AQUATIC PLANT MANAGEMENT PLAN

LAKE WINGRA
Lower Rock River Basin

DANE COUNTY, WISCONSIN

January 2007

OFFICE OF LAKES AND WATERSHEDS
DANE COUNTY LAND AND WATER RESOURCES DEPARTMENT
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Summary

The Wisconsin Department of Natural Resources (WDNR) Bureau of Integrated Science Services performed an aquatic plant survey on Lake Wingra during the summer of 2005. WDNR shared the data with the Dane County Office of Lakes and Watersheds to assist with the preparation of this plan. WDNR researchers sampled 112 sites across the lake. Consistent with results from the Lake Mendota, Lake Kegonsa, Fish Lake and Indian Lake surveys conducted in 2006, the 2005 point intercept survey indicated that Eurasian watermilfoil (*Myriophyllum spicatum*) and coontail (*Ceratophyllum demersum*) were the dominant plants in Lake Wingra. Consistent with surveys performed in the early 1990's, Eurasian watermilfoil remained at a much lower density than when the exotic plant initially invaded the lake in the 1960s. Native species richness was higher in Lake Wingra than in the other Yahara lakes and included species that were not found elsewhere in the Yahara lakes chain. These species included spatterdock (*Nuphar variegata*), bushy pondweed (*Najas flexilis*), variable leaf pondweed (*Potamogeton gramineus*), Illinois pondweed (*Potamogeton illinoensis*), white stem pondweed (*Potamogeton praelongis*), small pondweed (*Potamogeton pusillus*), and common bladderwort (*Utricularia vulgaris*). The presence of these high value species and greater native species richness suggest that the littoral zone habitat in Lake Wingra is in better condition than most lakes in the county.

Dane County infrequently operates mechanical harvesters on Lake Wingra, occasionally preceding special events or clearing access channels in front of the public boat ramp. The current management appears to be compatible with the relatively diverse plant community in the lake that appears to benefit from limited shoreline disturbances. Current research suggests that carp pose the primary form of shoreline disturbance, and native plants and water clarity could improve if the population declines or is eradicated.

Sensitive Areas [NR 107.05 (3i)] proposed for Lake Wingra encompass the publicly owned shorelines but do not include the public beach or boat landing. Aquatic plant management activities would be restricted within the Sensitive Areas because they support high value native species [NR 107.08(4).

In addition to monitoring aquatic plant communities and assessing management strategies, public participation was planned and executed at all stages of plan development. Prior to conducting the aquatic plant surveys, two public meetings were advertised and conducted to educate the public on ecological and habitat values of aquatic plants and management issues. A final public meeting was held in December 2006 to share results of the aquatic plant surveys and draft aquatic plant management plans for public review and input. Public comment on the draft plan was solicited on the Dane County Office of Lakes and Watersheds/Lakes and Watershed Commission website.

Also, an Aquatic Plant Management Committee created by the Dane County Board met for much of the time coincident with plan field work and preparation. Members of that Committee were invited to provide comments on the draft plan. Recommendations from the Committee's final report (October 20, 2006) are included in Appendix A. This plan will be amended as necessary to implement recommendations that are approved by the County Executive and County Board and implemented by county staff.

Ultimately, the plan recommendations did not represent a significant change from the relatively long history of mechanical harvesting operations on the lake. However, the plan has identified important steps that will enhance the county's aquatic plant harvesting program and protect important habitat features in the lake.

Lake Wingra Recommendations

1. Mechanical harvesting should focus on Eurasian watermilfoil control, in areas where this exotic plant impedes lake access or if open water is needed for special events such as competition rowing or swimming.
2. Mechanical harvesting should avoid nearshore areas to protect the diverse plant community.
3. Chemical treatments are not recommended and may undermine the ecologically diverse plant community in the lake. (Lake Wingra has not been chemically treated in the recent past and Eurasian watermilfoil declined significantly due to ecological factors and not intensive management).

4. Ecologically acceptable methods to remove carp from Lake Wingra are recommended since both water clarity and native plant distribution will likely improve.
5. Consider sampling nearshore nongame fish populations to assess the ecological health of Lake Wingra.
6. Publicly owned shorelines should be designated as Sensitive Areas [NR 107.05 (3i)] due to the presence of high value native species identified under NR 107.08(4). Aquatic plant management activities within the Sensitive Areas would be restricted to protect the important habitat functions. The public beach and boat ramp would not be included in the proposed Sensitive Areas.
7. Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment. The fact sheet in Appendix B is included in the harvesting crews' operations manual.

Introduction

As required in Wisconsin Administrative Code NR 109.04(d), the purpose of this plan is to guide mechanical harvesting activities and the effective management of aquatic plants in Lake Wingra. Dane County occasionally operates mechanical harvesters in the lake when the exotic Eurasian watermilfoil (*Myriophyllum spicatum*) interferes with public access near the boat ramp or during special events such as competition rowing.

Dense stands of this exotic plant significantly undermined the ecological balance in the lake decades ago, but significant declines eliminated the need for frequent harvesting or management. As Eurasian watermilfoil declined valuable native species expanded. The pattern of invasion and decline is typical in lakes with Eurasian watermilfoil, and the ecological changes coincided with minimal aquatic plant management.

The primary goals of this plan are to establish long-term realistic objectives for managing Eurasian watermilfoil while protecting valuable native species and their important habitat functions. While the goal is not to create a comprehensive lake management plan, aquatic plant communities are linked to other aspects of lake and watershed management, and these links are identified.

While the plan was designed to develop a variety of strategies for managing aquatic plants, chemical treatments are not performed or sponsored by either Dane County or Wisconsin Department of Natural Resources (WDNR). WDNR regulates chemical herbicide treatments in public waters and permits are required under Administrative Code NR 107.

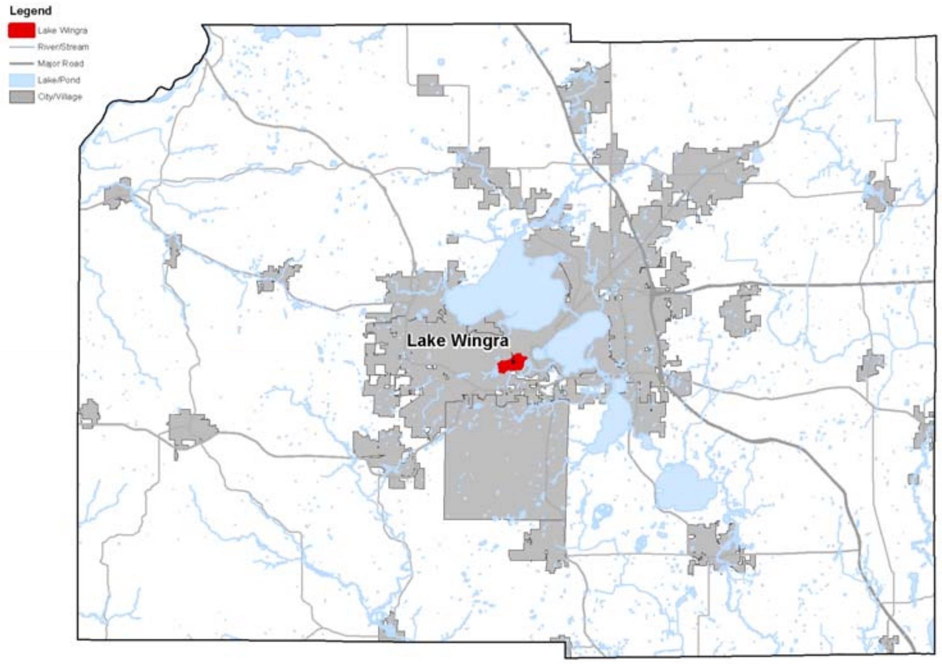
Lake Wingra Goals

The goals for managing aquatic plants in Lake Wingra are to: (1) protect high value species [NR 107.08(4)] found in the lake, and to (2) periodically control Eurasian watermilfoil when growths undermine lake access or interfere with special events. High value species found in Lake Wingra are: Illinois pondweed (*Potamogeton illinoensis*), clasping-leaf pondweed (*P. richardsonii*), white stem pondweed (*P. praelongis*), sago pondweed (*Struckenia pectinatus)*, and wild celery (*Vallisneria Americana*). Other important native plants in Lake Wingra that require protection include floating-leaf pondweed (*P. natans*), variable pondweed (*P. gramineus*), flat-stem pondweed (*P. zosteriformis*), variable-leaf pondweed (*P. gramineus*), muskgrass (*Chara*), water stargrass (*Heteranthera dubia*), bushy pondweed (*Najas flexilis*), bladderwort (*Utricularia vulgaris*), spatterdock (*Nuphar variegata*), and white water lily (*Nymphaea tuberosa*).

Background

Lake Wingra (345 acres) is a eutrophic lake that forms the headwaters of Wingra Creek, a tributary to Lake Monona (Figure 1). The water level is maintained by a dam at the outlet but is actually 1 foot lower than the original lake level (Day et al. 1985). The maximum depth is only 12 feet and the lake does not thermally stratify throughout the summer. The lake is relatively undeveloped with the UW Arboretum and City of Madison parkland surrounding most of the lake.

Figure 1: Lake Wingra location within Dane County



The Lake Wingra watershed is approximately 4525 acres with a watershed to lake ratio of about 13:1. While this ratio is relatively modest compared to many eutrophic lakes in Wisconsin with much larger drainage areas, most of the watershed beyond the riparian areas is urbanized with approximately 58% residential and 17% commercial land uses (Friends of Lake Wingra 2003). Urban stormwater runoff and other impacts have been linked to the eutrophic conditions in the lake, with estimated phosphorus and sediment loading rates of 3,300 lbs and 500 tons/year respectively. Urban runoff has contributed to the eutrophic conditions in the lake as indicated with Secchi, chlorophyll and total phosphorus Trophic State Index (TSI) values of 65, 53 and 55 respectively.

Lake Wingra had a long history of watershed and wetland modifications including dredging, draining, construction and polluted runoff affecting water quality (Day et al. 1985). Historic dredging and wetland draining significantly altered the surrounding wetlands, original lake surface area and water levels. The outlet was moved upstream from Fish Hatchery Road to the present location in the early 1900s, establishing the lake at its current level. Other factors that compounded the hydrologic modifications and pollution sources included carp and Eurasian watermilfoil (EWM) invasions (Baumann et al. 1974). Following significant efforts to eradicate carp from the lake, EWM displaced many species during the period of disturbance and expansion during the 1960s (Madsen 1991, Trebitz et al. 1993). Ecological effects of EWM in Lake Wingra likely included predator-prey interruptions (Savino et al. 1982, Dibble et al. 1996, Trebitz et al. 1997, Olson et al. 1998) and increased nutrient loading from the littoral zone to the pelagic zone (Carpenter 1980). As a likely response to the former EWM effect, the fishery was dominated by stunted panfish (Churchill 1976).

Principal management of EWM following the invasion in Lake Wingra was by mechanical harvesting. However, by 1977 EWM had declined significantly in Lake Wingra (Carpenter 1980) and routine harvesting was no longer needed. The pattern of EWM invasion and decline was typical in many lakes with this exotic (Smith and Barko 1992, Nichols 1994). More recently, valuable native plants have increased in the lake (Trebitz et al. 1993, Nichols and Lathrop 1994). Lake Wingra now supports a relatively diverse aquatic plant community, an indication that ecological conditions have improved significantly since the 1960s. Current efforts to reduce urban stormwater runoff and control carp populations (Lathrop, personal communication) may further improve the littoral plant community and water clarity in the pelagic zone.

Consistent with the other Yahara lakes, Lake Wingra supports a diverse fish community of 23 species (Table 1). Popular sportfish managed in the lake include musky, largemouth bass, walleye and bluegills. Electrofishing and fyke net results indicated that Lake Wingra sustains relatively abundant musky numbers while growth rates of bluegills and largemouth bass are below state averages (Welke, unpublished data). Further restoration of native plants in Lake Wingra will likely enhance fish populations. A detailed nearshore survey of nongame species may provide additional information regarding the ecological health within the littoral zone of the lake.

Table 1: Lake Wingra fishes

Scientific Name	Common Name
Lepisosteus osseus	Longnose gar
Amia calva	Bowfin
Esox lucius	Northern pike
Esox masquinongy	Musky
Umbra limi	Central mudminnow
Cyprinus carpio	Common carp
Notemigonus crysoleucas	Golden shiner
Pimephales notatus	Bluntnose minnow
Pimephales promelas	Fathead minnow
Catostomus commersoni	White sucker
Ameiurus melas	Black bullhead
A. natalis	Yellow bullhead
A. melas	Black bullhead
Nebulosus	Brown bullhead
Ambloplites rupestris	Rock bass
Lepomis cyanellus	Green sunfish
L. gibbosus	Pumpkinseed
L. macrochirus	Bluegill
Pomoxis nigromaculatus	Black crappie
P. annularis	White crappie
Micropterus salmoides	Largemouth bass
Perca flavescens	Yellow perch
Stizostediun vitreum	Walleye

2005 Aquatic Plant Survey Update

Methods

WDNR researchers conducted the aquatic plant survey in 2005. The sampling protocol was developed by Senior Scientist Jen Hauxwell, with the Bureau of Integrated Science Services. The point intercept method was used, consisting of a large number of sampling sites distributed equidistantly across the lake. GPS units were used to locate the sites and double-headed rakes were used to collect aquatic plants. The sampling rakes are constructed in two forms. The pole rake is used for sampling aquatic plants up to 15 ft (4.6 m) and rope rake can be used to sample deeper areas. Density ratings from 1-3 are determined by the amount of plant material in the two-headed rake. Plants that were observed near the boat but were not collected in the rake were also recorded. Samples of each species found in a lake were collected, pressed and submitted as voucher specimens to the UW Madison Herbarium.

Statistical analysis included the following:

- Frequency of occurrence within vegetated sites (number of times a species was found divided by the total number of vegetated sites).
- Relative frequency of plant species collected (describes each species contributing a certain percentage of the whole aquatic plant community).

Detailed statistical results appear in Appendix C.

Wisconsin Department of Natural Resources provided the sampling grids and spreadsheet software for data entry and analysis. A more detailed sampling description can be found in Baseline Monitoring of Aquatic Macrophytes (Hauxwell 2006).

Results

During the summer 2005, WDNR researchers sampled aquatic plants at 112 points across Lake Wingra. A total of 17 native submersed and floating leaf macrophytes were around the lake out to a maximum depth of 11 feet. Approximately 52% of the sites contained macrophytes. Two exotic species found were EWM and curly-leaf pondweed (CLP). EWM was the dominant plant in the lake followed by coontail. This was a common pattern found in most Dane County eutrophic lakes. While EWM remained the dominant species based on both relative frequency and occurrence, the plant continues to remain at lower levels than when it invaded the lake, and the relatively high native species richness suggests ecological improvements in the lake. EWM displayed a moderate density in 2005 based on an average rake fullness value of 1.56. Figure 2 displays the 112 sampling points across the lake and Appendix D displays the distribution maps for the species collected in 2005. Figure 3 displays the relative frequency results and Figure 4 the frequency of occurrence for each species. Figure 5 shows the proposed sensitive areas for Lake Wingra. Appendix E contains the complete list of species found in the lake and their ecological values.

Figure 2: Point intercept sampling grid for Lake Wingra

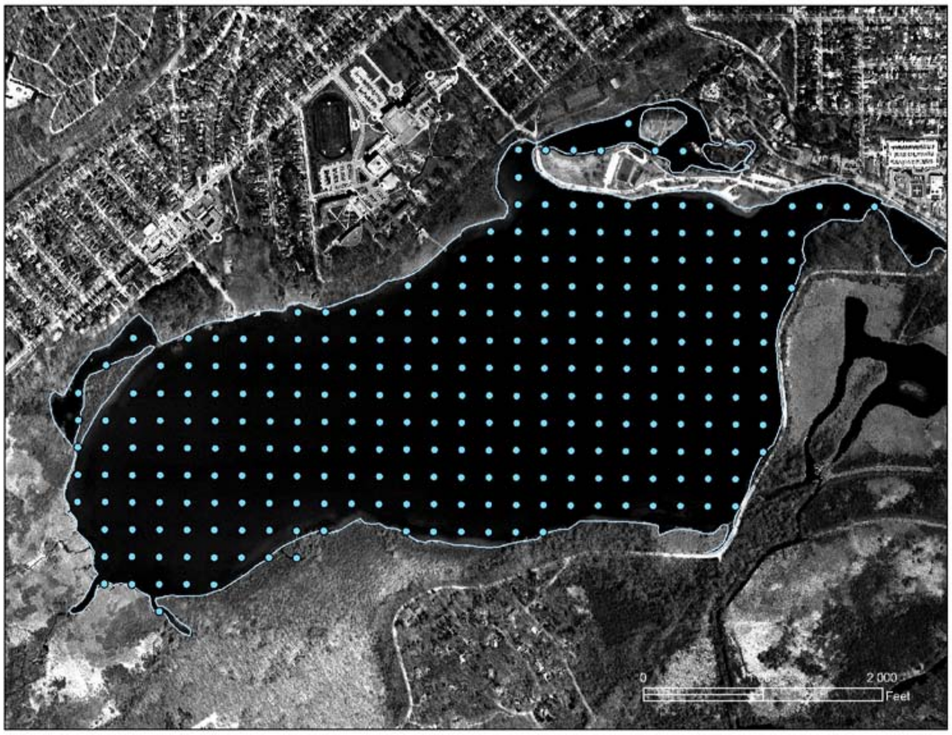
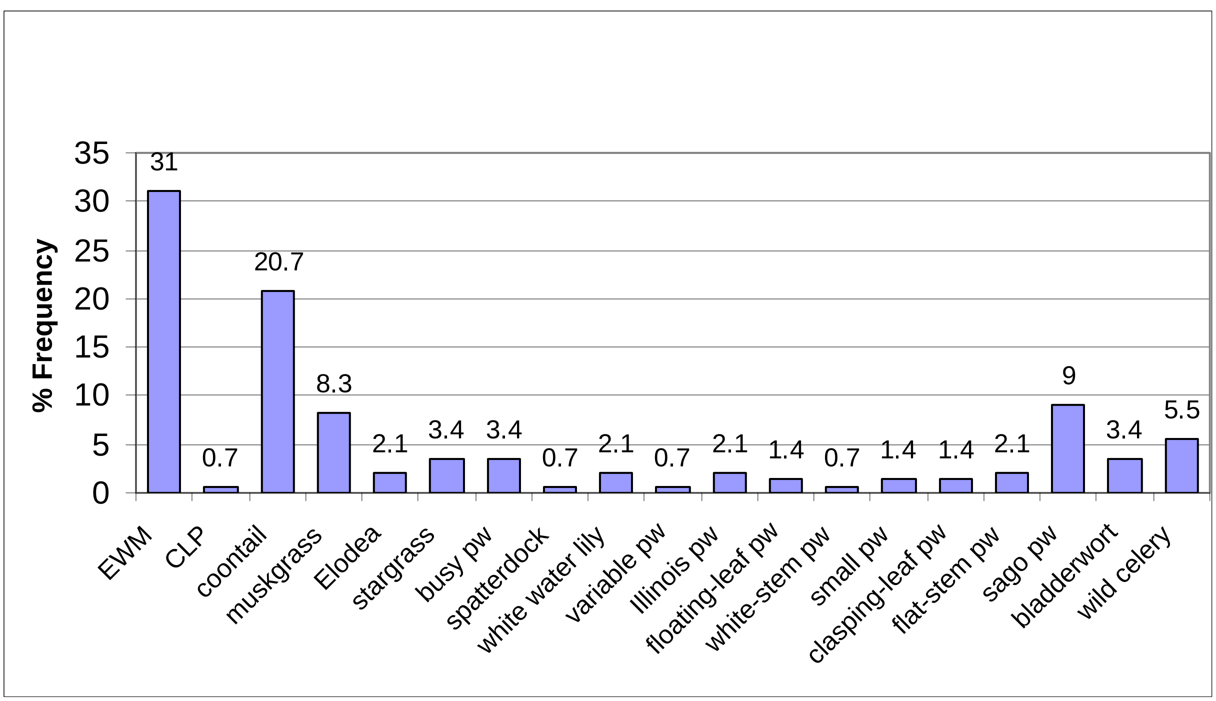


Figure 3: Lake Wingra relative aquatic plant frequency results from 2005



The relative frequency describes the percentage that each aquatic plant species contributes to the whole aquatic plant community. Relative frequency is a commonly used metric since survey results can be compared with surveys that used different sampling techniques.

Figure 4: Lake Wingra frequency of occurrence within vegetated sites from 2005

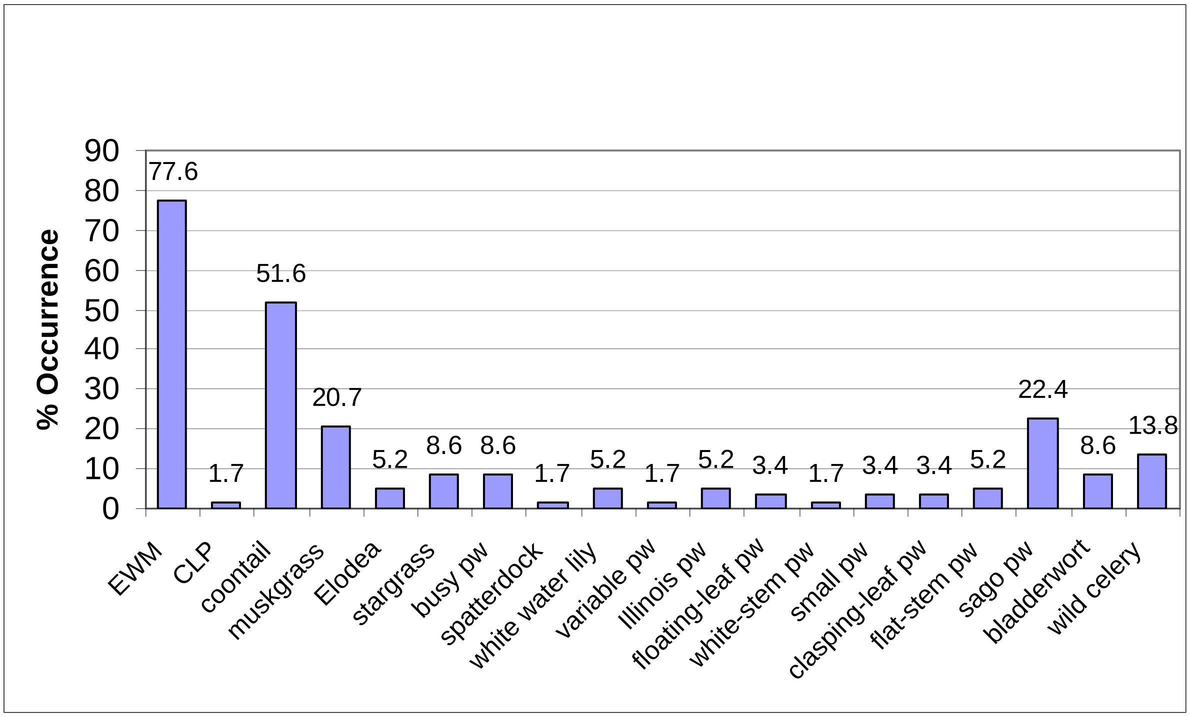
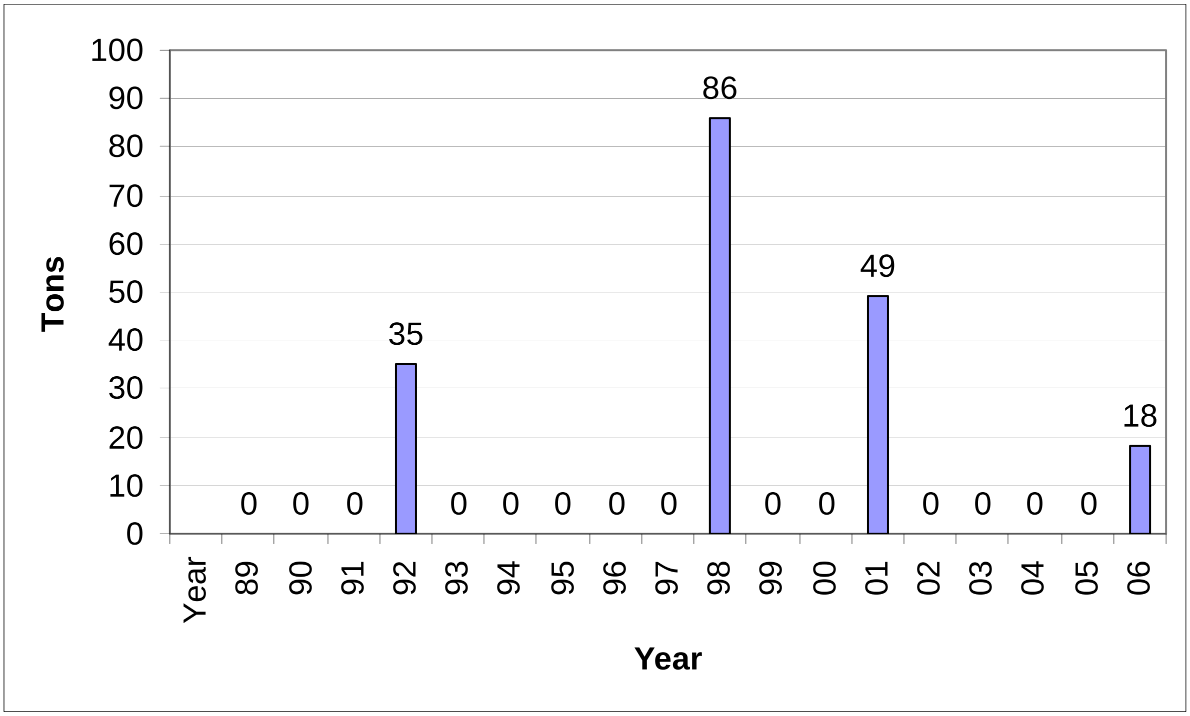


Figure 5: Proposed Lake Wingra sensitive areas

Current Aquatic Plant Management

Mechanical harvesting is used infrequently in Lake Wingra to provide access from the public boat ramp and clear areas for special events such as rowing events. Dane County harvesting activity on Lake Wingra is summarized in Figure 6. Prior to the preparation of this plan, Sensitive Areas designations [NR 107.05(3-i)] had not been proposed. Given the very limited aquatic plant management in the lake coupled with extensive protected public shorelines, the nearshore areas should be protected from harvesting to sustain the ecological diversity in the lake. Ongoing research is looking at methods to reduce carp populations that have negative impacts on native plants and water quality (Lathrop, personal communication).

Figure 6: Lake Wingra aquatic plant harvesting summary



Aquatic Plant Management Alternatives

Results of the 2005 aquatic plant survey indicated that overall macrophyte diversity is relatively high and the EWM beds are sustained at lower densities than historically found in Lake Wingra. These positive changes occurred without intensive management and reflect typical ecological responses to the invasion. Often invasive species grow, expand and dominate so well because disease, predation, or other normal population controls are not found at the invasion site. This situation provides the opportunity for the invader to become a problem in its new location. After some period of time, there may be a decline in density or population, but it may not always be possible to determine why that decline occurred. Single species stands may be more vulnerable to change if their populations suddenly decline. Diverse populations are more resistant to disruption.

Limited mechanical harvesting has provided a useful function when conditions and special events warrant management. Otherwise, current efforts focusing on watershed management and carp removal will likely benefit native plant beds in the lake since they do not create the disturbances that typically benefit weedy exotic aquatic plants.

Mechanical harvesting often removes juvenile panfish in the conveyor with the vegetation. However, WDNR biologists consider the inadvertent removal of small panfish to have no effect on population levels. In some cases, removal of juvenile panfish may actually improve size structure when population levels are too high.

Specific Alternatives

1) **No treatment**: Rejecting all types of aquatic plant control may be reasonable given the natural EWM decline and increased native species.
2) **Biological control**: This method does not appear realistic at this time. Research findings are not clear if weevils can reduce EWM when panfish populations are high. EWM densities currently are not causing significant ecological or habitat problems in the lake.
3) **Chemical control:** Not recommended given the extensive public shorelines and natural EWM decline. Introducing chemical control of aquatic plants in Lake Wingra would represent a dramatic shift in past management without clear benefit.
4) **Manual - hand removal**: Manually removing plants around swimming areas is a viable option. However, property owners should be educated about the importance of high value native species so that their efforts should focus on weedy exotics such as EWM. All plants that are cut must be removed. Sensitive Areas cannot be harvested.
5) **Mechanical harvesting**: In 2005, mechanical harvesting was not needed due to modest densities of EWM, CLP and coontail. Some harvesting was done in 2006, and this option should remain available if a resurgence of EWM undermines lake access or undermines special events such as competition rowing or swimming.
6) **Physical control**: Most physical methods of controlling aquatic plants require permits from WDNR under Chapter 30 Wisconsin State Statutes. Hydraulic dredging is an unlikely option in Lake Wingra and could create an unnecessary ecological disturbance. Reducing watershed sources of sediment and phosphorus should certainly precede any proposed dredging operation. Sheets of dark fabrics anchored to the bottom covering the plants from any light create bottom or benthic barriers. A benthic barrier eliminates all plants, including non-target species, with the exception of free-floating plants and algae. These types of barriers can interfere with fish spawning and other pond wildlife. Over time, barriers may require maintenance due to siltation, ice damage, bubbling up and normal wear and tear.

Fabrics applied in this way will require a permit. Fabrics are rarely used by property owners because of the labor of installation and maintenance.

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GLOSSARY

Alleopathy — Harmful effect of one plant on another caused by the release of chemical compounds produced by the first plant.

Biomanipulation — A technique involving using predatory fish to reduce the number of fish that feed on organisms that eat algae.

Chlorophyll a — The green pigment present in all plant life and needed for photosynthesis. The amount present in lake water is related to the amount of algae found there and is used as an indicator of water quality.

Columnaris — Bacterial infection of fish which especially occurs when they are stressed. The disease is highly contagious to fish and typically enters through gills, mouth or small skin wounds.

Cyanobacteria — Another name for blue-green algae. A group of algae that are often associated with "problem" lake blooms. Certain species can produce toxins which can cause illness and even death in animals and humans. Blue-green algae can "fix" nitrogen from the atmosphere and thus are often found when phosphorus levels in water are high.

Dessicated — Something that is thoroughly dried.

Emergent plants — Species with leaves that extend above the water surface that are usually found in shallow water.

Eutrophication — The process by which lakes are enriched with nutrients thereby increasing the amount of rooted plants and algae. The extent to which this process has occurred is reflected in a trophic state classification system.

Eutrophic — Within a lake trophic state classification system, this is a lake that is rated as being very productive and fertile.

Extirpation — The act of being eliminated.

Floating-leaf plants — Rooted plants with leaves that float on the water surface, such as water lilies.

Filamentous algae — Algae that forms filaments or mats which attach to the bottom sediments, rooted plants, piers, etc.

Hectare — A metric unit of measure which is equivalent to about 2.47 acres.

Herptiles — A broad group of cold-blooded animals including turtles and amphibians.

Hypereutrophic	A very nutrient-enriched lake characterized by severe and dominant algal blooms and very poor water quality.
Hypolimnion	The layer of the lake closest to the bottom and immediately below the metalimnion or thermocline, within lakes deeper than 20 feet stratify, or layer, based on temperature differences.
Hypolimnetic	Referring to the hypolimnion.
Internal loading	Internal loading refers to sources of phosphorus within a lake, typically from deep water sediment or decaying aquatic plants in the littoral zone.
Intolerant	Aquatic species that are impacted by changing conditions. For example, if water quality worsens, certain intolerant species may disappear because of lowered oxygen levels or a loss of their habitat.
Limnologist	A specialist in the study of freshwater ponds and lakes.
Littoral zone	The shallow part of a lake where most of the rooted aquatic plants are found.
Littoriprofundal	Transition zone below the littoral zone, characterized by its lack of macrophytes; often adjacent to the metalimnion of stratified lakes.
Macrophytes	The higher (multi-celled) plants found growing in or near the water. They produce oxygen and provide food and cover for lake organisms.
Mesotrophic	Lakes that are in-between eutrophic (very fertile) and oligotrophic (infertile) waters. They exhibit fairly good water quality and rooted aquatic plant growth.
Monotypic	Involving only one species.
Moss	Mosses are bryophytes or non-vascular plants. These primitive plants lack flowers and seeds and produce spore capsules to reproduce. Mosses live in a variety of shady moist environments including deeper areas in clear lakes.
Oligotrophic	Very low nutrient, clear lakes having lower amounts of rooted aquatic plant growth and productivity, but rich in oxygen throughout their depth.
Pelagic	The open water zone of a lake outside of the littoral zone.

Phosphorus entrainment	Movement of phosphorus and other nutrients from the hypolimnion into the epilimnion due to wind-generated mixing and erosion of the thermocline.
Phytoplankton	Algae-like organisms found in waters that use light to support photosynthesis. Examples include diatoms, cyanobacteria and dinoflagellates.
Planktivores	A free-floating or drifting organism (example Daphnia) that feeds on phytoplankton.
Planktonic algae	Small free-floating algae including green algae, blue-green algae and diatoms.
Point source	Source of pollution (e.g. wastewater treatment plant) with a defined discharge point such as a discharge pipe.
Secchi disc	An 8-inch diameter disc with four alternating quadrants of black and white. It is lowered into a lake on a rope and used to measure light penetration. Lakes are infertile (oligotrophic) if the depth you can see the disc are great. Lakes are fertile (eutrophic) if the disc disappears quickly.
Species richness	The number of different species present.
Thermocline	The narrow transition zone between the epilimnion (top lake temperature layer) and the hypolimnion (bottom lake temperature layer). This portion of a lake is where the temperature changes most rapidly, and in most waters is found around 20 feet or deeper. Also called the metalimnion.
Trophic State Index (TSI)	A way to measure, rate and classify the quality of a water body. Trophic state (e.g. eutrophic, mesotrophic, oligotrophic and hypereutrophic) is a measure of biological productivity.
Turion	The over-wintering bud produced by aquatic plants.
Two story fisheries	Fisheries that support both warm water and cold water fish species, and that are thermally segregated for most of the year.
Winter dormancy	Refers to the condition of aquatic plants during the winter months, often in the form of seeds, turions, rhizomes or non-growing vegetation.