LAKE COUNTY, ILLINOIS

2010 WATERFORD SUMMARY REPORT

PREPARED BY THE

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Waterford Lake

Picture provided by: Lake Lindenhurst Lake Commission

Waterford Lake, located in the Village of Lindenhurst in Lake Villa Township, was created in 1969. The lake has a surface area of 66.7 acres and an average depth of 3.34 feet. It is located entirely within the village limits of Lindenhurst and is almost completely private, with the exception of two access points open to Lindenhurst residents. The lake is managed by the Lindenhurst Lakes Commission and is used for non-gas motor boating and fishing. The lake has no public beach; however, several residents on the lake have private beaches on their property. Waterford Lake has also been a participant in the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program since 1986.

Waterford Lake receives water from its approximate 241 acre watershed which includes Potomac Lake. Waterford Lake drains into Spring Ledge Lake which enters McDonald Woods Lake #2. The primary land use within the Waterford Lake watershed was single family homes.

Many water quality parameters have improved since the 2006 lake study. Total phosphorus concentrations in Waterford Lake averaged 0.040 mg/L in 2010 which is a 34% decrease from the 2006 concentration of

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SPECIAL POINTS OF INTEREST:

- *Improved water quality*
- *Single Family Homes primary land use*
- *Increase in density of aquatic plant community*

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WATERFORD LAKE SUMMARY (CONTINUED)

Lake Facts:

Major Watershed: Des Plaines

Sub-Watershed: North Mill Creek

Location: T46N, R10E, Section 26, 35, 25,36

Surface Area: 67.52 acres

Shoreline Length: 1.82 miles

Maximum Depth: 11.09 feet

Average Depth: 3.34 feet

Lake Volume: 287.26 acre -feet

Watershed Area: 241.2 acres

Lake Type: Impoundment

Management Entity: Lindenhurst Lakes Commission

Current Uses: swimming, fishing, and non-gas powered boating

0.061 mg/L and below the IEPA impairment rate of 0.050 mg/L. Nitrogen is the other nutrient critical for plant growth. The average Total Kjeldahl nitrogen concentration for Waterford Lake was 0.85 mg/L which is below the county median (1.18 mg/L) and lower than the 2006 concentration by 79% (1.52 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 Waterford Lake as eutrophic with a TSIp value of 57.3.

The 2010 average total suspended solids (TSS) concentration for Waterford Lake was 3.9 mg/L, which was less than the county median (7.9 mg/L) and is a notable decrease from the 2006 average of 12.0 mg/L. Water clarity was measured by Secchi depth, with the lowest reading in August (2.30 feet) corresponding with a high TSS concentration (4.8 mg/L). The average Secchi depth for the season was 4.70 feet, which was higher than the county median (3.15 feet).

Conductivity concentrations are correlated with chloride concentrations. The average conductivity reading for Waterford Lake in 2010 was 0.8536 mS/cm, which was above the county median (0.7910 mS/cm). This was a 41% decrease from the 2006 average (1.2022 mg/L). The chloride concentration in Waterford Lake in 2010 was 234 mg/L which is above the county median of 145 mg/L.

Aquatic plant sampling was conducted on Waterford Lake in July. Three species of plants were present covering 76% of all sites sampled. A dramatic shift occurred in the aquatic plant community since 2006 which was completely dominated by *Chara* spp. a macro algae. Water Stargrass, a native plant was the dominant species, in 2010 with plants present at 72% of sites. In addition to Water Stargrass and *Chara* spp., Sago Pondweed was also documented at 11% of the sites.

Based on the 2010 assessment, Waterford Lake had approximately 25% of the shoreline having some degree of erosion. Overall, 75% of the shoreline had no erosion, 12% had slight erosion, 8% had moderate, and 5% had severe erosion.

WATERFORD 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. Waterford Lake is in the North Mill Creek watershed and receives water from its residential watershed and Potomac Lake, and drains into Springledge Lake under Teal Road from the south outlet. The 241.2 acre watershed carries storm water and pollutants into Waterford Lake. The external sources affecting Waterford Lake were from the following land uses: single family homes (47%) and transportation (11%). 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 the ground, more runoff is generated than undeveloped land.

The two major sources of the total runoff for Waterford Lake were single family homes (54%) and transportation (36%). The lake is surrounded by developed land which provides the lake with little protection from runoff and nutrients before they enter the lake.

The size of the watershed feeding the lake relative to the lake 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 600 days.

Typically water quality declines as pollutants accumulate from the top to the bottom of the watershed and as the watershed area increases. However in 2010 water quality actually improved as it traveled from Potomac Lake to Waterford Lake (table pg 3). Waterford Lake's aquatic plant community significantly improved since 2006. Aquatic plants compete with algae for nutrients and help to stabilize sediments. As water continues to move downstream into McDonald Lake #2 it passes through Springledge Lake, another residential watershed. McDonald Lake #2 has excessive amounts of phosphorus and total suspended solids which are influenced internally by common carp. Their feeding disrupts shallowly rooted plants muddying the water and releasing phosphorus.

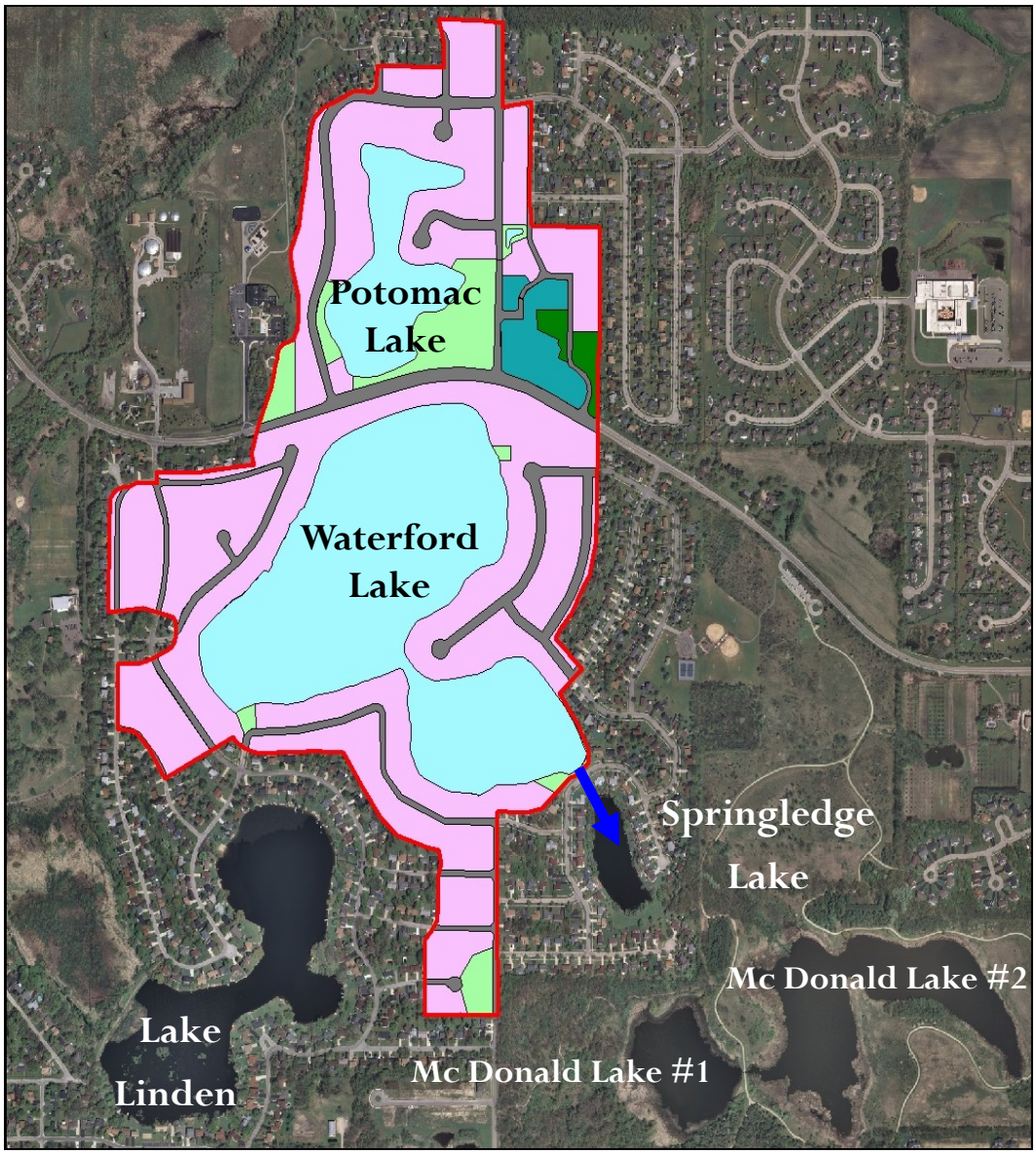
2010 Land use in the Waterford Lake

- 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

Waterford Lake Outlet

Direction of watershed: Potomac Lake drains into Waterford Lake from the south outlet. Waterford Lake drains south into Springledge Lake that drains into McDonald Lake #2 and eventually enters North Mill Creek

POTOMAC WATERSHED



Lake	Potomac Lake	Potomac Lake	Potomac Lake	Waterford Lake	Waterford Lake	Waterford Lake	McDonald Lake # 2	McDonald Lake # 2	McDonald Lake # 2
Year	**2000**	**2006**	**2010**	**2000**	**2006**	**2010**	**2003**	**2006**	**2010**
Secchi (feet)	NA*	NA*	NA*	6.4[b]	3.048	4.70	0.56	1.08	0.50
TSS (mg/L)	3.9	3.42	2.7[k]	2.7	12.0	3.9	70.1	27.3	77.0
TP (mg/L)	0.032	0.042	0.085	0.032	0.061	0.040	0.271	0.325	0.225
Conductivity (mS/cm)	0.8577	1.5533	0.8883	0.8375	1.2022	0.8536	1.1532	1.2494	0.7876

2000 to 2010 Comparisons for epilimnetic averages for total suspended solids, total phosphorus, and conductivity readings for Potomac Lake and Waterford Lake.

* = Secchi visible to bottom "b" Secchi obstructed by plants k = Denotes that the actual value is known to be less than the value presented.

VOLUNTEER LAKE MONITORING PROGRAM

The VLMP was established in 1981 to gather information on Illinois inland lakes, and to provide an educational program for citizens. The primary measurement by volunteers is the secchi depth (water clarity). Other observations such as water color, suspended algae and sediment, aquatic plants and odor are also recorded. The sampling season is May through October with measurements taken twice a month. . In 2010 there were **43 lakes** participating in Lake County.

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

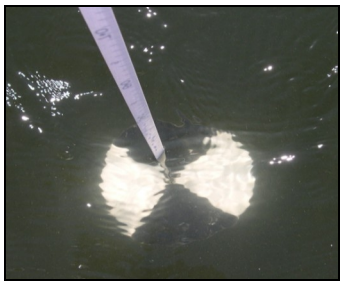
WATER CLARITY

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

Measurements taken with a Secchi disc 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 Waterford Lake was 4.70 feet; this was a 65% increase in the lake's transparency since 2006 (3.05 feet) above the county median of 2.95.



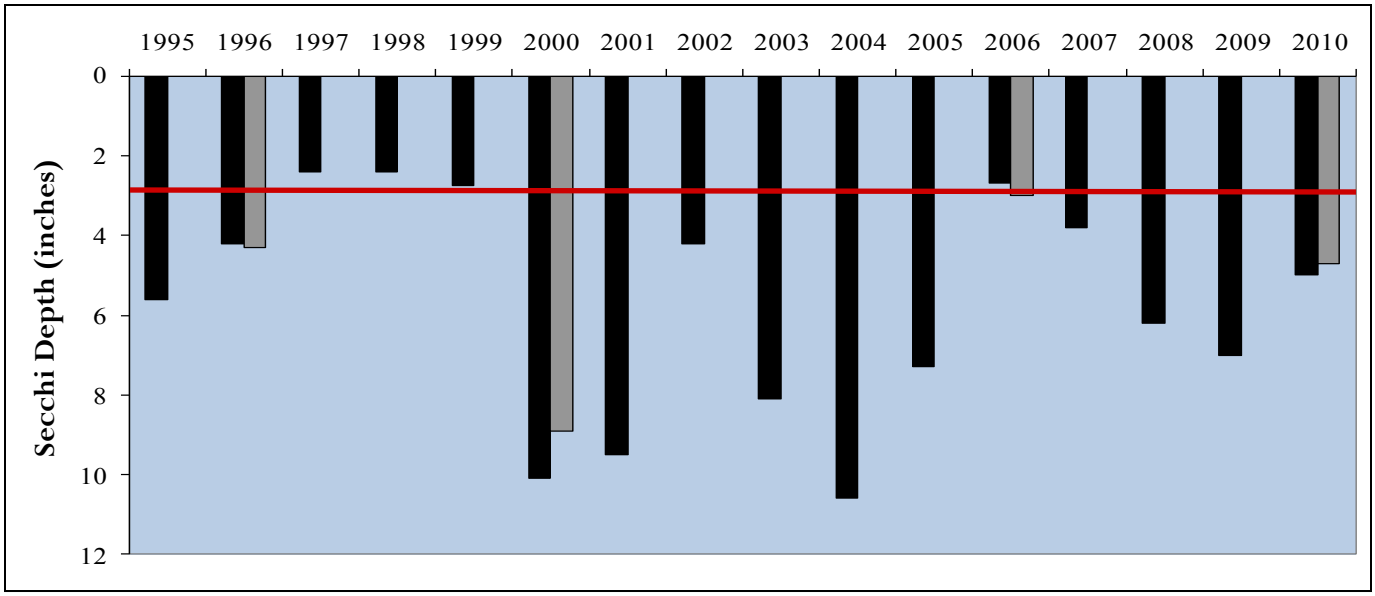
A Secchi disk is an eight-inch diameter weighted metal plate painted black and white in alternating quadrants. A calibrated rope is used to lower the disc into the water and measure the depth to which it is visible.

WATER CLARITY-VOLUNTEER LAKE MONITOR PROGRAM

Additional water clarity measurements were taken in Waterford Lake through participation in the Illinois Environmental Protection Agency's (IEPA) Volunteer Lake Monitoring Program (VLMP). Waterford Lake has participated in the program since 1986. Waterford Lake was monitored by Ray McKoski from 1986 - 2009 and Lyle Erickson with McCloud Aquatic Services from 1997– 2010. Participation in the VLMP program has provided Waterford Lake with baseline data that can be used to determine long-term water quality trends and support current lake management decision making. The average VLMP Secchi disk depth from 1986 through 2010 was 6.44 feet. Yearly readings have varied from 2.34 feet in 1997 to 10.6 feet in 2004. Water clarity has mostly remained above the 2010 county median since 1986 the exceptions being 1997, 1998, and 2006. The volunteers on Waterford Lake have provided data that is vital for the continued monitoring and management of this lake. The LCHD-ES would like to thank them for their efforts and recommend continued involvement in the future.

SECCHI DISK AVERAGES FROM VLMP AND LCHD RECORDS FOR WATERFORD LAKE 1995-2010.

- VLMP
- LCHD
- LAKE COUNTY 2010 MEDIAN 2.95 FEET



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).

2010 TSS concentrations averaged 3.9 mg/L which was below the county median of 8.1 mg/L and more than three times lower than the 2006 average concentration of 12.0 mg/L.

High TSS values are typically correlated with poor water clarity (Secchi disk depth) and can be detrimental to many aspects of the lake ecosystem including the plant and fish communities.

Calculated nonvolatile suspended solids (NVSS) was <1 mg/L. This means that the majority of the TSS concentration in 2010 can be attributed to organic particles, such as algae. Turbidity caused by algae reduced the water clarity in Waterford Lake. Algae blooms were documented throughout the sampling season.

Similar to Lake Linden there were two main types of algae documented during the 2010 sampling season. Early in the summer filamentous algae mats could be found along the shorelines, primarily consisting of *Mougeotia* sp. a non branching filamentous green algae *Zygnema* sp. and *Spirogyra* sp. were also documented. As summer progressed planktonic algae (free -floating) blooms occurred. In August a blue-green algae bloom consisting primarily of *Anabaena* sp. occurred.

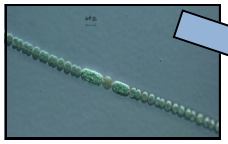
Year	TSS
2010	3.9
2006	12.0
2000	2.7
1996	8.18

Total Suspended Solids concentration (mg/L) in Potomac Lake 1996-2010.

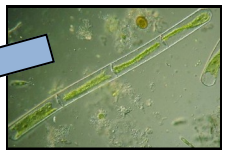
***2010 Lake County median TSS = 8.1 mg/L**

Green Filamentous Algae Bloom

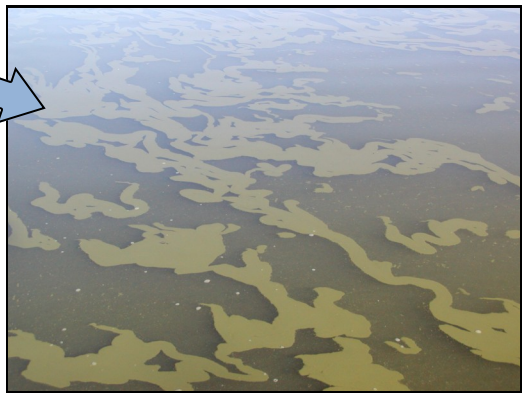
Picture provided by: Lindenhurst Lakes Commission



Anabaena *Sp.*

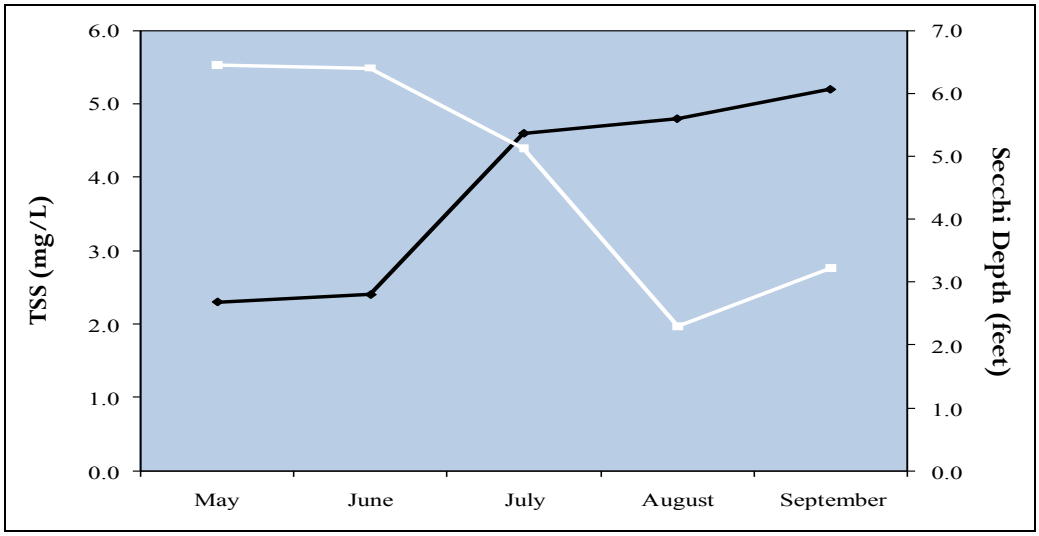


Mougeotia *Sp.*



Blue-green Planktonic Algae Bloom

Picture provided by: Lindenhurst Lakes Commission



Monthly Total Suspended Solid Concentrations and Secchi Depth in Waterford Lake, 2010.

TSS (mg/L)

Secchi Depth (feet)

Blue-green algae-the facts

Homeowners can help reduce nutrient concentrations by promoting the following land management practices:

- Use phosphorus free fertilizers and only where truly needed
- Plant and maintain native plant buffer strips along shorelines of lakes, ponds, and streams
- Prevent yard debris from leaving property (ie leaves, grass clippings, etc.)
- Clean up after pets

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

Bacteria 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 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

Toxins 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.

Treatments 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

Symptoms 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.

During a blue green algae bloom the lake can develop a paint-like appaearance

Slocum Lake

Aquatic Herbicides-Copper Sulfate

Copper salts is one of the earliest know herbicides for terrestrial and aquatic weed control. Cupper 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 restriction on the use of water following a treatment. McCloud Aquatic Services treated Waterford Lake for algae every two weeks in May and June with copper sulfate. The largest application occurred on Waterford Lake June 28, 2010 to treat a moderate filamentous algae bloom and moderate Chara sp. growth. The efficiency of copper sulfate is greatly affected by the carbonate alkalinity ($CaCO_3$) concentrations in the water. The copper will combine with the carbonates and precipitate out of the water preventing the copper from entering the algal cells. Waterford Lake average alkalinity concentration in 2010 was 142 mg/L. Alkalinity concentrations 50 to 250 mg/L provide effective treatment and protect fish from lethal doses of copper. Copper sulfate is a contact herbicide. Therefore, direct exposure of the algae to the compound is required. Copper sulfate has a fairly short active period, and is quickly absorbed into the sediment. Over time a build up of copper can occur in the sediment. Copper is toxic to invertebrates, which are aquatic bugs that live in the sediment. This can cause a disruption in the food chain from the bottom up resulting in a reduction in growth rates in the fish community.

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.

Copper Sulfate Application

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-Floridone (Sonar)

Sonar™ is a broad spectrum herbicide used to reduce the populations of a variety of submerged, emergent, and floating plants, and shoreline plants. Sonar is absorbed through the leaves and shoots and from the soil through the roots. Sonar is a photosynthetic inhibitor, the application blocks the light reactions of photosynthesis where plants convert the energy from sunlight into food. Depending on conditions symptoms of the treatment can be observed 7-10 days after treatment. Leaves will appear pale green, yellow, or yellow-white in color. McCloud Aquatic Services applied a one time application of Sonar at 6ppb on April 13, 2010 to reduce Waterstargrass populations.

New Permit Requirements for Applying Pesticides in Waters

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 20 acres of treatment or 20 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 20 acre threshold requirement.

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

For full details of the rule see:

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

Excerpt from Winter 2011 Cattail Chronicles.

YEAR	TP
2010	0.040
2006	0.061
2000	0.032
1996	0.037

PHOSPHORUS CONCENTRATIONS FOR WATERFORD LAKE 1996-2010

2010 Lake County median TP = 0.065 mg/L

WHAT HAS BEEN DONE TO REDUCE PHOSPHORUS LEVELS IN WATERFORD LAKE

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

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

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

WHAT YOU CAN DO TO HELP LOWER PHOSPHORUS LEVELS IN WATERFORD 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 Waterford 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.

NUTRIENTS-PHOSPHORUS/NITROGEN

Organisms take nutrients in from their environment. In a lake the primary nutrients needed for aquatic plant and algal growth are phosphorus and nitrogen. In most lakes, phosphorus is the limiting nutrient, which means everything that plants and algae need to grow is available in excess: sunlight, warmth, and nitrogen. Phosphorus has a direct effect on how much aquatic plants and algae can grow in lakes. The 2010 average total phosphorus concentration in Waterford Lake was 0.040 mg/L this was a 34% reduction from the 2006 concentration (0.060 mg/L). Other Lindenhurst lakes sampled in 2010 included Lake Linden and Potomac Lake. These lakes are considered impaired by the Illinois Environmental Protection Agency for violation of water quality standards. Lake Linden and Potomac Lake phosphorus concentrations of 0.057 mg/L and 0.085 mg/L, respectivily 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 Waterford Lake was 0.85 mg/L, which was lower than the county median of 1.18 mg/L and a 44% reduction from the 2006 concentration (1.52 mg/L).

TROPHIC STATE INDEX

Another way to look at phosphorus levels and how they affect lake productivity is to use a Trophic State Index (TSI) based on phosphorus (TSIp). TSIp values are commonly used to classify and compare lake productivity levels (trophic state). A 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, Waterford Lake was eutrophic with a TSIp value of 57.3. Based on the TSIp, Waterford Lake ranked 46th out of 162 lakes studied by the ES from 2000-2010. The 2010 value has increased 25 spots from the 2006 TSIp value of 64.5.

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.

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 Waterford Lake was 0.8536 mS/cm. This parameter was above the county median of 0.7800 mS/cm and a 29% decrease from 2006 (1.2022 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 175 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. Waterford Lake had slightly lower chloride concentrations than Potomac Lake (195 mg/L) but higher than McDonalds #2 (136 mg/L) which is surrounded by the Lake County Forest Preserves McDonalds Woods. 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.

YEAR	COND	Cl^-
1996	0.8360	138
2002	0.9772	183
2006	1.203	209
2010	0.7294	134

CHLORIDE CONCENTRATIONS (CL-) AND CONDUCTIVIY FOR WATERFORD LAKE 1996-2010

***2010 Lake County medians**

Conductivity = 0.7800 mS/cm

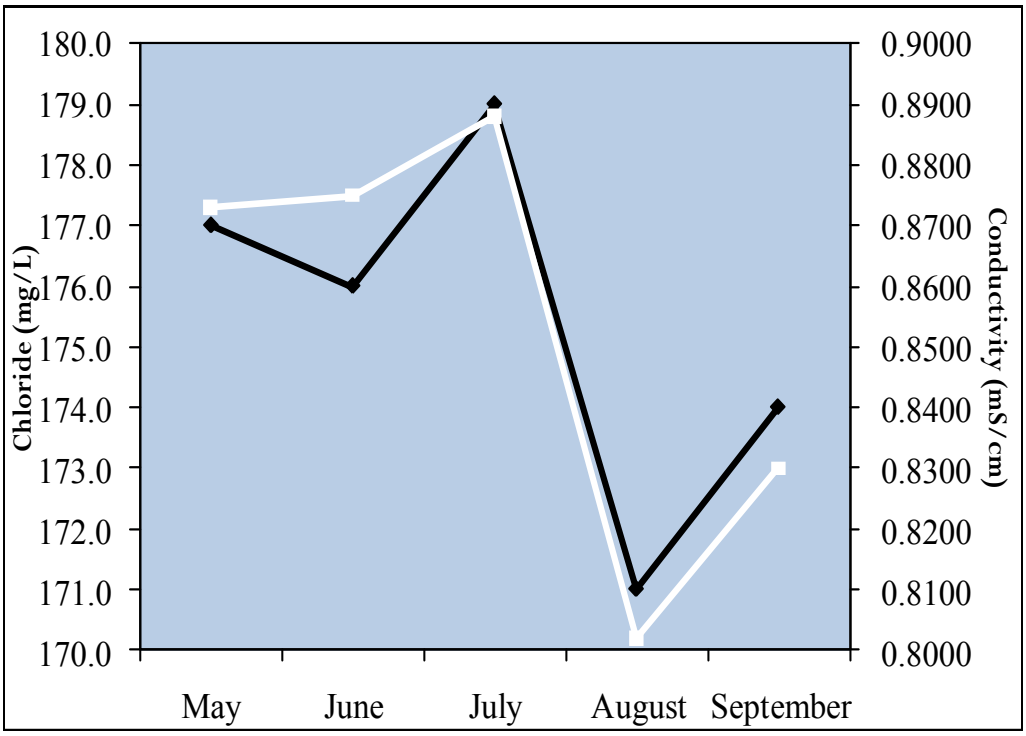
Chloride= 142mg/L

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.



Monthly Chloride Concentrations (CL) Vs. Conductivity in Waterford Lake, 2010.

Conductivity

Chlorides

DATE	COND	Cl^-
May	0.728	137
June	0.730	139
July	0.768	142
August	0.685	122
September	0.736	128

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

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.

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 around 20 degrees (below zero).
3. Creates a composition that sticks to the pavement versus dry salt that can bounce off of the pavement.
4. Reduces salt use by 20%.
5. Environmentally friendly product.

Lake County Division of Transportation:

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

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

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

ZOOPLANKTON

***DIAPHANOSOMA* SP. IN WATERFORD 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 Waterford 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 most abundant type of zooplankton in Waterford Lake in 2006 and 2010 was the Cladocerans. In July 2010 the 1% light level reached to the bottom of the lake, enabling Zooplankton to be collected from the entire water column. In July 2010 the most abundant Cladoceran was *Diaphanosoma* sp. This species is commonly found in both open water in depths of 3-6 meters and inshore areas of lakes. Diaphanosoma are a filter feeding species with a preference for chlorophytes and diatoms. In the Great Lakes region this genus is an important source of food for predatory zooplankton and multiple species of fish including Largemouth Bass.

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 October 2010 the LCHD-ES collected the field data to replace the bathymetric map created by the LCHD-ES in 1994. Field data was collected using Biosonics equipment along with a Trimble GPS unit with sub-foot accuracy. Once collected, the data was analyzed and imported into ArcGis for further analysis. In ArcGis, the contours were drawn and the volume was calculated.

Morphometric Data

Surface Area: 67.54 acres

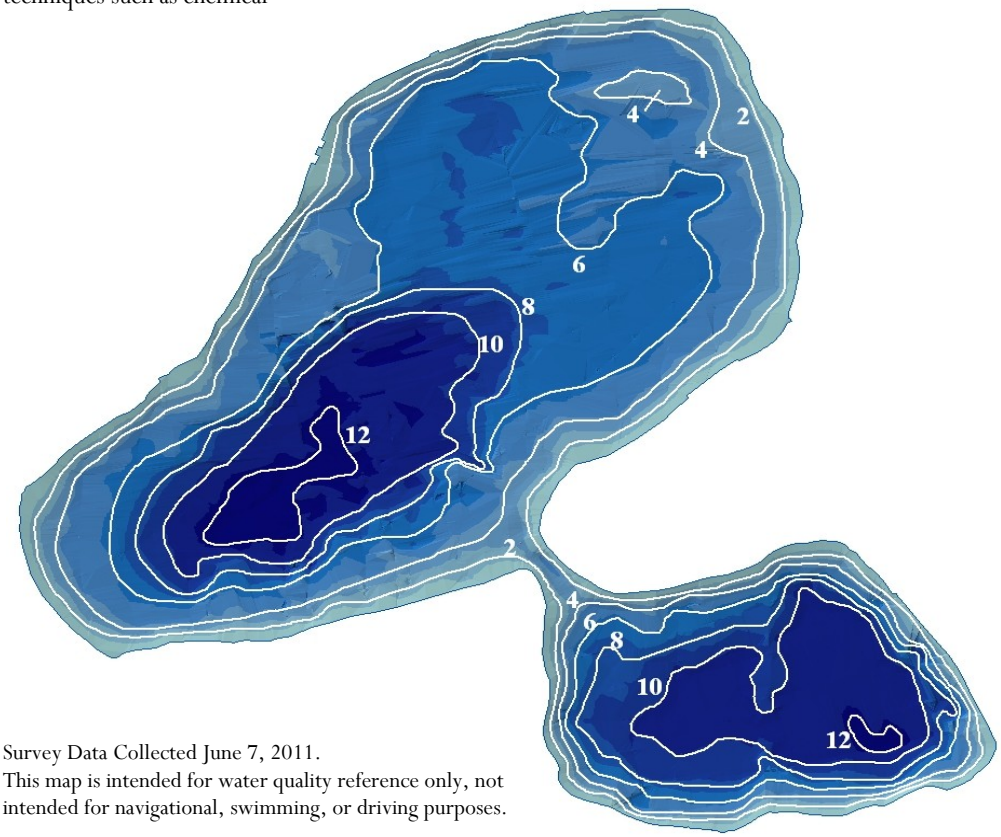
Maximum Depth: 12.86 feet

Average Depth: 6.35 feet

Lake Volume: 423.78 acre-feet

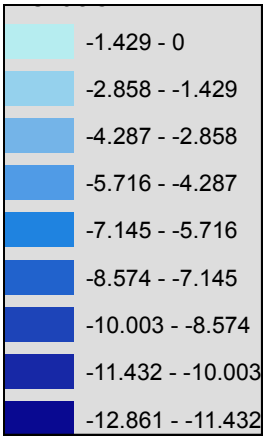
Shoreline Length: 1.82 miles

Lake Elevation: 767.25 feet, msl



Survey Data Collected June 7, 2011.
This map is intended for water quality reference only, not intended for navigational, swimming, or driving purposes.

COLOR RAMP ILLUSTRATING ELEVATION OF WATERFORD LAKE



At the time of data collection Waterford Lake had an elevation of 772.74 feet above mean sea level.

Contour (feet)	Area enclosed (acres)	Percent of total acres	Volume (acre-feet)	Depth zone (feet)	Area (acres)	Depth Zone to Total Acres (percent)	Acre-Feet to Total Volume (percent)
0	67.54	100%	65.94	0 - 1	3.20	4.7%	15.5%
1	64.34	95%	62.68	1 - 2	3.31	4.9%	14.8%
2	61.04	90%	59.18	2 - 3	3.70	5.5%	13.9%
3	57.34	85%	54.72	3 - 4	5.20	7.7%	12.9%
4	52.15	77%	48.28	4 - 5	7.63	11.3%	11.4%
5	44.51	66%	39.89	5 - 6	9.08	13.4%	9.4%
6	35.44	52%	29.33	6 - 7	11.81	17.5%	6.9%
7	23.62	35%	21.36	7 - 8	4.45	6.6%	5.0%
8	19.17	28%	17.55	8 - 9	3.19	4.7%	4.1%
9	15.98	24%	13.92	9 - 10	4.01	5.9%	3.3%
10	11.97	18%	8.31	10 - 11	6.85	10.1%	2.0%
11	5.1196	8%	2.61	11 - 12	4.36	6.5%	0.6%
12	0.7550	1%	0.541	12+	0.76	1.1%	0.1%
			424.32		67.54	100%	100%

2007 FISH SURVEY: ILLINOIS DIVISION OF NATURAL RESOURCES

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 northeastern part of the Waterford Lake as they will splash around in the shallows.

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

In September of 2007 the Illinois Department of Natural Resources (IDNR) conducted a 40 minute daytime electrofishing survey of Waterford Lake. The survey was undertaken to assess the abundance and diversity of fish following rehabilitation on September 30, 1999. The IDNR collected 387 fish representing four fish species: Largemouth Bass, Bluegill, Catfish, and Black Crappie. Largemouth Bass was the most abundant fish species collected at 55.6% of the catch (215 individuals) ranging in length from 2.4 to 19.5 inches. The catch per unit effort of 5.4 was well above the Management Objective of 1.0 fish per minute. A high proportion of the catch (45%) was composed of individuals less than 6" (young of the year (YOY)). A population parameter called Young:Adult ratio helps quantify the proportion of small fish in a sample by comparing the number of fish less than 6" long to those over 12" long (and sexually mature). A value of from 1.0 to 10.0 indicates successful reproduction. Waterford Lake's Young:Adult ratio was 1.8 indicated a very successful spawn in 2007. 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 Waterford Lake sample had a PSD of 56%, within management goals and had a good balance between mature and immature fish. In addition the Relative Weight (Wr's) for the Largemouth Bass sample was 98 and within management parameters of 90 to 105. Lakes in our area usually have bass Wr's between 90 and 93 so the population in Waterford Lake appears to be relatively "plump" compared to neighboring lakes in Lake County.

Bluegill made up 41% of the sample even though they were only collected for half the sample time. Due to the large quantities of Bluegill, IDNR focuses their collection on size groups and sunfish diversity to save space and reduce stress in the holding tank. Overall in 2007 the population had strong reproduction, a dominant size group of 4 to 5 inches and fish up to 8 inches long. The Young / Adult ratio of Waterford Lake's Bluegill was 6.8 suggested very strong reproduction. It was noted that the lack of near shore vegetation can inhibit the IDNR's ability to collect bluegills, especially larger fish because in lakes with little rooted aquatic vegetation fish become pelagic (open water) and feed on zooplankton instead of the invertebrates associated with vegetation. In 2010 the LCHD-ES documented a significant increase in aquatic vegetation in Waterford Lake (page 14).

The only other species detected were eight black crappie and four channel catfish. The black crappie were probably introduced into Waterford around the same time they were introduced into Lake Linden. Crappie probably won't expand their presence unless something impacts the bass population.

Following the 2007 IDNR fish survey fisheries biologist, Frank Jakubicek, concluded that following the 1999 rehabilitation the largemouth bass and bluegill population has remained relatively undiluted. "A testament to the public relations work done to promote lake practices that are healthy and in the best interest of prolonged success". The IDNR had the following recommendations for Waterford Lake in 2008 (page 13).

ILLINOIS DIVISION OF NATURAL RESOURCES 2007 CATCH SUMMARY FOR WATERFORD

SPECIES	NUMBER	PERCENT	LENGTH (In) MINIMUM	AVERAGE	MAXIMUM
LARGEMOUTH BASS	215	55.6	2.4	10.3	19.5
BLUEGILL	160	41.3	1.6	4.5	9.4
BLACK CRAPPIE	8	2.1	6.4	7.3	8.3
CHANNEL CATFISH	4	1.0	25.2	27.7	28.7
SPECIES= 4 TOTAL=	**387**	**100.0**			

FISHING

Waterford Lake is located entirely within the village limits of Lindenhurst and is almost completely private, with the exception of two access points open to Lindenhurst residents. The lake is used for non-gas motor boating and fishing and managed by the Lindenhurst Lakes Commission (LLC). The village of Lindenhurst has passed several ordinances (95.58 Fishing) to protect the Waterford Lake fishery. The two ordinances that further restrict Illinois anglers are the use of live bait fish and the catch and release of game fish species. The village also urges anglers to use barbless hooks. The village reduced the state unlimited daily bag limit on Bluegill to 25 and specifically stated that all Largemouth Bass, Muskellunge species, and Channel Catfish must be released.

The village of Lindenhurst supplements the fish populations in Waterford Lake based on IDNR and LLC recommendations to maintain a balanced fish community.

STOCKING IN WATERFORD LAKE

Pictures provided by: Lake Lindenhurst Lake Commission

2007:

122 Tiger Muskellunge 18-22 inches at a rate of 2/acre

2008:

975 Channel Catfish 8-11 inches at a rate of 15/acre

2010:

50 Natural Muskellunge

IDNR 2007 RECOMMENDATIONS

1. **Stock (at least) 25 non-vulnerable channel catfish per acre, every two or three years.**
2. **Work with Commercial applicators and homeowners to establish areas where rooted aquatic vegetation can grow, expand and diversify.**
3. **Remove carp if caught.**
4. **There's no need to stock largemouth bass, or bluegills, or minnows.**

2007 ELECTROFISHING SURVEY WATERFORD LAKE

Pictures provided by: Lake Lindenhurst Lake Commission

COLLECTION

DATA

EQUIPMENT

AQUATIC PLANT SAMPLING

DISTRIBUTION OF RAKE DENSITY ACROSS ALL SITES SAMPLED

Rake Density (Coverage)	# of Sites	%
No plants	17	23.6
>0 to 10%	11	15.3
>10 to 40%	15	20.8
>40 to 60%	10	13.9
>60 to 90%	11	15.3
>90%	8	11.1
Total Sites	55	76.4
Total # of Sites	72	100.0

The stem grows to 2m, is more or less limp, and often forms profuse roots at the nodes

Flower: bright yellow with 6 petals forming a star just above the waters surface.

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.

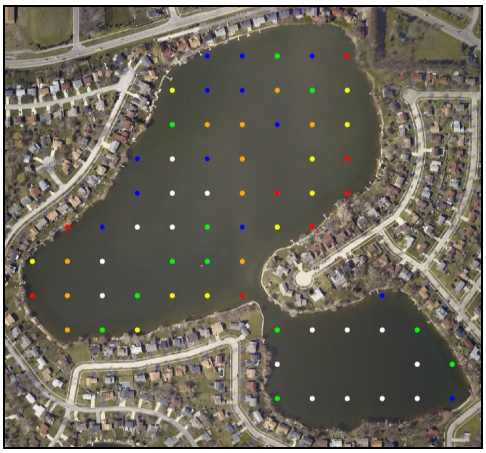
Aquatic plant sampling was conducted on Waterford Lake in July 2010. There were 74 points generated based on a computer grid system with points 60 meters apart. Aquatic plants existed at 55 of the sites that included 2 native aquatic plant species and one macro-algae (Chara sp.). No exotics species were present.

Species diversity has remained small, but improved from the 2006 monoculture of Chara sp. In 2010 the most common species was Water Stargrass at 72% of the sites sampled while Chara sp. and Sago Pondweed were present at 18% and 11%, respectively. A truly healthy aquatic plant community contains a large number of plant species that provide different types of habitat and structure to the lake that covers 30-40% of the lake. In 2010 Waterford Lake aquatic plants covered 76% of the lake bottom. 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 Waterford Lake could reach the bottom of the lake May through July, but was limited to 10 feet in August and September. Waterford Lake's water clarity and relatively shallow morphology are key components in establishing an effective aquatic plant management plant. In 2006 the aquatic plant community consisted one species covering 19% of the lake. The 2010 aquatic plant community contained no exotic species and an increase in species diversity and abundance. The future aquatic plant management plan should incorporate additional native aquatic plant species, to diversify the plant community and provide a variety of habitats. Control of Water Stargrass may be needed in the north central portion of the lake where densities are high and the lake depth is relatively shallow. Aquatic plants provide sediment stabilization and competition for algae for resources. The water quality benefits of an improved aquatic plant community in Waterford Lake are supported by the increase in water clarity and decrease in total phosphorus and suspended solids when compared to the 2006 values.

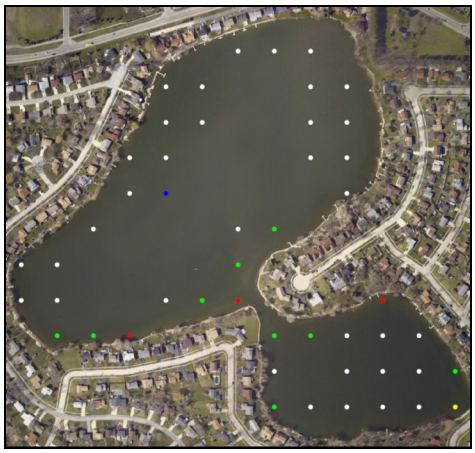
Plant Density	Chara	Sago Pondweed	Water Stargrass
Absent	59	64	20
Present	8	3	9
Common	4	2	15
Abundant	1	0	12
Dominant	0	3	16
% Plant Occurrence	18.1%	11.1%	72.2%

AQUATIC PLANT DENSITY

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



Aquatic Plant Density at 72 sites on Waterford Lake in July 2010, Maximum depth that plants were found was 11.5 feet



Aquatic Plant Density at 49 sites on Waterford Lake in July 2006, Maximum depth that plants were found was 5.8 feet

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. Waterford Lake has an FQI of 9.2 ranking 45th out of 124.

The Average FQI for Lake County Lakes = 14.4

AQUATIC PLANTS: WHERE DO THEY GROW?

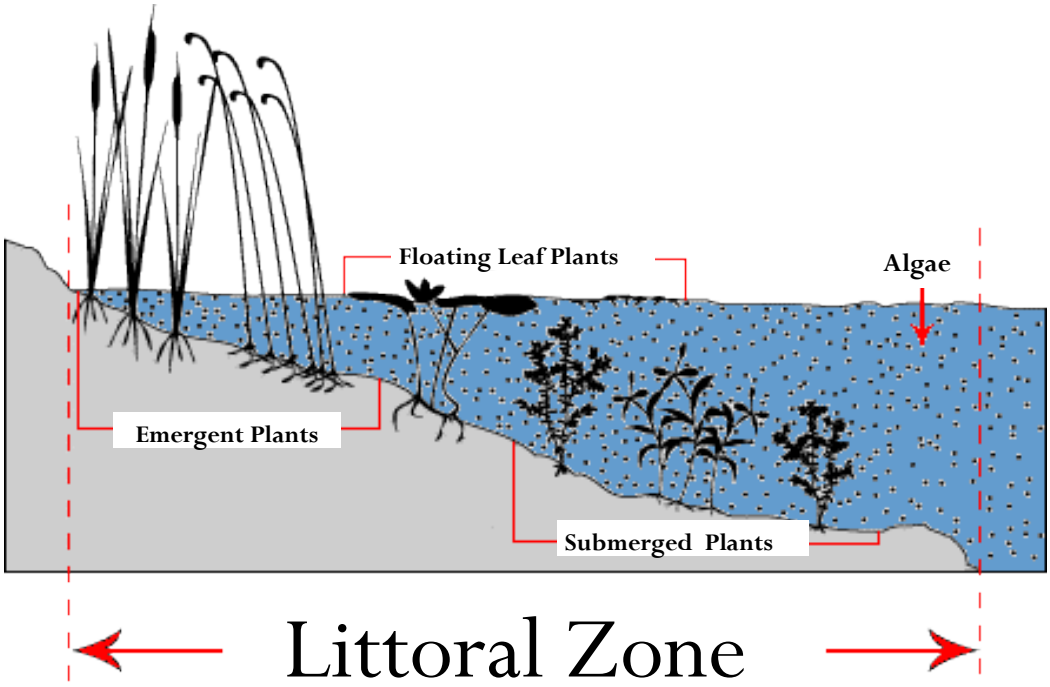
Littoral Zone– the area that aquatic plants grow in a lake.

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

Shoreline Erosion

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 89% of the shoreline having some degree of erosion. Overall, 75% of the shoreline had no erosion, 12% had slight erosion, 8% had moderate, and 5% had severe erosion.

Severe erosion was documented is two places around the lake. The first is on the south east side of Thunderbay. This area was also considered severely eroded in 2006. The second area was located on the north east side of the main part of Waterford Lake. This area was reclassified from having moderate erosion in 2006 to severe in 2010.

The areas of moderate and severe erosion occur around the lake these should be addressed soon. It is much easier and less costly to mitigate slightly eroding shorelines than those with more severe erosion. While some residents have installed filter strips along their lakefront, many areas of manicured lawn remain with erosion problems. The roots of lawn grass do not provide the stabilization needed to hold sediment in place. Additional native filter strips and repaired seawalls and riprap should be installed to prevent further erosion.

Proportion of Shorelin erosion on Waterford Lake 2010

Classification	% Erosion
none	75
slight	12
moderate	8
severe	5

Shoreline erosion on Waterford Lake, 2010

Monthly Water Levels in Waterford Lake, 2010 and Lake County Stormwater Management Commission Rain gauge data from the Lindenhurst rain gauge

2010	Level (in)	Rain (in)
May	16.00	
June	18.50	3.26
July	21.00	3.18
August	18.50	7.34
September	21.75	3.26

Water level was measured from the top of a dock to the water surface

Lindenhurst Rain gauge
Photo: Lake County Stormwater Management Commission

Water Level

Lakes with stable water levels potentially have less shoreline erosion problems. The lake level in Potomac Lake was measured from the top of a dock to the waters surface. The water level fluctuations in Waterford Lake were generally stable. The lake level decreased gradually by 5.75 inches from May to September. The highest water level occurred in May and the lowest level in September. The most significant water level fluctuation occurred from August to September with an decrease in the lake level of 3.25 inches. Waterford Lake's water level does not appear to be significantly influenced by rain events. The watershed's primary landuse of single family homes surrounding the lake has the potential to deliver significant amounts of stormwater. 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).

RESTORATION: HIGH POINT DRIVE

Shoreline restoration through the installation of a buffer strip with native, plants can improve lake health three fold. First, the erosion is repaired and the new native plants can stabilize the shoreline to prevent future erosion. Second, the addition of native plants adds habitat for wildlife to a shoreline that is otherwise limited in habitat. Thirdly, buffer habitat can help filter pollutants and nutrients from the near shore areas and keep geese and gulls from congregating, as it is not desirable habitat for them.

In 2006, with the cooperation of the Lindenhurst Lakes Commission (LLC), Lindenhurst Park District (LPD), Lake County Forest Preserve (LCFP), and volunteers a demonstration project to restore a section of the shoreline at High Point Drive was implemented. The High Point Drive shoreline was selected based on its need for restoration and visibility to the public.

In 2007 on the ground work began. Undesirable shoreline plants and lawn were replaced with 1000 native wildflowers, sedges, and grasses.

A successful restoration project includes a long-term plan that factors in maintenance. The High Point Drive project has been maintained since implementation. With the combined efforts of volunteers and partnered agencies the project is a success. The restored area provides shoreline stabilization, habitat diversity, and an increased ability to filter nutrients. The LLC mission includes the encouragement of the use of shoreline buffer strips for the health of lakes and the surrounding ecosystem through the sharing of information. For more information on this project or creating your own buffer zone visit the LLC website.

FOR MORE INFORMATION ON THIS PROJECT OR CREATING YOUR OWN BUFFER ZONE VISIT THE LLC WEBSITE.

www.lindenhurstlakes.com

High Point Drive 2006 Prior to Restoration

June 2007

Volunteers plant 1000 plugs

June 2010

Native Wildflowers, Sedges, Grasses

June 2010

Volunteers remove undesirable weeds

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.

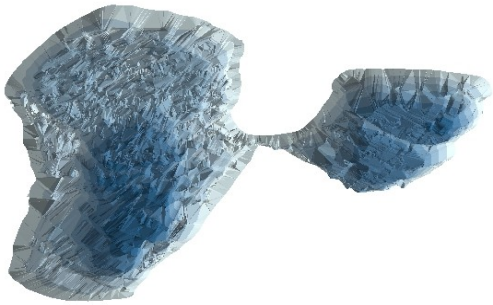
LAKE RECOMMENDATIONS

Waterford Lake's water quality has improved since 2006, total phosphorus, total suspended solids, and chloride concentrations have decreased and water clarity increased. The aquatic plant density has significantly expanded but diversity remains low. Waterford Lake has successfully demonstrated shoreline restoration at the High Point Drive access.

Waterford Lake, lake's management is administered by Lindenhurst Lakes Commission. To improve the overall quality of Waterford Lake, the ES (Environmental Services) has the following recommendations:

- **Increase aquatic plant diversity**
- **Participate in the winter Volunteer Lake Monitoring Program administered by the LCHD-ES**
- **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**

SHORELINE RESTORATION ON WATERFORD LAKE



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 Waterford Lake 2000, 2006, and 2010.

2010	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
18-May	3	153	0.68	<0.1	<0.05	0.022	<0.005	177	NA	2.3	496	86	6.45	0.8730	8.53	11.63
15-Jun	3	150	0.8	<0.1	0.24	0.029	<0.005	176	NA	2.4	486	72	6.40	0.8750	8.32	6.87
20-Jul	3	143	0.98	<0.1	0.06	0.050	<0.005	179	NA	4.6	500	84	5.12	0.8880	8.38	5.58
17-Aug	3	128	0.919	<0.1	<0.05	0.057	<0.005	171	NA	4.8	452	75	2.30	0.8020	8.34	5.33
20-Sep	3	138	0.885	<0.1	<0.05	0.041	<0.005	174	NA	5.2	465	81	3.22	0.8300	8.02	7.16
	Average	142	0.85	<0.1[k]	0.09[k]	0.040	<0.005[k]	175	NA	3.9	480	80	4.70	0.8536	8.32	7.31

2006	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
17-May	3	168	1.07	0.1	0.05	0.027	<0.005	259	NA	2.7	626	85	5.90	1.1460	8.23	10.88
21-Jun	3	166	1.33	0.1	<0.05	0.077	<0.005	260	NA	9.4	650	110	3.11	1.1890	8.13	6.77
19-Jul	3	169	1.98	<0.1	<0.05	0.071	<0.005	269	NA	16.0	688	113	2.13	1.2330	7.79	6.43
16-Aug	3	169	1.58	<0.1	<0.05	0.068	<0.005	285	NA	16.0	704	110	1.97	1.2520	8.64	7.80
20-Sep	3	157	1.65	<0.1	<0.05	0.062	<0.005	279	NA	16.0	659	107	2.13	1.1910	8.65	9.22
	Average	166	1.52	0.1[k]	0.05[k]	0.061	<0.005	270	NA	12.0	665	105	3.05	1.2022	8.29	8.22

2000	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	Cl	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
1-May	3	136	1.77	<0.1	<0.05	0.037	<0.005	NA	550	5.8	580	110	3.77	0.9778	8.96	12.28
5-Jun	3	105	1.20	<0.1	0.09	0.029	<0.005	NA	476	1.0	508	101	0[a]	0.8618	9.05	7.54
10-Jul	3	97.2	0.79	<0.1	0.06	0.037	0.005	NA	430	2.0	465	88	0[a]	0.7784	8.89	8.66
7-Aug	3	93.5	1.20	<0.1	<0.05	0.015	<0.005	NA	422	2.0	439	81	9.00	0.7715	8.92	8.06
5-Sep	3	98.2	1.03	<0.1	<0.05	0.041	0.007	NA	438	2.7	474	93	0[a]	0.7978	9.17	7.44
	Average	106	1.20	<0.1[k]	0.08[k]	0.032	0.006[k]	NA	463	2.7	493	95	6.4[b]	0.8375	9.00	8.80

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO2+NO3 = Nitrite and Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chlorides, 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 was analyzed

2010	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
18-May	10	153	0.73	<0.1	<0.05	0.031	<0.005	173	NA	2.3	496	86	NA	0.8730	8.54	11.56
15-Jun	9	151	1.64	0.1	0.05	0.027	<0.005	176	NA	3.4	497	81	NA	0.8780	8.26	6.01
20-Jul	10	148	1.12	0.3	0.14	0.136	0.038	178	NA	6.6	498	83	NA	0.8880	8.29	4.09
17-Aug	10	129	0.87	<0.1	<0.05	0.053	0.009	170	NA	2.8	457	79	NA	0.7990	8.19	4.17
20-Sep	10	135	0.97	0.0	0.00	0.039	0	172	NA	4.8	472	83	NA	0.8300	8.12	6.79
	Average	143	1.07	0.2[k]	0.08[k]	0.057	<0.014	173.8	NA	4.0	484	82	NA	0.8536	8.28	6.52

2006	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
17-May	8	169	1.22	0.1	0.05	0.040	<0.005	257	NA	3.8	626	83	NA	1.1490	8.10	9.38
21-Jun	8	167	1.32	0.1	<0.05	0.065	<0.005	261	NA	9.6	656	113	NA	1.1900	8.13	6.32
19-Jul	7	167	2.00	0.2	<0.05	0.098	<0.005	267	NA	19.0	672	104	NA	1.2370	7.89	4.15
16-Aug	7	169	1.67	<0.1	<0.05	0.068	<0.005	286	NA	17.0	707	121	NA	1.2540	8.20	4.38
20-Sep	8	157	1.50	<0.1	<0.05	0.060	<0.005	279	NA	16.0	667	112	NA	1.1910	8.68	9.21
	Average	166	1.54	0.1	0.05[k]	0.0662	<0.005	270	NA	13.1	666	107	NA	1.2042	8.20	6.69

2000	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	Cl	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
1-May	8	136	1.52	<0.1	<0.05	0.041	<0.005	NA	566	6.4	542	154	NA	0.9811	8.96	2.69
5-Jun	9	105	1.18	<0.1	0.06	0.026	<0.005	NA	481	1.1	507	110	NA	0.8622	9.05	7.19
10-Jul	9	97.3	0.99	<0.1	0.05	0.032	<0.005	NA	447	1.7	461	104	NA	0.7791	8.89	5.41
7-Aug	9	94.9	1.10	<0.1	<0.05	0.029	0.01	NA	434	3.3	440	79	NA	0.7760	8.70	0.40
5-Sep	8	98.7	1.00	<0.1	<0.05	0.041	<0.005	NA	444	1.8	481	120	NA	0.7987	9.12	7.43
	Average	106	1.16	<0.1[k]	0.05[k]	0.034	0.01[k]	NA	474	2.9	486	113	NA	0.8394	8.94	4.62

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO2+NO3 = Nitrite and Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chlorides, 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 was analyzed

Comparison of epilimnetic averages for Secchi disk transparency, total suspended solids, total phosphorus and conductivity readings in the Waterford Lake watershed (Potomac Lake, Waterford Lake, and McDonald Lake #2).

Lake	Potomac Lake	Potomac Lake	Potomac Lake	Waterford Lake	Waterford Lake	Waterford Lake	McDonald Lake # 2	McDonald Lake # 2	McDonald Lake # 2
Year	**2000**	**2006**	**2010**	**2000**	**2006**	**2010**	**2003**	**2006**	**2010**
Secchi (feet)	NA*	NA*	NA*	6.4[b]	3.048	4.70	0.56	1.08	0.50
TSS (mg/L)	3.9	3.42	2.7[k]	2.7	12.0	3.9	70.1	27.3	77.0
TP (mg/L)	0.032	0.042	0.085	0.032	0.061	0.040	0.271	0.325	0.225
Conductivity (mS/cm)	0.8577	1.5533	0.8883	0.8375	1.2022	0.8536	1.1532	1.2494	0.7876

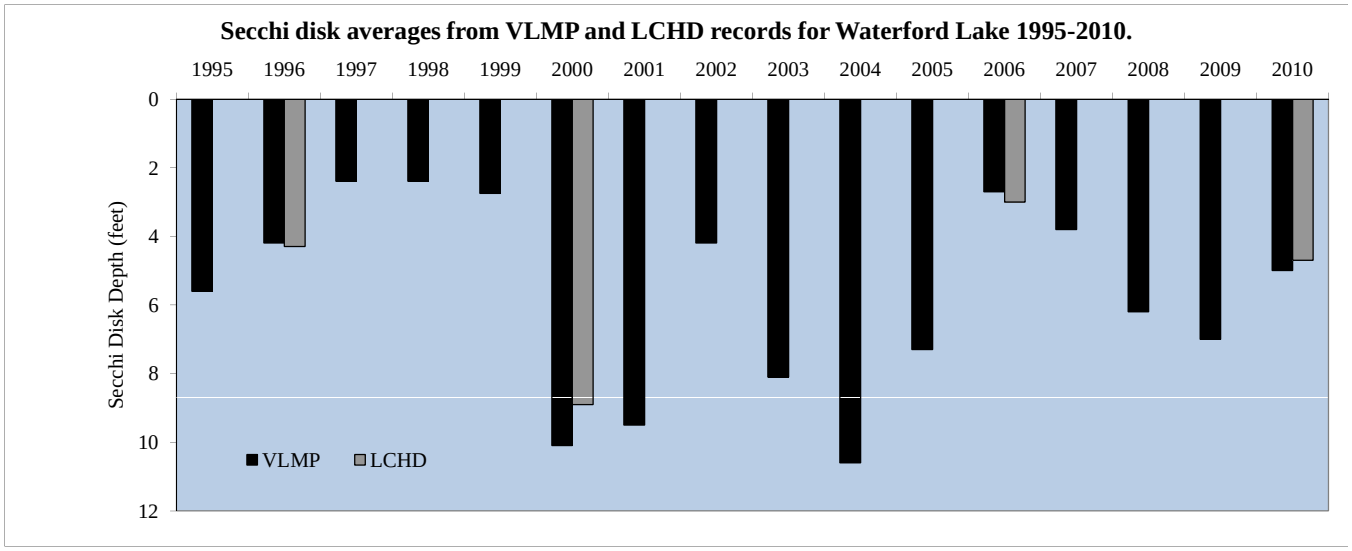
Direction of Watershed Flow

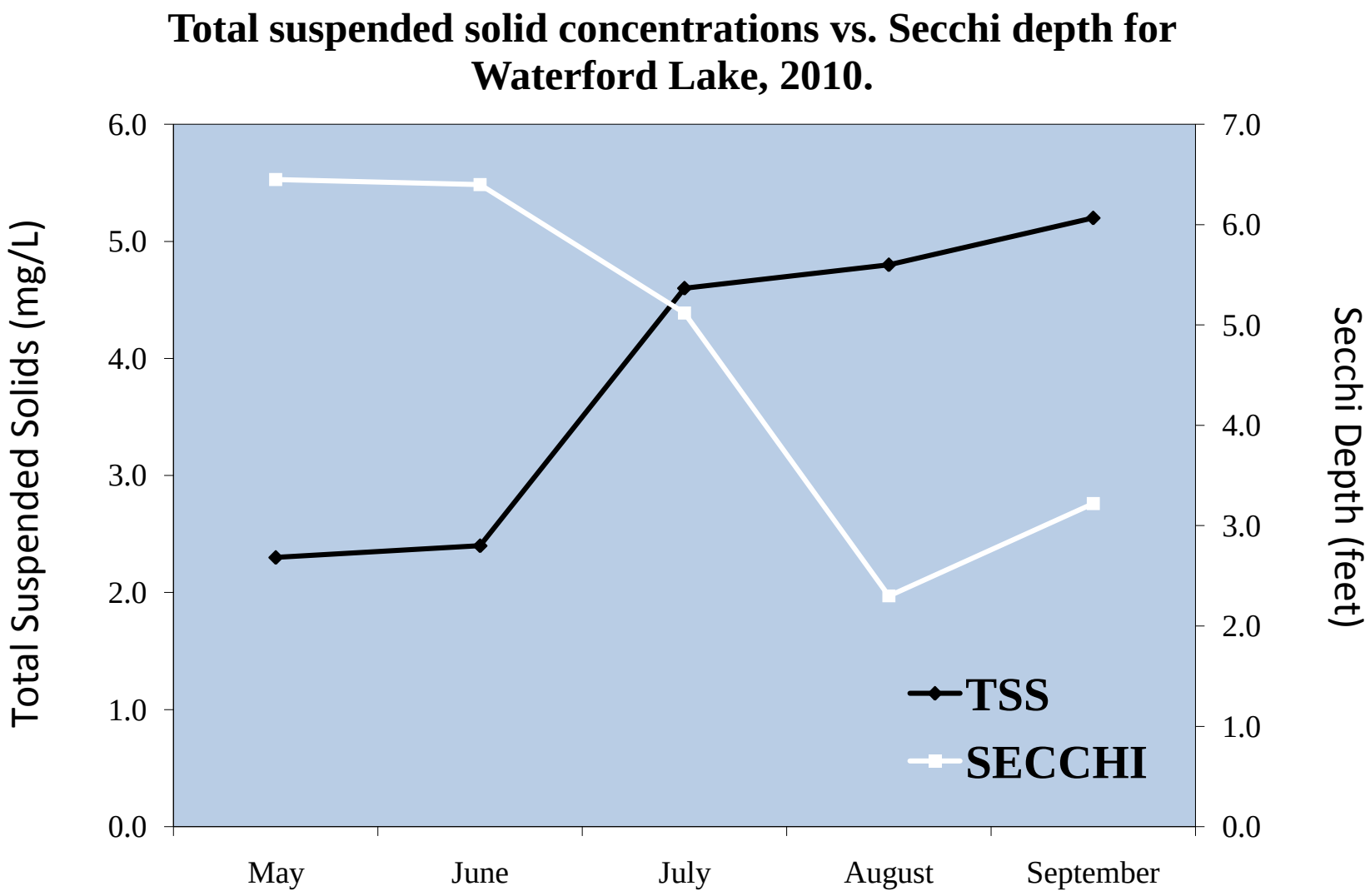
Waterford Lake 2010 IEPA Ranking

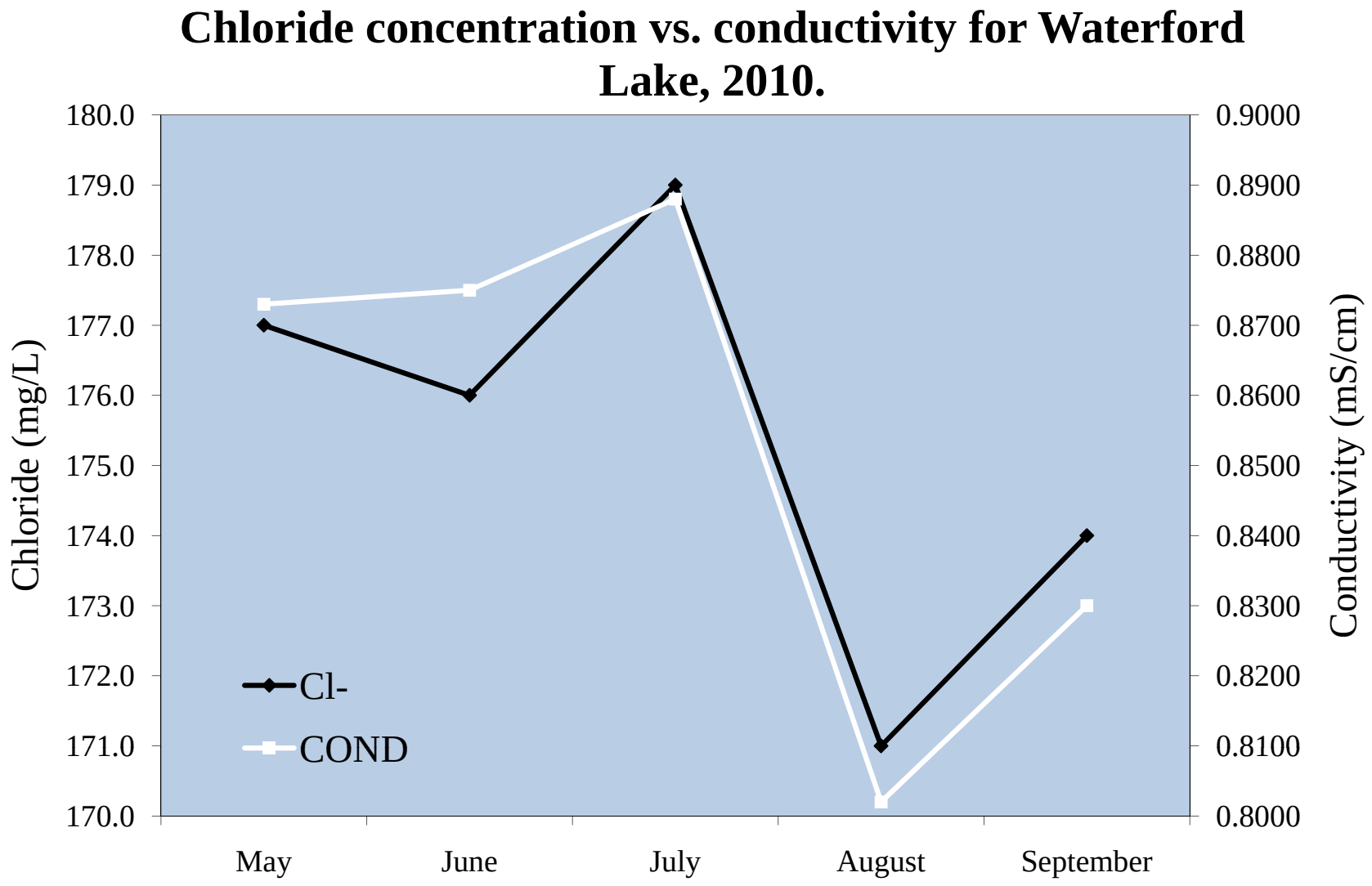
TROPHIC STATUS		
Carlson's TSIp	57.3	Eutrophic

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	None
Non-Native Animals	None

AQUATIC LIFE USE IMPAIRMENT INDEX	**Weighting Criteria**	**Points**	**Overall Use Support Points**	**Degree of Support**
Mean Trophic State	57.3	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	57.3	57.3		
Macrophyte Impairment	Substantial	15		
Sediment Impairment (NVSS)	Minimal	0		
Degree of Use Support		**72.3**	1	**Partial**
Overall Use Index			**0.50**	**Partial**


Secchi disk averages from VLMP and LCHD records for Waterford Lake 1995-2010.
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Secchi Disk Depth (feet)
0
2
4
6
8
10
12
VLMP
LCHD


Total suspended solid concentrations vs. Secchi depth for Waterford Lake, 2010.
Total Suspended Solids (mg/L)
Secchi Depth (feet)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
May
June
July
August
September
TSS
SECCHI


Chloride concentration vs. conductivity for Waterford Lake, 2010.
Chloride (mg/L)
Conductivity (mS/cm)
180.0
179.0
178.0
177.0
176.0
175.0
174.0
173.0
172.0
171.0
170.0
0.9000
0.8900
0.8800
0.8700
0.8600
0.8500
0.8400
0.8300
0.8200
0.8100
0.8000
May
June
July
August
September
Cl-
COND

Aquatic vegetation species found in July at the 72 sampling sites on Waterford Lake, July 2010. 11.5 feet. Maximum depth that plants were found was 11.5 feet.

Plant Density	Chara	Sago Pondweed	Water Stargrass
Absent	59	64	20
Present	8	3	9
Common	4	2	15
Abundant	1	0	12
Dominant	0	3	16
% Plant Occurrence	18.1%	11.1%	72.2%

Distribution of rake density across all sampling sites

Rake Density (Coverage)	# of Sites	%
No plants	17	23.6
>0 to 10%	11	15.3
>10 to 40%	15	20.8
>40 to 60%	10	13.9
>60 to 90%	11	15.3
>90%	8	11.1
Total Sites with Plants	55	76.4
Total # of Sites	72	100.0

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 Waterford Lake ~
Data From the June 7, 2011 Bathymetric Survey, LCHD Environmental Services

Contour (feet)	Area enclosed (acres)	Percent of total acres	Volume (acre-feet)	Depth zone (feet)	Area (acres)	Percent (depth zone to total acres)	Percent (acre-feet to total volume)
0	67.54	100%	65.94	0 - 1	3.20	4.7%	15.5%
1	64.34	95%	62.68	1 - 2	3.31	4.9%	14.8%
2	61.04	90%	59.18	2 - 3	3.70	5.5%	13.9%
3	57.34	85%	54.72	3 - 4	5.20	7.7%	12.9%
4	52.15	77%	48.28	4 - 5	7.63	11.3%	11.4%
5	44.51	66%	39.89	5 - 6	9.08	13.4%	9.4%
6	35.44	52%	29.33	6 - 7	11.81	17.5%	6.9%
7	23.62	35%	21.36	7 - 8	4.45	6.6%	5.0%
8	19.17	28%	17.55	8 - 9	3.19	4.7%	4.1%
9	15.98	24%	13.92	9 - 10	4.01	5.9%	3.3%
10	11.97	18%	8.31	10 - 11	6.85	10.1%	2.0%
11	5.1196	8%	2.61	11 - 12	4.36	6.5%	0.6%
12	0.7550	1%	0.541	12+	0.76	1.1%	0.1%
			424.32		67.54	100%	100%

Maximum Depth of Lake: 12.86 feet
Average Depth of Lake: 6.35 feet
Volume of Lake: 423.78 acre-feet

Area of Lake: 67.54 acres
Shoreline Length: 1.82 miles
Water Elevation at 767.25 feet above mean sea level
Water Elevation of Outlet: 767.29 feet above mean sea level

LakeCounty
Health Department and
Community Health Center

Waterford 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
											0.268
51810	0.25	0.25	14.76	11.64	115.1	0.875	8.40	2497	Surface		
51810	1	1	14.88	11.65	115.5	0.873	8.51	3228	Surface	100%	
51810	2	2	14.88	11.64	115.4	0.873	8.52	1392	0.33	43%	2.55
51810	3	3	14.88	11.63	115.3	0.873	8.53	1033	1.33	32%	0.22
51810	4	4	14.87	11.62	115.2	0.873	8.54	880	2.33	27%	0.07
51810	5	5	14.86	11.61	115.1	0.873	8.54	646	3.33	20%	0.09
51810	6	6	14.85	11.60	115.0	0.873	8.54	412	4.33	13%	0.10
51810	7	7	14.85	11.60	114.9	0.873	8.54	553	5.33	17%	-0.06
51810	8	8	14.84	11.59	114.8	0.873	8.54	326	6.33	10%	0.08
51810	9	9	14.84	11.58	114.7	0.873	8.54	338	7.33	10%	0.00
51810	10	10	14.83	11.56	114.5	0.873	8.54	141	8.33	4%	0.11
51810	11	11	14.81	11.54	114.3	0.873	8.54	134	9.33	4%	0.00
51810	12	12	14.77	11.51	113.8	0.873	8.54	112	10.33	3%	0.02
51810	13	13	14.75	8.08	79.9	0.865	8.53	79	11.33	2%	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
											0.137
61510	0.25	0.25	21.54	7.35	83.5	0.884	8.22	763	Surface		
61510	1	1	21.86	7.10	81.2	0.878	8.27	761	Surface	100%	
61510	2	2	21.99	6.96	79.8	0.888	8.31	641	0.33	84%	0.52
61510	3	3	22.00	6.87	78.7	0.875	8.32	359	1.33	47%	0.44
61510	4	4	21.97	6.78	77.7	0.876	8.33	237	2.33	31%	0.18
61510	5	5	21.96	6.72	77.0	0.876	8.33	171	3.33	22%	0.10
61510	6	6	21.94	6.61	75.7	0.876	8.32	112	4.33	15%	0.10
61510	7	7	21.91	6.39	73.1	0.890	8.30	74	5.33	10%	0.08
61510	8	8	21.89	6.20	70.9	0.888	8.28	56	6.33	7%	0.04
61510	9	9	21.86	6.01	68.8	0.878	8.26	43	7.33	6%	0.04
61510	10	10	21.82	5.92	67.6	0.878	8.25	32	8.33	4%	0.04
61510	11	11	21.79	5.89	67.3	0.877	8.24	22	9.33	3%	0.04

61510	12	12	21.78	5.85	66.8	0.877	8.24	18	10.33	2%	0.02
61510	13	13	21.77	2.39	27.2	0.877	8.22	9	11.33	1%	0.06

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
											0.251
72010	0.25	0.25	26.86	6.29	78.9	0.902	8.44	2471	Surface		
72010	1	1	27.46	5.76	73.1	0.892	8.40	1631	Surface	100%	
72010	2	2	27.60	5.99	76.2	0.889	8.38	738	0.33	45%	2.40
72010	3	3	27.68	5.58	71.1	0.888	8.38	626	1.33	38%	0.12
72010	4	4	27.74	5.83	74.3	0.887	8.37	500	2.33	31%	0.10
72010	5	5	27.76	5.45	69.5	0.887	8.36	370	3.33	23%	0.09
72010	6	6	27.76	5.28	67.4	0.886	8.35	231	4.33	14%	0.11
72010	7	7	27.76	5.45	69.5	0.886	8.35	200	5.33	12%	0.03
72010	8	8	27.75	4.86	62.0	0.887	8.34	156	6.33	10%	0.04
72010	9	9	27.72	4.70	59.9	0.887	8.31	130	7.33	8%	0.02
72010	10	10	27.69	4.09	52.1	0.888	8.29	111	8.33	7%	0.02
72010	11	11	27.60	2.88	36.7	0.888	8.23	90	9.33	5%	0.02
72010	12	12	27.37	1.58	20.0	0.915	8.15	69	10.33	4%	0.03
72010	13	13	27.16	1.51	19.0	0.8940	8.08	51	11.33	3%	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
											0.188
81710	0.25	0.25	20.83	11.20	125.2	0.002	6.90	1323	Surface		
81710	1	1	23.39	6.34	74.6	0.827	8.35	2360	Surface	100%	
81710	2	2	25.70	5.42	66.6	0.806	8.36	1914	0.33	81%	0.64
81710	3	3	25.98	5.33	65.9	0.802	8.34	533	1.33	23%	0.96
81710	4	4	26.12	5.27	65.2	0.800	8.33	461	2.33	20%	0.06
81710	5	5	26.16	5.22	64.7	0.799	8.32	341	3.33	14%	0.09
81710	6	6	26.18	5.15	63.8	0.799	8.31	254	4.33	11%	0.07
81710	7	7	26.18	5.04	62.4	0.799	8.30	195	5.33	8%	0.05
81710	8	8	26.15	4.77	59.1	0.799	8.27	125	6.33	5%	0.07
81710	9	9	26.13	4.51	55.9	0.799	8.25	79	7.33	3%	0.06
81710	10	10	26.07	4.17	51.6	0.799	8.19	22	8.33	1%	0.15

81710	11	11	26.00	3.78	46.7	0.800	8.14	15	9.33	1%	0.05
81710	12	12	25.97	3.39	41.8	0.801	8.09	11	10.33	0%	0.03
81710	13	13	25.96	1.81	22.4	0.8010	8.06	8	11.33	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 0.336
92010	0.25	0.25	18.66	7.51	80.6	0.830	7.97	648	Surface		
92010	1	1	18.66	7.34	78.8	0.830	7.98	627	Surface	100%	
92010	2	2	18.66	7.22	77.4	0.830	8.00	250	0.33	40%	2.79
92010	3	3	18.65	7.16	76.9	0.830	8.02	125	1.33	20%	0.52
92010	4	4	18.64	7.11	76.2	0.830	8.04	83	2.33	13%	0.18
92010	5	5	18.63	7.03	75.4	0.830	8.06	44	3.33	7%	0.19
92010	6	6	18.61	6.97	74.7	0.830	8.08	36	4.33	6%	0.05
92010	7	7	18.60	6.92	74.2	0.830	8.09	31	5.33	5%	0.03
92010	8	8	18.59	6.87	73.6	0.830	8.10	22	6.33	4%	0.05
92010	9	9	18.59	6.83	73.1	0.830	8.11	14	7.33	2%	0.06
92010	10	10	18.57	6.79	72.7	0.830	8.12	9	8.33	1%	0.05
92010	11	11	18.56	6.76	72.4	0.830	8.13	8	9.33	1%	0.02
92010	12	12	18.53	6.66	71.3	0.831	8.13	6	10.33	1%	0.03
92010	13	13	18.66	3.99	42.8	0.8250	8.11	3	11.33	0%	0.07