TP) ratio of 23:1 indicates phosphorus was limiting. Also using phosphorus as an indicator, the trophic state index (TSIp) ranked Hastings Lake as eutrophic with a TSIp value of 58.5.

The 2010 average total suspended solids (TSS) concentration for Hastings Lake was 5.2 mg/L, which was less than the county median (8.1 mg/L) and down from the 2006 average of 6.2 mg/L. Water clarity was measured by Secchi depth, with the lowest reading in September (2.46 feet) corresponding to the high TSS concentration (5.7 mg/L). The average Secchi depth for the season was 3.52 feet, which was slightly higher than the county median (2.95 feet).

Conductivity concentrations, are correlated with chloride concentrations, the average conductivity reading for Hastings Lake in 2010 was 0.8491 mS/cm, which was above the county median (0.7910 mS/cm). This was a 28% decrease from the 2006 average (1.0886 mg/L). The chloride concentration in Hastings Lake in 2010 was 160 mg/L which is above the county median of 142 mg/L.

Aquatic plant sampling was conducted on Hastings Lake in July. Nine species of plants were present covering 89% of all sites sampled. Similar to 2006 Eurasian Watermilfoil and Coontail were the two dominant species with plants present at 84.8% and 41.3% of sites, respectively. Curlyleaf Pondweed was also found in the lake. Eurasian Watermilfoil and Curlyleaf Pondweed are invasive, exotic species that tend to crowd out native species.

HASTINGS LAKE 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. Hastings Lake is in the North Mill Creek watershed and receives water from Slough Lake and Crooked Lake from the west inlet and Lake Linden which drains into Hastings Lake from the south inlet. The 2129 acre watershed carries storm water and pollutants into Hastings Lake. The external sources affecting Hastings Lake were from the following land uses: single family homes (28%)and public and private open space (18%). 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 Hastings Lake were single family homes (31%) and transportation (29%). The lake is surrounded by wetland, forest, and grassland which help to absorb runoff and nutrients before it enters the lake.

The size of the watershed feeding the lake relative to the lakes size is also an important factor in determining the amount of pollutants in the lake. The retention time, the amount of time it takes for water entering a lake to flow out of it again was calculated to be approximately 166 days.

Typically water quality declines as pollutants accumulate from the top to the bottom of the watershed. However the water quality actually improves as it travels downstream to Hastings Lake. Slough Lake at the top of the watershed historically had a duck farm contributing to the poor water quality in the lake. Water leaving Slough Lake travels through a wetland which may filter some of the pollutants. It then enters Crooked Lake which has a good aquatic plant abundance which also acts as a filter. In addition a large wetland complex borders Hastings Lake which acts as a buffer against upstream impacts.

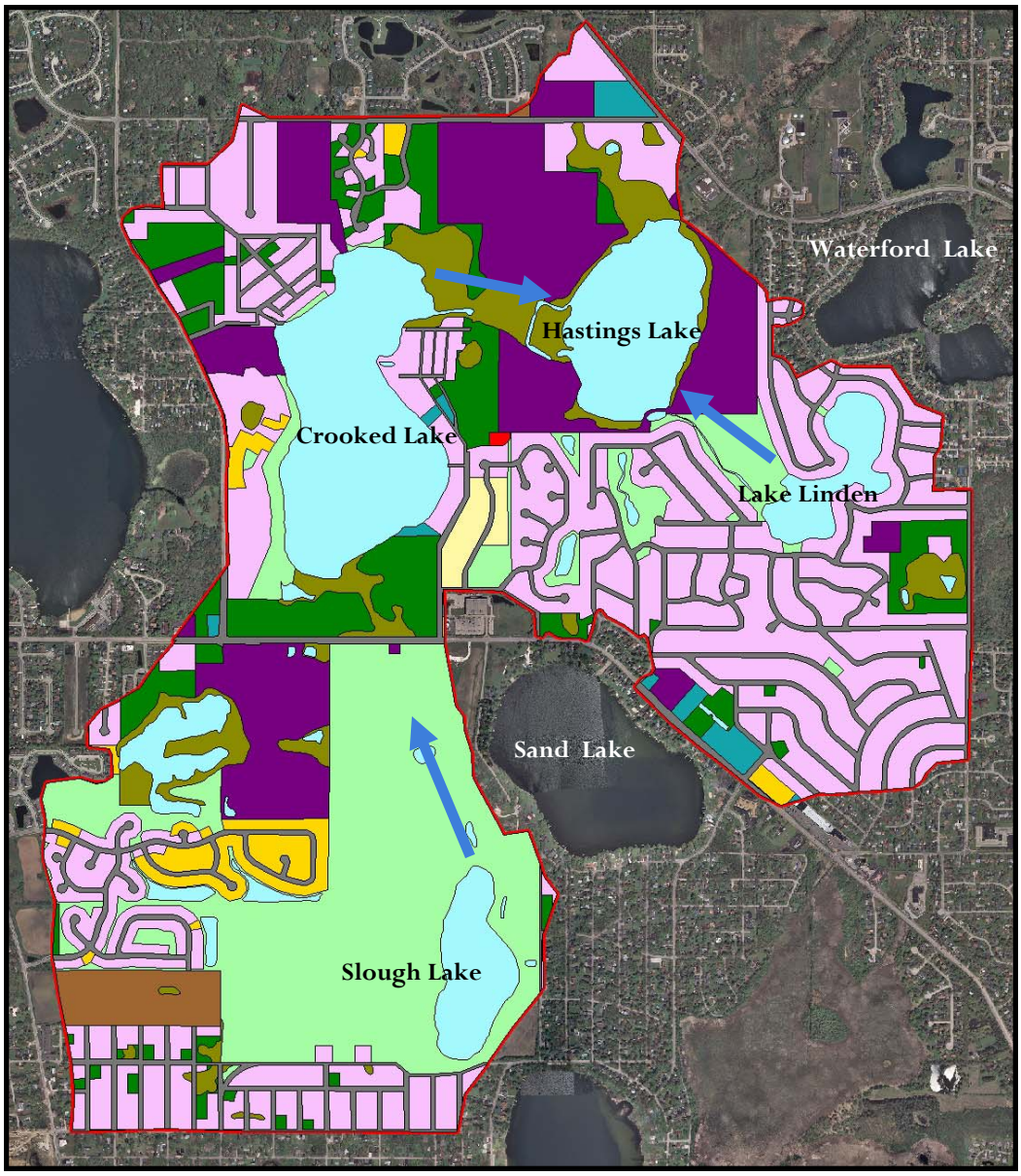
Hastings Lake Watershed

- 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

2010 Land use in the Hastings Lake watershed

Direction of watershed:

Slough Lake flows into Crooked Lake which enters Hasting Lake from the west and Lake Linden enters Hastings from the south inlet. Hastings Lake drains north into North Mill Creek and eventually enters Rasmussen Lake.



Lake	Slough Lake	Slough Lake	Slough Lake	Crooked Lake	Crooked Lake	Crooked Lake	Lake Linden	Lake Linden	Lake Linden	Hastings Lake	Hastings Lake	Hastings Lake
Year	**2000**	**2006**	**2010**	**2001**	**2006**	**2010**	**2002**	**2006**	**2010**	**2001**	**2006**	**2010**
Secchi (feet)	1.53	2.00	1.63	2.51	4.39	4.28	5.87	6.54	4.6	3.29	4.85	3.52
TSS (mg/L)	33.8	18.8	19.4	13.7	7.7	7.3	2.3	2.9	4.2	7.6	6.2	5.2
TP (mg/L)	0.263	0.413	0.386	0.101	0.061	0.070	0.042	0.033	0.057	0.066	0.068	0.052
Conductivity (milliSiemens/cm)	0.8659	1.5228	1.1306	0.7927	1.1034	0.8843	0.9772	1.2028	0.7294	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, Lake Linden, 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.

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

The 2010 average water clarity in Hastings Lake was 3.52 feet; this was a 21% reduction in the lake's transparency since 2006 and is above the county median of 2.95 feet.

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.

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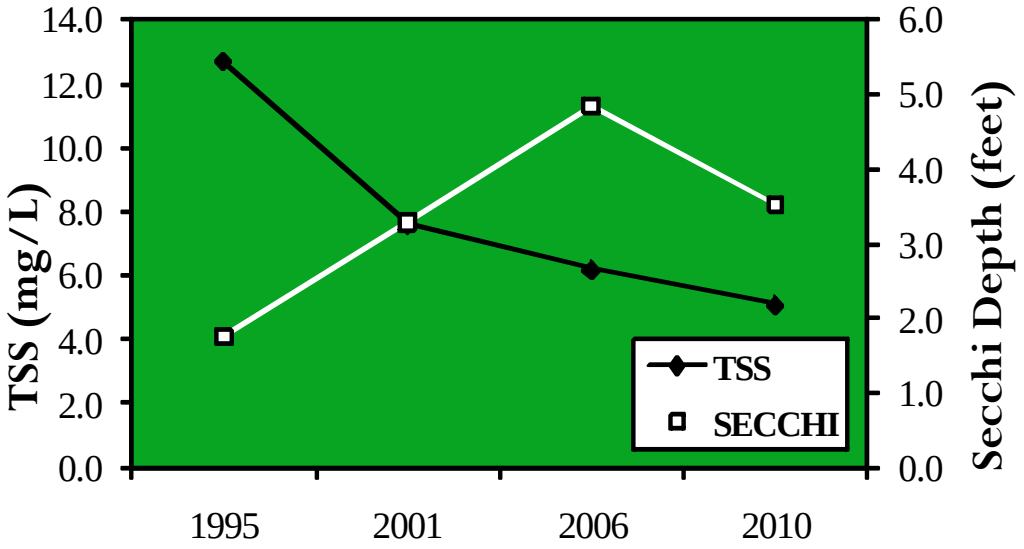
TOTAL SUSPENDED SOLIDS

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 5.2 mg/L which was below the county median of 8.1 mg/L . Since 2006 the TSS value of 6.2 mg/L has decreased by 19%. 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 1.2 mg/L. This means that 23% of the TSS concentration is related to suspended inorganic particles. The other 77% can be attributed to organic particles. In June Hastings Lake had the lowest level of NVSS (0.8 mg/L) Turbidity caused by algae is the most common reason for low Secchi disk readings. The lowest Secchi disk in 2010 on Hastings Lake occurred in June this sampling event was visually noted as having the highest density of algae during the sampling season.

The 2010 median Secchi depth in Lake County was 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 Hastings Lake has improved significantly.



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

DATE	SECCHI
1995	1.75
2001	3.29
2006	4.85
2010	3.52

Average Secchi Depth (feet) in Hastings Lake.

Nutrients-Phosphorus/Nitrogen

Year	TP
2010	0.052
2006	0.068
2001	0.066
1995	0.119

Total phosphorus concentration (mg/L) in Hastings Lake.

2010 Lake County median TP = 0.065 mg/L

Organisms need nutrients 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 Hastings Lake phosphorus is the limiting nutrient, which means most 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, meaning the more phosphorus in the system the more plants and/or algae.

The 2010 average total phosphorus concentration in Hastings Lake was 0.052 mg/L this was a 31% reduction from the 2006 concentration (0.068 mg/L). The Illinois Environmental Protection Agency (IEPA) lists Hastings 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 Hastings Lake was 1.78 mg/L, which was higher than the county median of 1.18 mg/L.

What Has Been Done to Reduce Phosphorus Levels in Hastings Lake

2005-2008- Common Carp removal, Illinois Division of Natural Resources removed 20.1 lbs of carp per acre totaling 1469.2 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

April 2009- Lake County Forest Preserve (LCFP) purchases five acres to expand the Hastings Lake Forest Preserve to 268 acres.

Present- LCFP upland habitat restoration

Trophic State Index

Another way to look at phosphorus levels and how they affect lake productivity is to use a Trophic State Index (TSI) based on phosphorus (TSIp). TSIp values are commonly used to classify and compare lake productivity levels (trophic state). A 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, Hastings Lake was eutrophic with a TSIp value of 61.1, placing it 58 out of 162 lakes in the county.

What you can do to help lower phosphorus levels in Hastings 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 Hastings 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

OLIGOTROPHIC:

Lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they

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.

WHAT HAS BEEN DONE TO REDUCE CHLORIDE LEVELS IN HASTINGS LAKE

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

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

CHLORIDE CONCENTRATIONS (CL-) VS. CONDUCTIVIY FOR HASTINGS LAKE 1995-2010

DATE	COND	Cl^-
1995	0.5693	38
2001	0.7863	114
2006	1.0886	209
2010	0.8491	160

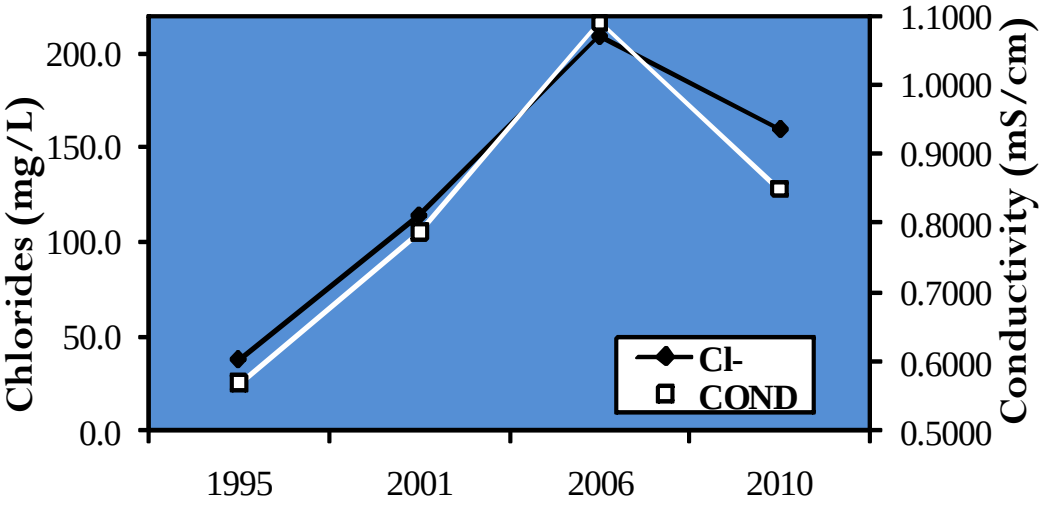
TIPS

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

CONDUCTIVITY AND CHLORIDE

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 Hastings Lake was 0.8491 mS/cm. Although this parameter was higher than the county median of 0.7800 mS/cm the average concentration was a 30% decrease from 2006 (1.0886 mS/cm). This reduction was likely 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. Concentrations averaged 160 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 10% of 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. Hastings Lake had lower conductivity readings than Crooked and Slough lake. Chlorides tend to accumulate within a watershed as these ions do not break down and are not utilized by plants or animals. High chloride concentrations may make it difficult for many of our native species to survive. However, many of our invasive species, such as Eurasian Watermilfoil, Cattail and Common Reed, are tolerant to high chloride concentrations.



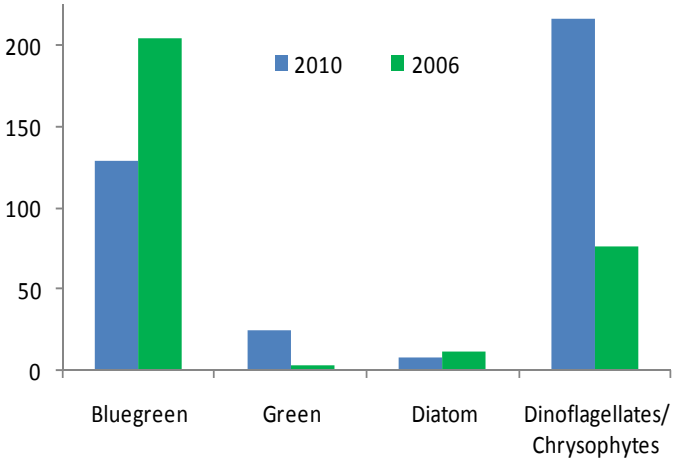
Pavement Temp. °F	One Pound of Salt (NaCL) melts	Melt Times
30°	46.3 lbs of ice	5 min.
25°	14.4 lbs of ice	10 min.
20°	8.6 lbs of ice	20 min
15°	6.3 lbs of ice	1 hour
10°	4.9 lbs of ice	Dry salt is ineffective and will blow away before it melts anything

PHYTOPLANKTON

Ceratium bloom in Hastings Lake, July 2010

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 plankton sample was collected in July, during which a *Ceratium* bloom had occurred. *Ceratium* are a relatively harmless group of dinoflagelletes that play an important role as both predators and prey in their environment. In July 2006 in Hastings Lake blue-green algae was the dominant phytoplankton, blue-green algae possess certain adaptations that enable them to out compete other 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. Blue-green algae populations decreased in 2010 this was a favorable transition in Hastings Lake as the dominant genus of blue-green algae found in Hastings Lake in 2006 and 2010 was Anabaena. In addition to having unique adaptations, *Anabaena* can also produce toxins, these are known collectively as cyanotoxins.

Plankton are microscopic plants and animals that are free-floating within the water column and serve as the base of the food chain.



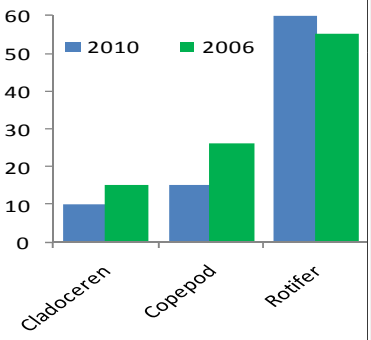
PHYTOPLANKTON IN HASTING LAKE, JULY 2006 AND 2010.

ZOOPLANKTON

Keratella in Hastings Lake, July 2010

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 Hastings 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 Hastings Lake did not change significantly since 2006. Rotifers were the most abundant type of zooplankton in 2006 and 2010 composed primarily of Keratella. Kertella is a footless rotifer which possesses a protective covering and anterior spines approximately equal in length.

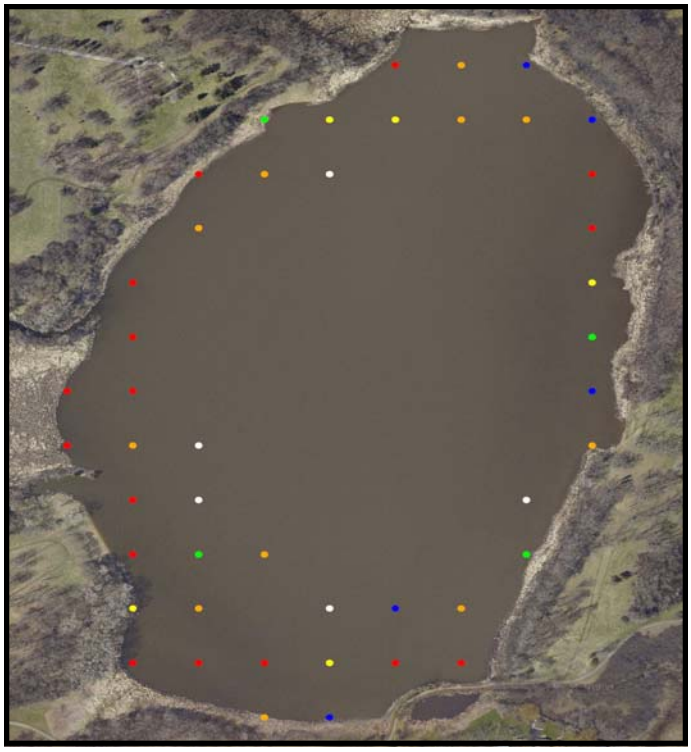


ZOOPLANKTON IN HASTING LAKE, JULY 2006 AND 2010.

AQUATIC PLANT SAMPLING

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 Hastings Lake in July 2010. There were 87 points generated based on a computer grid system with points 60 meters apart. Aquatic plants existed at 41 of the sites (47%) 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 Duckweed and Watermeal to the aquatic plant community. In 2010 the most common species was Eurasian Watermilfoil (EWM) at 45% of the sampled sites, while White Water Lily (30%) and Coontail (22%) were the next most abundant species. The aquatic plant community has not changed significantly since 2006. There has been a slight increase in overall aquatic plant density. 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 Hastings Lake ranged from 10-20ft. during the sampling season. Plants were found at a maximum depth of 8.5 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.



DISTRIBUTION OF RAKE DENSITY ACROSS ALL SAMPLES SITES

Rake Density (coverage)	# of Sites	% of Sites
No Plants	5	6
>0-10%	4	5
10-40%	5	6
40-60%	11	13
60-90%	5	6
>90%	16	18
Total # with Plants	41	47
Total # of	87	53

AQUATIC PLANT DENSITY AT 47 SITES ON HASTINGS LAKE IN JULY 2010 , MAXIMUM DEPTH THAT PLANTS WERE FOUND WAS 8.5 FEET.

- No Plants
- 1 - 10%
- 11 - 40%
- 41 - 60%
- 61 - 90%
- 91 - 100%

Plant Density	Coontail	Curlyleaf Pondweed	Duckweed	Eurasion Watermilfoil	Flatstem Pondweed	Sago Pondweed	Spatterdock	Watermeal	White Water Lily
Absent	68	81	78	48	86	71	85	84	61
Present	5	5	7	8	0	8	1	2	8
Common	6	1	2	8	1	8	1	1	12
Abundant	5	0	0	7	0	0	0	0	5
Dominant	3	0	0	16	0	0	0	0	1
% Plant Occurrence	21.8	6.9	10.3	44.8	1.1	18.4	2.3	3.4	29.9

The Average FQI for Lake County Lakes was Lake County was 14.4

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. Hastings Lake has an FQI of 15.0.

Aquatic plants: where do they grow?

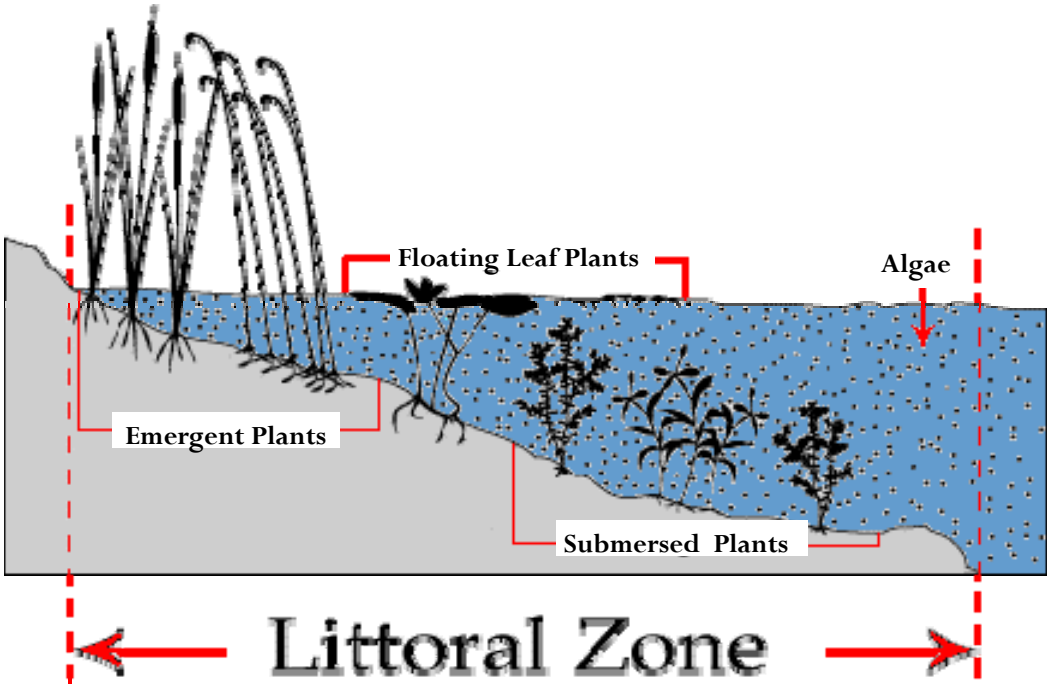
Littoral Zone– the area that aquatic plants grow in a lake.

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.

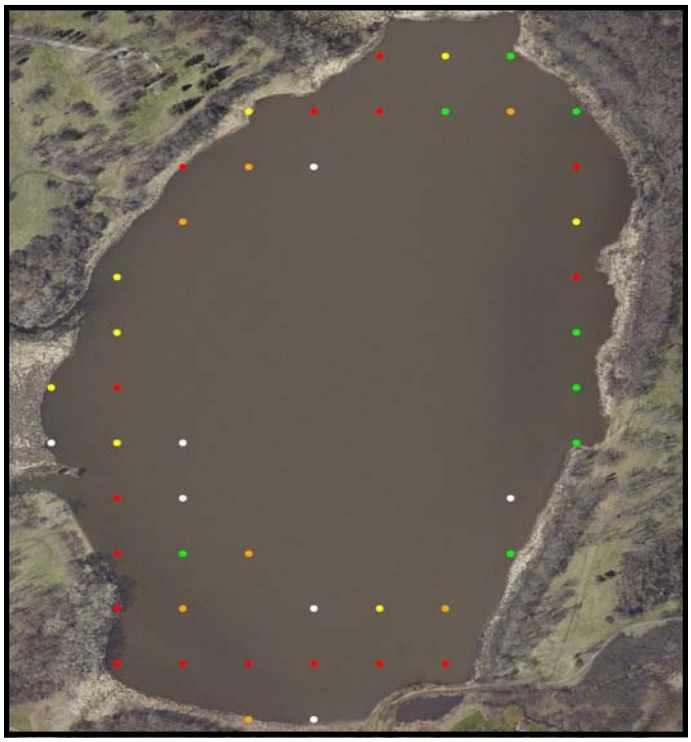
- Macrophyte leaves and stems provide a habitat or home for small attached plants and animals. Some are microscopic in size and some are larger. These attached organisms are valuable in that they are food for animals higher in the food chain, for example, fish and birds.
- Many types of small organisms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

Excerpt: Department of Ecology, Washington state

Eurasion 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.

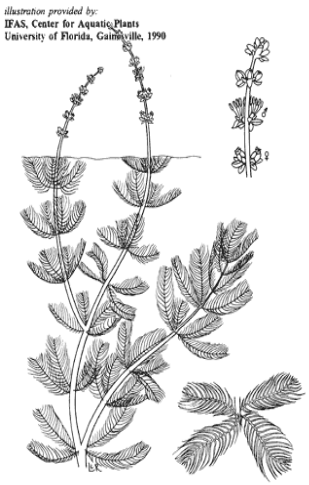


The abundance of EWM in Hastings Lake has increased by 10% since 2006. EWM was present at most sample sites with plants. Populations were most dense in the northern and southern portions of the lake extending from the shoreline into the lake to a depth of 8.5 feet.

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 largely targeting EWM. 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

Distribution of eurasion watermilfoil

Illustration of Erasian watermilfoil



Erasian watermilfoil density at 47 sites on Hastings Lake in July 2010 , Maximum depth that plants were found was 8.5 feet.

- No Plants
- Present
- Common
- Abundant
- Dominant

Map Source: USDA NRCS

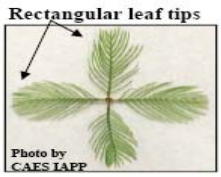
Myriophyllum spicatum *Exotic**

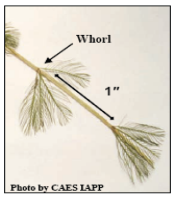
Common Names:
Eurasian watermilfoil

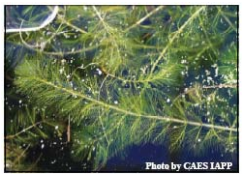
Origin:
Europe and Asia. Found throughout lake county and Illinois

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.

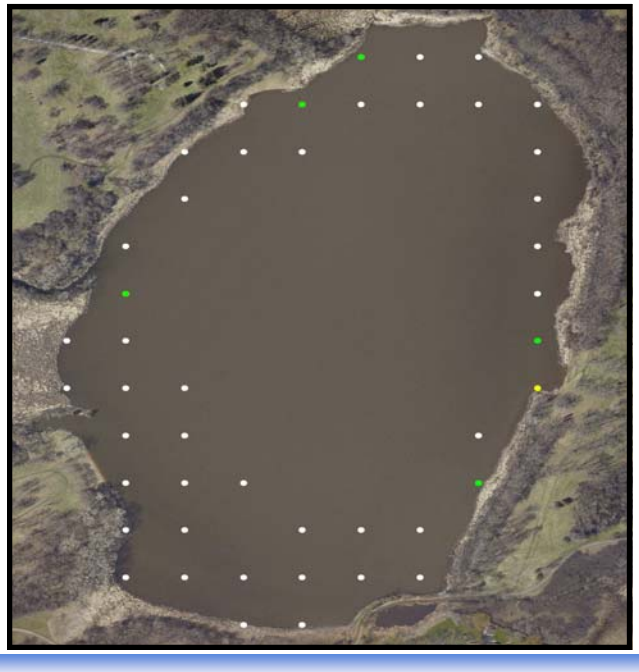
Flower: Small pinkish male flowers that occur on reddish spikes, female flowers lack petals and sepals and 4 lobed pistil.

Curlyleaf pondweed

Illustration of 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 Hastings Lake the CLP population was low, plants being found at 5 sampled sites (7% of lake). This is an increase of 5% from 2006 when CLP was only documented at 2 of the sample sites. At this time the density of CLP is not causing fluctuations in nutrient availability. Unlike Summer Hill Estates Lake another LCFP lake, which was observed to have 80 % of the lake with topped out CLP in May, 2009, resulting in reduced recreational opportunities and influx of phosphorus availability in July, 2009. While populations are low in Hastings Lake action should be taken to eradicate CLP. Hand removal could be an effective management technique. Typically tools such as rakes and cutting bars are used to remove vegetation. Hand removal is a quick, inexpensive, but labor intensive. Proper disposal of CLP should also be considered in the aquatic plant management plan.



Curlyleaf Pondweed density at 47 sites on Hastings Lake in July 2010 , Maximum depth that plants were found was 2.6 feet.

- No Plants
- Present
- Common
- Abundant
- Dominant

Potamogeton crispus *Exotic**

Common Names:
Curly leaf pondweed
Crispy leaved pondweed

Origin:EOXTIC*
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

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

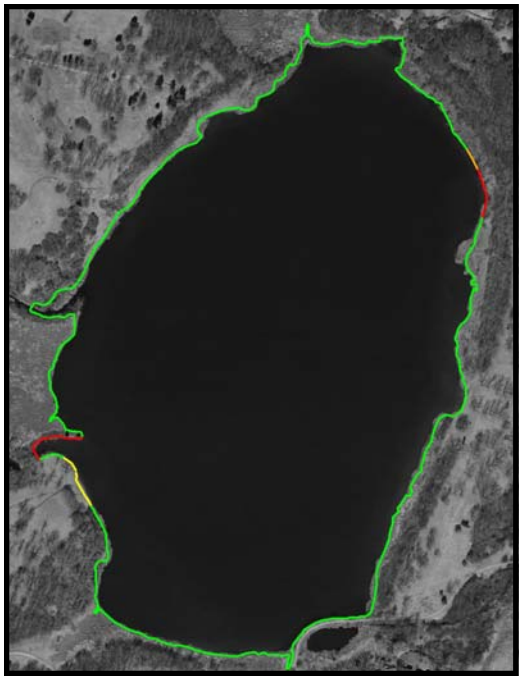
SHORELINE EROSION

INVASIVE EXOTIC PLANT SPECIES AROUND HASTINGS LAKE, INCLUDED REED CANARY GRASS, BUCKTHORN, MULTIFLORA ROSE, HONEYSUCKLE AND PURPLE LOOSESTRIFE. THESE PLANTS EXCLUDE NATIVE PLANTS AND PROVIDE POOR SHORELINE STABILIZATION.

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 slight increase in shoreline erosion with approximately 10% of the shoreline having some degree of erosion. Overall, 90% of the shoreline had no erosion, 3% had slight erosion, 1% had moderate, and 5% had severe erosion. The areas of moderate and severe erosion were mostly located in channel from the west inlet and an area on the northeast side of the lake 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 are heavily vegetated with a variety of habitats including wetland and woodland. The benefits to Hastings Lake from these types of shoreline include a stabilized shoreline, habitat for wildlife, and the filtration of pollutants and nutrients.

SHORELINE EROSION ON HASTINGS LAKE, 2010



None
Slight
Moderate
Severe

MONTHLY WATER LEVELS IN HASTINGS LAKE, 2010 AND LAKE COUNTY STORMWATER MANAGEMENT COMMISSION RAIN GUAGE DATA FROM THE LINDHURST RAIN GAUGE

2010	Level (in)	Rain (in)
May	23.00	
June	21.50	4.12
July	16.20	4.99
August	26.50	5.76
September	28.00	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 water level fluctuations in the west inlet into Hastings Lake were considerably unstable. The lake level decreased by 5.0 inches from May to September. The highest water level occurred in July with the lowest level in September. The most significant water level fluctuation occurred from July to August with an decrease in lake level of 10.3. Hastings Lake does not appear to be significantly influenced by rain events; even though the watershed is large (1791.1 acres). The wetland complex between Crooked Lake and Hastings Lake has the ability to hold and slow storm water so that Hastings Lake was less susceptible to storm water runoff. However, these types of water level fluctuations can have detrimental effects on shorelines. This is documented by the amount of erosion occurring in the west inlet. 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).

Shoreline Restoration

BUCKTHORN REMOVAL
Picture provided by: Lake County Forest Preserves

Habitat restoration is under way at Hastings Lake. District crews are removing invasive vegetation along the lake shoreline and throughout the preserve. Crews are also removing dead or dying trees that may become future hazards. This project began on the eastern portion of the property near the YMCA facility, will continue up to the northwest quadrant, and will end with the southwest corner. Restoration at Hastings Lake Forest Preserve is implemented year round.

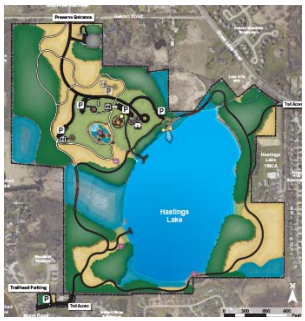
Hastings Lake Forest Preserve

This preserve features open fields, dense woodlands and wetlands. A rise on the west side of the property offers panoramic views of Hastings Lake. Visitors can enjoy one mile of temporary mowed grass trail and connecting asphalt trail for hiking and nature observation, and for cross-country skiing during winter. The temporary trail encircles open areas and woodlands. Shore fishing on Hastings Lake is also permitted.

After public input from three open houses and from comments from visiting the Lake County Forest Preserve District's website as well as feedback from a 2007 Attitude and Interest Survey. The Conceptual Master Plan for Hastings Lake Forest Preserve was approved by the Forest Preserve Board of Commissioners on July 22, 2008. Recreational improvements and natural resource improvements will be supplemented by a $400,000 Open Space Lands Acquisition and Development (OSLAD) grant received from the Illinois Department of Natural Resources. Currently the Hastings Lake Forest Preserve is in the Engineering Phase with preliminary site preparation and habitat restoration taking place. Construction is anticipated to start in 2011 which will include approximately 4 miles of asphalt and crushed-stone trails; 3 picnic shelters; toilets; playground; parking; car-top boat access with parking; and 2 fishing piers. The development of shelters and natural areas at the preserve will provide a setting for environmental education programs. For more information about the Conceptual Master Plan for Hastings Lake Forest Preserve, visit the LCFP webpage.

http://www.lcfpd.org/preserves/index.cfm?fuseaction=home.view&object_id=24081&type=P

Conceptual Master Plan for Hastings Lake forest preserve



Visit the Lake County Forest Preserve website for details

www.lcfpd.org/

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.

MANGAEMENT RECOMMENDATIONS

Hastings Lake's water quality has improved since 2006, chloride and total phosphorus concentrations have decreased by 31% despite the downstream location in the North Mill Creek Watershed. This can be attributed to the 87% of shoreline surrounded by wetland that acts as a buffer. Due to this, shoreline erosion was minimal on the lake. Although plant coverage around and in the lake was good, plant diversity was low and included exotic species.

Hastings Lake, lake management is administered by the Lake County Forest Preserve. To improve the overall quality of Hastings Lake, the ES (Environmental Services) has the following recommendations:

- **Develop an aquatic plant management plan that targets the removal of Eurasian Watermilfoil and Curlyleaf Pondweed.**
- **Continue shoreline restoration, removing exotics**
- **Assess Hastings Lake fish population post Common Carp removal**
- **Mitigate shoreline exhibiting erosion**
- **Participate in the Volunteer Lakes Monitoring Program**

SHORELINE RESTORATION ON HASTINGS LAKE

A BATHYMETRIC MAP WAS CREATED FOR HASTING LAKE IN 2008, FOR A COPY VISIT:

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

Water quality data for Hastings Lake 2001, 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	184	1.07	<0.1	<0.05	0.047	0.006	511	169	4.7	542	126	7.21	0.9220	8.59	8.79
9-Jun	3	164	1.1	<0.1	<0.05	0.058	<0.005	487	154	4.6	511	121	1.46	0.8750	8.64	7.9
14-Jul	3	159	1.12	<0.1	0.066	0.039	<0.005	448	165	5.6	506	111	3.63	0.7970	8.73	9.28
11-Aug	3	151	1.15	<0.1	<0.05	0.037	<0.005	451	156	5.3	477	112	2.85	0.8026	8.86	11.11
15-Sep	3	160	1.44	<0.1	<0.05	0.078	<0.005	474	155	5.7	496	122	2.46	0.8490	8.56	10.05
	Average	163.6	1.18	<0.1[k]	<0.0532[k]	0.052	<0.005[k]	474	160	5.2	506	118	3.52	0.8491	8.68	9.43

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	173	1.91	0.103	<0.05	0.084	<0.005	585	205	4.4	638	161	6.23	1.0700	8.32	10.73
21-Jun	3	180	1.68	<0.1	<0.05	0.074	<0.005	590	202	7.3	653	166	4.75	1.0790	8.41	11.55
19-Jul	3	178	1.71	<0.1	<0.05	0.057	<0.005	585	207	5.8	669	178	5.25	1.0700	8.54	6.35
16-Aug	3	165	1.53	<0.1	<0.05	0.037	<0.005	615	216	4.6	646	164	5.57	1.1280	8.53	7.49
20-Sep	3	164	2.09	0.203	<0.05	0.090	<0.005	599	217	8.8	664	173	2.46	1.0960	7.86	4.34
	Average	172	1.78	0.121[k]	<0.05[k]	0.068	<0.005[k]	595	209	6.2	654	168	4.85	1.0886	8.33	8.09

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	169	0.58	<0.1	<0.05	0.063	<0.005	492	NA	6.3	528	149	4.62	0.8185	8.44	9.21
20-Jun	3	160	1.24	<0.1	<0.05	0.118	<0.005	500	NA	12.0	525	150	2.72	0.7973	8.40	10.20
25-Jul	3	138	1.12	<0.1	<0.05	0.045	<0.005	498	NA	6.5	517	140	2.99	0.7929	8.55	7.65
22-Aug	3	134	0.97	<0.1	<0.05	0.041	<0.005	496	NA	6.0	500	156	3.35	0.7503	8.45	7.32
19-Sep	3	138	1.32	<0.1	<0.05	0.065	<0.005	457	NA	7.3	488	148	2.76	0.7725	8.24	6.72
	Average	148	1.05	<0.1[k]	<0.05[k]	0.066	<0.005[k]	489	114	7.6	512	149	3.29	0.7863	8.42	8.22

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

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	188	1.02	<0.1	<0.05	0.047	<0.005	510	169	8.3	544	123	NA	0.9200	8.55	8.36
9-Jun	21	183	1.01	0.123	<0.05	0.059	0.020	506	156	4.2	537	121	NA	0.9125	7.55	0.27
14-Jul	19	197	1.88	0.732	0.693	0.243	0.176	475	159	5.6	536	115	NA	0.8500	7.33	0.22
11-Aug	19	210	2.95	1.940	<0.05	0.337	0.287	516	160	4.6	547	134	NA	0.9319	7.11	0.19
15-Sep	19	162	1.75	<0.1	<0.05	0.084	<0.005	479	155	5.4	497	119	NA	0.8575	8.01	1.16
	Average	203	3.68	<0.599[k]	<0.268[k]	0.358	0.280[k]	604	207	4.8	658	166	NA	0.8944	7.33	2.04

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	23	176	2.33	0.605	<0.05	0.143	0.064	585	203	3.0	616	143	NA	1.0700	7.86	1.16
21-Jun	22	191	2.47	1.100	<0.05	0.212	0.145	597	201	2.3	660	174	NA	1.0930	7.54	0.09
19-Jul	21	212	3.58	2.210	<0.05	0.367	0.294	597	203	3.4	679	182	NA	1.0930	7.83	0.19
16-Aug	22	271	7.88	6.890	<0.05	0.974	0.895	650	210	4.1	693	171	NA	1.1990	6.91	0.34
20-Sep	21	165	2.16	0.259	<0.05	0.093	<0.005	591	216	11.0	642	161	NA	1.0810	7.75	3.01
	Average	203	3.68	2.213	<0.05[k]	0.358	0.280[k]	604	207	4.8	658	166	NA	1.1072	7.23	0.96

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	25	180	0.60	0.433	<0.05	0.117	0.049	483	NA	6.6	530	141	NA	0.8580	6.82	0.02
20-Jun	23	173	2.29	0.910	<0.05	0.223	0.147	507	NA	6.2	527	144	NA	0.8336	6.86	0.05
25-Jul	23	220	4.62	2.920	<0.05	0.467	0.380	544	NA	6.0	546	158	NA	0.8907	6.55	0.04
22-Aug	22	251	6.73	5.390	<0.05	1.240	1.110	564	NA	3.8	559	166	NA	0.9039	6.43	0.00
19-Sep	23	205	5.26	4.320	<0.05	1.270	0.398	510	NA	5.8	532	148	NA	0.9643	6.36	0.00
	Average	206	3.90	2.795	<0.05[k]	0.663	0.417	522	NA	5.7	539	151	NA	0.8901	6.60	0.02

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, Lake Linden, and Hastings Lake).

Lake	Slough Lake	Slough Lake	Slough Lake	Crooked Lake	Crooked Lake	Crooked Lake	Lake Linden	Lake Linden	Lake Linden	Hastings Lake	Hastings Lake	Hastings Lake
Year	**2000**	**2006**	**2010**	**2001**	**2006**	**2010**	**2002**	**2006**	**2010**	**2001**	**2006**	**2010**
Secchi (feet)	1.53	2.00	1.63	2.51	4.39	4.28	5.87	6.54	4.6	3.29	4.85	3.52
TSS (mg/L)	33.8	18.8	19.4	13.7	7.7	7.3	2.3	2.9	4.2	7.6	6.2	5.2
TP (mg/L)	0.263	0.413	0.386	0.101	0.061	0.07	0.042	0.033	0.057	0.066	0.068	0.052
Conductivity (milliSiemens/cm)	0.8659	1.5228	1.1306	0.7927	1.1034	0.8843	0.9772	1.2028	0.7294	0.7863	1.0886	0.8491

Direction of Watershed Flow: Slough flows into Crooked which enters Hasting from the west and Linden enters Hastings from the south inlet

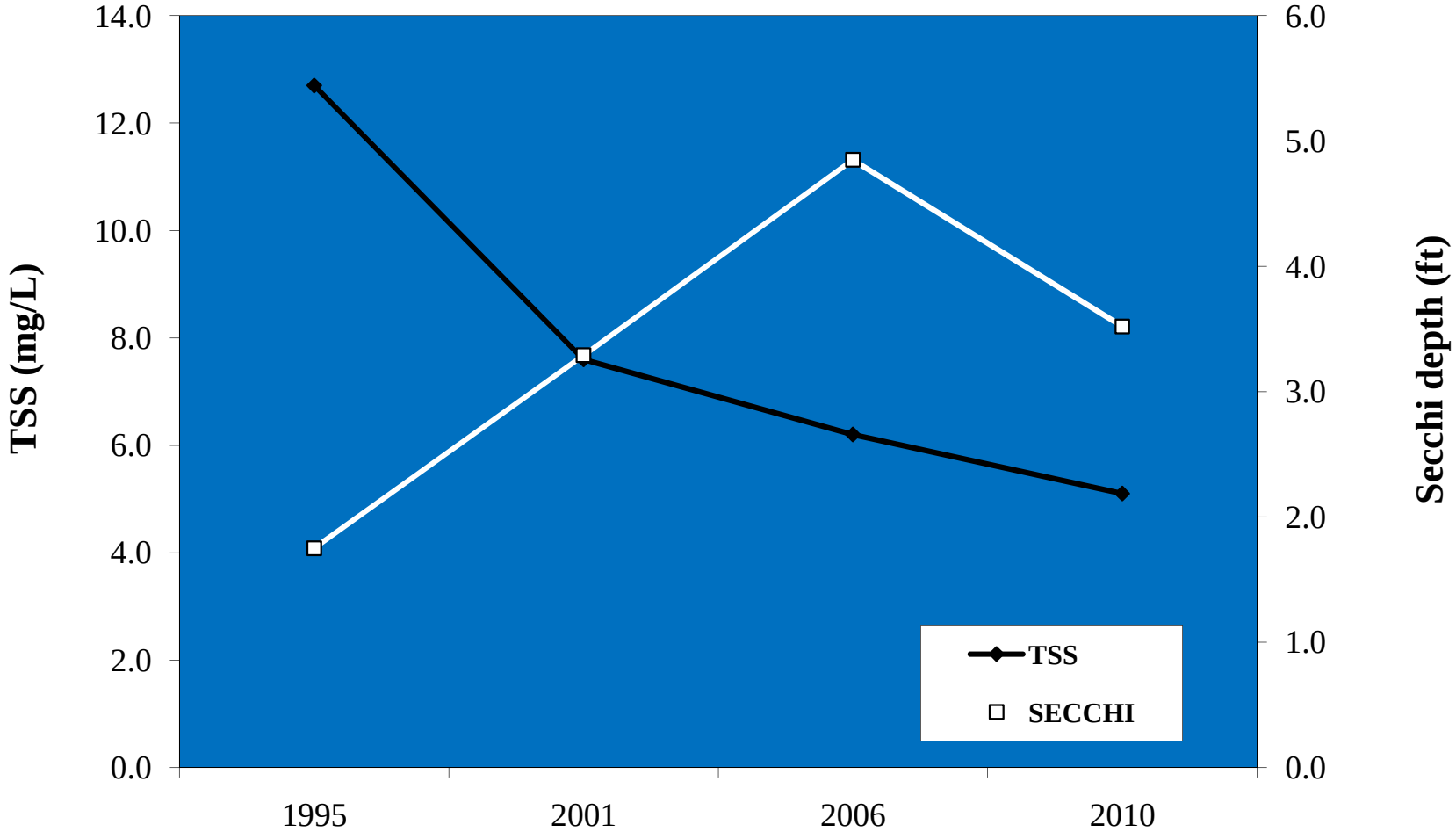
Hastings Lake 2010 IEPA Ranking

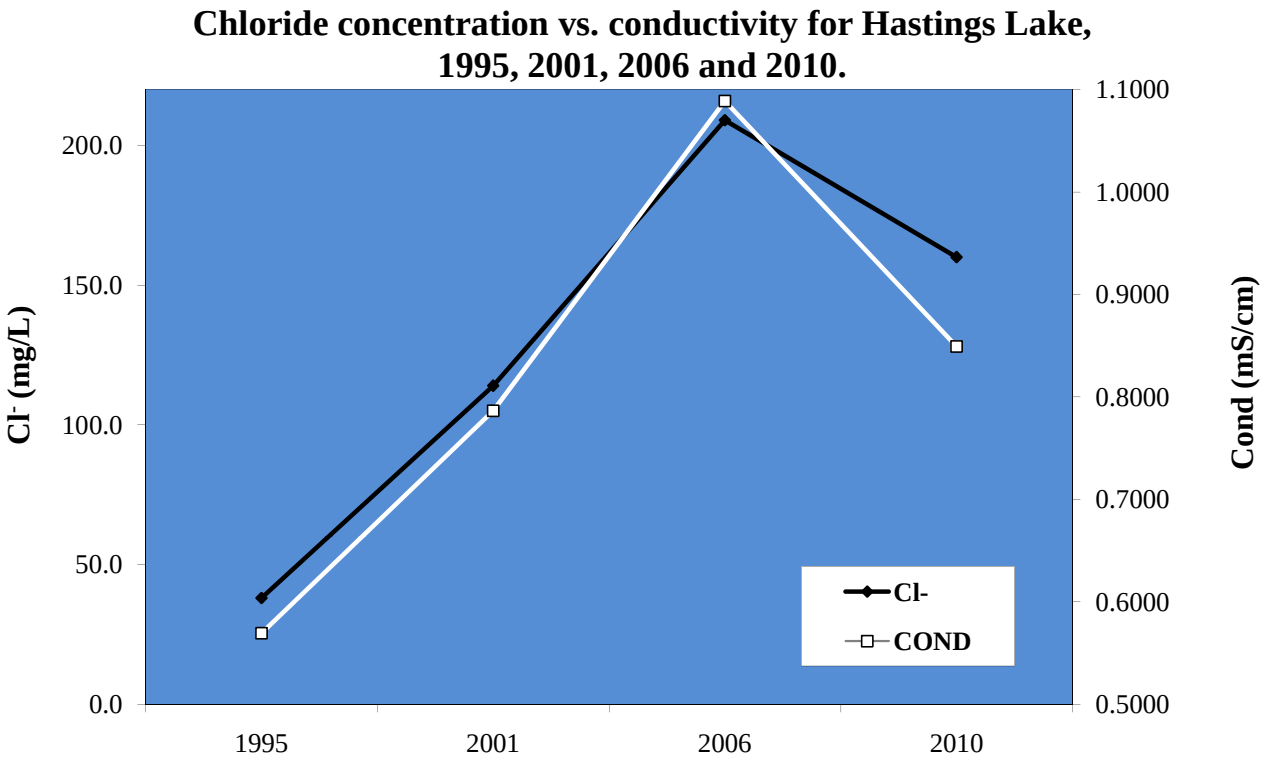
TROPHIC STATUS		
Carlson's TSIp	58.5	Eutrophic

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

AQUATIC LIFE USE IMPAIRMENT INDEX	**Weighting Criteria**	**Points**	**Overall Use Support Points**	**Degree of Support**
Mean Trophic State	58.5	40		
Macrophyte Impairment	Substantial	15		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**55**	0	**Full**
RECREATION USE IMPAIRMENT INDEX				
Mean Trophic State Index	58.5	58.5		
Macrophyte Impairment	Substantial	15		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**73.5**	1	**Partial**
Overall Use Index			**0.50**	**Partial**

Total suspended solid concentrations vs. Secchi depth for Hastings Lake, 1995, 2001, 2006, and 2010.




Chloride concentration vs. conductivity for Hastings Lake, 1995, 2001, 2006 and 2010.
Cl- (mg/L)
Cond (mS/cm)
200.0
150.0
100.0
50.0
0.0
1.1000
1.0000
0.9000
0.8000
0.7000
0.6000
0.5000
1995
2001
2006
2010
Cl-
COND

Morphometric Features of Hastings Lake ~
Data From the August 2008 Bathymetric Survey, LCHD Enviornmental 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	74.97	100.0%	69.59	0 - 1	10.61	14.2%	9.8%
1	64.35	85.8%	60.27	1 - 2	8.09	10.8%	8.5%
2	56.27	75.1%	53.41	2 - 3	5.66	7.5%	7.5%
3	50.61	67.5%	48.51	3 - 4	4.17	5.6%	6.8%
4	46.44	61.9%	44.89	4 - 5	3.07	4.1%	6.3%
5	43.36	57.8%	41.95	5 - 6	2.82	3.8%	5.9%
6	40.55	54.1%	39.40	6 - 7	2.28	3.0%	5.6%
7	38.27	51.0%	37.25	7 - 8	2.03	2.7%	5.3%
8	36.24	48.3%	35.07	8 - 9	2.32	3.1%	4.9%
9	33.92	45.2%	32.95	9 - 10	1.93	2.6%	4.6%
10	31.99	42.7%	31.05	10 - 11	1.87	2.5%	4.4%
11	30.12	40.2%	29.25	11 - 12	1.72	2.3%	4.1%
12	28.40	37.9%	27.46	12 - 13	1.87	2.5%	3.9%
13	26.53	35.4%	25.55	13 - 14	1.95	2.6%	3.6%
14	24.58	32.8%	23.30	14 - 15	2.53	3.4%	3.3%
15	22.05	29.4%	20.48	15 - 16	3.10	4.1%	2.9%
16	18.96	25.3%	17.75	16 - 17	2.38	3.2%	2.5%
17	16.58	22.1%	15.46	17 - 18	2.20	2.9%	2.2%
18	14.38	19.2%	13.11	18 - 19	2.49	3.3%	1.8%
19	11.89	15.9%	10.55	19 - 20	2.61	3.5%	1.5%
20	9.27	12.4%	8.66	20 - 21	1.21	1.6%	1.2%
21	8.07	10.8%	7.53	21 - 22	1.07	1.4%	1.1%
22	7.00	9.3%	6.42	22 - 23	1.14	1.5%	0.9%
23	5.87	7.8%	5.11	23 - 24	1.47	2.0%	0.7%
24	4.39	5.9%	3.17	24 - 25	2.30	3.1%	0.4%
25+	2.095	2.8%	1.18	25+	2.09	2.8%	0.2%
			709.36		74.97	100%	100%

Maximum Depth of Lake: 25.69 Feet
Average Depth of Lake: 9.46 Feet
Volume of Lake: 709.36 Acre-Feet

Area of Lake: 74.97 Acres
Shoreline Length: 1.47 Miles
Water elevation: 764.95 feet above mean sea level

LakeCounty
Health Department and
Community Health Center

Aquatic vegetation species found in July at the 46 sampling sites on Hastings Lake, 2010. The maximum depth that plants were found was 8.5 feet.

Plant Density	Coontail	Curlyleaf Pondweed	Duckweed	Eurasion Watermilfoil	Flatstem Pondweed	Sago Pondweed	Spatterdock	Watermeal	White Water Lily
Absent	27	40	37	7	45	30	44	43	20
Present	5	5	7	8	0	8	1	2	8
Common	6	1	2	8	1	8	1	1	12
Abundant	5	0	0	7	0	0	0	0	5
Dominant	3	0	0	16	0	0	0	0	1
% Plant Occurrence	41.3	13.0	19.6	84.8	2.2	34.8	4.3	6.5	56.5

Distribution of rake density across all sampling sites.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	5	11
>0-10%	4	9
10-40%	5	11
40-60%	11	24
60-90%	5	11
>90%	16	35
Total Sites with Plants	41	89
Total # of Sites	46	100

e

Site:
Locale: Hastings Lake
Date: July, 2010 4 hours
By: Dane Bradberry
File: u:\EH\Engineering\Lakes Management\FQA\HastingsLake2010.inv

FLORISTIC QUALITY DATA	Native	7	77.8%	Adventive	2	22.2%
7 NATIVE SPECIES	Tree	0	0.0%	Tree	0	0.0%
9 Total Species	Shrub	0	0.0%	Shrub	0	0.0%
6.4 NATIVE MEAN C	W-Vine	0	0.0%	W-Vine	0	0.0%
5.0 W/Adventives	H-Vine	0	0.0%	H-Vine	0	0.0%
17.0 NATIVE FQI	P-Forb	5	55.6%	P-Forb	2	22.2%
15.0 W/Adventives	B-Forb	0	0.0%	B-Forb	0	0.0%
-5.0 NATIVE MEAN W	A-Forb	2	22.2%	A-Forb	0	0.0%
-5.0 W/Adventives	P-Grass	0	0.0%	P-Grass	0	0.0%
AVG: Obl. Wetland	A-Grass	0	0.0%	A-Grass	0	0.0%
	P-Sedge	0	0.0%	P-Sedge	0	0.0%
	A-Sedge	0	0.0%	A-Sedge	0	0.0%
	Cryptogam	0	0.0%			

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
CERDEM	5	Ceratophyllum demersum	-5	OBL	Nt P-Forb	HORNWORT
LEMMIO	5	Lemna minor	-5	OBL	Nt A-Forb	SMALL DUCKWEED
MYRSPI	0	MYRIOPHYLLUM SPICATUM	-5	OBL	Ad P-Forb	EUROPEAN WATER MILFOIL
NUPVAR	8	Nuphar variegatum	-5	OBL	Nt P-Forb	BULLHEAD LILY
NYMTUB	7	Nymphaea tuberosa	-5	OBL	Nt P-Forb	WHITE WATER LILY
POTCRI	0	POTAMOGETON CRISPUS	-5	OBL	Ad P-Forb	BEGINNER'S PONDWEED
POTPEC	5	Potamogeton pectinatus	-5	OBL	Nt P-Forb	SAGO PONDWEED
POTZOS	8	Potamogeton zosteriformis	-5	OBL	Nt P-Forb	FLAT-STEMMED PONDWEED
WOLCOL	7	Wolffia columbiana	-5	OBL	Nt A-Forb	AMERICAN WATER MEAL

Hastings 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
											0.134
51210	0.25	0.25	13.41	8.91	85.6	0.9220	8.56	285	Surface		
51210	1	1	13.54	8.82	85.0	0.9220	8.59	249	Surface	100%	
51210	2	2	13.56	8.80	84.8	0.9220	8.59	181	0.33	73%	0.97
51210	3	3	13.56	8.79	84.7	0.9220	8.59	126	1.33	51%	0.27
51210	4	4	13.56	8.78	84.6	0.9220	8.59	99	2.33	40%	0.10
51210	6	6	13.56	8.77	84.4	0.9220	8.59	75	4.33	30%	0.07
51210	8	8	13.56	8.74	84.2	0.9220	8.59	54	6.33	22%	0.05
51210	10	10	13.55	8.72	84.0	0.9220	8.59	35	8.33	14%	0.05
51210	12	12	13.55	8.70	83.8	0.9220	8.59	25	10.33	10%	0.04
51210	14	14	13.54	8.66	83.4	0.9220	8.58	14	12.33	6%	0.05
51210	16	16	13.46	8.54	82.1	0.9210	8.57	5	14.33	2%	0.07
51210	18	18	13.43	8.47	81.3	0.9210	8.56	4	16.33	2%	0.01
51210	20	20	13.40	8.39	80.5	0.9200	8.56	3	18.33	1.1%	0.02
51210	22	22	13.39	8.36	80.2	0.9200	8.55	2	20.33	0.9%	0.01
51210	24	24	13.40	4.39	30.5	0.9200	8.41	1	22.33	0.4%	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
											0.854
60910	0.25	0.501	21.34	8.12	91.9	0.8610	8.50	3655	Surface		
60910	1	0.693	21.28	8.05	91.0	0.8620	8.56	3518	Surface	100%	
60910	2	1.086	21.25	7.96	89.9	0.8630	8.61	1770	-0.58	50%	-1.18
60910	3	1.731	21.21	7.90	89.2	0.8750	8.64	885	0.06	25%	11.36
60910	4	2.545	21.17	7.86	88.7	0.8620	8.65	674	0.88	19%	0.31
60910	6	4.547	21.11	7.78	87.7	0.8620	8.67	527	2.88	15%	0.09
60910	8	6.246	21.07	7.70	86.7	0.8620	8.68	232	4.58	7%	0.18
60910	10	8.639	20.70	6.46	72.2	0.8660	8.61	156	6.97	4%	0.06
60910	12	11.79	15.65	1.40	14.1	0.9040	7.86	55	10.12	2%	0.10
60910	14	13.48	14.91	0.75	7.4	0.9040	7.73	36	11.81	1%	0.04
60910	16	15.65	14.62	0.47	4.6	0.9050	7.68	22	13.98	1%	0.04

60910	18	17.1	14.31	0.34	3.3	0.9070	7.64	15	15.43	0%	0.02
60910	20	19.38	13.58	0.28	2.7	0.9110	7.58	9	17.71	0%	0.03
60910	22	21.03	13.30	0.26	2.4	0.9140	7.53	6	19.36	0%	0.02
60910	24	21.99	13.19	0.23	2.2	0.9090	7.43	3	20.32	0%	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
											0.072
71410	0.25	0.25	26.04	9.46	117.0	0.8210	8.27	3591	Surface		
71410	1	1	27.61	9.30	118.2	0.7990	8.68	1401	Surface	100%	
71410	2	2	27.67	9.28	118.2	0.7980	8.71	1497	0.33	107%	-0.20
71410	3	3	27.69	9.28	118.1	0.7970	8.73	1056	1.33	75%	0.26
71410	4	4	27.69	9.28	118.2	0.7970	8.74	843	2.33	60%	0.10
71410	6	6	27.68	9.29	118.2	0.7960	8.75	318	4.33	23%	0.22
71410	8	8	27.64	9.30	118.3	0.7960	8.75	281	6.33	20%	0.02
71410	10	10	26.34	1.94	24.1	0.8060	8.11	75	8.33	5%	0.16
71410	12	12	24.87	0.41	4.9	0.8070	7.94	39	10.33	3%	0.06
71410	14	14	21.55	0.34	3.8	0.8170	7.72	18	12.33	1.3%	0.07
71410	16	16	18.11	0.25	2.7	0.8390	7.46	10	14.33	0.7%	0.04
71410	18	18	16.23	0.24	2.5	0.8460	7.40	4	16.33	0.3%	0.05
71410	20	20	14.63	0.19	1.9	0.8540	7.27	2	18.33	0.1%	0.05
71410	22	22	14.11	0.18	1.7	0.8590	7.22	1	20.33	0.1%	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
											0.328
81110	0.25	0.52	27.94	10.76	142.0	0.8026	8.83	1541	Surface		
81110	1	1.10	27.95	11.08	146.4	0.8028	8.86	1424	Surface	100%	
81110	2	2.05	27.95	11.11	146.8	0.8027	8.86	519	0.38	36%	2.66
81110	3	3.09	27.95	11.11	146.7	0.8026	8.86	281	1.42	20%	0.43
81110	4	4.030	27.95	11.05	146.0	0.8026	8.86	180.0	2.36	13%	0.19
81110	6	6.05	26.37	6.39	82.1	0.8081	8.36	73	4.38	5%	0.21
81110	8	8.07	25.63	3.16	40.0	0.8125	7.99	26	6.40	2%	0.16
81110	10	10.04	25.32	1.65	20.8	0.8145	7.77	11	8.37	0.8%	0.10
81110	12	12.15	25.01	0.25	3.1	0.8149	7.61	5	10.48	0.4%	0.08

81110	14	14.14	23.97	0.19	2.3	0.8252	7.54	3	12.47	0.2%	0.04
81110	16	16.08	20.37	0.18	2.0	0.8964	7.31	2	14.41	0.1%	0.03
81110	18	18.04	17.84	0.18	2.0	0.9245	7.18	1	16.37	0.1%	0.04
81110	20	20.04	15.41	0.20	2.1	0.9394	7.05	1	18.37	0.1%	0.00
81110	22	21.72	14.56	0.20	2.0	0.9485	6.96	1	20.05	0.1%	0.00

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient #DIV/0!	
91510	0.25	0.25	20.78	9.37	104.9	0.8480	8.61	3084	Surface			
91510	1	1	20.78	10.14	113.5	0.8490	8.59	297	Surface	100%		
91510	2	2	20.79	9.91	111.0	0.8490	8.56	**NA**	0.33			NOTE: PAR not working
91510	3	3	20.79	10.05	112.5	0.8490	8.56	**NA**	1.33			
91510	4	4	20.79	10.36	116.0	0.8490	8.55	**NA**	2.33			
91510	6	6	20.78	10.38	116.3	0.8490	8.54	**NA**	4.33			
91510	8	8	20.76	10.76	120.4	0.8490	8.54	**NA**	6.33			
91510	10	10	20.58	9.09	101.3	0.8510	8.51	**NA**	8.33			
91510	12	12	20.13	3.37	37.2	0.8540	8.36	**NA**	10.33			
91510	14	14	19.91	2.00	22.0	0.8560	8.22	**NA**	12.33			
91510	16	16	19.81	1.84	20.3	0.8560	8.13	**NA**	14.33			
91510	18	18	19.70	1.60	17.6	0.8570	8.04	**NA**	16.33			
91510	20	20	19.61	0.72	7.9	0.8580	7.98	**NA**	18.33			
91510	22	22	19.50	0.61	6.6	0.8640	7.93	**NA**	20.33			