Lake County, Illinois

2010 McDonald Woods Lake #2 Summary Report

Prepared by Environmental Services

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Figure 1. McDonald Woods Lake # 2 turbid waters near outlet

Special points of interest:

- *Impaired Waters*
- *Carp*
- *Total Suspended Solids*
- *Phosphorus*
- *Dissolved Oxygen*

McDonald Woods Lake#2 is part of the McDonald Woods Forest Preserve in Lindenhurst, Lake County, Illinois. The preserve was purchased in the 1970's and named after its former owner A.B. McDonald. The 21.2 acre impounded wetland is separated by a weir on it's western edge from McDonald Woods Lake #1 (MC1). The water elevation set by a spillway at its eastern edge.

The water quality of MC2 is poor. MC2 is listed as impaired by the Illinois Environmental Protection agency for phosphorus, dissolved oxygen and total suspended solids.

Aquatic vegetation was sparse in MC2, likely due to the abundant carp population causing turbid waters.

Common carp are the main cause of many of the water quality problems experienced in MC2. This will be demonstrated on numerous occasions throughout this report.

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WATER CLARITY

LAKE FACTS

MAJOR TRIBUTARIES
MILL CREEK

WATERSHED
DES PLAINES

SUB-WATERSHED
NORTH MILL CREEK

RECEIVING WATERBODY
NORTH MILL CREEK

SURFACE AREA
21.2 ACRES

SHORELINE LENGTH
1.65 MILES

MAX DEPTH
2.8 FT.

AVERAGE DEPTH
2.0 FT

LAKE VOLUME:
27.5 ACRE-FEET

LAKE TYPE:
IMPOUNDMENT

WATERSHED AREA
578.6 ACRES

MAJOR LANDUSES
SINGLE FAMILY
FOREST AND GRASSLAND

BOTTOM OWNERSHIP
LCFPD

MANAGEMENT ENTITY
LCFPD

CURRENT AND HISTORICAL USES
AESTHETICS

ACCESS
NO WATER ACCESS

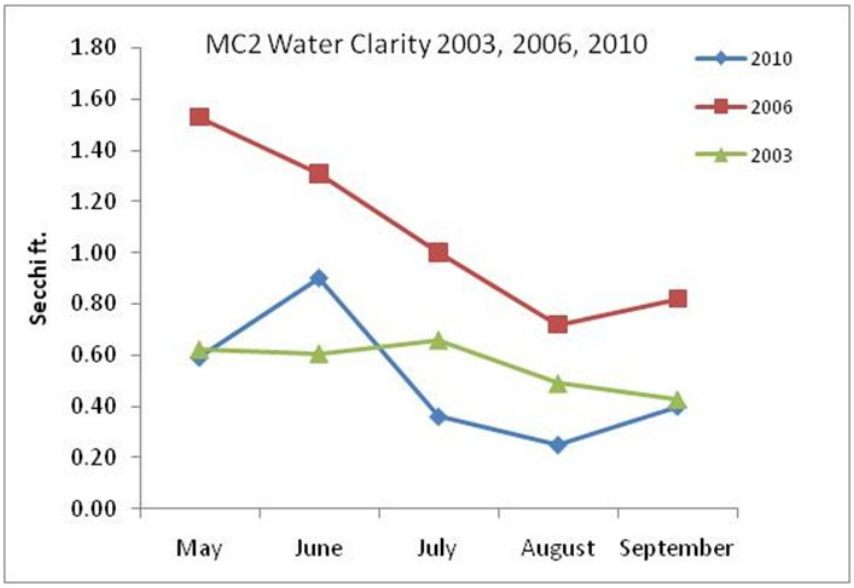
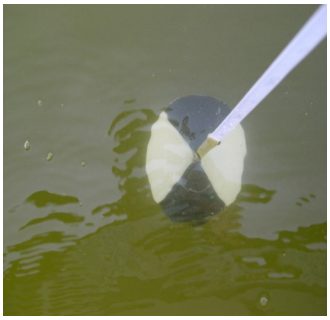


Figure 1. Water Clarity of MC2 during monitoring seasons 2003, 2006 and 2010



As the cover photo indicates the water clarity in MC2 is poor. MC2 is ranked last out of 153 lakes sampled in Lake County. The an average Secchi disk depth of 0.5 feet, was well below the county median of 2.95 feet. In 2010, Secchi depths ranged from a low in August of 0.25 ft. to a high in June of 0.90 feet. The average Secchi depth has worsened since the last monitoring conducted by LCHD-ES by 116%, however it is very similar to the average from 2003 (0.56 ft.). Factors contributing to poor Secchi depths are Common Carp which distribute sediments into the water column, lack of aquatic vegetation in the lake which promotes algae growth, as well as anthropogenic imputs coming from MC2's watershed.

Light to moderate rains did fall within 48 hours of water quality sampling and these type of events can also affect water clarity especially in shallow lakes that are subject to mixing through wave action as is the case in MC2.

MCDONALD WOODS LAKE #2 RANKED AT THE BOTTOM OF 153 LAKES SAMPLED IN TERMS OF WATER CLARITY.

COMMON CARP

Common Carp (*Cyprinus carpio*) have been identified as a main cause for poor water clarity and lack of diversity in shallow lakes and ponds worldwide. This is due to common carp foraging in soft bottom sediments and re-distributing nutrient rich sediments into the water column. The sediment ridden water reduces the availability of light affecting the growth of submerged vegetation in lakes.

It is recommended that carp be removed from MC2.

Removing carp, would likely reduce the amount of nutrient laden sediments being distributed into the lake and improve the overall water quality of MC2.

Figure 2. Carp Roundup. Photo provided by The Wetlands Initiative (Gary Sullivan).

TOTAL SUSPENDED SOLIDS

Total suspended solids (TSS), is a measure of the amount of solids, (ie. sediment, nutrients, organic matter, etc.) suspended in a given amount of sample. MC2 is listed as impaired by the IEPA for TSS.

In 2010 the average TSS concentration was 77.0 mg/L (Table 3). This is the greatest average concentration of solids measured in any of the years that LCHD-ES has monitored MC2 and way above the median of 8.1 mg/L for samples collected on lakes within the county since 2000. TSS concentrations ranged from 45 mg/L in May to 126 mg/L in July. TSS concentrations were greatest during July and August. In July, it was noted that Carp were spawning and it was the beginning of a heavy rain. At that time, an estimated 87% of non-volatile solids (NVSS) were in the lake. Depending on the month, the amount of NVSS represented between 20-71% of the TSS.

Algae was present in the lake by July and in August, an algal bloom was noted as being present on the surface by September an algal mat had formed.

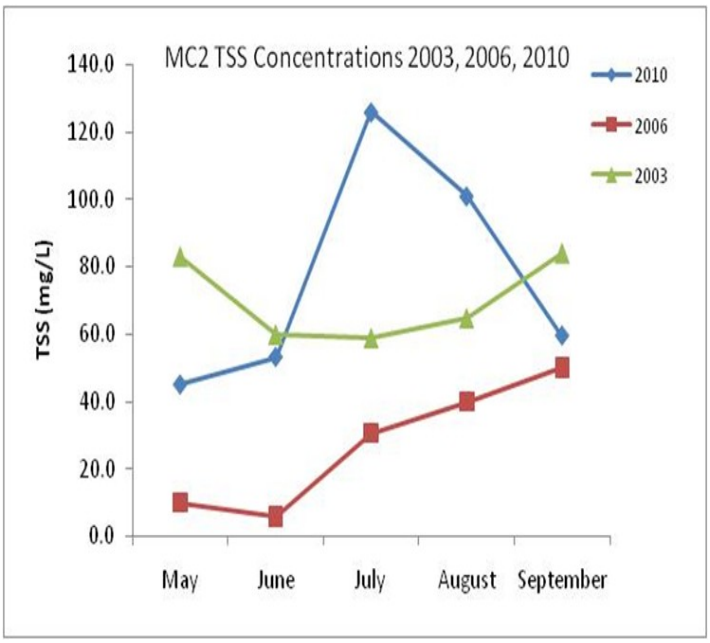


Figure 3. Total Suspended Solids in MC2 during 2003, 2006 and 2010.

WATERSHED

Table 1. Average Water Quality Parameters for McDonald Woods Lake #2 watershed - 2010

Parameters	Potomac			Waterford			McDonald Woods Lake #1		
Year	**2000**	**2006**	**2010**	**2000**	**2006**	**2010**	**2003**	**2006**	**2010**
Secchi (feet)	NA*	NA*	NA*	6.4[b]	3.048	4.70	1.08[b]	1.198	5.30
TSS (mg/L)	3.9	3.4	2.7[k]	2.7	12.0	3.9	13.7	30.3	3.5
TP (mg/L)	0.032	0.042	0.085	0.032	0.061	0.040	0.172	0.100	0.040
Conductivity (mS/cm)	0.8577	1.5533	0.8883	0.8375	1.2022	0.8536	1.0376	1.0546	0.5274

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

The watershed of MC2 is delineated in Figure 2 . MC2 is a 21.2 acre impounded wetland situated at the bottom of an estimated 578.6 acre watershed. The dominant land usage within MC2's watershed are single family and forest and grassland , representing 36% and 21.3% of the land use respectfully. However, when estimating the amount of runoff contributed by a certain land use, single family and transportation contributed 54.4% and 28.9% respectfully. Table 1 (above) somewhat supports the estimated source of stormwater pollutants coming from the watershed of MC2, however, the when comparing the same water quality parameters of the watershed with MC2, above table are the lakes sampled within the MC2 watershed during the 2010 monitoring season. In the case of MC2, the quality conditions found in MC2, however Carp would be considered the top contributor. The watershed and it's land use are delineated in Figure 2 and at 578.6 acres is quite expansive for a lake whose volume holds an estimated 27.5 acre-feet of water. The estimated retention time for MC2 based on this account is 32.13 days. The dominating land use of MC2 watershed is single family and forest and grassland representing 36% and 21.3% land use, respectively. However, when estimating the amount of runoff contributed by a certain land use the two dominating forces are single family and transportation contributing 54.4% and 28.9% of total estimated runoff. McDonald Woods Forest Preserve has 123 acres contained in the MC2 watershed buffering the lake from the remaining 579 acre watershed. Land usage in a lakes watershed can impact a lake substantially. However, this appears not to be the case for MC2. Although runoff entering into MC2 from single family and transportation represents 83.3% of the total estimated runoff, the other lakes within the MC2 watershed that have total phosphorus levels at much lower concentrations than what was measured in MC2 (Table 1 and 2). Internal cycling of pollutants appear to be a large component of water quality problems experienced in MC2 and is likely accentuated by the numerous Common Carp observed in the lake redistributing nutrient laden bottom sediments throughout the water column.

Table 2. McDonald Woods Lake #2 Averages:

Year	2003	2006	2010
Secchi (feet)	0.56	1.08	0.50
TSS (mg/L)	70.1	27.3	77.0
TP (mg/L)	0.271	0.325	0.225
Conductivity (Ms/cm)	1.1532	1.2494	0.7876

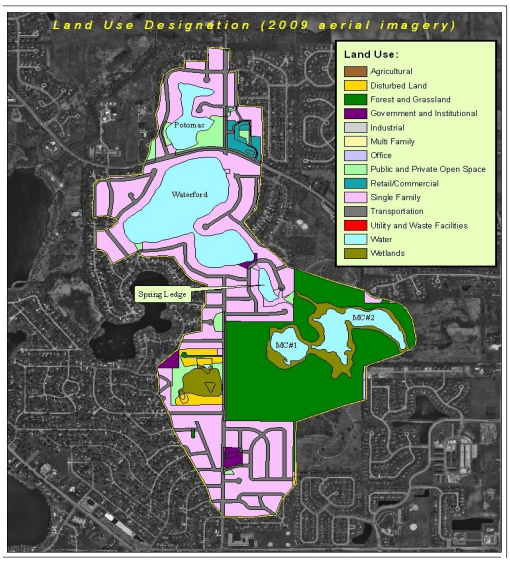


Figure 4. MC2 estimated watershed—2010.

NUTRIENTS

MC2 has a mean trophic state index (TSI) calculated at 82.3 and is considered a hypereutrophic lake. TSI is calculated using total phosphorus concentrations (TP) and Secchi depth. The poor TSI is an artifact of the phosphorus and TSS impairments found within the lake.

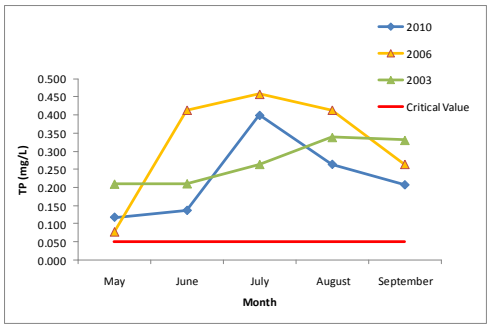
Table 3. Carlson's Trophic State Index

Trophic State	TSI score
Oligotrophic	<40
Mesotrophic	≥40<50
Eutrophic	≥50<70
Hypereutrophic	≥70

Phosphorus and nitrogen are normally limiting nutrients in our environment. However, due to the internal cycling of nutrients by carp and anthropogenic inputs from activities taking place within the MC2 watershed, both of these nutrients have exhibited increases during monitoring years.

Total phosphorus concentrations in MC2 have become excessive, with an average 2010 TP concentration of 0.225 mg/L , which well exceeds the critical TP concentration of 0.05 mg/L of phosphorus This is 4.5 times more phosphorus than allotted under the IEPA standard. TP concentrations measured in 2010 ranged from 0.117 mg/L in May to a high of 0.400 mg/L collected in July, all which exceed the standard. Only 10 of the lakes sampled since 2000 have had TP concentrations greater than what was found in MC2 during 2010. Phosphorus concentrations measured throughout the season decreased from what was measured in 2006 and 2003 with exception of the July sampling. The high concentration of TP found in 2006 was likely a result of lack of precipitation in 2005 , which was considered a year of extreme drought (Illinois State Climatologist), however, existing pressures (ie. carp, nutrients etc.), have not changed much since 2005 within the lake's watershed, and pollutants were probably just more concentrated due to lack of flushing of the system. Since 2006, the area has experienced wetter than average to average years of precipitation, possibly improving conditions within the lake in terms of phosphorus.

Figure 5. TP Concentrations (mg/L) in McDonald Woods Lake#2 2003, 2006, 2010



TP concentrations for lakes in the watershed which feed into MC2 are much lower than what is found within MC2 (Table 1 and 2), indicating that there is a lot of internal cycling of phosphorus happening within the lake. Although the average TP concentrations in Potomac Lake are elevated above the standard, the concentrations are diluted as it flows through Waterford Lake.

Nitrogen concentrations in MC2 in 2010 were sufficient to support excessive plant and algal growth. The TN:TP ratio, which indicates whether one of the nutrients are limiting to the growth of plants or algal growth ranged from 10.6 in July to 14.4 June, the average for the 2010 season was 11.4. The ratios found in MC2 indicate that at no time in 2010 were either phosphorus or nitrogen a limiting nutrient to plant or algal growth. Total Kjeldahl Nitrogen (TKN), the organic form of nitrogen that is readily available for plant use, has decreased slightly over time in MC2. However, inor-

1 pound of phosphorus containing Fertilizercan produce 300 - 500 Pounds of algae

Nutrients Continued

ganic nitrogen species that can be converted for plant use (ie. NO3) have increased from being non-detectable to having concentrations that are at certain times of the 2010 monitoring period, detectable. Nitrogen comes from many sources such as anthropogenic sources like fertilizers to atmospheric or natural deposition, and therefore harder to control than phosphorus.

There are best management practices which may help to reduce phosphorus inputs into a lake that should be encouraged within the watershed, among those are phosphorus ordinances that ban the use of fertilizers containing phosphorus, Lindenhurst has passed such an ordinance.

Removal of Common Carp would improve TP and TSS conditions. There are different options to consider if this fits into the management plan for the lake.

Increasing aquatic vegetation would help decrease phosphorus concentrations through plant uptake, although some of the phosphorus would recycle back into the waters as plants die back each season. The root systems of aquatic plants that root into the substrate would help to secure nutrient laden bottom sediments from future upheavals.

Remediation of eroding shorelines would alleviate some of the phosphorus pollution as phosphorus binds to sediments Repopulating areas of shoreline dominated with invasive non-native plants such as Cattail and reed canary grass with native vegetation would reduce the amount of sediments and nutrients entering the water column.

ALGAE

Conditions were favorable to the growth of algae in MC2 due to the sufficient amount of nutrients available and lack of competition of plants. It has been demonstrated that as phosphorus concentrations increase there is a subsequent increase in the phytoplankton biomass and potentially more of the biomass is represented by cyanobacteria, which make cause health issues to humans. Spirolina, a cyanobacteria from the Oscillatoria family was identified from a plankton tow collected in July, 2010. Algae from this family has been found to be more successful under low light conditions (Scheffer, et.al, 1997) , as is found in MC2. In MC2, clearing the waters of MC2 through removal of carp would be a step towards restoring water quality of MC2 rather than those aimed at phosphorus or nitrogen reduction.

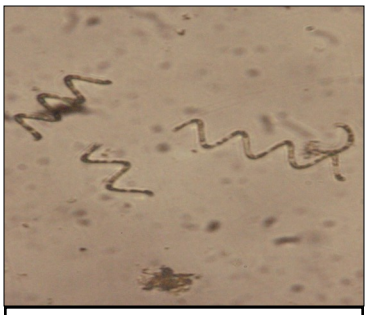


Figure 6. Spirulina, a cyanobacteria, was identified from a plankton sample taken from MC2 in July, 2010

In September, a dense algal mat formed on the water surface of MC2, a sample was collected and it was identified as a green filamentous algae, Hydrodicton.

Both from a water quality standpoint and a aesthetic standpoint, it is recommended that the LCFPD take steps to reduce algal blooms occurring in MC2.

DISSOLVED OXYGEN (DO)

Dissolved oxygen (DO) within MC2 is considered impaired by IEPA standards. The standard states that if the DO is <5 mg/L at one foot below the water surface at anytime during the monitoring year the waterbody is considered impaired. Some fish begin to feel stressed when DO dip to these levels. The DO concentration at 1 foot below the surface in May was 10.08 mg/L falling to a low of 4.33 mg/L measured in August before rebounding in September. In July, MC2 was anoxic by 2 feet or basically the lake bottom. The volume of water oxygenated sufficiently to support fish was likely not available at during July, 2010. MC2 has been subject to low dissolved oxygen concentrations every year that LCHD-ES has monitored the lake. Even if conditions such as nutrients and plant abundance improved in this lake, it would still not be a likely candidate for introduction of fish. High biological oxygen demand, the shallow nature of the lake and it's ability to heat up during the summer and freeze completely during winter, make conditions favorable to fish kills. However, it is recommended that carp be removed from the lake, this would improve the dissolved oxygen concentrations as well as many other water quality parameters in the lake, as can be seen in the MC1 water quality data (available as a separate report).

Figure 7. Fish kills can occur when DO concentrations fall below 5 mg/L and fish become stressed.

CHLORIDES

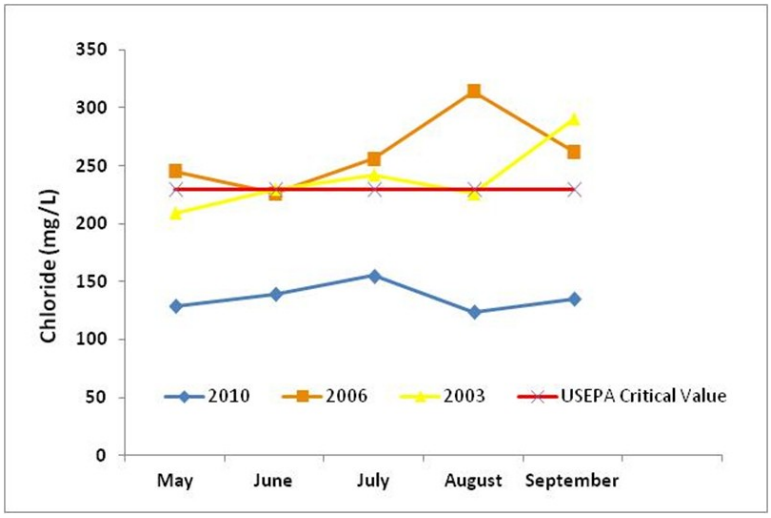


Figure 8. Chloride concentrations measured in MC2, 2003, 2006 and 2010.

CHLORIDES CONTINUED

IT ONLY TAKES 1 TEASPOON OF SALT TO CONTAMINATE 5 GALLONS OF WATER!

Road salt contributes significantly to rising chloride levels of lakes and streams within regions of the snowbelt. Recently, there has been emphasis on educating municipalities and agencies and the private sector on practices that can reduce the amount of road salt used in winter maintenance throughout Lake County while keeping our passageways safe.

Road salt, which is widely used throughout the county and the region, contains as high as 60 percent chloride and has been determined to be a main source of chloride pollution.

Chloride concentrations during 2010 in MC2 were much lower than that found in any other LCHD sampling years (Figure) The average chloride concentration of 136 mg/L during 2010 is lower than the median concentration of 142 mg/L calculated from 552 samples collected from Lake County lakes between years 2000 – 2010. Although there was a reduction in chloride concentrations found in MC2 during 2010, in 2003 and 2006 concentrations were hovering around the critical toxicity limit for chloride at 250 mg/L, this limit is not above the IEPA general use standard of 500 mg/L. It is notable that some species are sensitive to chloride concentations as low as 12 mg/L.

Other implications have been discovered, as waters polluted with chlorides are more dense than than freshwater and therefore sink to the bottom of the lake, in deeper lakes, this can have profound impacts on an entire lake ecosystem.

Due wetter than average years occurring since our last sampling, dilution and flushing of MC2 has likely occurred. This would explain the drop in conductivity and chloride levels which were observed in 2010. The Lindenhurst rain gauge registered 23.85 inches of rainfall during the period April – September, 2010. Which is about average based upon 10 years of data collected by the Illinois State Water Survey between 2000 and 2010 at their Mundelein station. In 2010, June and July were above average in terms of rainfall based upon this data. In July, we collected our water quality samples within 48 hour of a rain event. This date (July 21) marked a storm event that registered 2.27 inches at the Lindenhurst station. Our sampling appears to have taken place at the start of the rain event (LCSMC website)..

Table 4. Precipitation data 2010 from Illinois State Water Survey (ISWS) and Lake County Stormwater Commission (LCSMC)

Month	2010 LCSMC Rain Gauge Data (in.)	ISWS 10 Year Average 2000—2010 (in.)
April	2.56	3.21
May	4.59	4.80
June	5.53	4.16
July	6.48	3.92
August	2.06	4.29
September	2.63	3.28
Total	23.85	23.66

Submergent and Emergent Aquatic Vegetation

Table 5. Species average cover and importance 2010

Common Name	Average Cover	Importance
Coontail	6.20	115.57
Duckweed	1.76	43.00
Flatstem Pondweed	0.43	16.57
Watermeal	0.65	24.86
Total Average Cover	9.04	

Figure 9. Coontail, the dominant species found in MC2 during 2010.

Aquatic vegetation was not plentiful in 2010. In July, 2010 a quantitative survey was conducted to evaluate the submerged aquatic vegetation at 23 locations in MC2. The total average cover of plants detected during the July survey was 9.04% Plants were only detected at nine points within the lake.

Coontail (*Ceratophyllum desmerum*), whose average cover was 6.2% was the dominant plant species, representing more than 50% of the plant importance. Importance is the sum of the relative cover and the relative frequency and is used to establish dominance.

Common duckweed (*Lemna minor*), a floating leaf species was estimated to have a cover of 1.76%. The remaining species were found at less than 1% cover. There were no invasive plant species detected in the survey. It is desirable to have approximately 40% cover of a lake bottom by vegetation to support a fishery as well as from a water quality standpoint. It is recommended that carp be removed from MC2, removal of carp from the shallow waters of MC2 would likely result in increasing the water clarity increasing light penetration, subsequently an explosion of submerged aquatic vegetation is possible. It is likely that the colonizing vegetation would be native in origin and based upon the present species composition and importance, dominated by coontail.

Increasing the amount of vegetation in the lake would additionally provide competition for nutrients between plant and algal populations.

From an aesthetics standpoint, MC2 potentially would not have dense algal mats as was found during a visit in September floating on the surface of the water. The algae was identified as a greem filamentous algae called Hydrodicton, it forms such thick mats that it is resistant to copper treatment as the chemical is unable to penetrate the mat.

SHORELINE

Figure 10. Moderate erosion occurring in MC2—2010.

Plants

In September, 2010, a meander survey was conducted along the shoreline of MC2, twelve herbaceous plants were found colonizing cattails. The dominant vegetation observed along the shoreline other than cattail (*Typha* spp.) was Reed Canary Grass (*Phalaris arundinacea*). Both of these species are non-native invasives with relatively shallow root systems compared to many other perennial native aquatic matrix species (ie., Common Bur-reed (*Sparganium eurycarpum*), Sedge (*Carex* spp.,) whose root sytems are expansive in comparison. Cattail and Reed Canary grass both are subject to eroding soils especially in areas where water levels fluctuate or that there are strong currents that can undercut banks allowing the vegetation to slough off into the water leaving behind a soil water interface. Working towards integrating some shoreline areas with native plant communities would help to alleviate erosion and to some extent introduction of nutrients.

Table 6. Shoreline species

Scientific name	Common name
Solanum dulcamara	bittersweet nightshade
Impatiens capensis	jewelweed
Boehmeria cylindrica	false nettle
Pilea pumila	clearweed
Scutellaria lateriflora	mad-dog skullcap
Lycopus americanus	common water horehound
Phalaris arundinacea	reed canary grass
Typha spp.	cattail
Cicuta bulbifera	bulbet-bearing water hemlock
Bidens cernua	nodding bur marigold
Verbena hastata	blue vervain
Leersia oryzoides	rice cut grass
Iris spp.	Iris

Erosion

In September, 2010, the shorelines of MC2 were assessed for erosion. Seventy percent of the shoreline had some degree of erosion occurring along it. Fifty percent of the shoreline was assessed as having moderate erosion. An additional five percent was considered to have areas of severe erosion. These magnitudes of erosion were occurring mainly along stretches of cattail and reed canary grass dominated shoreline.

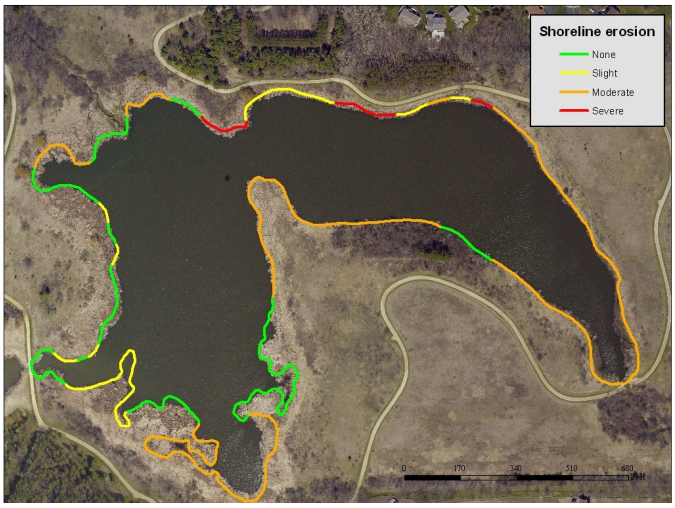


Figure 11. MC2 shoreline assessed for erosion, September 2010.

LakeCounty
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ENVIRONMENTAL SERVICES

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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.

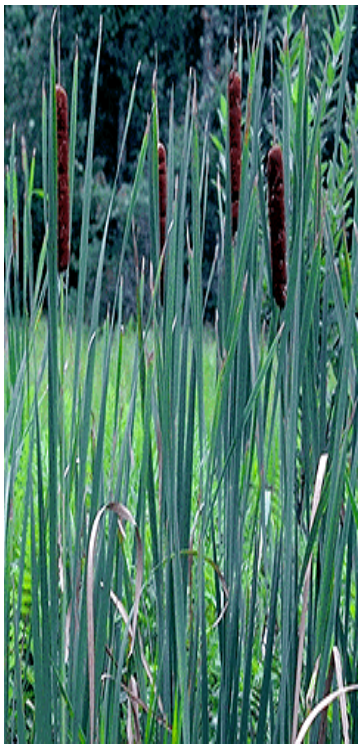
Environmental Service's goal is to monitor the quality of the county's surface water in order to:

- 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.

RECOMMENDATIONS

McDonald Woods Lake #2 is an impaired waterbody for the following water quality parameters; phosphorus, dissolved oxygen and total suspended solids. It is suspect that the main cause of the impairments is the very abundant carp population inhabiting the lake. Therefore, the LCHD-ES recommends removing the carp from the lake. We would refer to the Illinois Department of Natural Resources to assist with this task, as they would be able to decide upon the method most effective for their removal.

The shoreline plant community is dominated by Cattail and Reed Canary Grass. It is recommended that consideration be given on removing these invasive species and establishing other vegetation types such as sedges, bulrushes or other forbs that would be better at anchoring deep into sediments to stabilize the shoreline, this along with carp removal should begin to improve water quality impairments.

LCHD-ES recommends that LCFPD consider becoming a VLMP for their lakes. The information collected can assist the LCHD in future studies, as well as assist the LCFPD in managing their resource.