Lake Magnor Comprehensive Planning Report 2003

Prepared for the Lake Magnor Lake Association

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What Actions Can Be Taken To Improve and Protect Lake Magnor?

Engage the landowner in conversations about reducing agricultural land impacts to Lake Magnor. A number of techniques are available to filter runoff and trap sediments, such as filter strips, grassed waterways, and diversions.
(Contact LWRD at (715) 485-8699)

Maintain a strong Lake Association by increasing communications:

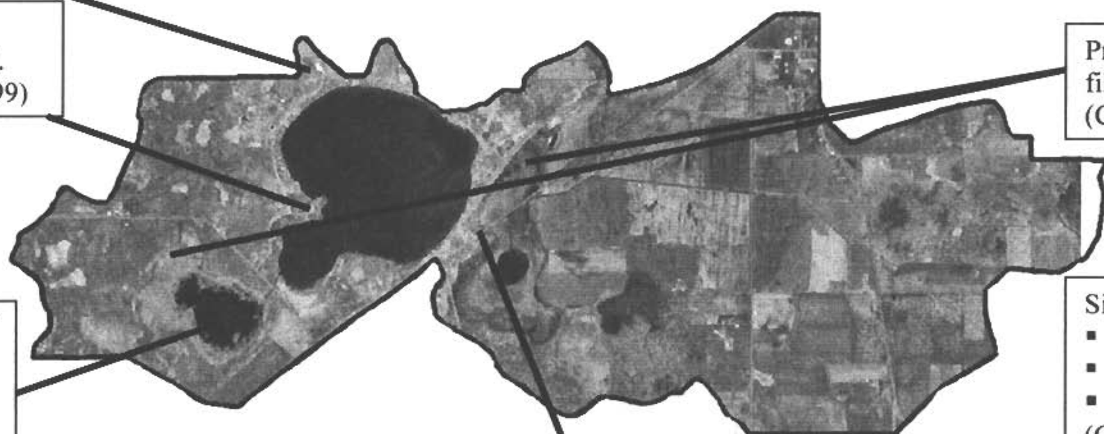
- Send out regular newsletters
- Plan picnics and other events
- Invite speakers to functions and meetings
- Keep all members updated on shoreland regulations
- Talk about your expectations for the lake. You are the most valuable asset this lake has.

Shoreline development needs to be sensitive to the lake ecosystem or water quality will suffer. Lakeshore Property Owners Should:

- Install shoreline restorations
- Use no phosphate fertilizers (Article 5.D. of the Shoreland Ordinance)
- Clean up spills (gas, oil, etc.) immediately
- Not mow up to the shoreline

(Contact LWRD at (715) 485-8699)

Monitor and remove purple loosestrife (invasive exotic plant).
(Contact LWRD at (715) 485-8699)



Protect wetlands that are crucial in filtering runoff.
(Contact LWRD at (715) 485-8699)

Barbo Lake is not a likely source of nutrients. Efforts to improve or protect water quality should be concentrated in the watershed.
(Contact LWRD at (715) 485-8699)

Signage for boat landing on:

- Exotic species
- Cleaning off boats/trailers
- No powering up

(Contact DNR at (715) 635-4265)

To control the pollution from Hwy 63:

- Install a curb and gutter system
- Increase street sweeping
- Install a sand trap to promote infiltration (requires maintenance).

(Contact Highway Department at (715) 485-8700)

Consider local regulations to reduce boat traffic and wave action that stirs up sediment and causes shoreline erosion.
(Contact Township at (715) 948-2564)

Controlling snails without dangerous chemicals requires manipulating fish populations to increase predation on snails. An increase in panfish (pumpkinseed) should show a decrease in snails. The limits on bass and northerns may have to be increased to sustain a viable panfish population.
(Contact DNR at (715) 635-4265)

Improve walleye spawning habitats to help the walleyes compete with the growing largemouth bass population.
(Contact DNR at (715) 635-4265)

All development threatens the lake if done in an environmentally insensitive manner. Remain vigilant and when developments are proposed become involved.
(Contact Zoning at (715) 485-9279)

Morphological Characteristics

Lake Area:
230 acres

Watershed Area:
1,989 acres

Watershed to Lake Area Ratio:
8.6 to 1

Volume:
2,296 acre-feet

Mean Depth:
10 feet

Maximum Depth:
25 feet

Fetch:
3,539 feet (0.7 miles)

Miles of Shoreline:
2.7 miles

DNR Classification of Lake Type:
Seepage

Littoral Area:
230 acres.

Annual Precipitation:
The annual precipitation in 2001 at the Amery_2_N station was 36.42 inches

Average Annual Evaporation:
44.15 inches per year. (This figure was from the closest station measuring mean pan evaporation in Minneapolis.)

Residence Time:
1.54 years

Mixing:
polymictic

Phosphorus Concentration:
272 mg/l

Introduction to the Land and Water

Glaciers

Lake Magnor was formed about 12,300 years ago as the last glacier receded from the landscape. The glacier left behind monstrous chunks of ice, wholly or partially buried, that melted to form the earliest version of lake's basin. Lake Magnor Lake is a kettle lake located on the edge of a terminal moraine with pitted outwash from the moraine to the west-northwest.

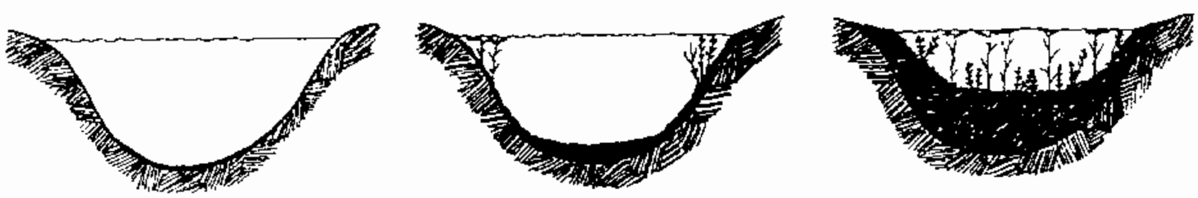
Twelve thousand years ago river systems connected the glacial meltwater with the lakes that dotted the landscape. The landscape and the lakes at this time were neither rich nor diverse in plants or wildlife. The soil and vegetation was stripped from the land by the glaciers and the water filling the rivers and lakes was low in nutrients. The closest "living" example of what Lake Magnor looked like at this time is probably Lake Superior: cold, clean, and clear, but not very fertile.

Over the millennia soils material was carried here by wind and eroded from the landscape. The ecosystem matured over time to eventually resemble what we see today: mixed forests, stands of pines, occasional prairie open space, and lots of lakes, rivers, and wetlands. The soils material that brought the nutrients necessary to sustain such a diverse landscape continue to build today.

Lake aging process

When plants and trees die their decomposing structures nourish subsequent generations of plants and animals. Water, wind, and ice breakdown rocks and flatten hills. All of this material, both organic and inorganic, is pulled by gravity to the lowest point on the landscape, typically lakes. So lakes naturally fill in with this sediment to a point that they are more land than water. In the interim they transition from clear open water to something a little greener and a little more fertile. It takes thousands of years but lakes 'age' to become wetlands rich in nutrients and busy with wildlife.

Typical natural aging process of a lake



OLIGOTROPHIC
- Clear water low productivity
- Very desirable fishery of large game fish

MESOTROPHIC
- Increased production
- Accumulated organic matter
- Occasional algal bloom
- Good fishery

EUTROPHIC
- Very productive
- May experience oxygen depletion
- Rough fish common

Human influence

Unfortunately human activity on the landscape has increased the rate at which lakes age.

Introduction to the Land and Water

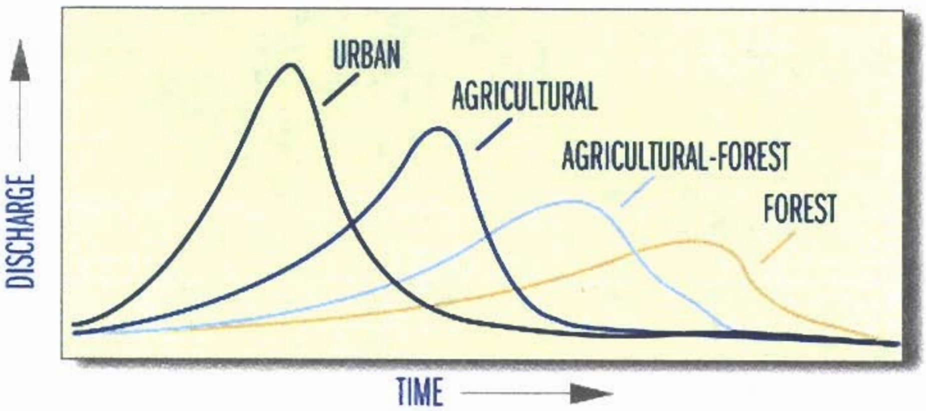
Logging was the first industry to have a major impact on this region's lakes. The removal of vast stands of trees left soil bare and vulnerable to erosion. Dams were erected to store the force of water and then let loose flushing logs and water down streams towards the mills. Both water and logs scoured the stream channels. Furthermore, sudden and drastic changes in lake level wreaked havoc with shorelines.

Farming was the second wave of development in this region. Originally farms were small and diverse. Due to the fragile nature of their tools and techniques early settlers generally worked with the land instead of against it. But mechanization soon changed the way people farmed. Larger machines required larger fields and larger fields required more chemical inputs to control weeds and insects. Wetlands and flood-prone areas were drained and cultivated. In general, farming opened up the fertile but fragile soils to the erosive forces of wind and rain thereby compromising the health of both land and water.

A third wave of major human influence is upon us: residential development. The landscape is quickly being carved up from vast fields into relatively tiny lots complete with driveways and sod lawns. Construction erosion, runoff from lawn fertilizers, removing vegetation from both shorelines and lakes, septic system effluent, and runoff from roofs, driveways and roads all contribute nutrients and pollutants to lakes.

Humans have increased the rate at which lakes become green and fertile by 10, 100, and even 1,000 times. This is a threat that most people resonate with: the threat that their clean, clear lake will become green and stale in their lifetime. Humans cannot change the fact that lakes will change over time but they can affect the rate at which that change occurs. And ideally, like time itself, it will occur so slowly that it will be imperceptible in our lifetimes and the lifetimes of those to follow.

STORMWATER DISCHARGES FROM VARIOUS LAND COVERS



Natural Resources Research Institute, http://wow.nrri.umn.edu/wow/

Watersheds

A watershed, also called a drainage basin, is all of the land that drains toward a particular river or lake. Thus, a watershed is defined in terms of the selected lake (or river). There can be subwatersheds within watersheds. For example, a tributary to a lake has its own watershed, which is part of the larger total drainage area to the lake.

A lake is a reflection of its watershed. More specifically, a lake reflects the watershed's size, topography, geology, landuse, soil fertility and erodibility, and vegetation. The impact of the watershed is evident in the relation of nutrient loading to the watershed; and lake surface area ratio.

Introduction to the Land and Water

The Lake Magnor watershed is primarily agricultural which does not bode well for the lake. Agricultural land is bare for much of the year and its simple vegetative canopy keeps erosion potential high. Furthermore, fertilizer and herbicide application threatens nearby water bodies. Conversely, forests tend to hold tightly onto nutrients as well as store water for the short term in the canopy thereby reducing runoff volume and erosion potential. Maintaining a high percentage of forest land and other complex natural habitats in the watershed will help to guarantee good water quality into the future.

The ratio of watershed area to lake area also jeopardizes water quality/ . Typically, water quality decreases with an increasing ratio of watershed area to lake area. This is obvious when one considers that as the ratio of watershed to lake area increases there are additional sources (and volumes) of runoff to the lake. In larger watersheds, there is also an increased opportunity for water from precipitation to contact the soil and leach minerals before discharging into the lake.

Groundwater

Lake Magnor has a large watershed that is maintained primarily by groundwater flow (according to the DNR) and is referred to as a seepage lake. In contrast, lakes fed primarily by inflowing streams or rivers are known as drainage lakes. Seepage lakes tend to have good water quality compared with drainage lakes.

There really isn't anything one can do about watershed size to lake ratio or the fact that Lake Magnor is a seepage lake. However, land uses can be manipulated or changed to filter pollutants and distancing threatening land use activities from the lake. Such actions will help to protect the lake from further degradation and may even improve water quality.

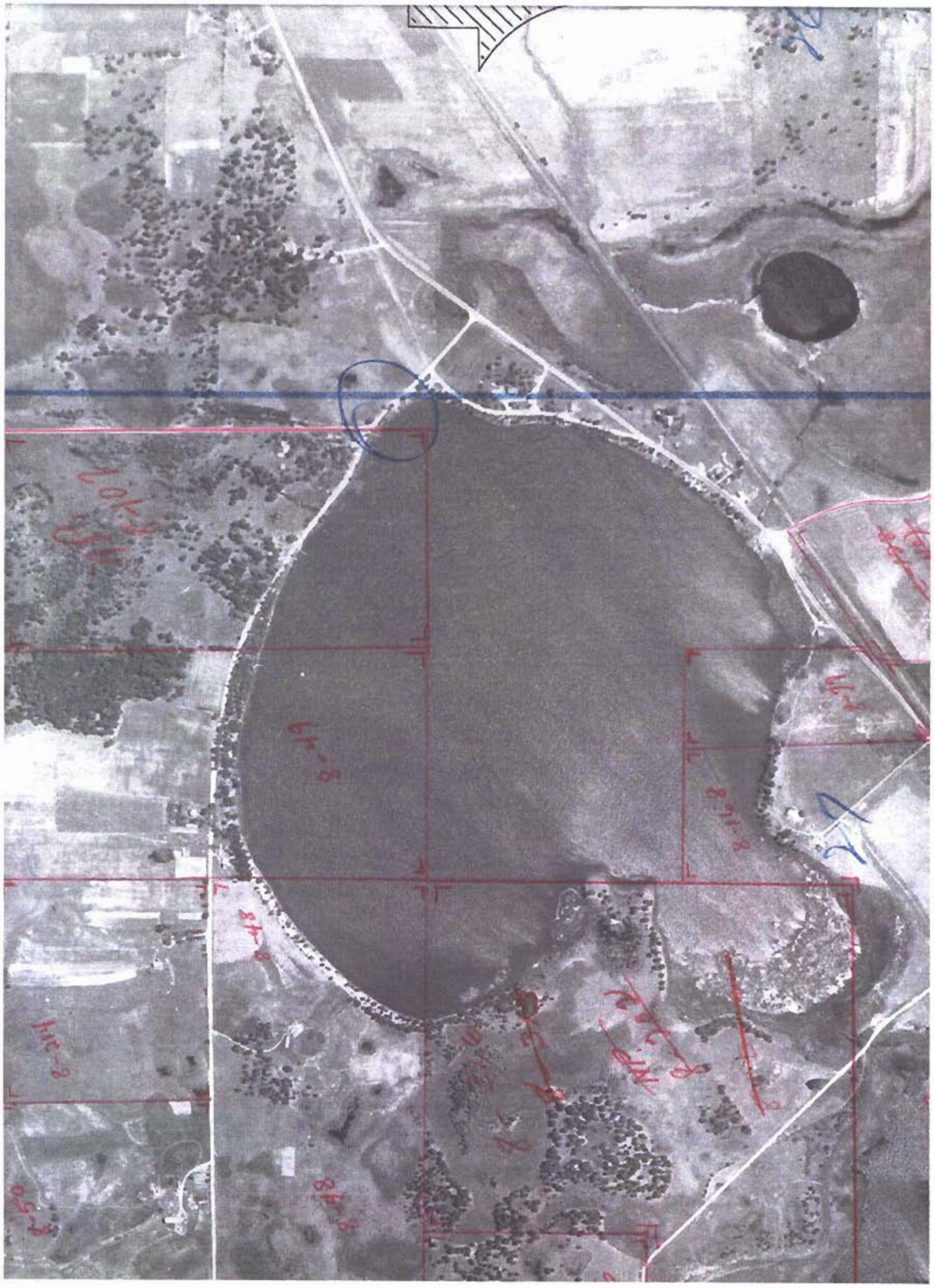
Watersheds in greater depth

As a form of ecosystem management, watershed management encompasses the entire watershed system, from uplands and headwaters, to floodplain wetlands and river channels. It focuses on the processing of energy and materials (water, sediments, nutrients, and toxics) downslope through this system.

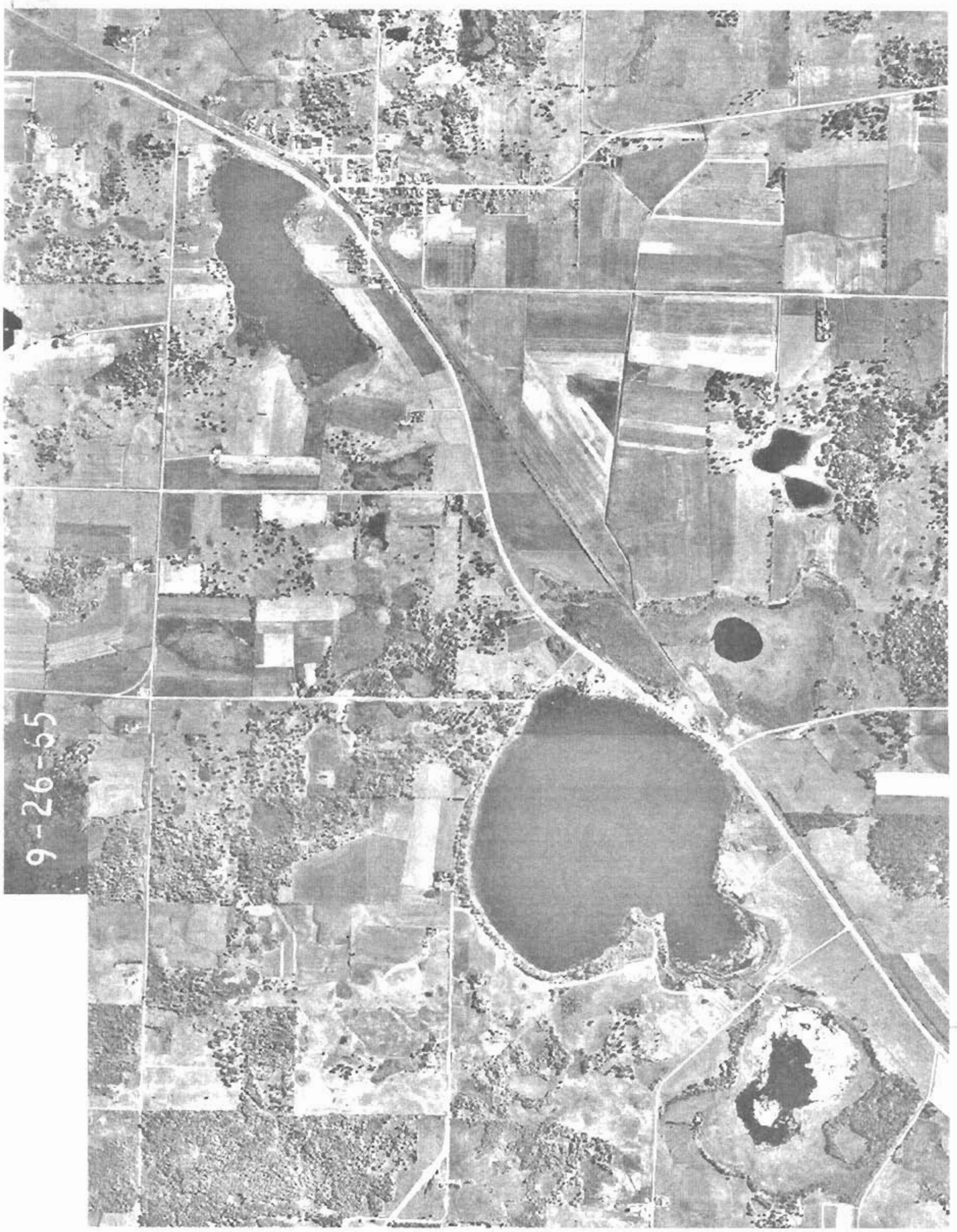
Of principle concern is management of the basin's water budget, that is the routing of precipitation through the pathways of evaporation, infiltration, and overland flow. This routing of groundwater and overland flow defines the delivery patterns to particular streams, lakes, and wetlands; and largely shapes the nature of these aquatic systems.

Watershed management requires the use of the social, ecological, and economic sciences. Common goals for land and water resources must be developed among people of diverse social backgrounds and values. An understanding of the structure and function--historical and current--of the watershed system is required, so that the ecological effects of various alternative actions can be considered. The decision process also must weigh the economic benefits and costs of alternative actions, and blend current market dynamics with considerations of long-term sustainability of the ecosystem.

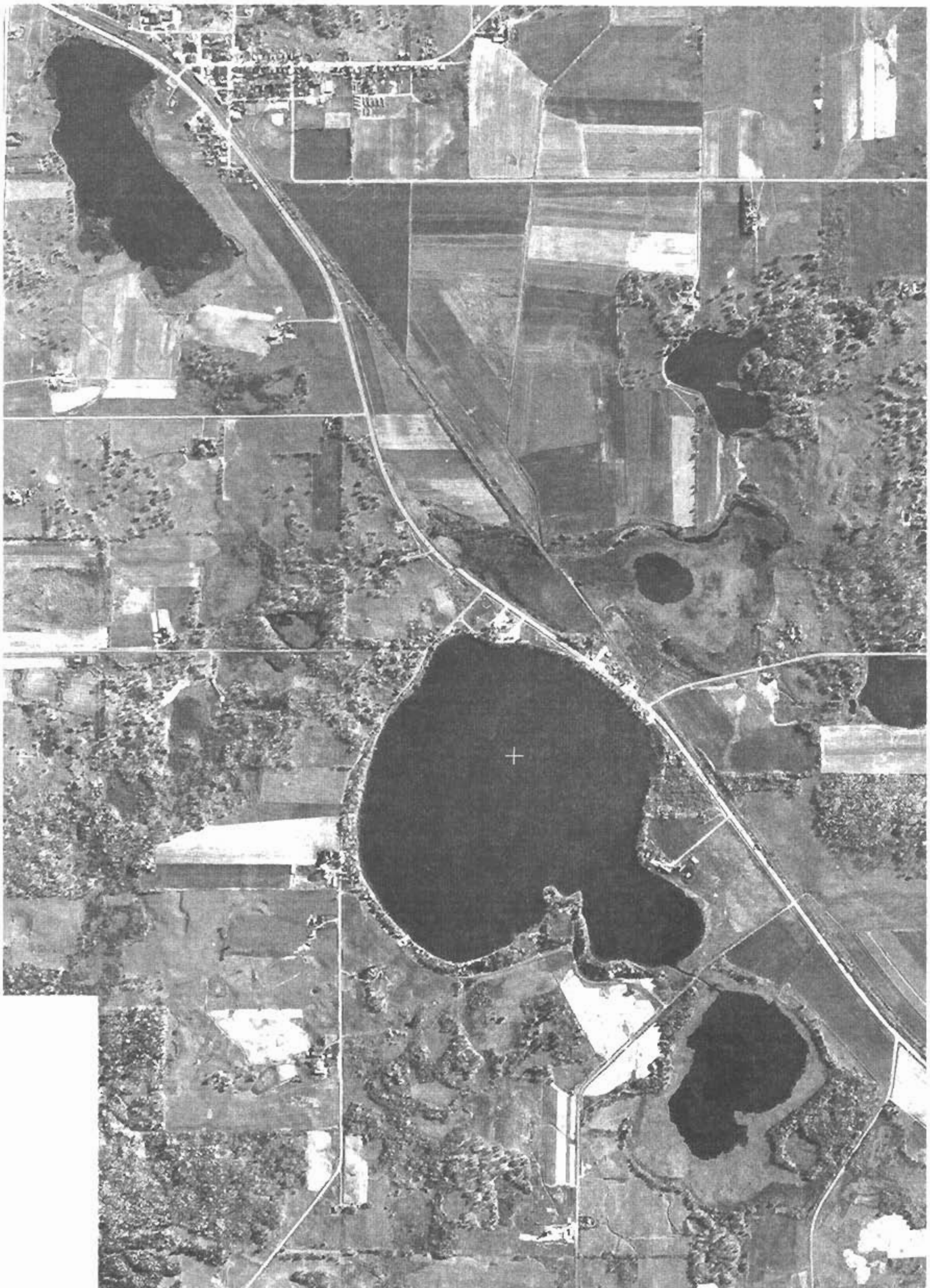
1938



1965



1973



1992

The Lake

Water clarity

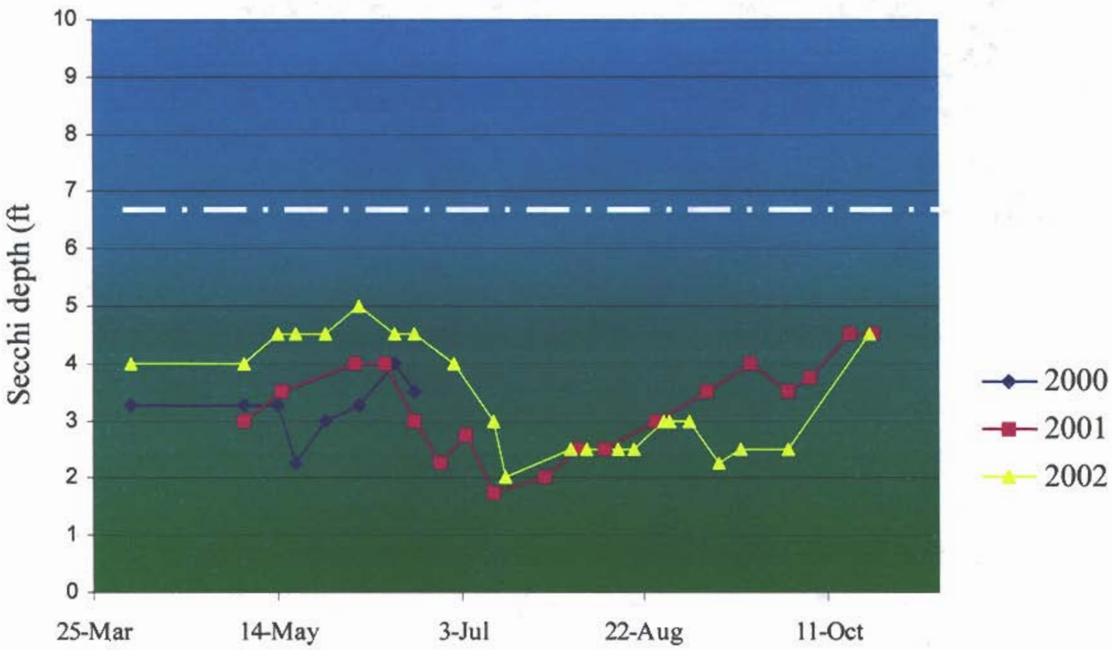
Generally lake water clarity varies throughout the year and even throughout the summer. Lake water is clearest during late fall, winter, and early spring. During these seasons there is typically little runoff from the neighboring landscape and the water is too cold to support prolific microorganism growth in the water column. As summer progresses, runoff from rain and snowmelt carry suspended particles to the lake that reduce light penetration. Also, as the water warms microorganisms in the water column, such as algae, become dense enough to further limit light penetration. Then in the fall, as the water cools and biological processes slow, lakes again become clearer.

Water clarity is measured with a Secchi disk. This 8-inch disk is lowered from a boat usually at the deepest part of a lake until it just disappears from sight, then raised until it is just visible. The average of the two depths is recorded as the 'Secchi depth.'

Lake Magnor's Secchi disk readings are low when compared to other lakes in the region. This lack of water clarity is caused by a combination of factors (true-color, chlorophyll-a, total suspended sediments, and suspended organic matter) that scatter or absorb light.

Determining which factor or factors affect the light regime is the key to formulating a management plan that maintains or improves the water clarity while maintaining the ecological integrity of the lake system.

Secchi disk, 2000-2002



*Lillie,R.A. and J.W. Mason. 1983. *Limnological Characteristics of Wisconsin Lakes.* WiDNR Tech. Bull. 138, Madison. Based on a sample of 595 Wisconsin Lakes.

The Lake

True-color

The average true-color of Lake Magnor was measured once on April 9, 2002. A sample was taken at the surface (50.0 SU) and near the bottom (55.0 SU). Both samples indicate that the ambient color of the water contributes to the low water clarity. There are really no management techniques that can effectively affect true-color.

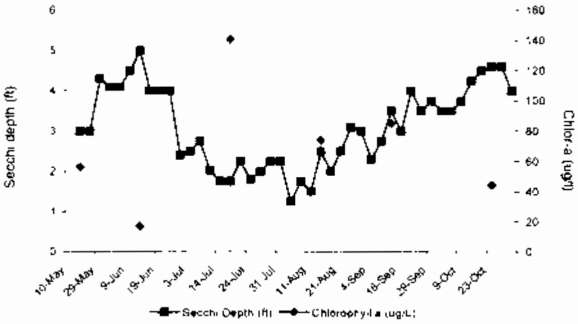
Chlorophyll-a

Chlorophyll is a measure of algae in the water column. Algae and other microorganisms are a natural part of lake ecosystems. These microscopic critters comprise the base of a lake's food chain just like plankton in the oceans.

In 2001 the chlorophyll-a levels in Magnor varied considerably throughout the summer but averaged 58.5 mg/l (median = 50.0) between May and October. This is quite high and is likely the cause of many problems. Some types of algae, specifically blue-green algae, can be offensive (and at times overpowering) when they 'bloom' or die in great quantities and are then swept to shore.

Dense algae growth in the water column also decreases water clarity and this is already occurring on Magnor to some extent. In fact, there is an inverse relationship between Secchi depth and chlorophyll-a concentrations as illustrated in the following chart. As chlorophyll-a concentrations increase Secchi depth (a measure of water clarity) decreases. It is obvious that the algae in Lake Magnor causes turbidity problems.

Chlorophyll-a vs. Secchi depth, 2001



TSS

TSS quantifies the amount of inorganic matter that is floating in the water column. Wind, waves, boats, and even some fish species can stir up lake bottom sediment. Fine sediment and especially clay can remain suspended for weeks. These particles scatter light and decrease water transparency.

TSS was measured once in 2001 in Lake Magnor. The result was 50 mg/l which is quite high and indicates that sediment is a key factor of turbid water. However, this one sampling event may not be indicative of the lake as a whole. More sampling throughout the summer months is necessary to draw more definite conclusions.

Phosphorus

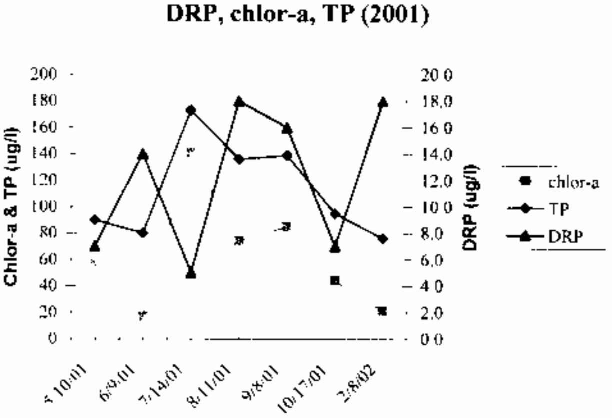
The **total phosphorus** samples in Magnor are high enough to classify the lake as *eutrophic*. Eutrophic lakes are typically characterized by extremely low water clarity, nuisance aquatic plant growth that affects boating and recreation, and algal scums.

Surface concentrations averaged 113 ug/l (median = 95 ug/l). Bottom concentrations were high enough at times to suggest that sediment had inadvertently been collected along with the water sample. Therefore, bottom total phosphorus concentrations were disregarded for this analysis. The surface concentration is plenty high to warrant attention by itself.

The **dissolved reactive phosphorus** (DRP) results are also relatively high (average = 13 ug/l and median = 15 ug/l). DRP is the phosphorus that is immediately available in the water column to fuel plant and algae growth.

DRP appears to be linked to chlorophyll-a and total phosphorus. When chlorophyll-a and total phosphorus levels are high DRP is low. This indicates that algae is making use of available DRP in the water column especially during

July. Therefore, limiting the availability of DRP could drastically limit the amount of algae in the water thereby increasing water clarity and limiting algae blooms.



N:P ratio

Magnor Lake's nitrogen-to-phosphorus ratio (N:P ratio) as factored for 2001 is about 1.2:1. This is a conspicuously low ratio and suggests that inputs of either nutrient will further pollute the lake. In many other lakes either nitrogen or phosphorus can be singled out as the nutrient of most concern, however, in Magnor both should be managed in both the lake and the watershed.

Stratification: temperature and oxygen

It appears that Magnor completely mixes shortly after ice-out. This means that even the bottom waters become oxygenated. However, around July the lake becomes thermally stratified and the bottom waters become devoid of oxygen. This makes Magnor *dimictic* which means that although the lake stratifies during the summer it will thoroughly mix during the spring and fall overturn events.

By late spring Magnor has separated into two or three distinct layers with warmer water at the top and cooler water at the bottom. If this stratification persists, dissolved oxygen at the bottom drops dramatically and may cause phosphorus to be released from the lake bottom sediments.

Although Magnor's bottom water is almost completely devoid of oxygen from May through September it is uncertain whether phosphorus is being released from the lake bottom sediments. The water samples taken from the bottom of the lake are so incredibly high in phosphorus that it is likely that sediment contaminated the samples. This is a common occurrence and just one of the risks of field work. Subsequent sampling through the DNR Small Scale Planning Grant will be helpful in this analysis.

pH, alkalinity, and acid rain

The average pH in Lake Magnor from 2001-2002 was 7.03 (median = 7.02). This is perfect for fish, aquatic plants, and wildlife. However, the lake's alkalinity (average = 20.9 mg/l $CaCO_3$, median = 18.0 mg/l $CaCO_3$) is relatively low. This makes the lake susceptible to the ravages of acid rain. A lake's alkalinity is a result of its geology so there's not much human influence to be considered with this parameter other than to resolve lakeshore erosion.

Lakes in this region already receive mercury deposits from the acid rain that primarily originates in the Twin cities Metropolitan Area as a result of automobile emissions and industrial pollution. (Incidentally, mercury levels are high enough that fish consumption advisories exist on all area lakes including Magnor.) These same sources cause acid rain. And the same atmospheric forces that carry mercury on the wind to Polk County lakes carry acid rain. Acid rain has the potential to lower the pH of Lake Magnor to the point that fish cannot survive – as has already occurred in Canadian provinces and some northern New England states.

The Lake

Conclusions

Based on water chemistry analysis it is apparent that Lake Magnor is a *eutrophic* lake. This means that it has an over-abundance of nutrients. These nutrients fuel plant and algal growth and are at least partially (although indirectly) responsible for relatively low water clarity.

Continued nutrient inputs will likely cause the lake to experience frequent and persistent algal blooms fouling the water and the shoreline. Such a shift will further stress the walleye population and perhaps eliminate this particular fish species all together. Bass and panfish won't likely be adversely affected, at least in the short term.

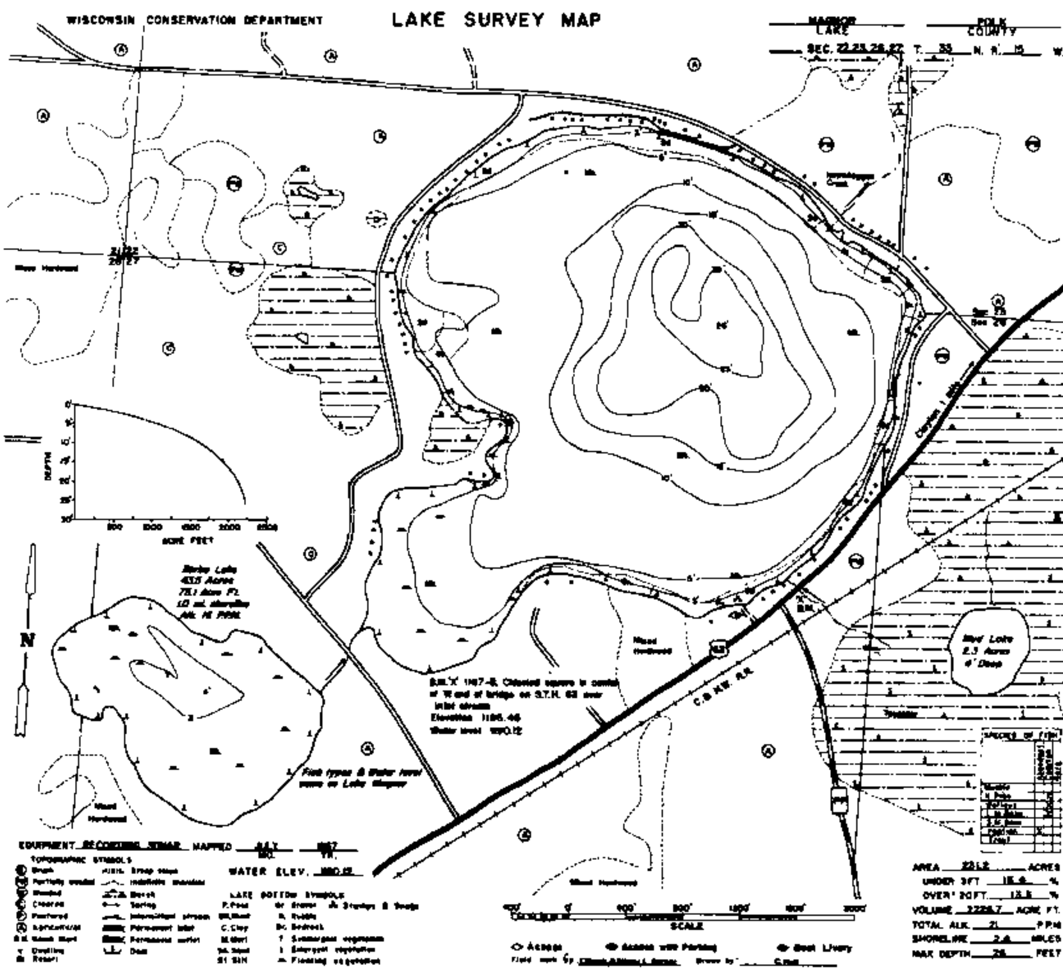
It is unknown when or if such a shift will occur. However, a pattern is apparent in almost all lakes in the Midwest: increased and unchecked human development on lakeshores and in watersheds has drastic and usually irreversible impacts on lakes such as Lake Magnor. Action should be taken to decrease the nutrient load to the lake and perhaps even reverse the eutrophication that has likely occurred since European settlement in the area.

TSI	Water Quality
<30	Oligotrophic; clear water; high DO throughout the year in the entire hypolimnion
30-40	Oligotrophic; clear water; possible periods of limited hypolimnetic anoxia (DO =0)
40-50	**Moderately clear water**; increasing chance of hypolimnetic anoxia in summer; fully supportive of all swimmable/aesthetic uses
50-60	Mildly eutrophic; **decreased water transparency**; anoxic hypolimnion; **nuisance aquatic plant growth**; warm-water fisheries only; supportive of all swimmable/aesthetic uses but "threatened"
60-70	**Blue-green algae dominance; scums possible;** extensive "weed" problems
70-80	Heavy algal blooms possible throughout summer; dense beds of aquatic plants; hypereutrophic
>80	Algal scums; summer fish kills; few macrophytes due to algal shading; rough fish dominance

Current condition of Lake Magnor TSI ~69

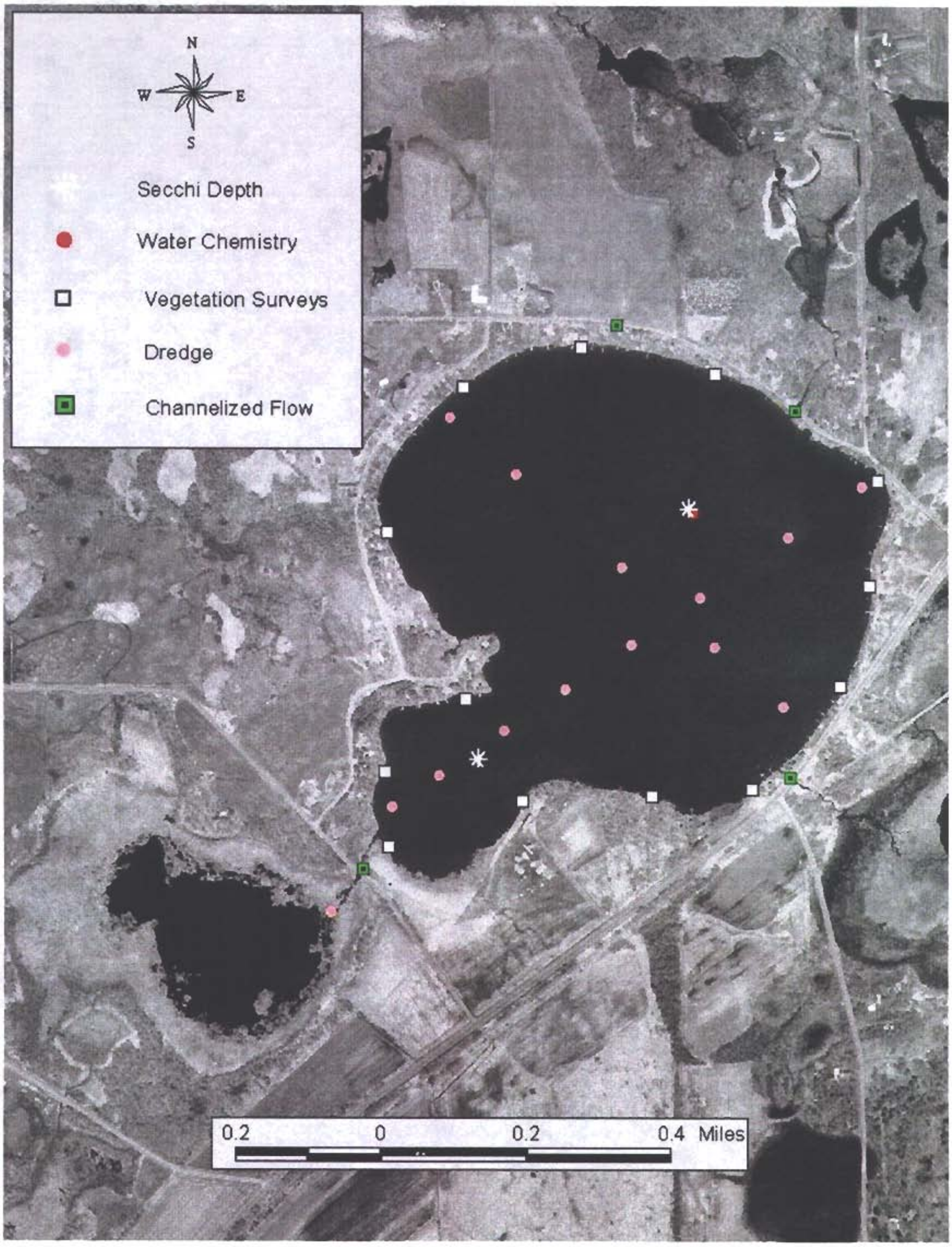
This Trophic State Index (TSI) is a method used to compare the relative productivity of one lake to another. Like mentioned elsewhere in this report it is natural for lakes to become more productive (green) as they age. However, the rate of that shift can be greatly accelerated by human activity. Furthermore, the higher the TSI the more likely recreational options like fishing and swimming will be negatively impacted and even curtailed.

Lake Topography

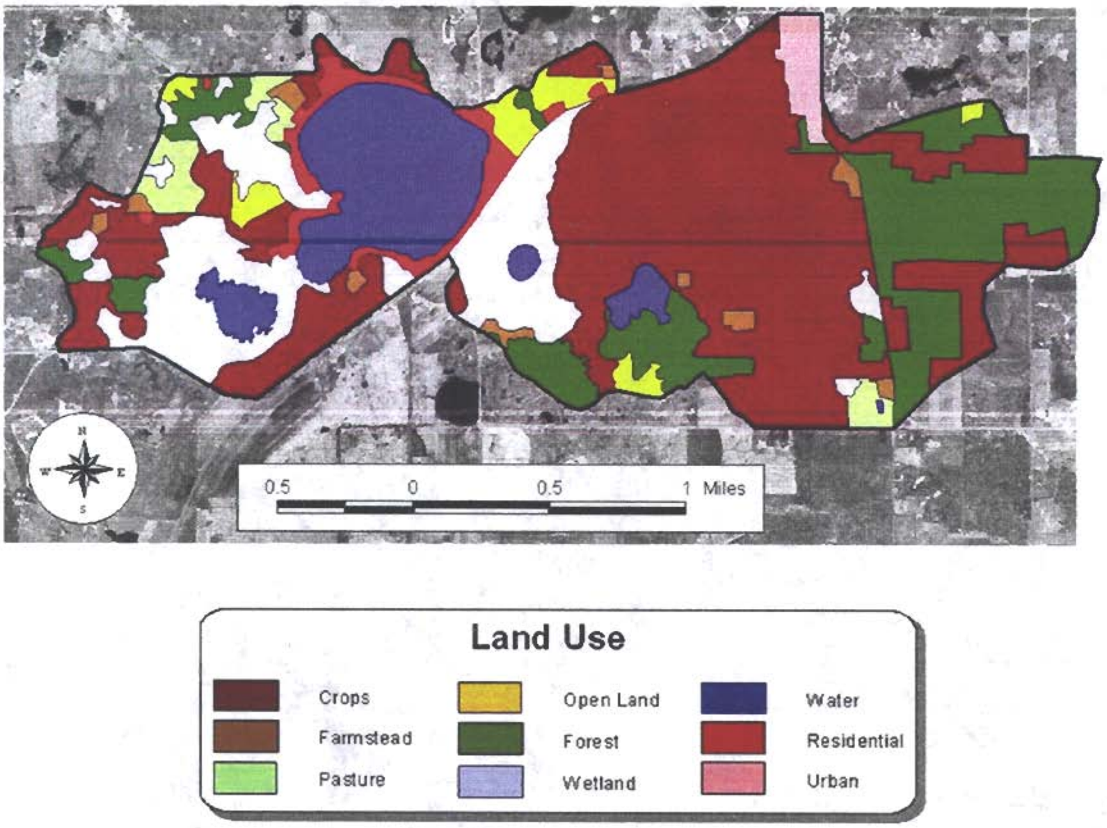


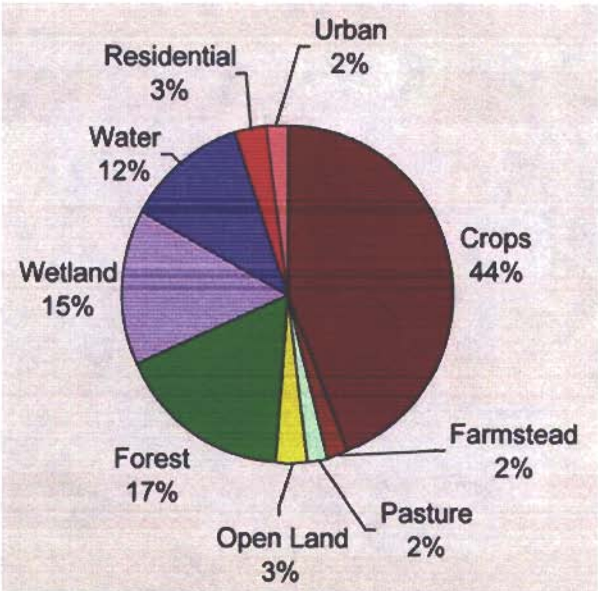
Map is a product of the WI-DNR.

Sampling Points on Lake Magnor



Land Use


0.5
0
0.5
1 Miles
Land Use
Crops
Open Land
Water
Farmstead
Forest
Residential
Pasture
Wetland
Urban


Urban 2%
Residential 3%
Water 12%
Wetland 15%
Crops 44%
Farmstead 2%
Forest 17%
Pasture 2%
Open Land 3%

Inlets and Outlet

Introduction

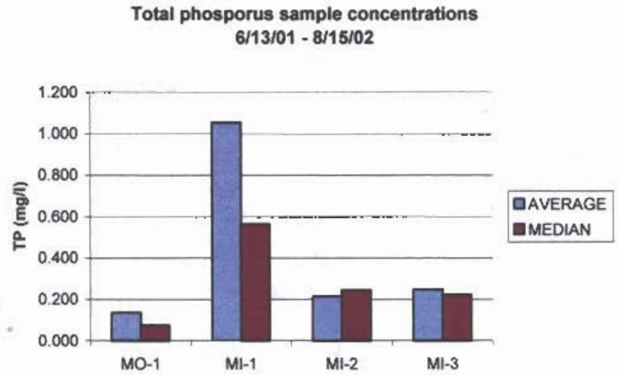
The goal of testing the inlets and the outlet of Lake Magnor was to look for any "hot spots" where nutrient levels far exceeded neighboring locations. Using this criteria for evaluation purposes it is apparent that inlet MI-1 is worthy of special attention. Its sample concentrations of key nutrients were far above those of other inlets.

It is quite possible to reduce nutrient loading from this source by engaging the upstream landowner and working with him/her to enlist best management practices (BMPs) on his/her land. BMPs are designed to reduce the nutrient application to the land as well as to encourage nutrients to remain on the land by limiting erosion and manipulating plant communities. County Conservationists (715-485-8699) will be able to assist the lake association and the landowner explore various BMP options.

NOTE: The following analysis of inlet and outlet nutrient concentration considers sample concentration. It does not calculate the actual amount of nutrients that are entering or exiting the lake. To make this important calculation flow data is needed and flow meters were not available for this project. Furthermore, quantifying the amount of water flowing from inlets is time-consuming, expensive, and difficult owing to the variations in flows due to rain events, soil moisture content, and other seasonal fluxes. Therefore, it is not possible to compare the inlets and the outlet nutrient contribution between sources based solely on the information found in the following charts.

Phosphorus

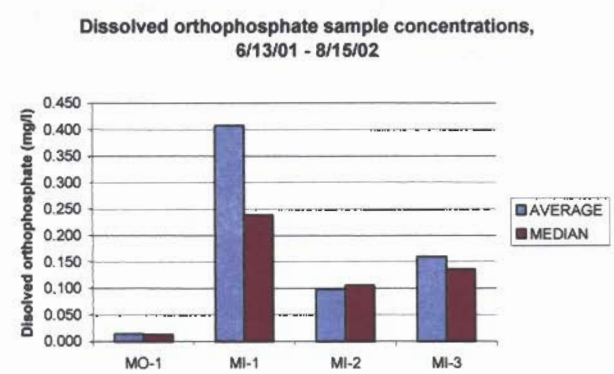
Phosphorus is typically the limiting nutrient affecting plant growth in this region. This means that a slight increase of phosphorus within a lake is likely to dramatically increase plant and algae growth while at the same time decreasing water clarity. Phosphorus occurs naturally in some soils and is a product of



decomposing plants. Phosphorus sources also include rainfall, septic systems, lawn and agricultural fertilizers, animal waste, yard and shoreline erosion, and detergents.

Total phosphorus is a measure of all forms of phosphorus, both organic and inorganic, and includes all of the aforementioned sources. This parameter was measured at least eight times (between 6/13/01 and 8/15/02) at all inlets and the outlet.

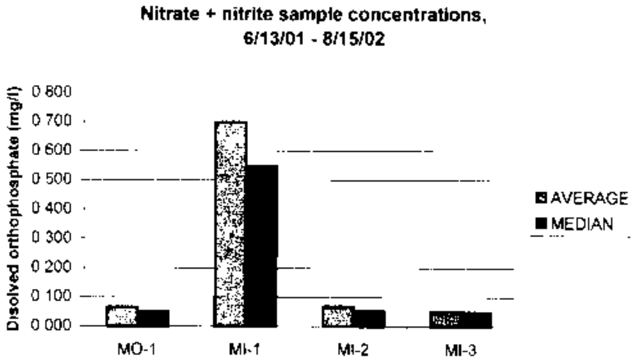
Dissolved orthophosphate is a measure of phosphorus that is immediately available for uptake by plants and algae. Large inputs of this parameter could trigger nuisance algal blooms as well as promote algal growth throughout the year. This parameter was measured on at least eight occasions at each inlet and the outlet.

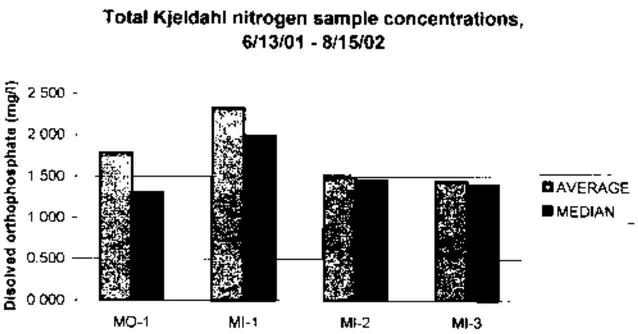


Inlets and Outlet

Nitrogen

Nitrogen is a naturally occurring element and is second only to phosphorus in its importance as a plant nutrient. Sources include rainfall, septic systems, lawn and agricultural fertilizers, and livestock wastes. Nitrogen was measured as nitrate+nitrite and total Kjeldahl nitrogen.





Sociologic Landowner Survey

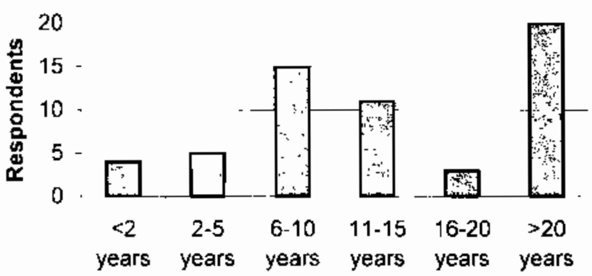
In summer 2001 a sociological landowner survey was sent to property owners within the Lake Magnor watershed. The survey was designed to assess landowner objectives, concerns and ideas as well as to forecast future change-of-ownership trends.

Of the 73 surveys that were returned 58 (79%) indicated that they owned shoreline property. The following analysis addresses only those respondents who indicated that they owned shoreline property.

Biographic data

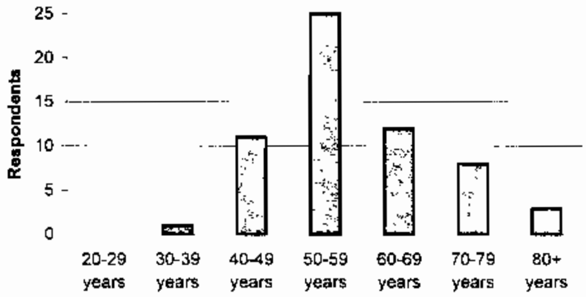
Although 34 respondents (34%) have owned their property for more than twenty years, 35 respondents (60%) have owned their property for ten years or less. This survey does not specify whether the newer property owners bought existing homes or built new homes on previously undeveloped lots.

How many years have you owned property on the lake?

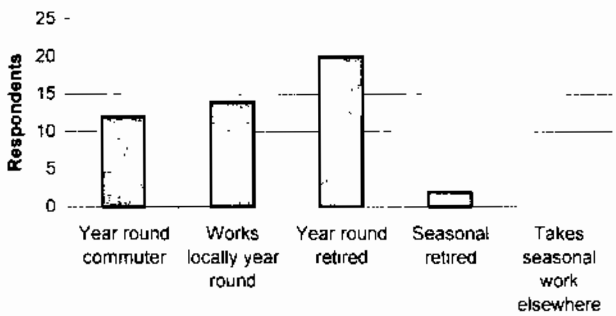


Forty-two percent (42%) of respondents indicated that the head of household was 50-59 years old. This is comparable to other lakes in the area. It is not unreasonable to assume that the 50-59 year-olds are gearing up for a retirement on the lake. Many of these people will be entertaining families and friends especially during the summer. The future will likely bring more recreational pressure on the lake especially considering people are living longer, healthier lives.

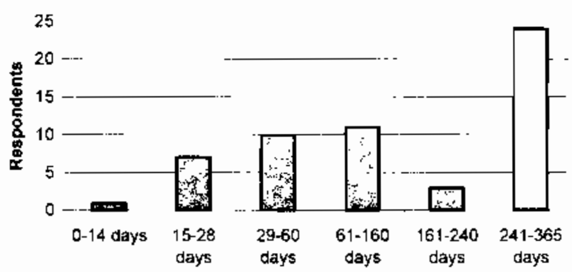
Age of head of household



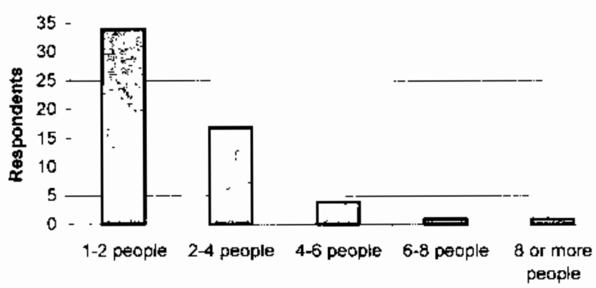
Employment status of head of household



How many days in an average year is your property occupied?



On an average day that your property is occupied, how many people occupy the property?

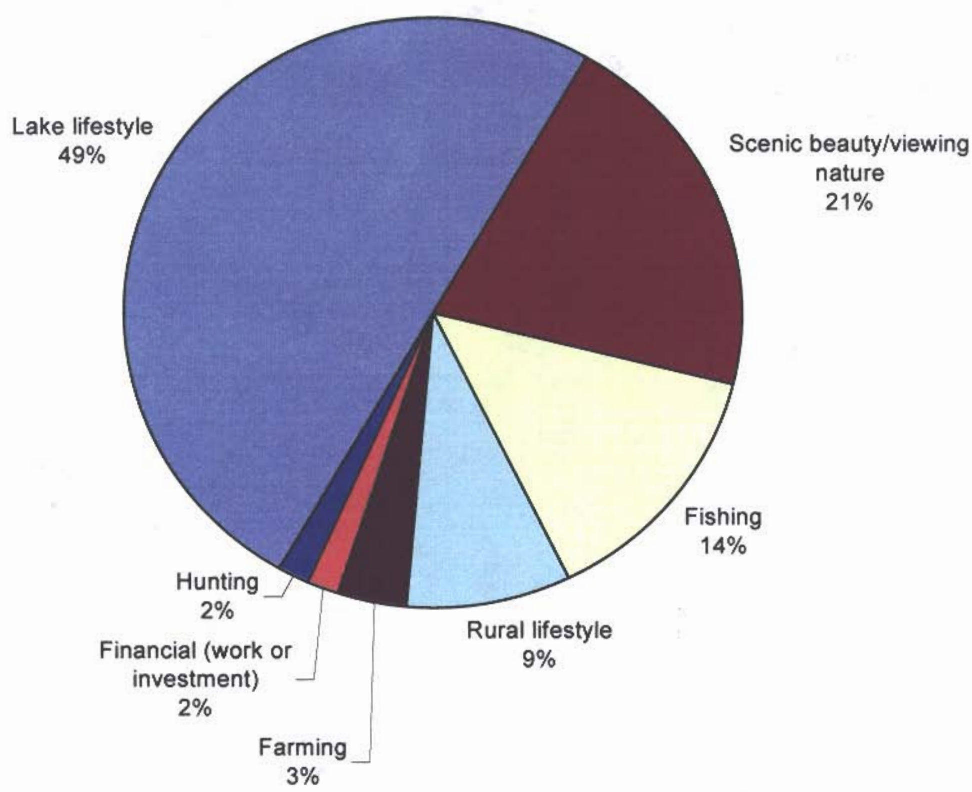


Sociologic Landowner Survey

Reasons for owning property

Property owners are attracted to the area for the amenities associated with living on a lake as well as the aesthetics offered by rustic and natural surroundings. Fishing is also notably popular. Therefore, fish and fish habitat management will likely factor heavily into lake management decisions.

*What is the most important reason that you Own property on or near Lake Magnor?**

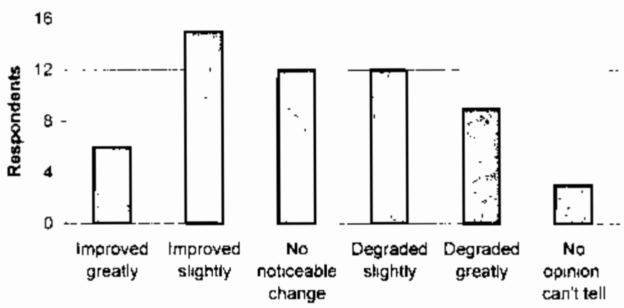


Respondents ranked their top three reasons for owning property on or near the lakes. The pie chart is a tally of all the issues ranked as the foremost reason.

Perceptions regarding water quality

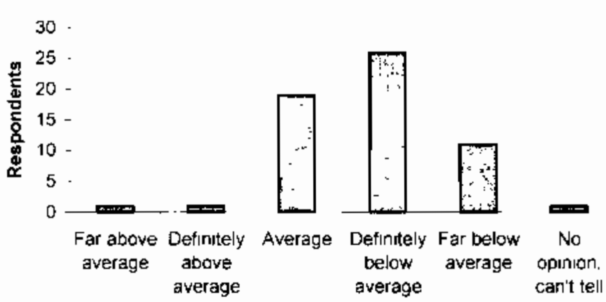
A majority of respondents (63%) described the water quality of Lake Magnor as below or far below average while 36% described the lake as average or above average.

Since you have lived on or near the lake, how would you describe the change in water quality?



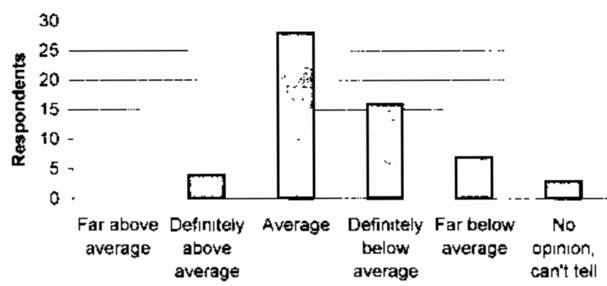
There was no such simple break in respondents' opinions regarding the change in water quality since their tenure on the lake. Based on these responses it can be assumed that there has been little or no change in water quality in the past several years. However, remember that a majority of respondents indicated that water quality was below average.

How would you describe the current water quality?



Fifty-five percent (55%) of respondents felt the quality of the shoreline was average or above average while 40% felt the shoreline was below average. These numbers contrast to a degree with perceptions about water quality. This is notable because degraded water quality is often associated with degraded shorelines. Public education and outreach in this area may help people understand this connection and become aware of the interaction of the land and water on Lake Magnor.

How would you describe the quality of the shoreline?

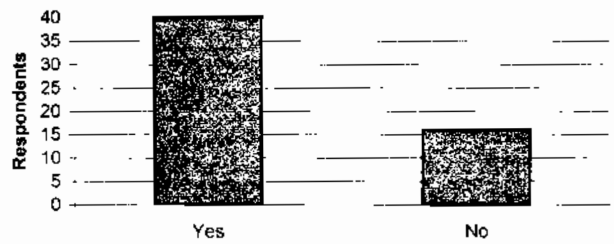


Sociologic Landowner Survey

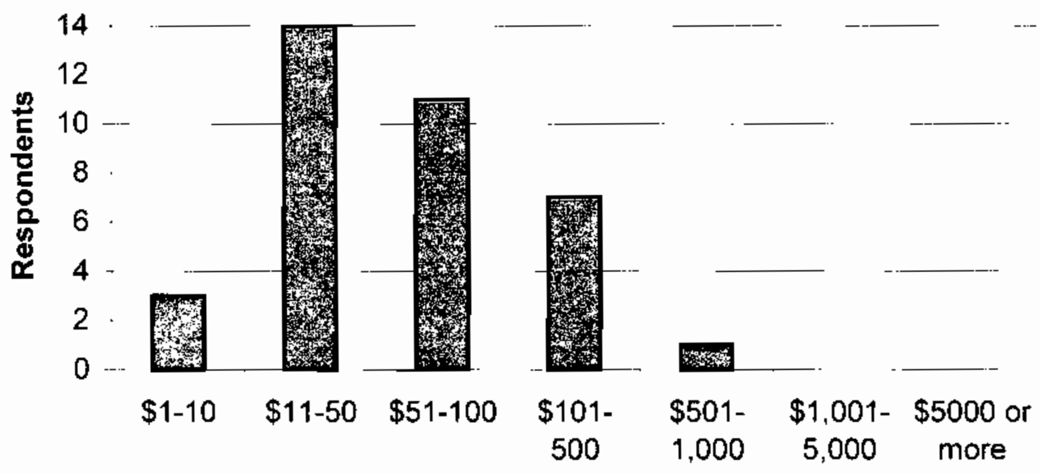
Willingness to provide financial support

The willingness of property owners to financially support the maintenance or improvement of Lake Magnor and its associated land resources is relatively strong. Seventy-six percent (76%) of respondents who own shoreline property are willing to provide annual financial support. Of those, 39% are willing to contribute between $11 and $50 per year and 31% are willing to contribute between $50 and $100 per year. Nineteen percent (19%) would offer annual contributions in the $101 to $500 range. That sort of commitment to protect or improve the lake indicates a strong sense of lake stewardship among shoreline property owners.

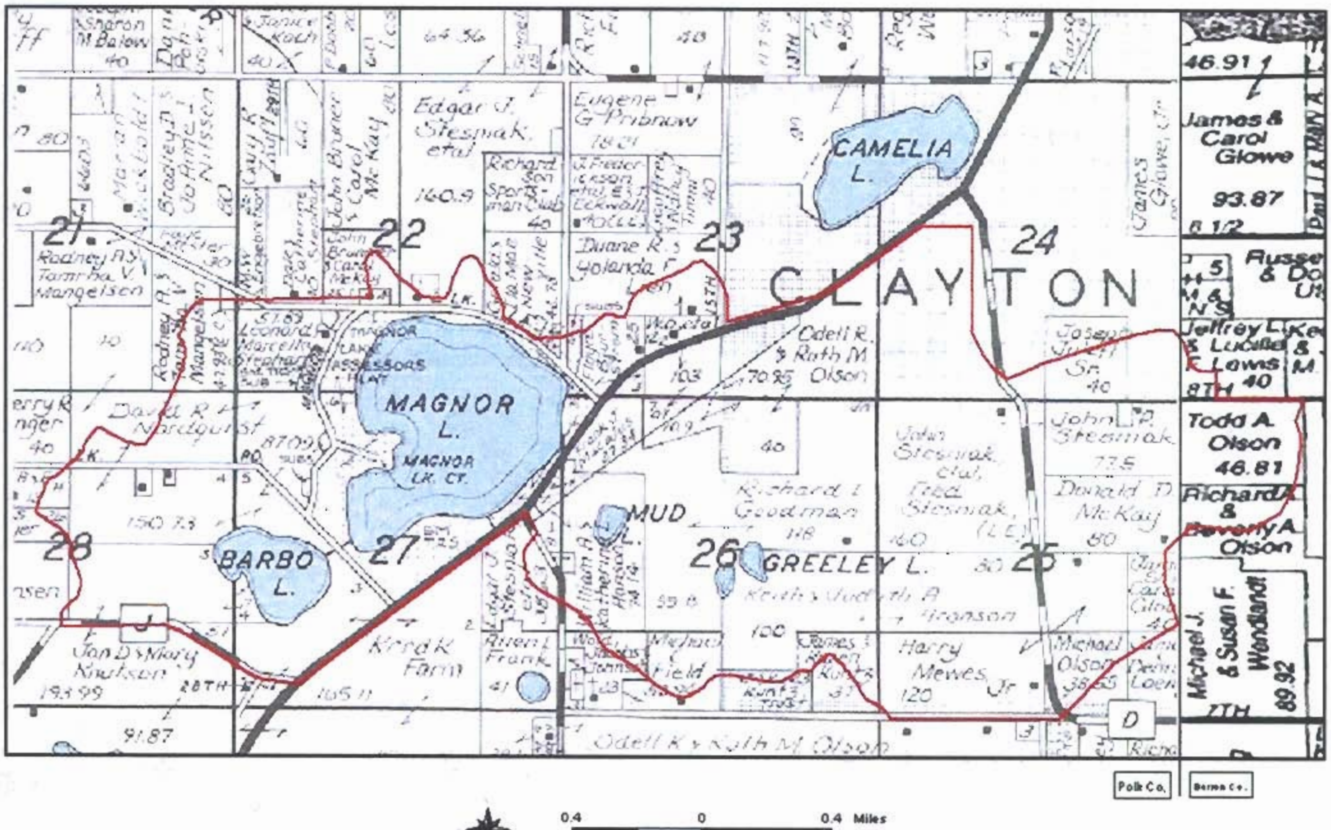
Would you be willing to provide financial support to protect or improve Lake Magnor and its associated land resources?



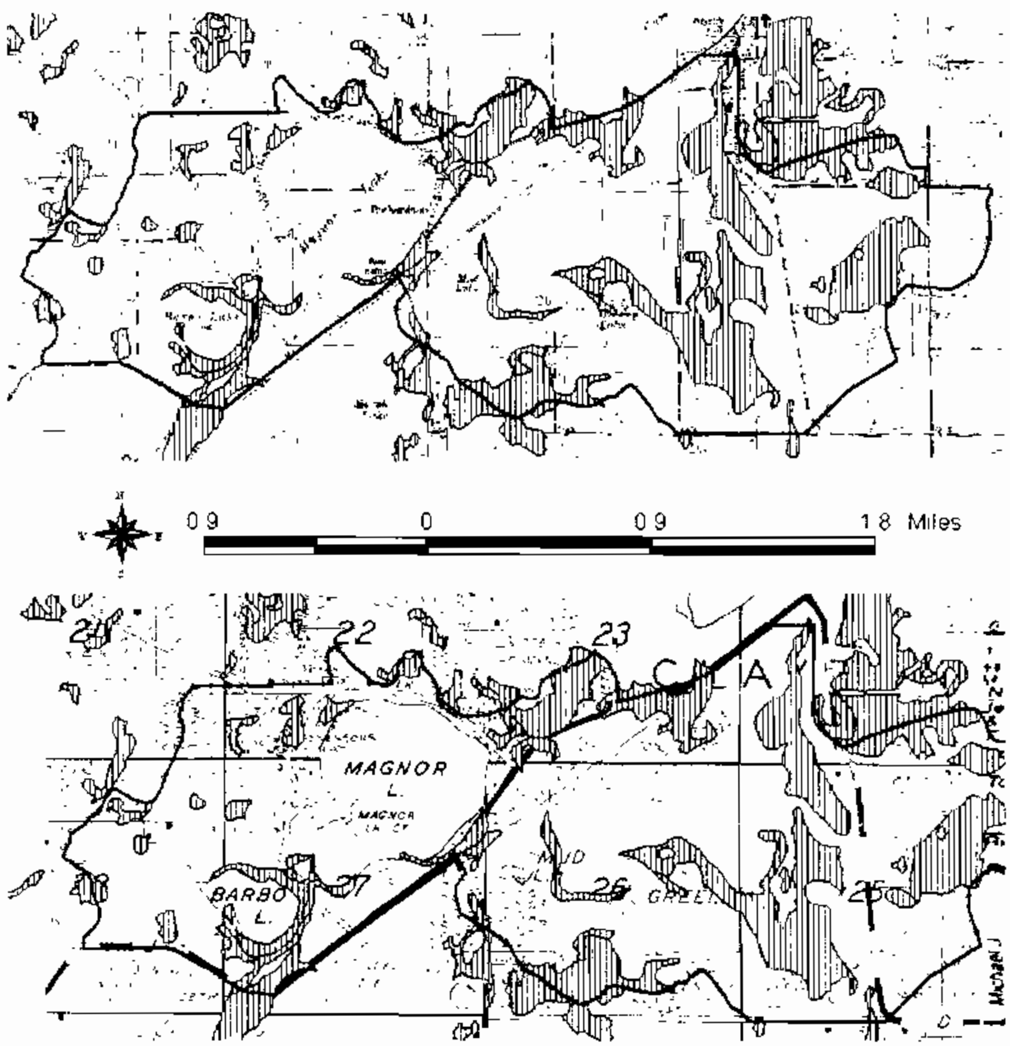
If you answered YES, how much would you be willing to contribute each year?



Property Owners in the Lake Magnor Watershed



Sensitive Areas by Soil Type



Areas in red refer to soils with severe limitations. Severe limitations indicate that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required – and even this may not make construction feasible.

Fisheries

The following excerpt is from a memo from Rick Cornelius (DNR Fisheries Biologist) dated January 11, 2002. The complete memo and accompanying data is included in the Appendix.

Introduction

Past management of Lake Magnor has consisted mainly of periodic walleye stocking since 1934. There have been a number of electrofishing surveys conducted from 1971 through 1994. In general, these surveys found walleyes to be the main predator fish present, with the walleye population supported by a combination of natural reproduction and stocking. Northern pike were fairly common, with bass present in low to moderate numbers.

There have been two walleye population estimates made on Lake Magnor: one in 1989 and one in 1994. Both estimates were conducted by GLIFWC. The 1989 walleye population was estimated at 10.3 adults per acre, and the 1994 estimate was 4.6 adults per acre.

An electrofishing survey was conducted on the evening of September 19, 2001, to update information on the fish population. Total effort was 0.8 hours of shocking and 2.6 miles of shoreline.

Results and discussion

A total of 31 largemouth bass ranging in size from 3.0 to 19.9 inches in length were captured. The bass catch per effort of 39 per hour indicates that bass are common. This CPE is higher than in any previous survey, and the bass population appears to have been increasing during the late 1980's and the 1990's. The size distribution of the bass population was good, with 32% of the captured bass being 14.0 inches or larger. The growth rates of bass were above average for northwest Wisconsin.

A total of five walleyes were captured ranging in size from 17.5 to 22.4 inches in length. The walleye CPE in the 2001 survey (61/hour) was far less than in any previous survey, indicating a significant decline in the walleye population. No walleyes less than six years of age were captured, indicating that walleye recruitment has been poor in recent years. Growth of walleyes was above average.

A total of 12 northern pike were captured ranging in size from 10.0 to 33.4 inches in length. Northern pike CPE's from the survey and past surveys show no clear trends, but indicate that, in general, northern pike are presently common in Lake Magnor, and have also been common in the past. Aside from one large northern pike, the captured northerns were all less than 22.5 inches in length. Growth of northern pike was below average.

Yellow perch and bluegills were the panfish captured in the largest numbers. A large number of young of the year perch were captured, and the largest perch captured was 8.2 inches in length. Bluegills were captured up to 8.0 inches in length. The size distribution of the bluegill population was fairly good, with a percent stock of 36%, and an RSD-7 of 23%. Growth of bluegills was above average.

Black crappies and pumpkinseeds were captured in lesser numbers. However, fall electrofishing usually does not effectively sample crappies. Most of the captured crappies were in the 6.7 to 8.5-inch size range. Growth of crappies was a little below average. Most of the captured pumpkinseeds were in the 5.0 to 7.1-inch size range.

Conclusions and recommendations

Lake Magnor has a fairly desirable fish population. However, the structure of the fish community found in the 2001 survey was markedly different from the fish community found in previous surveys. In previous surveys, walleyes were the primary predator fish present. Population estimates made in 1989 and 1994 by GLIFWC found walleyes to be common to abundant. In the 2001 survey the walleye population had declined substantially, and bass had become the primary predator fish.

The reason for this change is unknown, but it has occurred on a number of area lakes in the past 20 years (i.e. Loon, Balsam, Ward, Big Butternut, Half Moon). Catch per effort indicates that the bass population was increasing by the 1989 survey, and continued to increase in the 1994 and 2001 surveys. By contrast, walleye CPE was good through 1994, and then declined sharply by 2001. In the 2001 survey, no walleyes less than six years of age were captured, indicating poor year classes in recent years.

The northern pike population in the 2001 survey appeared similar to previous surveys. The panfish population appeared to be fairly desirable, with bluegill growth rates above average, but the crappie growth rates a little below average.

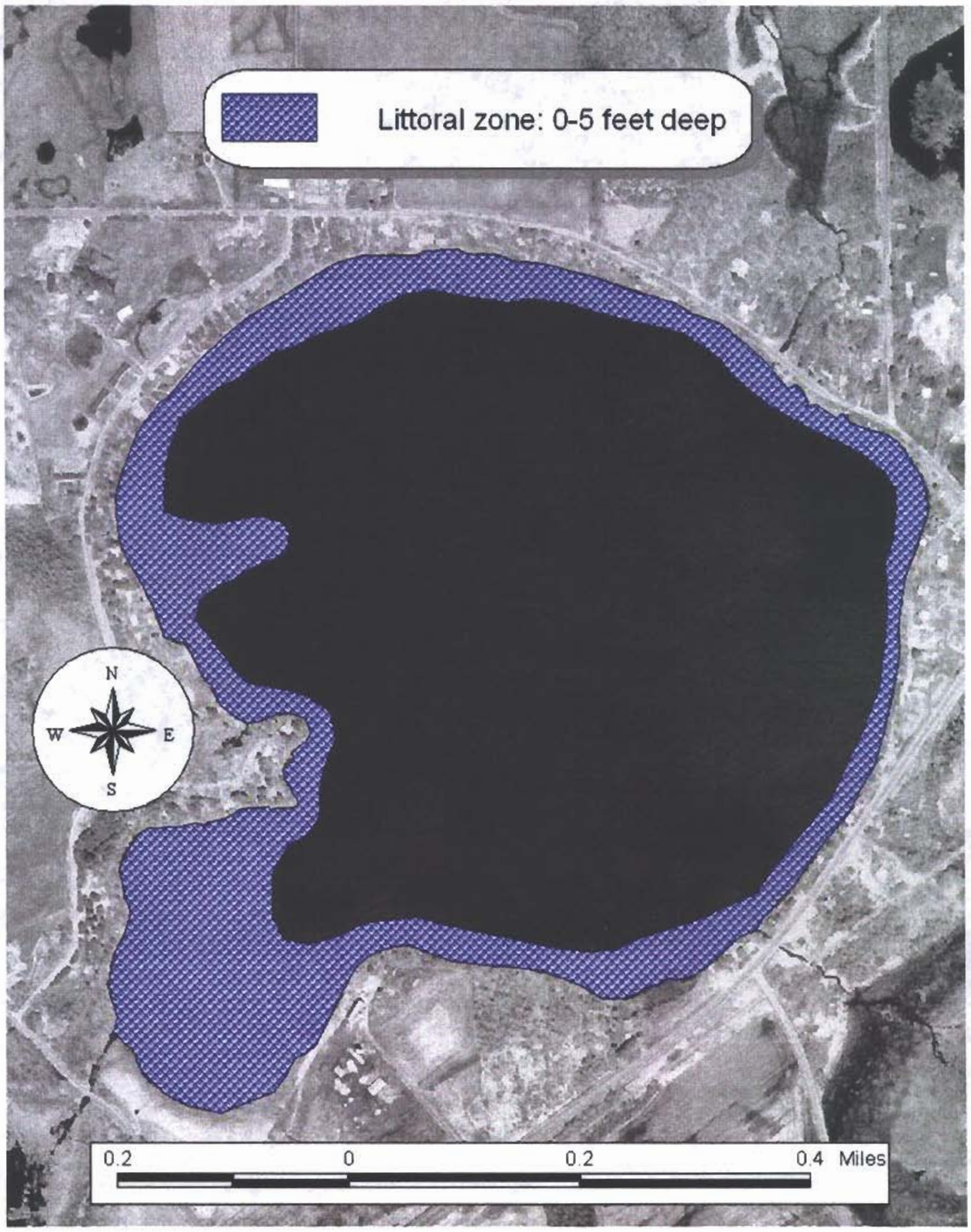
One management objective for Lake Magnor would be to increase walleye numbers back to levels found from the 1970's to the mid-1990's. However, the other area lakes where walleye numbers have declined and bass numbers have increased, efforts to increase the walleye population have had little success. Success has been documented on only one area lake, Granite Lake, and management of this lake consisted of walleye fingerling stocking.

It is recommended that walleye fingerling stocking continue on Lake Magnor at the rate of 50 per acre on an alternate year basis. If future surveys do not indicate an improvement in the walleye population, the stocking rate should be increased or extended growth fingerlings should be tried.

It is very important that walleye and northern pike spawning areas not be degraded. Habitat sensitive areas have been designated on Lake Magnor (see map). A document titled "Lake Magnor Sensitive Area Survey Report and Management Guidelines" from the DNR gives more details regarding the sensitive areas.

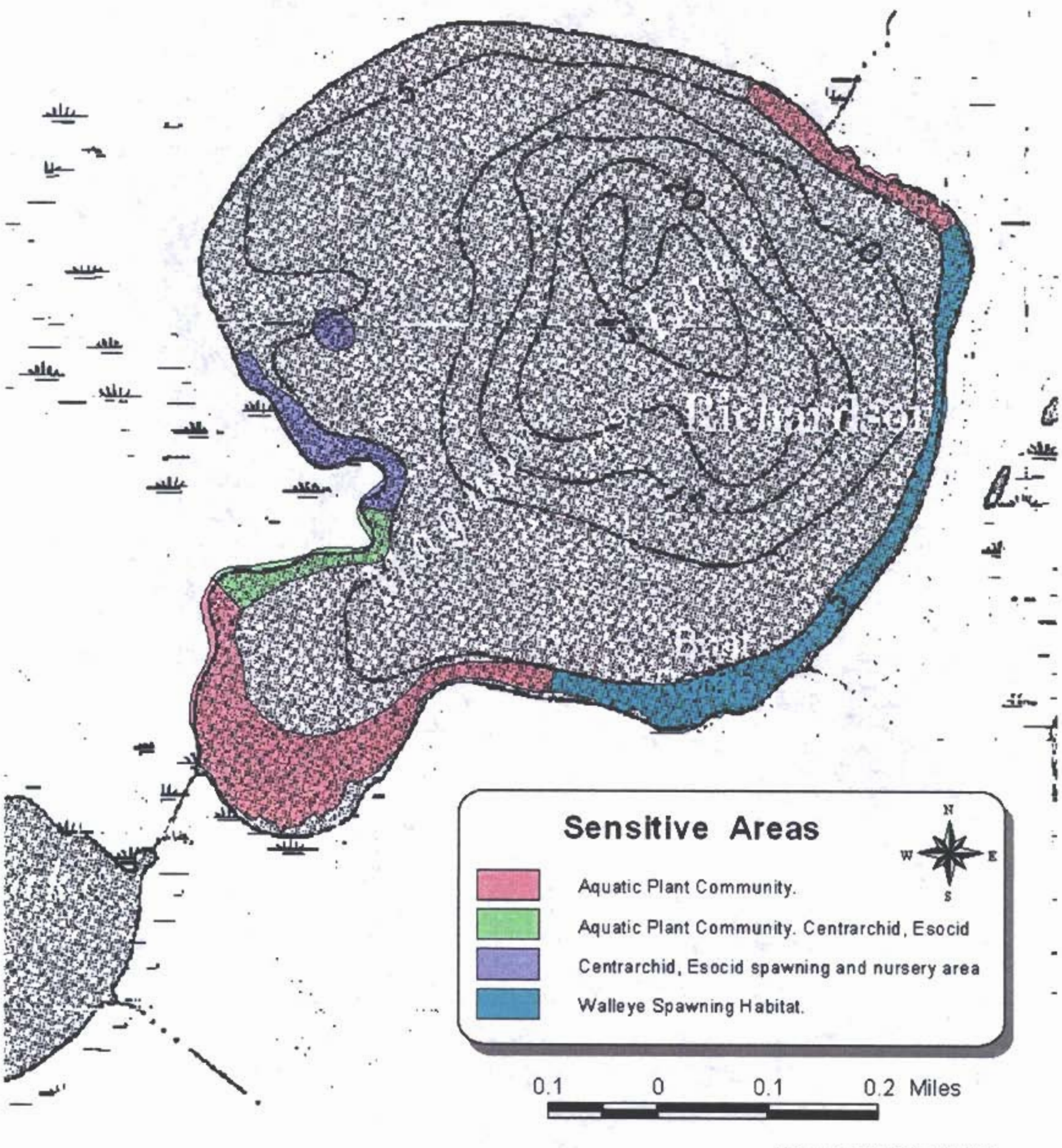
No changes in fishing regulations for Lake Magnor are currently recommended. Because the walleye population has recently declined, another fish survey should be conducted in 3 to 5 years to monitor changes in the walleye population.

The Littoral Zone of Lake Magnor



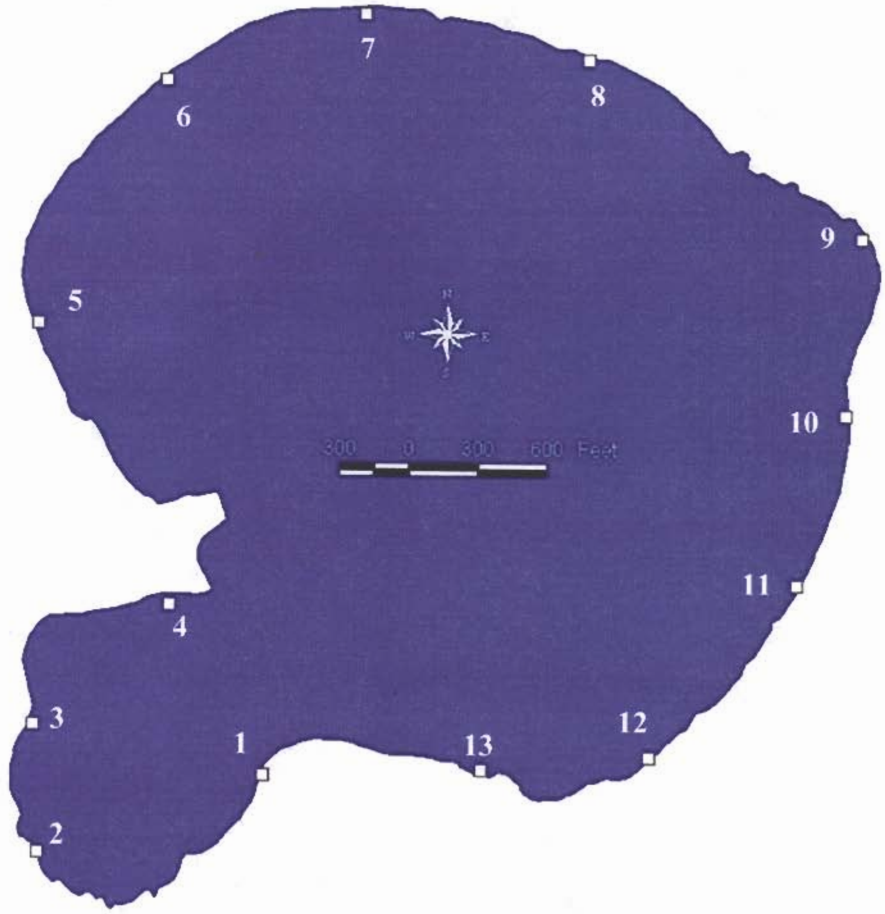
The littoral zone or shallow water area is the most important area for aquatic wildlife. This is where sunlight is able to reach the lake bottom, young fish find refuge, and the dynamics play out between the land and the water. As many as 90% of the living things in lakes and rivers are found along their shallow margins and shores. (Rideau Canal, Parks Canada)

Sensitive Areas of Lake Magnor



Recommended No Wake Zone

Aquatic Plant Survey



Transect 1
Pontederia cordata
Typha latifolia
Nuphar variegata
Potamogeton robbinsii

Transect 2
Brasenia schreberi
Ceratophyllum demersum
Potamogeton robbinsii
Cladophora

Transect 3
Ceratophyllum echinaturm
Nymphaea odorata
Typha latifolia
Nuphar variegata
Potamogeton robbinsii
Utricularia spp.

Transect 4
Myriophyllum tenellum
Eriocaulon spp.
Potamogeton robbinsii
Ceratophyllum demersum

Transect 5
Pontederia cordata
Sagittaria spp.
Myriophyllum tenellum
Nuphar variegata
Potamogeton robbinsii
Nymphaea odorata
Scirpus acutus
Valisneria americana

Transect 6
Brasenia schreberi
Eriocaulon spp.
Potamogeton robbinsii
Myriophyllum tenellum

Transect 7
Typha latifolia
Myriophyllum tenellum
Sagittaria spp.
Eriocaulon spp.
Potamogeton robbinsii

Transect 8
Eriocaulon spp.
Potamogeton robbinsii

Transect 9
Carex spp.
Scirpus validus
Valisneria Americana
Potamogeton robbinsii

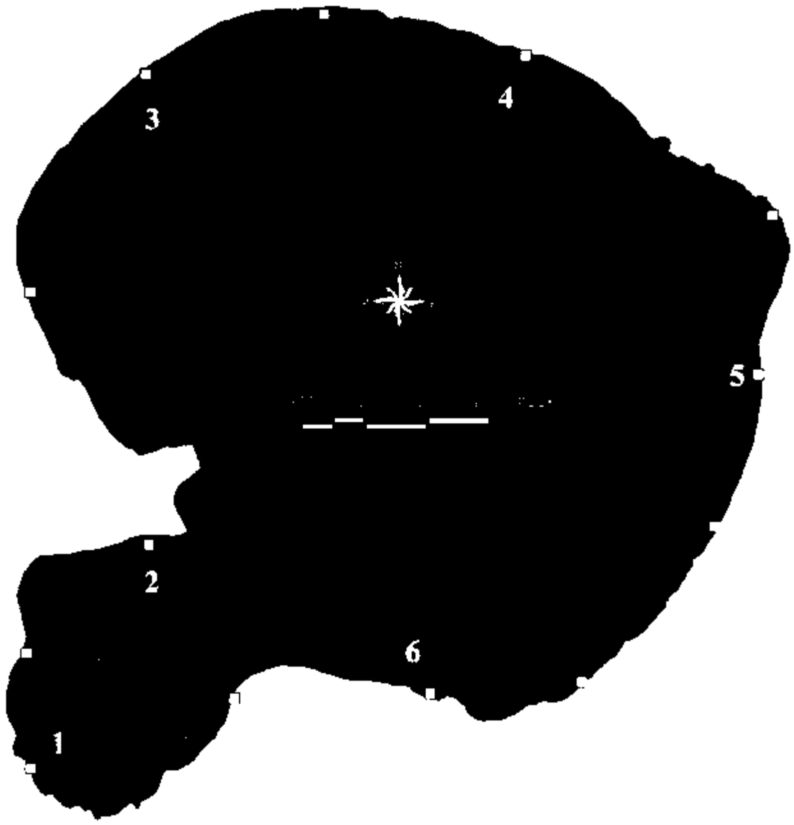
Transect 10
Cladophora
Myriophyllum tenellum

Transect 11
Carex spp.
Scirpus acutus
Eriocaulon spp.
Valisneria Americana
Potamogeton robbinsii

Transect 12
Myriophyllum tenellum
Eriocaulon spp.
Potamogeton robbinsii
Valisneria Americana

Transect 13
Myriophyllum tenellum
Valisneria Americana
Scirpus validus
Potamogeton robbinsii

Terrestrial Plant Survey



Transect 1
Scirpus spp.
Typha spp.
Impatiens capensis
Pontedaria cordata
Panicum virgatum

Transect 2
Phalaris arundinacea
Schoenoplectus pungens
Digitaria haller
Plantago major
Taraxacum officinale
Polytrichum commune
Digitaria ischaemum
Trifolium spp.
Achillea millefolium
Rubus idaeus
Maianthemum dilatatum
Glechoma hederacea
Oxalis acetosella

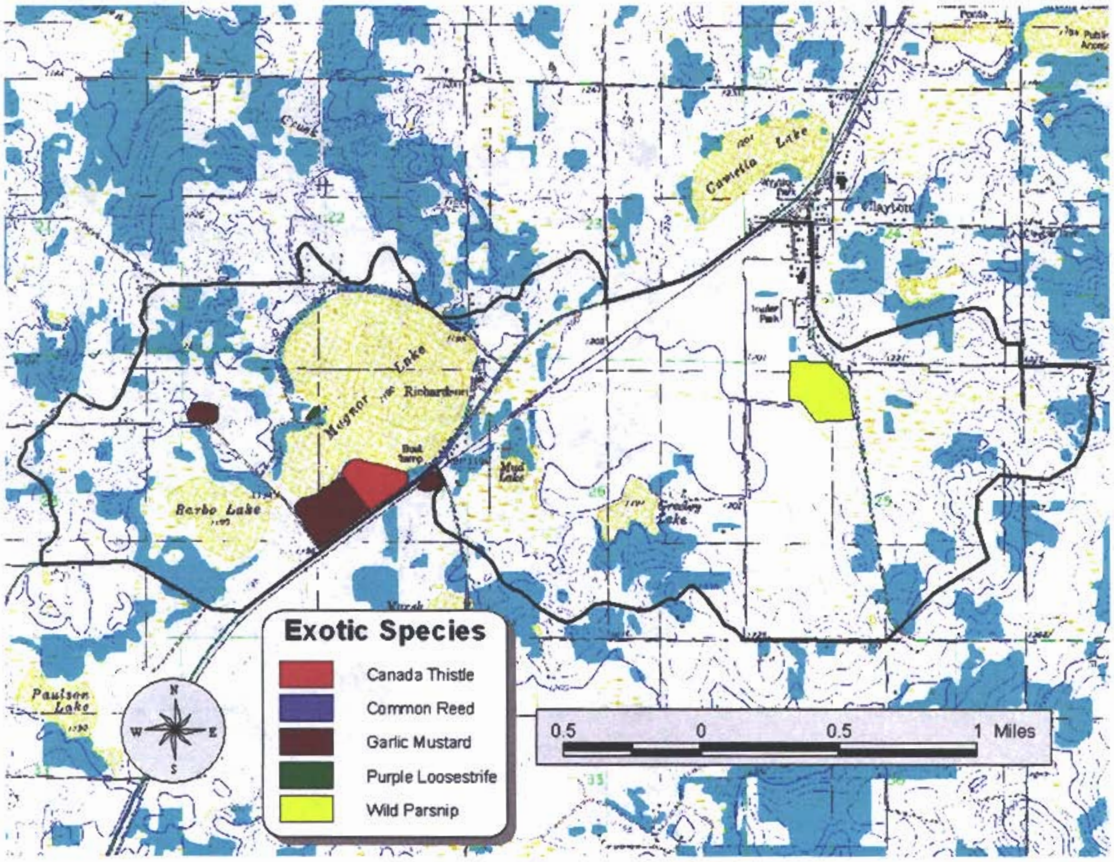
Transect 3
Digitaria haller
Glechoma hederacea
Taraxacum officinale
Plantago major
Oxalis acetosella
Calystegia sepium
Convolvulus spp.
Polytrichum commune
Potentilla gracillus

Transect 4
Impatiens capensis
Phalaris arundinacea
Scirpus atroverins
Acer nigrum
Bidens spp.
Glechoma hederacea
Digitaria haller
Oxalis acetosella
Plantago major
Taraxacum spp.
Taraxacum officinale
Viola sorroria

Transect 5
Salix exigua
Phalaris arundinacea
Aster symplix
Oxalis acetosella
Impatiens capensis
Bidens spp.
Polytrichum commune
Acer pensylvanicum
Nyssa sylvatica
Carex pensylvanica
Verbascum thapsus
Plantago major
Poa pratensis
Trifolium repens
Achillea millefolium
Hieracium aurantiacum
Cornus stolonifera

Transect 6
Phalaris arundinacea
Polygonum pensylvanicum
Glechoma hederacea
Taraxacum officinale
Trifolium repens
Polytrichum commune
Oxalis acetosella

Exotic Species



Exotic species are any species of plant or animal, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm or harm to human health. Many people recognize the names zebra mussel and Eurasian water milfoil as exotic species because of their extensive damage to lakes and rivers. Exotic species that have been found in Lake Magnor's watershed include Canada thistle, common reed, garlic mustard, purple loosestrife, and wild parsnip. These species need to be identified and controlled to limit their spread and threat.

Top Down Control of Snails

Some species of fish are specialized at feeding on mollusks. Well-known examples from North America are the redear sunfish (*Lepomis microlophus)* and the pumpkinseed (*Lepomis gibbosus). Lepomis gibbosus* is native to this area of the United States.

Pumpkinseed
Lepomis gibbosus

Pumpkinseeds can be found in shallow, cool to moderately warm water. They are most prevalent in small lakes and ponds or weedy bays of larger lakes. Preferring cover of some type, such as aquatic vegetation or submerged brush, they are seldom found in open water.

Human activities can have a severe impact on pumpkinseed populations. Shoreline development can destroy pumpkinseed spawning grounds, and increased siltation from shoreline erosion can cover spawning sites, disrupting spawning activities. Heavy lake use can also stir up sediment and disrupt spawning. Reducing human activity can have a positive effect on pumpkinseed populations because they are low on the food chain and reproduce rapidly (Fish of the Great Lakes by Wisconsin Sea Grant).

Pumpkinseeds can have a strong impact on snail density. In experiments in the littoral zone of two Wisconsin Lakes snail biomass was significantly reduced in the presence of a natural density of *Lepomis gibbosus* as compared with the control situation without them (Bronmark, C. and Weisner S. E. B., 1992 Indirect effects of fish community structure on submerged vegetation in shallow eutrophic lakes an alternative mechanism. *Hydrobiologia*, 243-244).

Reducing the human influence on Lake Magnor would increase the health of the littoral zone, and therefore allow the pumpkinseed population to increase. Subsequently, this would likely have an impact on the prolific snail population in Lake Magnor.

Modeling

The Wisconsin Lake Modeling Suite (WiLMS) was used to model current, pre-development, and future water quality conditions of Lake Magnor. The parameter of primary concern in these modeling scenarios was phosphorous because it is the limiting nutrient for algal growth in most lakes in this region. The lake was also modeled for a 12, 20 and 45% reduction in phosphorous loading.

The following tables and graphs were based on annual external loading and the Nurnberg model for estimating gross internal loading. The combination of these factors gives a model "fit" for Lake Magnor. These models estimate the amount of phosphorous in the water column (mg/m^3). The Reckhow Natural Lake Model (1979) and the Vollenweider Lake Model (1982) were used because they demonstrated the best "fit" for Lake Magnor. The Reckhow model predicts growing season observations, while the Vollenweider predicts a spring turnover and growing season average.

Table 1. Magnor Lake Current Conditions Prediction

Total Annual P Load (External Sources)	**Reckhow, 1979 Natural Lake Model Most Likely P [ ]**	**Vollenweider, 1982 Lake Model Most Likely P [ ]**
712.2 kg	**55 mg/m^3**	**95 mg/m^3**

Table 2. Magnor Lake Projected Development Conditions Prediction

Total Annual P Load (External Sources)	**Reckhow, 1979 Natural Lake Model Most Likely P [ ]**	**Vollenweider, 1982 Lake Model Most Likely P [ ]**
742 kg	**57 mg/m^3**	**99 mg/m^3**

Table 3. Magnor Lake Predevelopment Conditions Prediction

Total Annual P Load (External Sources)	**Reckhow, 1979 Natural Lake Model Most Likely P [ ]**	**Vollenweider, 1982 Lake Model Most Likely P [ ]**
39.7 kg	**3 mg/m^3***	**7 mg/m^3**

*The water column phosphorous content and the external loading became so low in this scenario that the Reckhow model no longer fit.

Because it is not possible to restore a watershed to a predevelopment condition, the lake was modeled for a range of potential in-lake phosphorous reductions. Lake Magnor was modeled for 12, 20 and 45% phosphorous loading reductions. These reductions may be achieved through efforts to employ best management practices (BMPs) on the land. BMPs include: shoreline restoration, erosion control during construction, conservation tillage, and conservation buffers, and a variety of stormwater management techniques. Limiting horsepower and speed limits on the lake could further reduce the internal lake loading.

Table 4. Magnor Lake Current Conditions Prediction with a 12% phosphorous reduction

Total Annual P Load (External Sources)	**Reckhow, 1979 Natural Lake Model Most Likely P [ ]**	**Vollenweider, 1982 Lake Model Most Likely P[ ]**
630.2 kg	**48 mg/m^3**	**85 mg/m^3**

Table 5. Magnor Lake Current Conditions Prediction with a 20% phosphorous reduction

Total Annual P Load (External Sources)	**Reckhow, 1979 Natural Lake Model Most Likely P [ ]**	**Vollenweider, 1982 Lake Model Most Likely P [ ]**
575.5 kg	**44 mg/m^3**	**79 mg/m^3**

Table 6. Magnor Lake Current Conditions Prediction with a 45% phosphorous reduction

Total Annual P Load (External Sources)	**Reckhow, 1979 Natural Lake Model Most Likely P [ ]**	**Vollenweider, 1982 Lake Model Most Likely P [ ]**
404.5 kg	**31 mg/m^3**	**58 mg/m^3**

Modeling

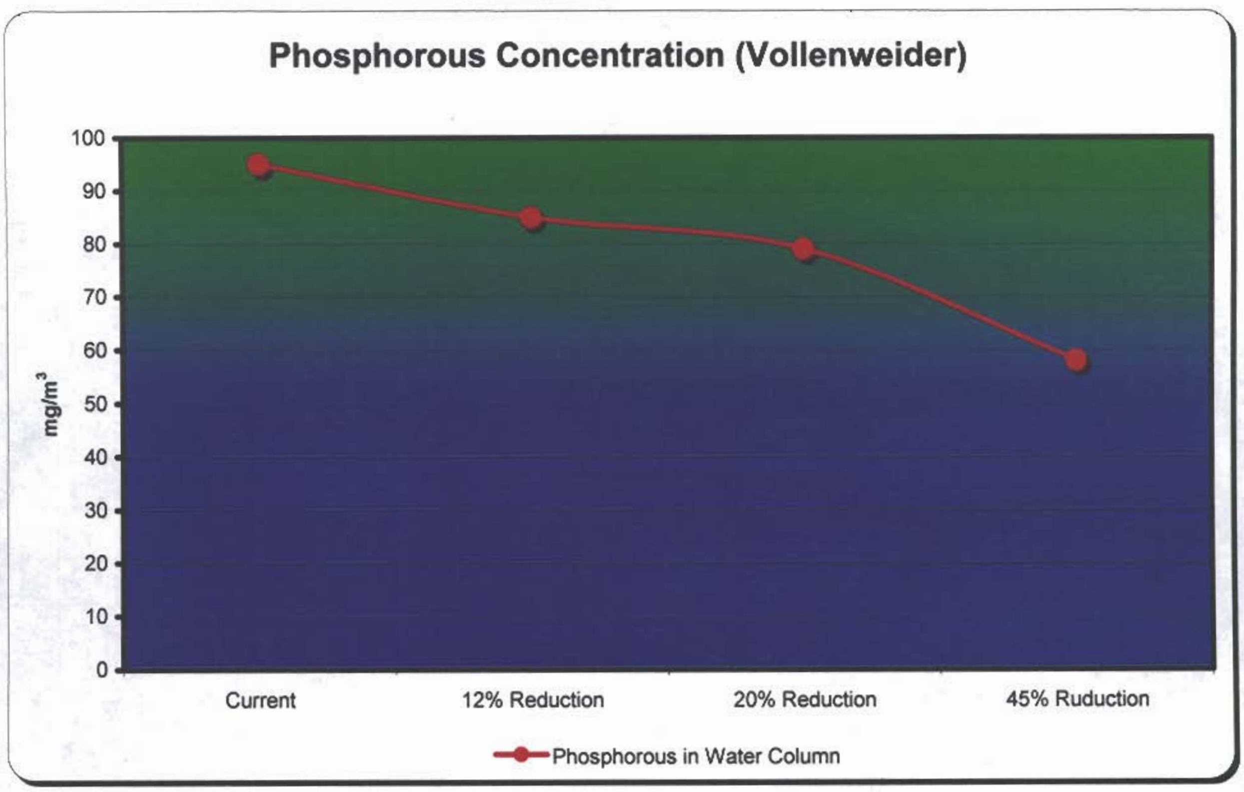
Modeling allows natural resource managers to predict the effects of a number of scenarios. For instance, if 40% of the agricultural land in the Lake Magnor watershed was converted from row crops to prairies it is likely that external phosphorus sources would be reduced by almost 30% and in-lake phosphorus levels would see a similar reduction. See Table 7.

Table 7. Magnor Lake Prediction with 40% of Ag. Land Converted to CRP

Total Annual P Load (External Sources)	Reckhow, 1979 Natural Lake Model Most Likely P [ ]	Vollenweider, 1982 Lake Model Most Likely P [ ]
509.2 kg	39 mg/m^3	71 mg/m^3

The modeling also predicts that internal loading makes up approximately 12.5% of the Phosphorus released from the sediment and decaying plant matter. However, the modeling suggests that significant reductions (45%) in in-lake phosphorus concentrations are necessary before any visible improvement in water quality is detectable (see the graph below). With most of the phosphorus originating from external sources, specifically runoff from the landscape, efforts to improve Lake Magnor must consider what is occurring on the land.

There is no quick fix to turn Lake Magnor into a clear, clean, walleye-abundant lake. Obviously decades of intensive agriculture, residential development, and road building in the watershed has affected the lake. It will take many years to minimize these effects. However, it is important to halt the nutrient loading to the lake now so no further degradation occurs.



Appendices

Appendix A....Water Chemistry Sampling

Appendix B....Aquatic Plant Survey

Appendix C....Terrestrial Plant Survey

Appendix D....Fish Survey

Appendix E....Exotic Species Survey

Appendix A
Water chemistry sampling

Secchi disk

Volunteers on Lake Magnor took Secchi readings twice a week from May through October of 2001 and once in February and April of 2002 in two locations, the deep spot of the lake and at the bay by Barbo Lake. Using landmarks and a depth finder to pinpoint the locations, the pontoon ran in neutral while readings were taken. The individual taking the readings did not wear sunglasses.

Secchi disk was lowered over the shady side of the boat and into the water until the disk disappeared. The disk was then pulled up so that it came into view again. The average of those two depths was recorded as the Secchi depth. This was done between 10:00 AM and 4:00 PM at each of the two locations.

Water chemistry

Water chemistry samples were taken once a month from May through October of 2001 and once in February and April of 2002 in the deep spot of the lake (26 feet). A Van Dorn sampling apparatus was lowered into the water 3 feet for a surface sample and 23 feet for a bottom sample. If there was any water leaking from the Van Dorn, the tube was emptied and another sample was taken.

Once the Van Dorn reached the boat, the sample was transferred into a bottle, preserved, and stored in a cool, dark place, as per Wisconsin State Lab of Hygiene protocol. Several bottles were used each sampling event; two plastic quart bottles, one 60 mL bottle, and one 250 mL bottle acidified with sulfuric acid to be tested for alkalinity, pH, conductivity, chlorophyll a (uncorrected), dissolved orthophosphate, total phosphorus, ammonia-N, nitrate + nitrite as nitrogen, and total Kjeldahl-N. For the 2002 samplings, the previous bottles were used along with a 250 mL bottle acidified with nitric acid. Also tested for were chloride, color, sulfate, turbidity, total dissolved solids, dissolved silica, calcium, hardness, iron, magnesium, manganese, potassium, and sodium.

Lake profile

Profile data was taken twice a month (every two weeks) from May through October of 2001 and once in February and April of 2002 in the deep spot of the lake. A YSI meter was used to determine water temperature, dissolved oxygen, and specific conductance.

Once at the deep spot of the lake, the pontoon was put into neutral and the YSI was lowered over the shady side of the pontoon one meter into the water. Subsequent readings were taken at one-meter intervals until the bottom of the lake was reached. The bottom readings were noted as bottom readings because the data may have been skewed by sediment.

Tributary sampling

Three points of inflow and one point of outflow were identified for sampling in 2001 and 2002. Each time there was a rain event where all of the sample points were flowing, a volunteer took samples.

One 60 mL bottle was used to sample for dissolved orthophosphate, and one 250 mL bottle acidified with sulfuric acid was used to sample for total phosphorus, nitrate + nitrite as nitrogen, and total Kjeldahl nitrogen. Samples were taken during the rain event or immediately following the rain event.

Once at a sample location, the volunteer positioned himself on the lake side of the culvert, labeled a bottle with the date, lake name, and site name, and dipped it into the flow making sure not to touch the bottle to the ground and making sure not to take a sample of stagnant water. After the bottle was filled up to the bottom of the bottle's neck, nitric acid was added (if needed), the cover was screwed on tightly, and the bottle was placed into a cooler. This was done at each of the four sampling points.

The cooler was then brought immediately to the Land and Water Resources Department to be stored in a refrigerator, packed in ice, and sent by priority mail to the State Lab of Hygiene. Because of the State Lab of Hygiene's hours, samples could only be taken Sunday through Thursday.

Appendix B
Aquatic plant survey

Introduction

Aquatic plants are an important part of the aquatic ecosystem, and there are many advantages for using them in an overall biological assessment of a lake. Sampling aquatic plant communities and their taxonomy is relatively straightforward. An assessment can be made with a reasonable amount of effort, and the ecology of a variety of species is known well enough so that some reasonable interpretation of habitat can be assessed and a floristic quality assessment done.

Methods

Using a map, thirteen sampling points were chosen at random around the lake. Plant samples were taken on a transect line at each of these thirteen points. The transect line ran perpendicular to shore and started at the shore, running lake ward to rooting depth, or up to 100 feet from shore, whichever occurred first.

The Jessen and Lounds rake method was employed for sampling purposes. This involved lowering a rake with a handle of the appropriate length to the lake bottom and making a figure eight in an area that was approximately 1 m^2. The rake was then turned 180° and brought to the surface where the sample could be assessed.

These samples were assessed by identifying every species on the rake head, not the handle, and the approximate percentage of the tines covered by each species (e.g. *Potamogeton robbinsii* 40%). This estimated the species composition and/or dominance on a site and micro-community composition based on water depth.

Assessment

The presence of a species in a sample was then used in a floristic quality equation.

Floristic quality is a rapid assessment designed to evaluate the relative disturbance of a particular site as it relates to aquatic plant diversity. This index can be used to identify natural areas, compare the quality of different sites within a single site, monitor long-term floristic trends, and monitor habitat restoration efforts.

Using the equation $I = \overline{C}\sqrt{N}$ (where I is the floristic quality, $\overline{C}$ is the average coefficient of conservation and $\sqrt{N}$ is the square root of the number of species) the floristic quality of Lake Magnor was determined to be 24.8. The average for this area of the state (north central hardwood forest) was 17 to 24.4 with a median of 20.9. Lake Magnor scored just above the high end of the average because of the presence of more sensitive species than non-sensitive species. The sensitive species identified were: *Pontederia cordata, Nuphar variegata, Potamogeton robbinsii, Brasenia schreberi, Ceratophyllum echinaturm, Nymphaea odorata, Eriocaulon aquaticum, Myriophyllum tenellum, Valisneria Americana, Scirpus acutus*, and *Utricularia spp.* (sensitive designation after Davis and Brinson, 1980), and the non-sensitive species were: *Typha latifolia, Ceratophyllum demersum, Sagittaria spp. and Scirpus validus.* (Nichols et.al., 2000).

In order to assess samples, a rooting depth was determined using a rake. The depth was determined to be approximately 1.5 meters on Lake Magnor. Light penetration was determined to be 1.65 meters based off the equation: $E = 0.016Chl + 1.3/\sqrt{Sd}$ (where *Chl* equals chlorophyll a concentration, *Sd* equals the Secchi depth, and *E* is the light penetration). The shallow rooting depth is likely due to turbid water.

Appendix B
Aquatic plant survey

Conclusions

The aquatic plant community is an invaluable part of Lake Magnor's ecosystem, particularly to invertebrates and fisheries and should be protected at all costs. Decreasing the turbidity of the water may allow for further light penetration and a greater rooting depth, in turn providing sufficient habitat for the fisheries. No wake zones, a horsepower limit, and discontinuing "powering up" at the boat landing would be a step in the right direction. The aquatic plant community should continue to be monitored in order to ensure a healthy ecosystem and gauge restoration efforts.

Appendix C
Terrestrial plant survey

Introduction

Vegetative Communities have long been studied in Wisconsin for information about wildlife habitat, species diversity, and hydrology and evapotranspiration within a watershed.

Polk County lies in a vegetative tension zone that is a mix of northern and southern vegetative communities. These communities include: northern mesic forest, southern mesic forest, southern oak forest, pine forest, pine barrens, lowland hardwood, and sedge meadow. Lake Magnor falls into the northern mesic forest portion of Polk County.

Methods

Using a map of the Lake Magnor watershed, thirteen sites were chosen at random in an effort to best represent the area immediately around the lake as a whole. To assess the sites a transect line was drawn that reached 40 feet landward from the water's edge. A 1-m^2 metal frame was placed every ten feet along the transect starting at the OHWM (zero). All the species within the square were identified. In addition, the percentage of forbs, grasses, shrubs, trees, and other (e.g. rock, coarse woody debris) were estimated within the square.

Assessment and conclusions

The ecosystem health of Lake Magnor's riparian area is considered poor due to the lack of a diverse mix of communities. Diversity should be typical for areas within the northern mesic forest. The vegetation found within the transect lines were typical of an urban setting, with very few native species. Native species are generally better for a lake because they have deep, continuous root structures that are well suited to holding soil in place, minimizing erosion, as well as absorbing more nutrients such as phosphorus and nitrogen before they reach the lake. Turf grass, dandelions, and creeping Charlie, the dominant species found around Lake Magnor, offer very little in the way of erosion control and nutrient management. Maintaining a diverse vegetated shoreline is important to the health of the lake.

A diverse mix of communities can be achieved through practices such as shoreline restorations. In some cases, simply not mowing up to the shore may give some native species a chance to grow. Native plant communities increase a soils field capacity (ability to hold water) through their deep root systems and increased ability to transpire water. This process reduces polluted runoff and suspended sediments to the lake. This is especially important because there is such a small area between the lake and the surrounding roads that pollute the lake with oil, gas, and salt, and sediment.

Besides slowing runoff and filtering pollution, a diverse shoreline plant community also provides habitat for wildlife.

Appendix D
Fish survey

TO: Bill Smith

FROM: Rick Cornelius

DATE: January 11, 2002

SUBJECT: Fish Survey, Magnor Lake (2624600), Polk County - 2001

Introduction and Methods

Magnor Lake is a 231-acre lake located in southeast Polk County. The lake has a maximum depth of 26 feet. A man-made channel connects Magnor Lake to nearby Barbo Lake (44 acres, 4 feet deep). Barbo Lake probably provides northern pike spawning areas and productive shallow water habitat for fish from Magnor Lake. During very low water years the channel is dry, and fish may be trapped in Barbo Lake. However, the amount of fish movement between the lakes is unknown.

Another intermittent tributary enters Magnor Lake from the southeast. This tributary originates in a wetland area located east of Magnor Lake. A local sportsmen's club places grates at a road culvert by the inlet each spring to prevent walleyes from entering the tributary and getting stranded in the wetland. The necessity of these grates is unknown.

The water of Magnor Lake is clear and fertile, with an MPA of 21 ppm. Heavy algae blooms occur during summer and fall. The lakeshore is mostly developed, and a public boat landing is located on the southeast side of the lake off STH 63. Magnor Lake is a popular fishing lake.

Past management of Magnor Lake has consisted mainly of periodic walleye stocking since 1934. Recent stocking is shown in Table 1. There have been a number of electrofishing surveys conducted from 1971 through 1994. In general, these surveys found walleyes to be the main predator fish present, with the walleye population supported by a combination of natural reproduction and stocking. Northern pike were fairly common, with bass present in low to moderate numbers.

There have been two walleye population estimates made on Magnor Lake; one in 1989 and one in 1994. Both estimates were conducted by GLIFWC. The 1989 walleye population was estimated at 10.3 adults per acre, and the 1994 estimate was 4.6 adults per acre.

An electrofishing survey was conducted on the evening of September 19, 2001, to update information on the fish population. Total effort was 0.8 hours of shocking and 2.6 miles of shoreline.

Results and Discussion

A total of 31 largemouth bass ranging in size from 3.0 to 19.9 inches in length were captured. The bass catch per effort of 39 per hour indicates that bass are common. This CPE is higher than in any previous survey (Table 2), and the bass population appears to have been increasing during the late 1980's and the 1990's. The size distribution of the bass population was good, with 32% of the captured bass being 14.0 inches or larger. The growth rates of bass were above average for northwest Wisconsin (Table 3).

Appendix D
Fish survey

A total of five walleyes were captured ranging in size from 17.5 to 22.4 inches in length. The walleye CPE in the 2001 survey (61/hour) was far less than in any previous survey, indicating a significant decline in the walleye population. No walleyes less than six years of age were captured, indicating that walleye recruitment has been poor in recent years. Growth of walleyes was above average.

A total of 12 northern pike were captured ranging in size from 10.0 to 33.4 inches in length. Northern pike CPE's from the survey and past surveys show no clear trends, but indicate that, in general, northern pike are presently common in Magnor Lake, and have also been common in the past. Aside from one large northern pike, the captured northerns were all less than 22.5 inches in length. Growth of northern pike was below average.

Yellow perch and bluegills were the panfish captured in the largest numbers. A large number of young of the year perch were captured, and the largest perch captured was 8.2 inches in length. Bluegills were captured up to 8.0 inches in length. The size distribution of the bluegill population was fairly good, with a percent stock density of 36%, and an RSD-7 of 23%. Growth of bluegills was above average.

Black crappies and pumpkinseeds were captured in lesser numbers. However, fall electrofishing usually does not effectively sample crappies. Most of the captured crappies were in the 6.7 to 8.5-inch size range. Growth of crappies was a little below average. Most of the captured pumpkinseeds were in the 5.0 to 7.1-inch size range.

Conclusions and Recommendations

Magnor Lake has a fairly desirable fish population. However, the structure of the fish community found in the 2001 survey was markedly different from the fish community found in previous surveys. In previous surveys, walleyes were the primary predator fish present. Population estimates made in 1989 and 1994 by GLIFWC found walleyes to be common to abundant. In the 2001 survey the walleye population had declined substantially, and bass had become the primary predator fish.

The reason for this change is unknown, but it has occurred on a number of area lakes in the past 20 years (i.e. Loon, Balsam, Ward, Big Butternut, Half Moon). Catch per effort indicates that the bass population was increasing by the 1989 survey, and continued to increase in the 1994 and 2001 surveys. By contrast walleye CPE was good through 1994, then declined sharply by 2001. In the 2001 survey, no walleyes less than six years of age were captured, indicating poor year classes in recent years.

The northern pike population in the 2001 survey appeared similar to previous surveys. The panfish population appeared to be fairly desirable, with bluegill growth rates above average, but with crappie growth rates a little below average.

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Fish survey

The management objective for Magnor Lake would be to increase walleye numbers back to levels found from the 1970's to the mid-1990's. However, in other area lakes where walleye numbers have declined and bass numbers have increased, efforts to increase the walleye population have had little success. Success has been documented on only one area lake, Granite Lake, and management of this lake consisted of walleye fingerling stocking.

It is recommended that walleye fingerling stocking continue on Magnor Lake at the rate of 50 per acre on an alternate year basis. If future surveys do not indicate an improvement in the walleye population, the stocking rate should be increased or extended growth fingerlings should be tried.

It is very important that walleye and northern pike spawning areas not be degraded. Habitat sensitive areas have been designated on Magnor Lake (Figure 1). Aquatic plant sensitive areas, which would include northern pike spawning areas, are designated as Areas B, C, D, and E in Figure 1. Gravel and coarse rock rubble sensitive areas, which include walleye spawning areas, are designated as Areas A and C. A document titled *"Magnor Lake Sensitive Area Survey Report and Management Guidelines"* gives more details regarding the sensitive areas.

No changes in fishing regulations for Magnor Lake are currently recommended. Because the walleye population has recently declined, another fish survey should be conducted in 3 to 5 years to monitor changes in the walleye population.

Approved:

Phil Anderson: ____________________

Tom Beard: ________________________

cc: Cumberland office
Bureau of Fish & Habitat
Jerry Wagner
Steve AveLallemant

Appendix D
Fish survey

Table 1. Recent Fish Stocking, Magnor Lake, Polk County

Year	Species	Number	Size
1990	Walleye	11,520	3.0"
1992	Walleye	11,500	1.8"
1994	Walleye Northern pike	13,508 150	1.8 - 2.5" 8-11"-(rescued from outlet of Camelia Lake)
1996	Walleye	11,500	1.9 - 2.2"
1997	Walleye	4,587	3.3"
1998	Walleye	8,337	1.9 - 2.3"
2000	Walleye	11,200	1.5"

Table 2. Fall Electrofishing Catch Per Effort of Gamefish, Magnor Lake

	Catch per Effort (Number/Hour)		
Date	Walleye	Largemouth bass	Northern pike
09/01/71	21	9	12
09/20/77	58	7	10
09/03,26/85	34	8	20
09/20/89	67	21	8
09/19/94	74	27	28
09/19/01	6	39	15

Appendix E
Exotic species survey

Introduction

Exotic species are considered to be any plant or animal that is not native to a particular area. Such species are usually introduced for ornamental reasons, without thinking how they would affect native species.

Exotic species can be either invasive or noninvasive. Over 85 percent of all exotic plants and animals do not pose a threat to agricultural, ecological or human health. Many simply co-exist with the native species so they aren't considered invasive. Thousands of plants and animals have been introduced into North America without becoming a problem, however, there are certain characteristics that allow some species to spread out of control.

Methods

To survey the presence of exotic species in the Lake Magnor watershed, volunteers followed two booklets entitled, Wisconsin Manual of Control Recommendations for Ecologically Invasive Plants (May 1997, by the Bureau of Endangered Resources Wisconsin Department of Natural Resources), and the Supplemental Colored Photo Atlas (July 2001, by the Polk Co. LWRD).

Volunteers were asked to walk the watershed, paying attention to ditches and shorelines. When an exotic specie was spotted, it was identified using the guide books listed above. The specie's location was then outlined on an aerial photo that the volunteers were carrying with them. Once the aerial photo was turned in to the Land and Water Resources Department, a staff member field checked the watershed and verified the species that were found.

Assessment and conclusions

Exotic species that need to be kept under control in the Lake Magnor watershed are Canada thistle, common reed, purple loosestrife, garlic mustard, and wild parsnip.

Some organisms, particularly those living in water, often are not detectable until their populations are quite high. But it is still possible to control the spread of an invading species if correctly done. Eradication may be possible only if an effective control effort is begun when a population is still small and the site is monitored for recolonization for many years and treated when necessary.