Aquatic Plant Management Plan

Mercer Lake

Iron County, Wisconsin
June 2012

Sponsored By
Mercer Lake Association of Iron County

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Executive Summary

This Aquatic Plant Management Plan covers the years 2012 through 2017. The plan includes data about the plant community, watershed, and water quality of the lake. This plan also reviews a history of aquatic plant management on Mercer Lake.

An aquatic plant point intercept survey was first completed for Mercer Lake in 2010. The aquatic plant surveys found that Mercer Lake has a robust and dense plant community with relatively high diversity. Native plants provide fish and wildlife habitat, stabilize bottom sediments, reduce the impact of waves against the shoreline, and prevent the spread of non-native invasive plants – all critical functions for the lake.

This Aquatic Plant Management Plan, developed with input from an advisory committee including lake property owners, will help the Mercer Lake Association (MLA) plan and carry out activities to meet plan aquatic plant management goals. The implementation plan describes the actions that will be taken toward achieving these goals.

MLA has been active in the study and managing of Mercer Lake. This has included an extensive nutrient and water budget analysis conducted by the USGS. Also, the MLA and the Town of Mercer have worked on projects to mitigate nutrient loading into the lake. This plan works in conjunction with these efforts by considering habitat, water quality and aesthetics in the plant management.

A special thank you is extended to the aquatic plant advisory committee for assistance with plan development.

Plan Goals

1. ***Stop the introduction of aquatic invasive species (AIS).***

2. ***Educate residents about the importance of maintaining native species and stopping invasive species.***

3. ***Restore developed shorelines to native vegetation.***

4. ***Preserve critical, native habitats in Mercer Lake.***

5. ***Reduce the density of native plants in areas that impede navigation and recreation use of the lake.***

Introduction

The Aquatic Plant Management Plan for Mercer Lake is sponsored by the MLA with partial funding from a Wisconsin Department of Natural Resources Lake Planning Grant.

The plan includes data about the plant community, watershed, and water quality of the lake. It also reviews a history of aquatic plant management on Mercer Lake. This plan will guide the MLA and the Wisconsin Department of Natural Resources in aquatic plant management for Mercer Lake over the next five to six years (from 2013 through 2018).

Public Input for Plan Development

The Mercer Lake Association Aquatic Plant Management (APM) Advisory Committee provided input for the development of this plan. The APM Advisory Committee met in person once and by conference call four times. At the first meeting on August 2011, the committee reviewed aquatic plant management planning requirements, plant survey results and aquatic plant management efforts to date, and discussed aquatic plant management concerns. At a second meeting on February, 2012, and a third meeting on March, 2012, the committee reviewed goals, developed objectives and updated action steps. In a final meeting on April 2012, the committee developed more actions and discussed methods extensively. The APM Advisory Committee concerns are reflected in the goals and objectives for aquatic plant management in this plan.

The APM Committee expressed a variety of concerns that are reflected in the objectives for plan development and in the goals for aquatic plant management in this plan. Management concerns ranged from water quality, protection of fish and other habitat to the density of plant growth in Mercer Lake.

The MLA board announced the availability of the draft Aquatic Plant Management Plan for review with a public notice in the weeks of July 1 and July 8, 2012. Copies of the plan were made available to the public at the Mercer Public Library. Comments were accepted through, July 22, 2012.

Staff members at the Voigt Intertribal Task Force were invited to review of draft versions of the plan and offer suggested changes or additions. No comments have been received up to the publishing of this plan. This may be due to the fact that no wild rice was found in the point intercept (PI) survey.

Resident Concerns

A 2007 community survey provides some guidance for aquatic plant management activities. About half of the respondents felt that the amount of aquatic plants had increased in recent years.

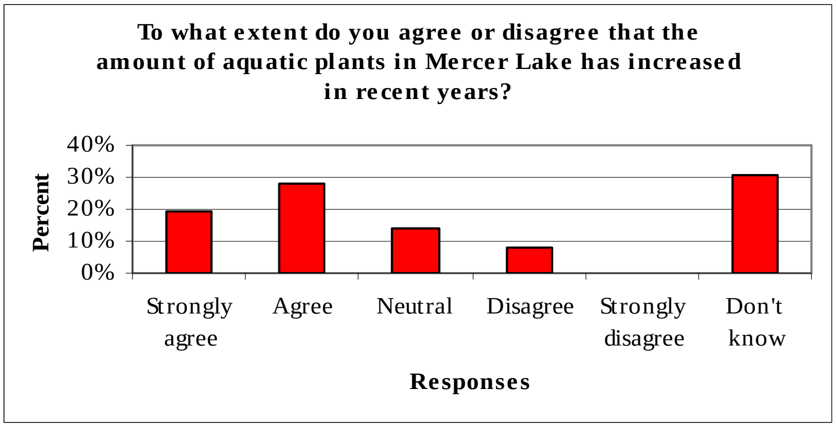


Figure 1. Survey Results: Has aquatic plant growth has increased in Mercer Lake?

Survey respondents felt that watching for and reporting exotic plants was a high priority activity for the lake association.

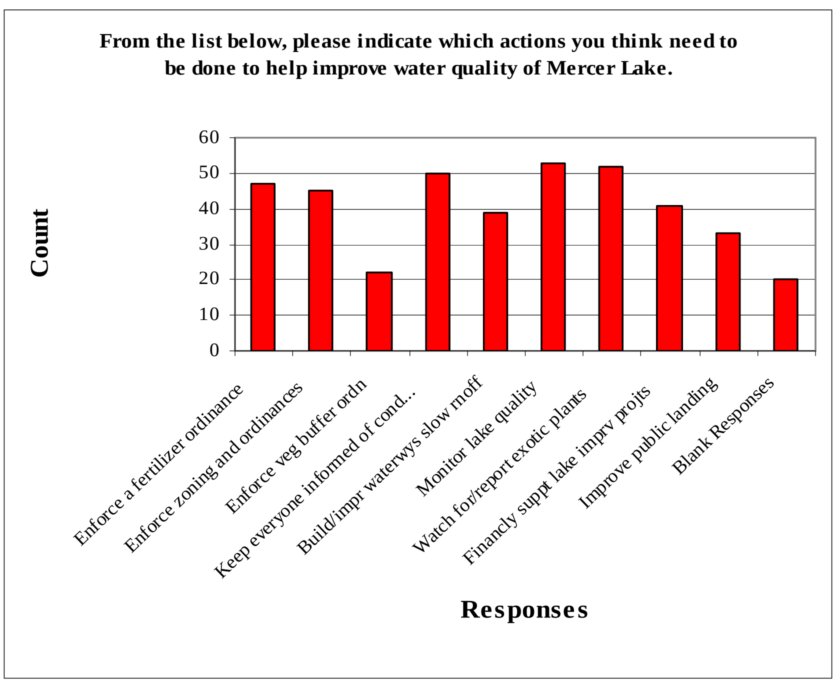


Figure 2. Survey Results - Actions to pursue to improve Mercer Lake.

Lake Information

The Lake

Mercer Lake is a 184-acre drainage lake located in Iron County in the town of Mercer (T43N, R3E, S36). Its Water Body Identification Code is 2313600. It has a maximum depth of 24 feet and a mean depth of 11 feet. The Little Turtle River is the main stream flowing into Mercer Lake from Grand Portage Lake and out of the lake to the Flambeau Flowage. A much smaller tributary flows from Lake Tahoe.

Table 1. Mercer Lake Information

Size (acres)	184
Mean depth (feet)	11
Maximum depth (feet)	24
Littoral zone depth (feet)	19.1
Average summer secchi depth (feet) 2002-2011	10.7

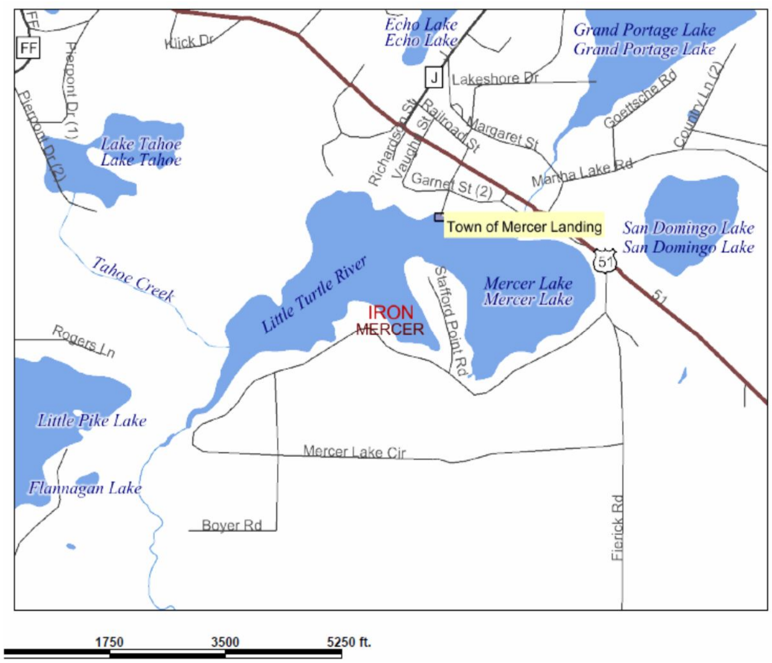


Figure 3. Map of Mercer Lake

Water Quality

The United States Geological Survey (USGS) completed a comprehensive study of Mercer Lake and its watershed beginning in 2008. The report was completed in 2012. The purposes of the study were to describe the water quality of the lake and the composition of its sediments; quantify the sources of water and phosphorus loading to the lake, and to evaluate the effects of past and future changes in phosphorus inputs on the water quality of the lake.

Based on a sediment-core analysis and in-lake monitoring data, the water quality of Mercer Lake appears to have been degraded as a result of past activities in its watershed. Water quality appears to have improved, however, after a new sewage-treatment plant was constructed in 1995 and its discharge was completely bypassed around the lake in 1995. From 1965 to 1995, the old wastewater treatment plant discharged effluent into and near the lake outflow to the Turtle River.

Since 2000, when a more consistent monitoring program began, the water quality of the lake appears to have changed very little. During the two monitoring years of the USGS study (2008–09), the summer average near-surface concentration of total phosphorus was 0.023 mg/L, indicating the lake is borderline between mesotrophic and eutrophic. The summer average chlorophyll *a* concentration was 3.3 mg/L and Secchi depth was 10.4 ft, both indicating mesotrophic conditions.

Recent citizen lake secchi monitoring in the deep hole of the lake also indicate mesotrophic to borderline eutrophic lake nutrient conditions as shown in Figure 4. The July and August secchi depth mean was 10.7 feet from 2002 through 2011.

> ***Lake Trophic State***
> *Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. At the high end of the eutrophic scale blue-green algae dominate and algal scums are present sometimes throughout the summer. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.*
>
> *Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic.*

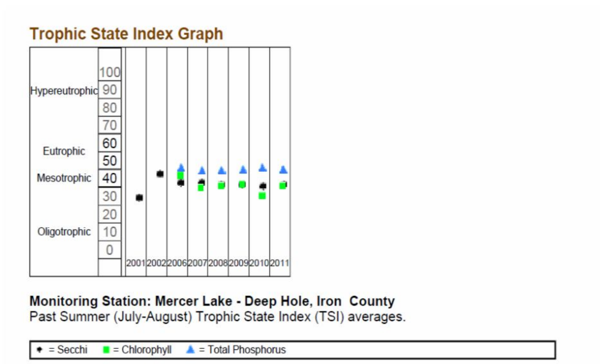
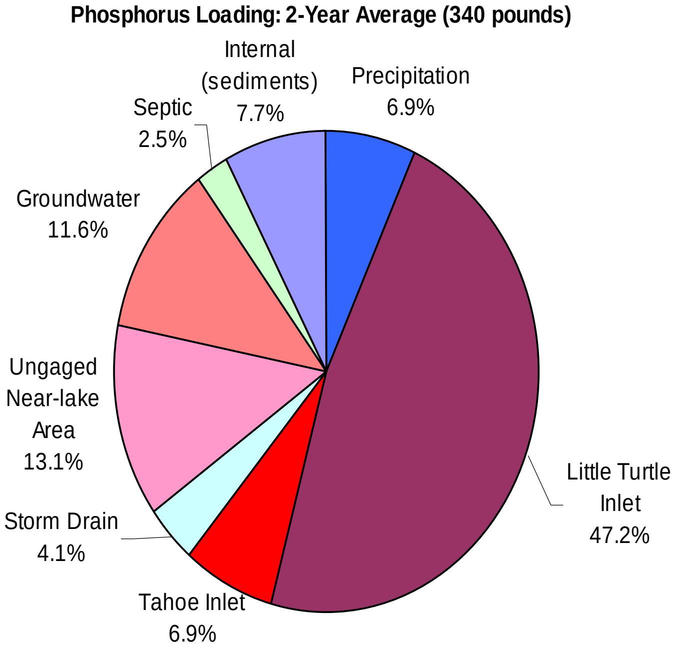


Figure 4. Citizen Lake Monitoring Data.

Algae growth in Mercer Lake is limited by phosphorus. Therefore, the lake study focused on phosphorus inputs to the lake. Phosphorus inputs in a typical year are summarized in Figure 5 below. The largest sources of phosphorus were from the Little Turtle inlet (about 45 percent) and the near-lake drainage area of urban and residential development (about 24 percent). This includes Un-gaged near-lake area, septic and storm drain inputs on the graphs below. Phosphorus loading from lake sediments (5.5 percent) and septic systems (1.8 percent) is relatively low.



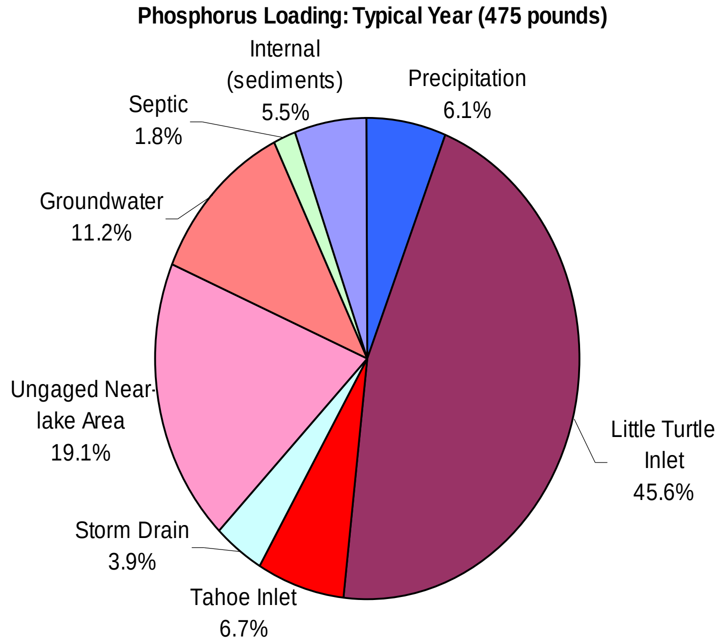


Figure 5. Annual Phosphorus Loading (from USGS 2012).

Watershed

A watershed map is included in Figure 6 below. The entire watershed is 7,625 acres with most of that (6,564 acres) draining to Mercer Lake from Grand Portage Lake through the Turtle River. Land use in the entire watershed is a mixture of forest (74.9 percent), wetlands (6.6 percent), open water (8.5 percent), low-density residential (5.9 percent), urban (2.2 percent), grassland/shrubland (1.1 percent), agriculture (0.4 percent), and golf course (0.4 percent).

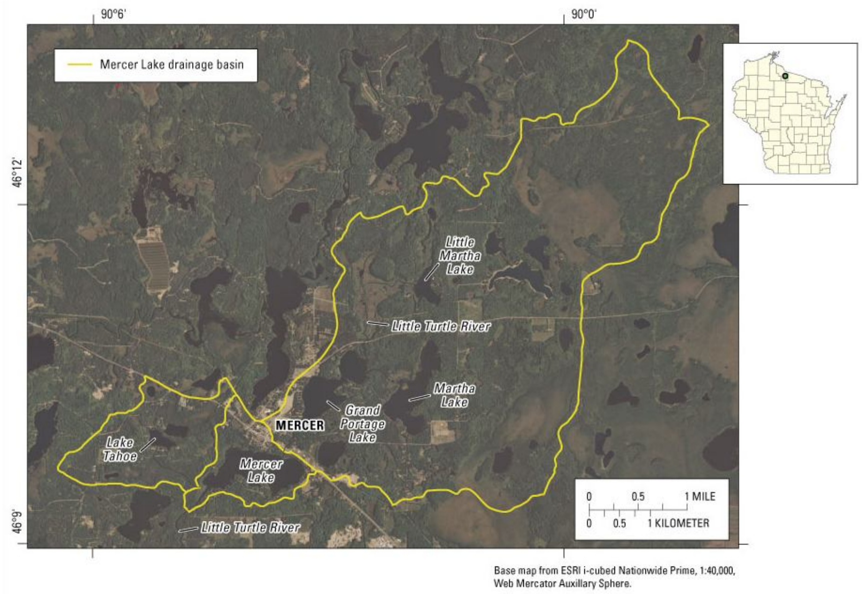


Figure 6. Mercer Lake Watershed (from USGS 2012).

Water Quality Study Conclusions

Eutrophication models were used to predict how the water quality of Mercer Lake would likely respond to changes in phosphorus loading and to estimate past water quality conditions. It is expected that reductions in watershed loading will result in less algae growth and increased water clarity. Because of the limited amount of phosphorus that is presently input into Mercer Lake, management actions to minimize future phosphorus and urban storm sewer input are likely to greatly benefit the lake's water quality. Planned highway modifications along with watershed best management practices are likely to reduce watershed phosphorus loading and lead to slight improvements in water quality.

The models also found that wastewater discharges likely negatively affected water quality in the past. Prior to 1965, when inputs from septic systems and other untreated wastewater were thought to be high, the lake was likely eutrophic, with average near-surface phosphorus concentrations near 0.035 mg/L, chlorophyll *a* concentrations about 7 µg/L, and Secchi depths about 6 ft. An analysis of a sediment core supported this conclusion. Based on sediment core analyses, the poorest water clarity and algal productivity in the lake occurred around 1965.

Wetlands make up 6.6% of the watershed and should be protected. These are important natural buffers that can help maintain higher water quality in Mercer Lake.

Aquatic Habitats

Primary Human Use Areas

A public boat landing owned by the Town of Mercer is located on the north side of the lake. The boat landing includes space for parking approximately 11 vehicles and trailers (estimated by area). A boat landing upgrade is planned for 2012.

Figure 7 below shows that much of the lakeshore development is along the south shore with Highway 51 and the town of Mercer along the northeast shoreline.

The 2007 watershed study reports that only 11 residences are not connected to the sanitary sewer system. It does not mention how many residences surround the lake. The 2007 survey results indicate that about 40 percent of residences are permanent. In 1970 there were 65 dwellings, 6 resorts, and a church located on the shoreline. Iron County has some acreage on the north shore having 0.48 mile of frontage.

Figure 7. Mercer Lake 2008 Aerial Photo from DNR WebView.

Habitat Areas

The littoral, or plant supporting, zone of the lake provides critical habitat for fish, waterfowl, and other wildlife. The shoreline is predominantly upland (85 percent) with the balance bog-coniferous wetland. Lesser scaup, bluewinged teal, hooded merganser, and wood duck utilize this lake on their spring and fall migrations. It is probable that the lake is also utilized by nesting waterfowl, such as mallard and common loon.[1]

A sensitive or critical habitat study has not been completed for the lake. A shoreline assessment was completed in 2009 and those results can be viewed in Appendix F. This assessment revealed that overall most developed areas are buffered. There are some properties that had unprotected developed areas which could be focused for improvement.

In 1970, sand was reported to be the predominant littoral material (50 percent) with rubble (25 percent), muck (20 percent), and a few boulders. In 2006 residents reported that the amount of muck had increased substantially. The 2010 aquatic plant survey found that muck was the dominant sediment (laying over sand/rock). The plant survey data collection method for bottom type is not very precise so any indication of change may not be a valid assessment, although it appears the sedimentation may have increased.

Concerns related to aquatic plant growth were expressed in a 1970 description of surface waters of Iron County. Emergent and submergent vegetation was described as moderate to dense. At that time, high nutrient effluent from the Town of Mercer sewage treatment plant was suggested a potential contributor to even greater plant nuisance growth.

A July 2003 aquatic plant survey using 21 transects across the lake found 21 plant species with plants covering an estimated 51% of the lake area. There was a mix of emergent (4), submerged (15) and floating (2) species. The plant identified as cabbage was said to be causing navigation problems, and mechanical cutting was recommended to alleviate this nuisance.

Mercer Lake Fishery

Musky, panfish, largemouth bass, northern pike, and walleye are common in the lake. Smallmouth bass and sturgeon are also present. Mercer Lake has been actively managed for musky and walleye since 1949. Annual stocking of fingerling walleye occurred most years from 1949 through 2011. Walleye stocking did not occur in only 24 years during this 62 year period. Musky were frequently stocked in years when walleye were not stocked.

The first inventory of the walleye fishery in 1970 found a lack of natural walleye reproduction. Ongoing inventories in the 1970's confirmed that result. Some walleye were assumed to be entering the lake from Grand Portage Lake. A 1983 survey recommended continued stocking and panfish thinning. The 1994 survey found no changes in panfish size structure, so additional panfish removal was recommended. Aquatic plant control was also recommended in this survey. By 2006, following the panfish removal program, some improvements in density and size structure were noted.

[1] Wisconsin DNR. 1970.

Recent management recommendations include discontinuing the stocking of walleye in even years with a new recommendation of musky stocking in alternate years. There is also a recommendation to continue aquatic plant harvesting as a means of providing "edge-effect" for increased predation.

Table 2. Fish Spawning Times and Considerations

Fish Species	**Spawning Temp. (Degrees F)**	**Spawning Substrate / Location**	**Comments**
Northern Pike	Upper 30s – mid 40s (right after ice-out)	Emergent vegetation 6-10 inches of water	Eggs are broadcast
Walleye	Low to upper 40s – (about one week after ice-out)	Rocky shorelines with rubble/gravel 0.5 – 3 feet of water	Eggs are broadcast
Black Crappie	Upper 50s to lower 60s	Nests are built in 1-6 feet of water.	Nest builders
Largemouth Bass Bluegills	Mid 60s to lower 70s	Nests are built in water less than 3 feet deep.	Nest builders
Muskellunge	Mid 50's to near 60	Organic sediment, woody debris and submerged vegetation.	Eggs are broadcast

Rare, Endangered, or Protected Species Habitat

Mercer Lake is located in the town of Mercer (T43N, R03E) in section 36. Natural Heritage Inventory records are provided to the public by town and range rather than section, so there is no indication if the incidences of these species occur in and immediately surrounding Mercer Lake.[2]

<u>Species listed in the Town of Mercer (T43N, R03E):</u>

Mottled Darner	*Aeshna clepsydra*	Special Concern
Gray Wolf	*Canis lupis*	Special Concern
Trumpeter Swan	*Cygnus buccinator*	Special Concern
Spruce Grouse	*Falcipennis Canadensis*	Threatened (Federally)
Bald Eagle	*Haliaeetus leucocephalus*	Special Concern
American Marten	*Martes Americana*	Endangered (Federally)

The proposed actions within the plan are not anticipated to affect native plants and wildlife including the natural heritage species listed above.

[2] Natural Heritage data for Wisconsin is found at http://dnr.wi.gov/org/land/er/nhi. (data current as of 11/04/11)

Functions and Values of Native Aquatic Plants
Naturally occurring native plants are extremely beneficial to the lake. They provide a diversity of habitats, help maintain water quality, sustain fish populations, and support common lakeshore wildlife such as loons and frogs.

Water Quality
Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algal growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent re-suspension of sediments from the lake bottom. Stands of emergent plants (whose stems protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline. Poor water clarity can limit aquatic plant growth by limited light penetration.

Shallow lakes typically have two alternative stable states—phytoplankton (algae)-dominated or macrophyte (plant)-dominated (Newton and Jarrell, 1999). In moderate densities, macrophytes are beneficial in these lakes. Macrophytes keep sediment from being resuspended by the wind and, therefore, help keep the water less turbid. Macrophytes also provide a place for attached algae to grow and remove phosphorus from the water column. If the macrophytes are removed or if external phosphorus inputs increase, the lake can shift from a macrophyte-dominated state to an algal-dominated state. Once a lake is in the algal-dominated state, macrophytes have a difficult time re-establishing themselves because algae reduce the penetration of light. Of these two conditions, it is commonly believed that the macrophyte-dominated state, which is present in Mercer Lake, is more desirable for human and biological use than the algal-dominated state (Newton and Jarrell, 1999). It is believed that Mercer Lake now has more macrophytes than it once had, but macrophytes may have always been common in the lake.[3]

Fishing
Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for many species of fish. Other fish, such as bluegills, graze directly on the plants themselves. Plant beds in shallow water provide important spawning habitat for many fish species.

Waterfowl
Plants offer food, shelter, and nesting material for waterfowl. Birds eat both the invertebrates that live on plants and the plants themselves.[4]

Protection against Invasive Species
Non-native invasive aquatic species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and curly leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in

[3] USGS. 2012.
[4] Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.

the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established and spread in the lake. This concept of opportunistic invasion can also be observed on land, in areas where bare soil is quickly taken over by weeds.

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. The presence of invasive species can change many of the natural features of a lake and often leads to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native plants may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.[5]

[5] *Aquatic Plant Management Strategy. DNR Northern Region.* Summer 2007.

Plant Community

Aquatic Plant Survey Results

In July 2010 a full-lake point intercept (PI) survey was completed. This survey involved the sampling of 485 predetermined points on Mercer Lake. Figure XX shows the sample point grid.

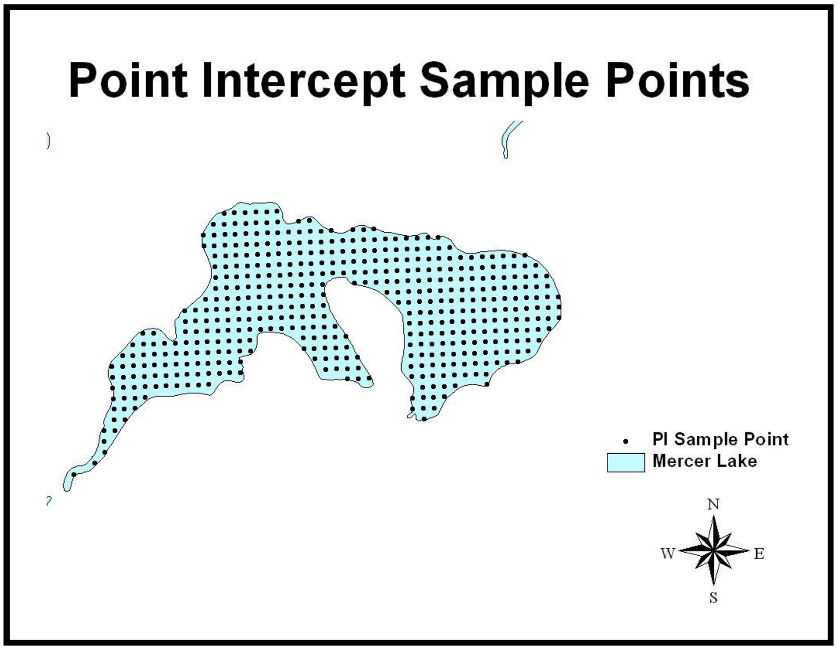


Figure 8: Sample point grid for the Mercer Lake Point Intercept aquatic plant survey.

At each sample point, a 14 tined rake was towed 1 meter and recovered. Each plant that was on the rake or fell off of the rake was identified and recorded as a density (1-3). Each sample point was also given a full rake density (due to all plants on the rake), ranging from 1-3. Figure 10 shows the rake density of plants at each sample point. The map in figure 9 shows the littoral zone, which is the area with plants in Mercer Lake. Any location with a green, yellow or red dot has plants present. The “x” represent areas where no plants were sampled.

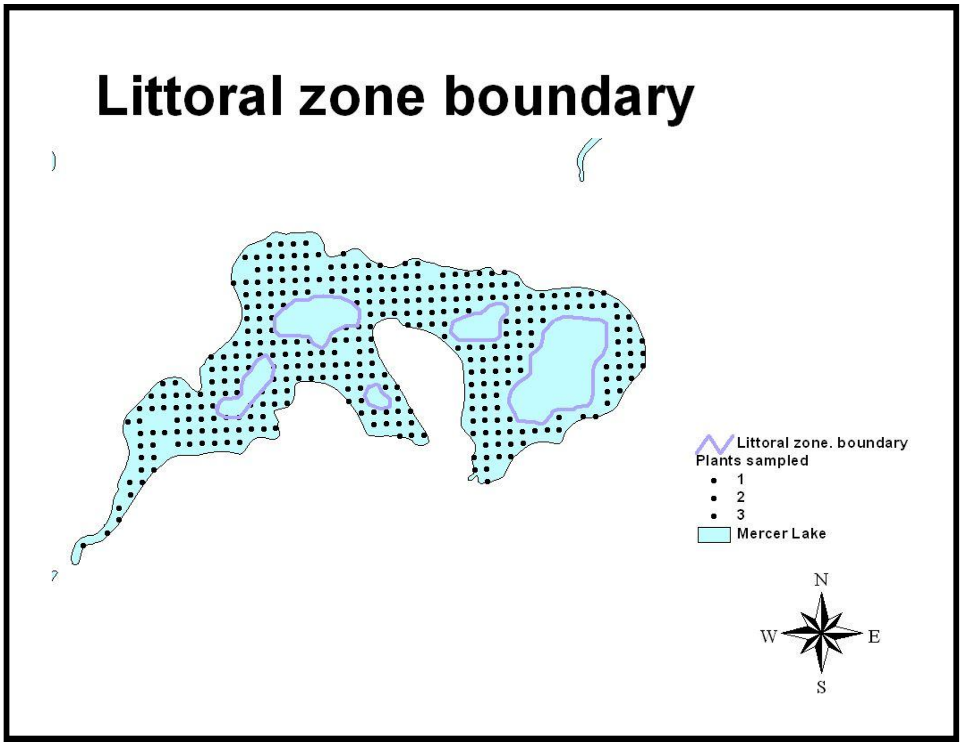


Figure 9: Littoral zone boundary of Mercer Lake from 2010 survey

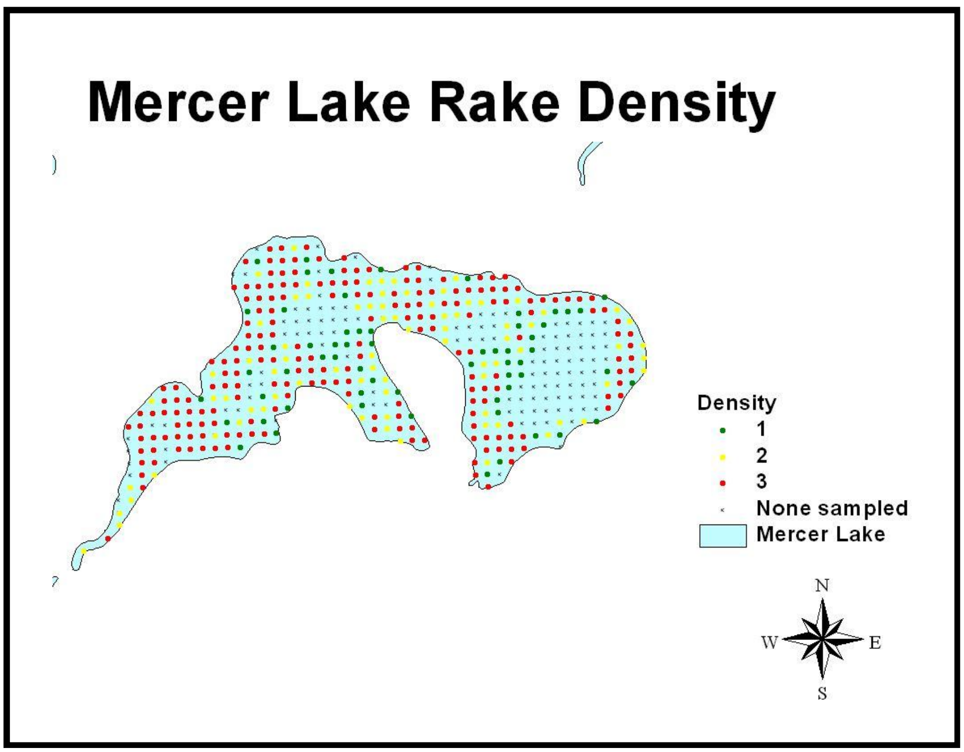


Figure 10: Rake density rating at each sample point on Mercer Lake-2010

The plant coverage of Mercer Lake is quite extensive. There were 369 sample points at or below a depth of 19.1 feet, which was the maximum depth plants were sampled, thereby defining the depth of the littoral zone. Of these sample points, 336 of them had vegetation or 91.06 % of the littoral zone. The statistic is somewhat misleading since the vast majority of sample points over 17 feet had no growth and only one point at 19.1 feet had growth. Therefore even more than 91 % of the littoral zone had plants, which supports extensive growth. The rake density map also shows several points with a high plant density of “3.” Of the 336 sites with vegetation, 198 had a density of 3, or 58.9%. There are some areas in Mercer Lake that become dense enough to reduce navigation and recreational use.

Table 3: Summary of point intercept survey statistics-July 2010.

Total number of sample points	**456**
Total number of sites with vegetation	**336**
Total number of sites shallower than maximum depth of plants	**369**
Frequency of occurrence at sites shallower than maximum depth of plants	**91.06**
Simpson Diversity Index	**0.92**
Maximum depth of plants (ft)	**19.1**
Average number of all species per site (shallower than max depth)	**3.19**
Average number of all species per site (veg. sites only)	**3.71**
Average number of native species per site (shallower than max depth)	**3.19**
Average number of native species per site (veg. sites only)	**3.71**
Species Richness	**37**
Species Richness (including visuals)	**43**

The diversity of plants growing in Mercer Lake is also quite high. There were 37 species (35 vascular plants and 2 species of algae) actually sampled on the rake. If species richness includes plants viewed near the sample point, this richness increases to 43 species. A boat survey involves observing plants that are in under-sampled areas such as bays (where few sample points are defined). When the boat survey species are included, there were 47 species of plants observed in Mercer Lake . All species sampled were native, with two non-native species observed in the boat survey. The two non-native species were aquatic for-get-me-not and reed canary grass.

The Simpson’s diversity index is a calculation that gives the probability that two species randomly sampled will be different. The Simpson’s diversity index for Mercer Lake is 0.92 (92% probability two species will differ), which is quite high and supports high diversity of the plant community in the lake. There were nearly 4 species (3.71) sample on average at each sample point.

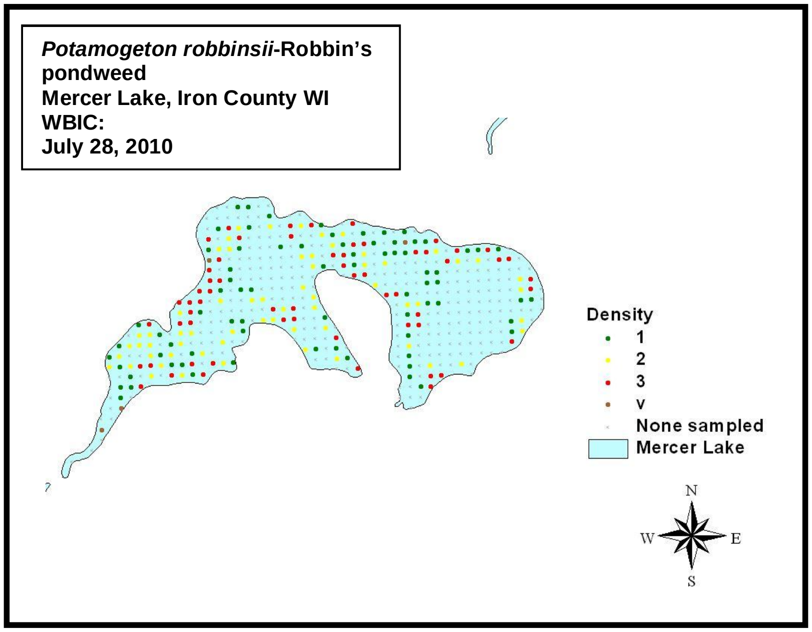


Figure 11: Distribution map of Robbin's pondweed, most abundant plant in Mercer Lake-2010.

The three most abundant plants are Robbin's pondweed (*Potamogeton robbinsii*), waterweed (*Elodea canadensis*), and large-leaf pondweed (*Potamogeton amplifolius*). All three of these plants are common native species found in Wisconsin lakes and serve important roles in the lake ecosystem. Large-leaf pondweed provides good cover for various fish species and these beds are often sought after by anglers.

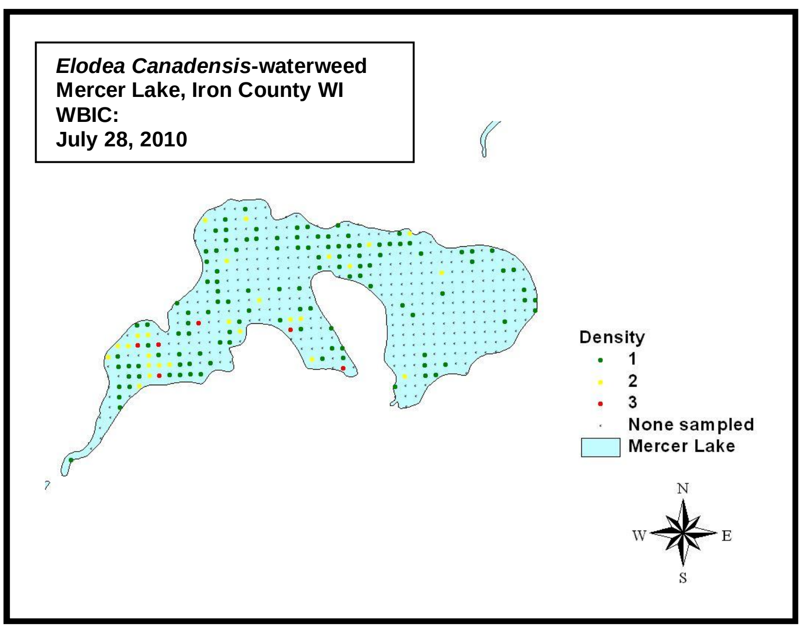


Figure 12: Distribution map of waterweed, second most common plant in Mercer Lake-2010

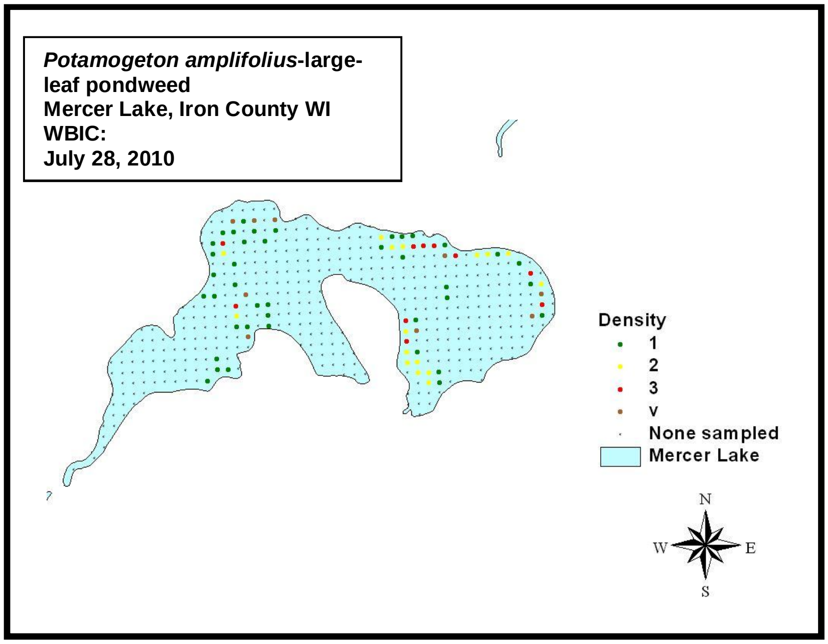


Figure 13: Distribution map of large-leaf pondweed, third most common plant in Mercer Lake-2010.

Mercer Lake holds a very diverse plant community. When the diversity per sample point is mapped, it reveals that the most diverse sample points are on the western end of the lake where the Little Turtle River flows out of the lake. This would suggest that would be a critical habitat area if such an analysis were conducted.

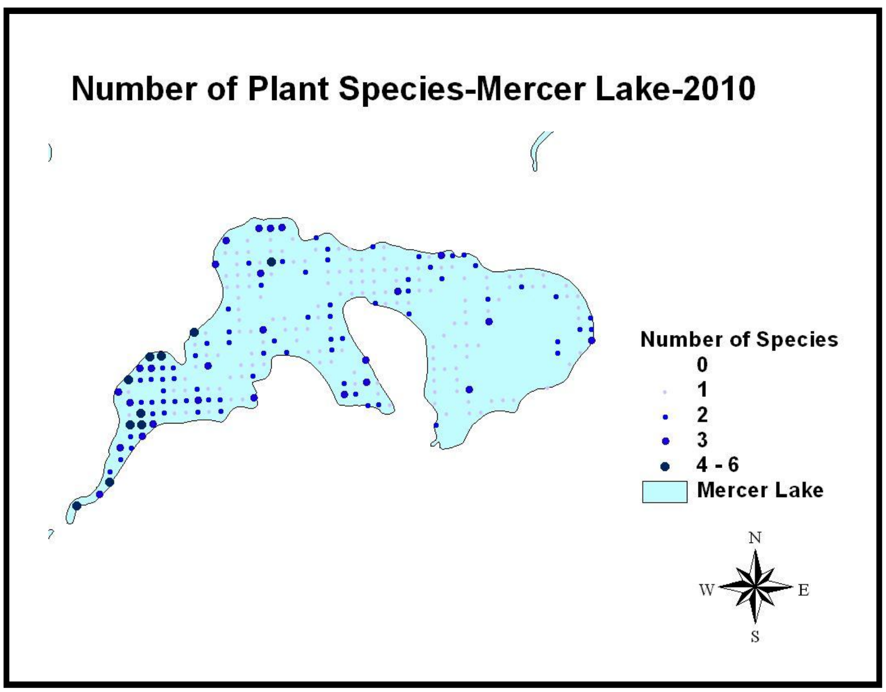


Figure 14: Species diversity at each sample point, Mercer Lake July, 2010.

Species	Frequency	Rel. freq	# of pts	Avg Density	# viewed
***Potamogeton robbinsii*, Fern pondweed**	56.52	15.25	195	1.92	4
***Elodea canadensis*, Common waterweed**	43.19	11.65	149	1.26	
***Potamogeton amplifolius*, Large-leaf pondweed**	30.92	9.70	124	1.44	13
***Ceratophyllum demersum*, Coontail**	29.57	7.97	102	1.05	1
***Vallisneria americana,* Wild celery**	27.25	7.35	94	1.60	
***Myriophyllum sibiricum*, Northern water-milfoil**	23.19	6.25	80	1.43	6
***Lemna trisulca*, Forked duckweed**	22.32	6.02	77	1.08	2
***Potamogeton zosteriformis*, Flat-stem pondweed**	22.03	5.94	76	1.11	3
***Potamogeton praelongus,* White-stem pondweed**	15.65	4.22	54	1.28	7
***Najas flexilis,* Slender naiad**	14.49	3.91	50	1.30	3
***Potamogeton pusillus*, Small pondweed**	11.59	3.13	40	1.08	2
***Potamogeton richardsonii*, Clasping-leaf pondweed**	11.30	3.05	39	1.31	9
***Bidens beckii*, Water marigold**	11.01	2.97	38	1.11	7
***Nymphaea odorata*, White water lily**	8.41	2.27	29	1.10	10
***Brasenia schreberi*, Watershield**	5.22	1.41	18	1.22	9
***Heteranthera dubia*, Water star-grass**	4.64	1.25	16	1.25	6
***Chara sp.*, Muskgrasses**	3.48	0.94	12	1.33	1
***Nuphar variegata,* Spatterdock**	3.48	0.94	12	1.08	5
***Potamogeton friesii*, Fries' pondweed**	2.90	0.78	10	1.00	2
***Utricularia vulgaris*, Common bladderwort**	2.90	0.78	10	1.30	3
***Pontederia cordata,* Pickerelweed**	1.74	0.47	6	1.33	9
***Schoenoplectus acutus*, Hardstem bulrush**	1.74	0.47	6	1.00	1
***Stuckenia pectinata*, Sago pondweed**	1.74	0.47	6	1.00	5
***Utricularia intermedia,* Flat-leaf bladderwort**	1.74	0.47	6	1.00	
***Nitella sp.*, Nitella**	1.45	0.39	5	1.00	
***Sparganium eurycarpum*, Common bur-reed**	1.45	0.39	5	1.00	4
***Eleocharis acicularis*, Needle spikerush**	1.16	0.31	4	1.00	
***Decodon verticillatus*, Swamp loosestrife**	0.87	0.23	3	1.33	3
***Sagittaria sp.*, Arrowhead (rosette)**	0.87	0.23	3	1.00	3
***Potamogeton gramineus*, Variable pondweed**	0.58	0.16	2	1.00	
***Ranunculus aquatilis*, White water crowfoot**	0.58	0.16	2	1.00	1
***Polygonum amphibium,* Water smartweed**	0.25	0.10	1	1.00	1
***Eleocharis palustris*, Creeping spikerush**	0.25	0.10	1	1.00	
***Isoetes lacustris*, Lake quillwort**	0.25	0.10	1	1.00	2
***Potamogeton natans*, Floating-leaf pondweed**	0.25	0.10	1	1.00	2
***Sagittaria rigida,* Sessile-fruited arrowhead**	0.25	0.10	1	1.00	
***Hydrodictyon reticulatum*, waternet**	0.25	0.10	1	1.00	
Aquatic moss	1.45		5	1.00	
Filamentous algae	10.14		35	1.03	

Species viewed only at sample points:

Comarum palustre, Marsh cinquefoil
Sagittaria graminea, Grass-leaved arrowhead
Sagittaria latifolia, Common arrowhead
Sparganium emersum, Short-stemmed bur-reed
Typha latifolia, Broad-leaved cattail
Carex sp, Sedge

Species observed in boat survey not seen at sample points:
Phalaris arundinacea, Reed canary grass*
Myosotis scorpioides, Aquatic for-get-me-not*
Typha x glauca Hybrid cattail
Carex camosa, Bottle brush sedge

***Not native.**

The Floristic Quality Index (FQI) is an index developed by Dr. Stanley Nichols of the University of Wisconsin-Extension. This index is a measure of the plant community response to development and human influence on the lake. It takes into account the species of aquatic plants present and their tolerance for changing water quality and habitat characteristics. A plant's tolerance is expressed as a coefficient of conservatism (C). Native plants in Wisconsin are assigned a conservatism value between 0 and 10. A plant with a high conservatism value has more specialized habitat requirements and is less tolerant of disturbance and/or water quality changes. Those with lower values are more able to adapt to disturbance or changing conditions, and can therefore be found in a wider range of habitats. The FQI is calculated using the number of species present and these plants' species conservatism values. A higher FQI generally indicates a healthier aquatic plant community.

Table 5: Floristic Quality Index species with conservatism value.

Species	Common Name	Conservatism
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Chara	Muskgrasses	7
Eleocharis acicularis	Needle spikerush	5
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Isoetes lacustris	Lake quillwort	8
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
Nitella	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Polygonum amphibium	Water smartweed	5
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton friesii	Fries' pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Sagittaria rigida	Sessile-fruited arrowhead	8
Schoenoplectus acutus	Hardstem bulrush	6
Sparganium eurycarpum	Common bur-reed	5
Stuckenia pectinata	Sago pondweed	3
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6

Stanley Nichols collected FQI data on a number of lakes in different ecoregions around the Wisconsin. This allows for a comparison between the Mercer Lake FQI data and the median for the lakes within the region Nichols researched. Figure 15 shows that comparison. The number of species is larger for Mercer Lake and the mean conservatism value is lower. The species number is so much higher the FQI is much higher too. This could be somewhat due to sampling techniques. However the difference is enough to suggest Mercer Lake is more diverse than the median lakes in the ecoregion.

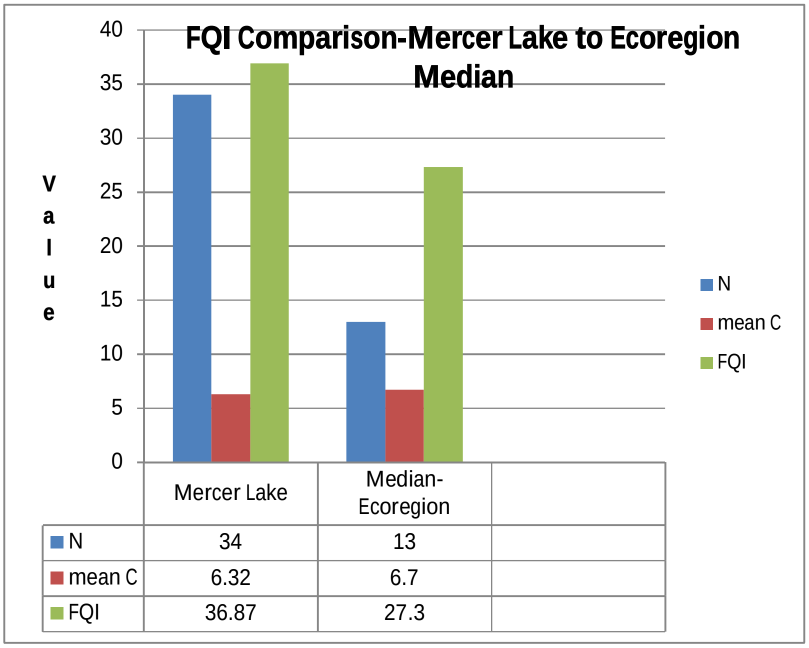


Figure 15: FQI comparison between Mercer Lake and ecoregion

Comparison to previous macrophyte survey

In 2003, an aquatic macrophyte survey was conducted. This survey used a protocol known as a transect survey. Several transects (straight lines) were established from the shoreline out to the end of the littoral zone. Along each transect, random points for sampling were selected. The sampling involved using a rake and a density of 0.5-5 was given for each plant sampled (ranging from least dense to most dense). No indication was given as to how each density was determined. The following data was available and allows for comparison:

Table 6: Plant survey comparison 2003 to 2010.

	# of species	Dominant species	Second dominant	Aerial coverage	Depth of plants	Non-native species
2003	21	*P. robbinsii*	*C. demersum*	51%	13 ft	none
2010	37	*P. robbinsii*	E. *canadensis*	74%	17 ft	2

There is significant difference in the two survey results. Due to the fact that different protocols were used, this could be the source of the differences. It is possible that over the last seven years the diversity and coverage of aquatic macrophytes in Mercer Lake has increased. The difference in results could be due to changes in the macrophyte community, but could also be due to differences in survey protocols.

Aquatic Invasive Species

Two species of non-native aquatic plants were observed in the aquatic plant survey of 2010. These species were reed canary grass and aquatic for-get-me-not. One invasive invertebrate species, the banded mystery snail, has been found in Mercer Lake. More information about several common aquatic invasive species is included in Appendix A. These species include curly leaf pondweed, Eurasian water milfoil, reed canary grass, and purple loosestrife.

Department of Natural Resource scientists have also found Eurasian water milfoil in other Iron County Lakes. They are: Long Lake, Long Lake Creek, and Wilson Lake.

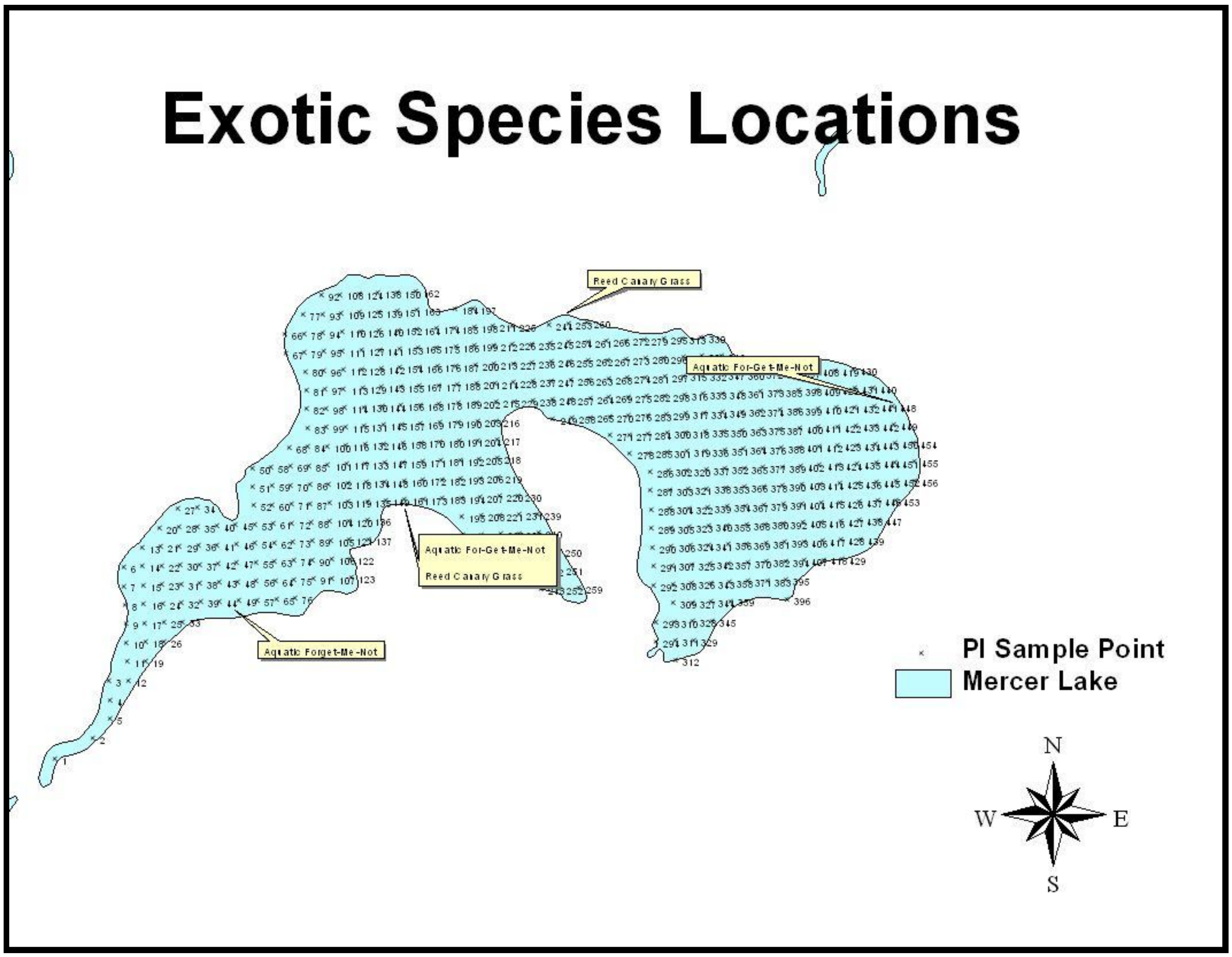


Figure 16: Locations of exotic plants species observed on Mercer Lake-2010.

Aquatic Plant Management

This section reviews the potential management methods available and reports recent management activities on the lakes.

Discussion of Management Methods

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management. **A permit is required for any aquatic chemical application in Wisconsin.**

The requirements for manual and mechanical plant removal are described in *NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations*. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline up to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal refers to the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.[6]

The *Department of Natural Resources Northern Region Aquatic Plant Management Strategy* (May 2007) requires documentation of impaired navigation or nuisance conditions before native plants may be managed with herbicides. Severe impairment or nuisance will generally mean that vegetation grows thickly and forms mats on the water surface.

Techniques to control the growth and distribution of aquatic plants are discussed in the following text. The application, location, timing, and combination of techniques must be considered carefully. A summary table of Management Options for Aquatic Plants from the WDNR is found in Appendix E.

Manual Removal[7]

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants with rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian

[6] More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site: www.dnr.state.wi.us.

[7] Information from APIS (Aquatic Plant Information System). U.S. Army Corps of Engineers. 2005. and the *Wisconsin Aquatic Plant Management Guidelines.*

water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to thirty feet wide. SCUBA divers may engage in manual removal for invasive species like Eurasian water milfoil. Care must be taken to ensure that all plant fragments are removed from the lake.

Mechanical Control

Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver-operated suction harvesting, and rotovating (tilling) are the most common forms of mechanical control available. WDNR permits under Chapter NR 109 are required for mechanical plant removal.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from one to six feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

The size, and consequently the harvesting capabilities, of these machines vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide, and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1,000 cubic feet (by volume) or 1 to 8 tons (by weight).

In some cases, the plants are transported to shore by the harvester itself for disposal, while in other cases, a barge is used to store and transport the plants in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm to be used as compost (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate, and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures don't make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time as well as cost.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, turions may have formed and may be spread, and there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. Harvesting contractors are not readily available in northern Wisconsin, so harvesting contracts are likely to be very expensive. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines.

Diver dredging operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against the pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can result from diver dredging, but fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated more than once to be effective. When applied to a pioneering infestation, control can be complete.

However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates play an important role in the effectiveness of a diver dredging operation. Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little difficulty. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment. Diver dredging will be considered as a rapid response control measure for Eurasian water milfoil if discovered in the lake.

Biological Control[8]

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases. With the introduction of pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

The effectiveness of bio-control efforts varies widely (Madsen, 2000). Beetles are commonly and successfully used to control purple loosestrife populations in Wisconsin. Weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is not allowed in Wisconsin. As a result, grass carp is not a viable bio-control in Wisconsin lakes and won't be utilized.

Weevils[9] *have potential for use as a biological control agent against Eurasian water milfoil. There are several documented "natural" declines of EWM infestations with weevil present. In these cases, EWM was not eliminated but its abundance was reduced enough so that it did not achieve dominance. These declines are attributed to an ample population of native milfoil weevils (Euhrychiopsis lecontei). Weevils feed on native milfoils but will shift preference over to EWM when it is present. Lakes where weevils can become an effective control have an abundance of native northern water milfoil and fairly extensive natural shoreline where the weevils can over winter. Any control strategy for EWM that would also harm native milfoil may hinder the ability of this natural bio-control agent. Lakes with large bluegill populations are not good candidates for weevils because bluegills feed on the weevils. The presence and efficacy of stocking weevils in EWM lakes is being evaluated in Wisconsin lakes. So far, stocking weevils does not appear to be effective.*

[8] Information from APIS (Aquatic Plant Information System). U.S. Army Corps of Engineers. 2005.

[9] *Control of Eurasian Water Milfoil & Large-scale Aquatic Herbicide Use*. Wisconsin Department of Natural Resources. July 2006.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, and plant-specific control. On the other hand there are several disadvantages to consider, including very long control times (years instead of weeks), a lack of available biological control agents for particular target species, and relatively specific environmental conditions necessary for success. Biological control is not without risks; new non-native species introduced to control a pest population may cause problems of its own.

Re-vegetation with Native Plants

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994).

Physical Control[10]

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit would be required. Such permits are not commonly granted.

Dredging removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson 1982). Lakes that are very shallow due to sedimentation tend to have excess plant growth. Dredging can form an area of the lake too deep for plants to grow, thus creating an area for open water use (Nichols 1984). By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community (Nichols 1984). Results of dredging can be very long term. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone. It is best used as a lake remediation technique.

Drawdown, or significantly decreasing lake water levels can be used to control nuisance plant populations. With drawdown, the water body has water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns need to be at least one month long to ensure thorough drying and effective removal of target plants (Cooke 1980a). In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Although drawdown may be effective for control of hydrilla for one to two years (Ludlow 1995), it is most commonly applied to Eurasian

[10] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980).

Although drawdown can be inexpensive and have long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to drawdown and individual species responses can be inconsistent (Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy species, particularly annuals. Drawdown requires a mechanism to significantly lower water levels.

Benthic barriers or other bottom-covering approaches are another physical management technique. The basic idea is to cover the plants with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt or clay; fly ash; and various combinations of the above materials (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with synthetic sheeting is that the gases evolved from plant and sediment decomposition collect underneath and lift the barrier (Gunnison and Barko 1992).
The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984).

Benthic barriers will typically kill the plants under them within 1 to 2 months, after which time they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing fish and invertebrate habitat. A WDNR permit would be required for a benthic barrier, and these barriers are not recommended.

Shading or light attenuation reduces the amount of light plants have available for growth. Shading has been achieved by fertilization to produce algal growth, application of natural or synthetic dyes, shading fabric, or covers, and establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are only of limited applicability. Physical control is not currently proposed for management of aquatic plants in Mercer Lake.

Herbicide and Algaecide Treatments
Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (Madsen, 2000).

An important caveat is that these products are considered safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. WDNR permits under Chapter NR 107 are required for herbicide application.

General descriptions of herbicide classes are included below.[11]

Contact herbicides
Contact herbicides act quickly and are generally lethal to all plant cells they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants directly. They are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides, but they quickly resprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat,** and **copper** are contact aquatic herbicides.

Systemic herbicides
Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides and those that are absorbed by leaves are referred to as foliar active herbicides. **2,4-D, dichlobenil, fluridone, and glyphosate** are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides.

[11] This discussion is taken from: *Managing Lakes and Reservoirs*. North American Lake Management Society.

Broad spectrum herbicides
Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most species of vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, endothall, and fluridone** are used as broad spectrum aquatic herbicides, but can also be used selectively under certain circumstances.

Selective herbicides
Selective herbicides are those that are used to control certain plants but not others. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, timing, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

Environmental considerations
Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community, and in turn affect other organisms or weed control operations. These operations can also impact water chemistry which may result in further implications for aquatic organisms.

Table 7. Herbicides Used to Manage Aquatic Plants

Brand Name(s)	**Chemical**	**Target Plants**
Cutrine Plus, $CuSO_4$, Captain, Navigate, Komeen	Copper compounds	Filamentous algae, coontail, wild celery, elodea, and pondweeds
Reward	Diquat	Coontail, duckweed, elodea, water milfoil, and pondweeds
Aquathol, Aquathol K, Aquathol Super K, Hydrothol 191	Endothall	Coontail, water milfoil, pondweeds, and wild celery as well as other submersed weeds and algae
Rodeo	Glyphosate	Cattails, grasses, bulrushes, purple loosestrife, and water lilies
Navigate, Aqua-Kleen, DMA 4 IVM, Weed-Rhap	2, 4-D	Water milfoils, water lilies, and bladderwort

General descriptions of the breakdown of commonly used aquatic herbicides are included below.[12]

Copper

Copper is a naturally occurring element that is essential at low concentrations for plant growth. It does not break down in the environment, but it forms insoluble compounds with other elements and is bound to charged particles in the water. It rapidly disappears from water after application as an herbicide. Because it is not broken down, it can accumulate in bottom sediments after repeated or high rates of application. Accumulation rarely reaches levels that are toxic to organisms or significantly above background concentrations in the sediment.

2,4-D

2,4-D photodegrades on leaf surfaces after being applied to leaves, and is broken down by microbial degradation in water and in sediments. Complete decomposition usually takes about 3 weeks in water but can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

A recent study in Tomahawk Lake in Bayfield County, Wisconsin illustrated a much slower breakdown time of 2,4-D than described above. Following a whole lake treatment of .5 mg/L 2,4-D, the chemical was still present 160 days after treatment. While there was successful removal of the target plant, Eurasian water milfoil, there were also significant declines in native plant biomass. A potential explanation was the low nutrient conditions in Lake Tomahawk which was described as an oligo-mesotrophic lake. (Nault 2010, Toshner 2010)

Diquat

When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection levels 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and bound tightly to particles in the water and bottom sediments. When bound to certain types of clay particles, diquat is not biologically available. When diquat is bound to organic matter, it can be slowly degraded by microorganisms. When diquat is applied foliarly, it is degraded to some extent on the leaf surfaces by photodegradation. Because it is bound in the plant tissue, a proportion is probably degraded by microorganisms as the plant tissue decays.

Endothall

Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water and 1 week in bottom sediments.

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12 These descriptions are taken from Hoyer/Canfield: *Aquatic Plant Management*. North American Lake Management Society. 1997.

Fluridone
Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs, and microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter, when the sun's rays are less direct and days are shorter, result in longer half-lives. Fluridone usually disappears from pondwater after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

Glyphosate
Glyphosate is not applied directly to water for weed control, but when it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

Copper Compounds
Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

Herbicide Used to Manage Invasive Species

Eurasian Water Milfoil
The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil (EWM): 2,4-D, diquat, endothall, fluridone, and triclopyr.[13] All of these herbicides with the exception of diquat are available in both granular and liquid formulations. It is possible to target invasive species by using the appropriate herbicide and timing of application. Diquat is used infrequently in Wisconsin because it is nonspecific.[14] The herbicide 2,4-D is most commonly used to treat EWM in Wisconsin. This herbicide kills dicots including native aquatic species such as northern water milfoil, coontail, water lilies, spatterdock, and watershield. A project in Bayfield County on Lake Tomahawk also found unexpected impacts on pondweeds which are monocots.[15] Early season (April to May) treatment of Eurasian water milfoil is recommended to limit the impact on native aquatic plant populations because EWM tends to grow before native aquatic plants.

Granular herbicide formulations are more expensive than liquid formulations (per active ingredient). However, granular formulations are generally thought to release the active

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[13] Additional information provided by John Skogerboe, Army Corps of Engineers, personal communication. February 14, 2008.
[14] Frank Koshere. Wisconsin DNR. email communication. 3/03/10.
[15] Nault 2010.

ingredient over a longer period of time. Granular formulations, therefore, may be more suited to situations where herbicide exposure time will likely be limited, as is the case of treatment areas in small bands or blocks. In large, shallow lakes with widespread EWM, a whole lake treatment with a low rate of liquid herbicide may be most cost effective because exposure time is greater. Factors that affect exposure time are size and configuration of treatment area, water flow, and wind.
Application rates for liquid and granular formulations are not interchangeable. A rate of 1 to 1.5 mg/L 2,4-D applied as a liquid is a moderate rate that will require a contact time of 36 to 48 hours. Negative impacts to native plants have occurred at whole-lake dosage rates as low as 0.5 mg/L.[16] Application rates recommended for Navigate (granular 2,4-D) are 100 pounds per acre for depths of 0 to 5 feet, 150 pounds per acre for 5 to 10 feet, and 200 pounds per acre for depths greater than 10 feet. Allowed and recommended application rates are found on herbicide labels.

Curly Leaf Pondweed

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Studies have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 to 60 degree F water, and that treatments of CLP this early in its life cycle can prevent turion formation.[17] Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are still dormant, early season treatment selectively targets curly leaf pondweed. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center have conducted trials of this method. These methods are accepted as standard operating procedures being approved in Wisconsin for aquatic invasive species control projects.[18]

Because the dosage is at lower rates than the dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.[19] Steep drop-off, high winds, and other factors

[16] Nault 2010.
[17] *Research in Minnesota on Control of Curly Leaf Pondweed.* Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.
[18] Plan comments, Frank Koshere, September 16, 2010.
[19] Personal communication, Frank Koshere. March 2005.

that increase herbicide dilution and contact time can decrease treatment effectiveness.[20] Early season treatment similar to that described above can be used to treat corridors for navigation purposes. Because of potential for drift, a higher concentration of endothall is generally used in navigation corridors.

Efforts are also made to treat as early in the season as possible and to absolutely not treat when temperatures reach 60 degrees F. Lake volunteers help to ensure that specified treatment conditions are followed. Because CLP is a monocot like many other aquatic plants, it is not possible to target its control later in the season when many other native plants are growing.

[20] *Draft Report Following April 2008 Aquatic Herbicide Treatments of Three Bays on Lake Minnetonka*. Skogerboe, John. Us Army engineer Research and Development Center.

Past Aquatic Plant Management

Historically Mercer Lake has had high density plant growth that has been managed for reduction. The more recent archives show that from 2004 until 2009, this reduction was achieved through harvesting. The following maps illustrate the location and amount of vegetation reduction that occurred. The exact date of harvest was not provided, but it is

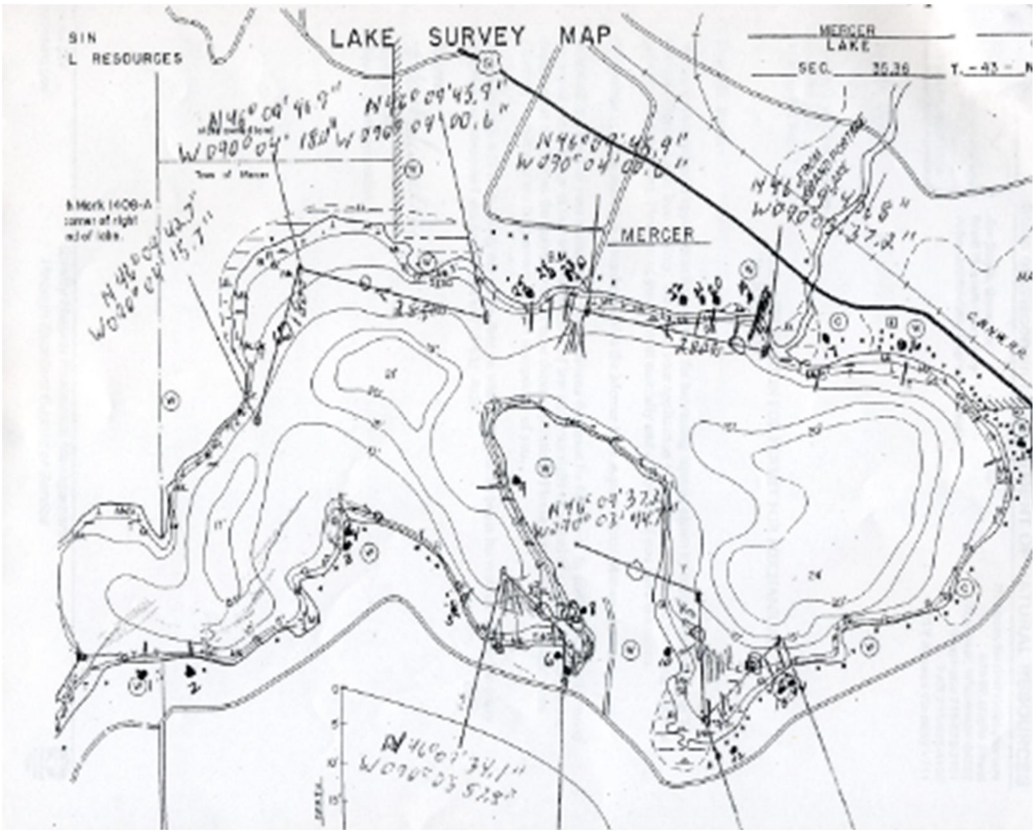

Figure 17: 2004 harvest locations with amount removed-22.5 tons

assumed to have been during peak growth in late July to early August. There is no record of any threshold or basis for harvest other than a request followed by a permit. No evaluation was conducted (or at least communicated) to determine if the harvest reduced macrophyte coverage into the following summer or not. All of this lack of information is needed if such harvest will be conducted in the future.

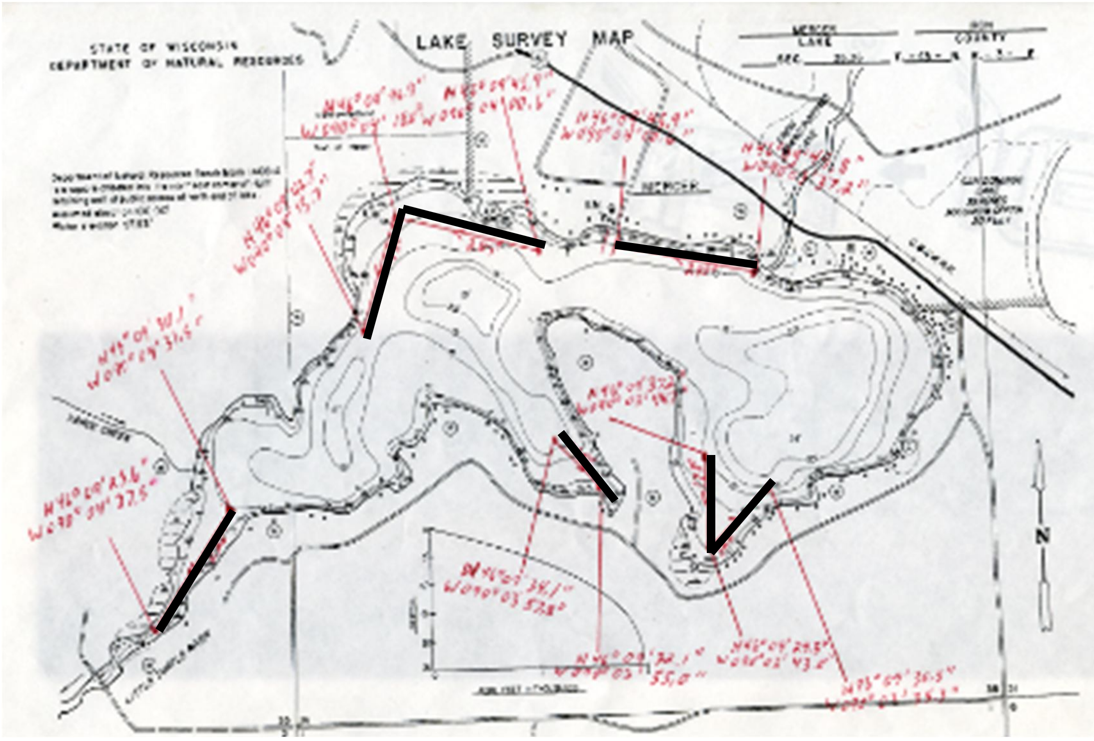

Figure 18: 2005 harvest locations-33 tons removed.

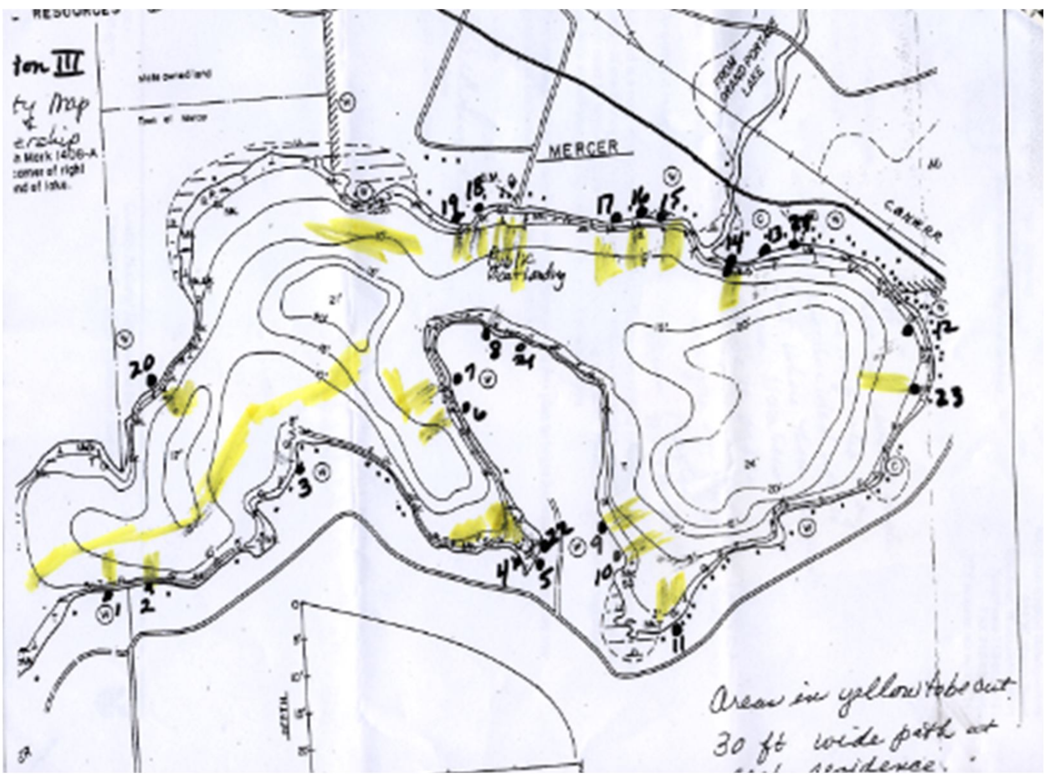

Figure 19: 2006 harvest locations-20 tons removed.

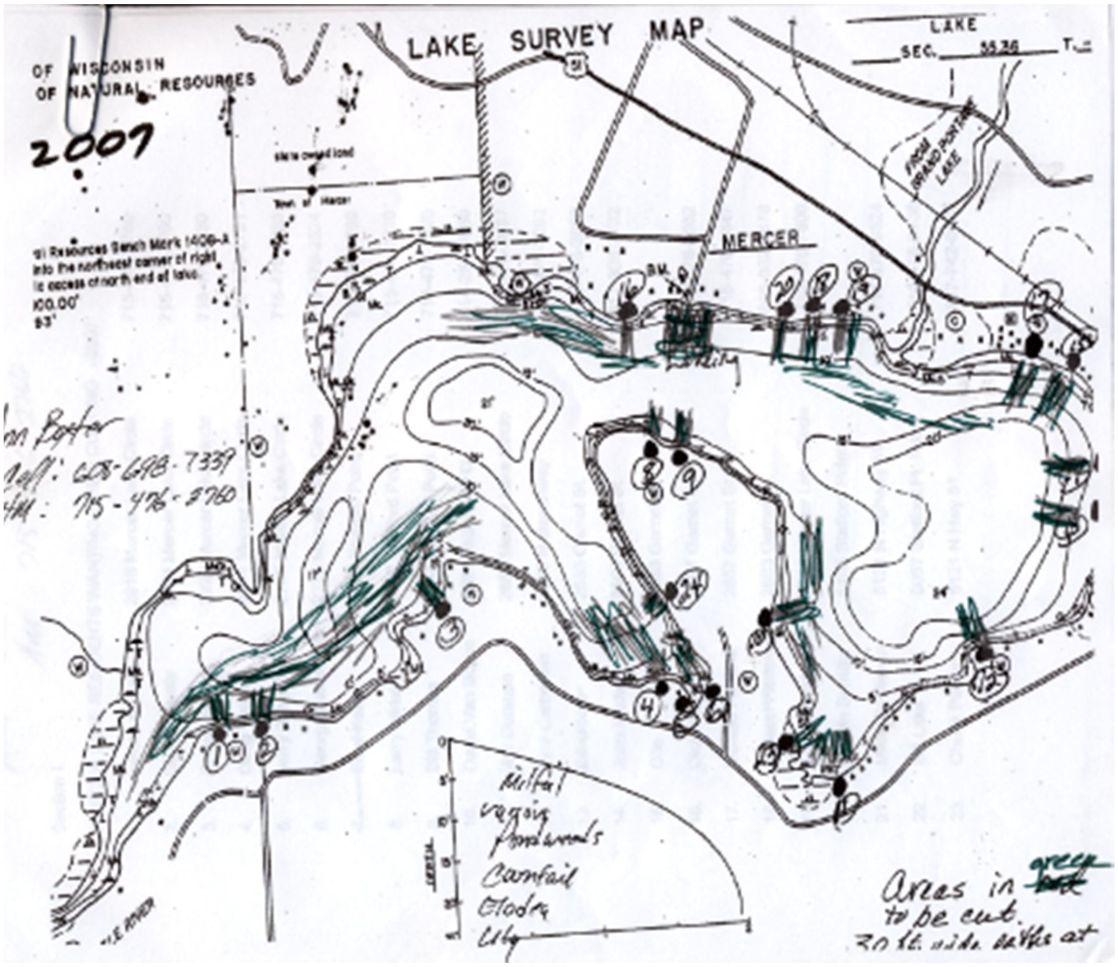

Figure 20: 2007 harvest locations-27.5 tons removed.

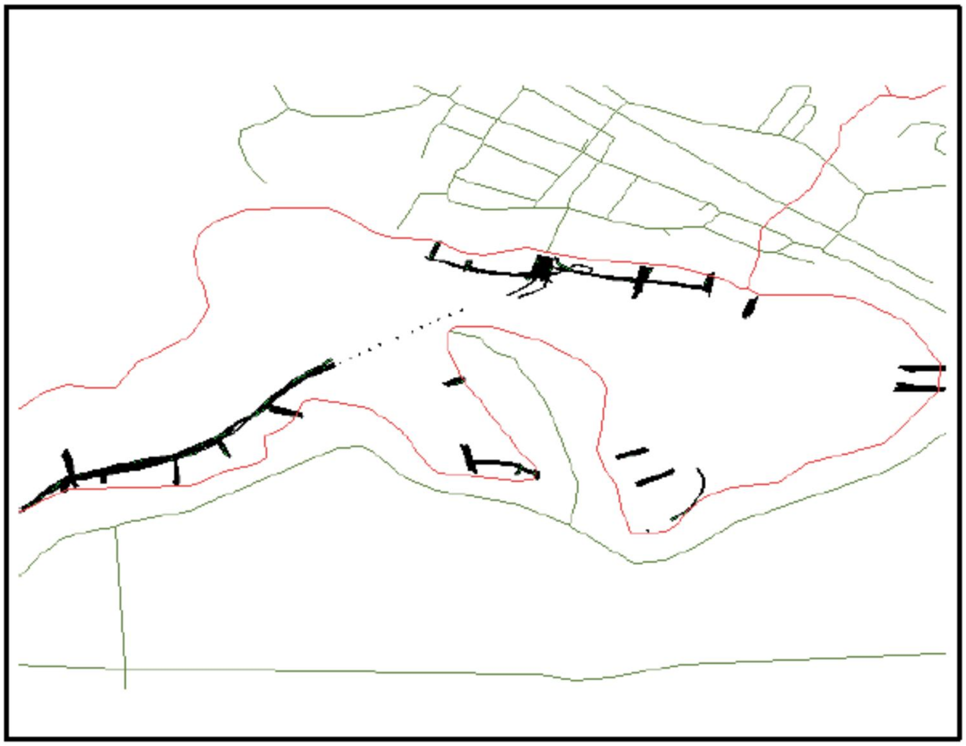

Figure 21: 2008 harvest locations-10 tons removed.

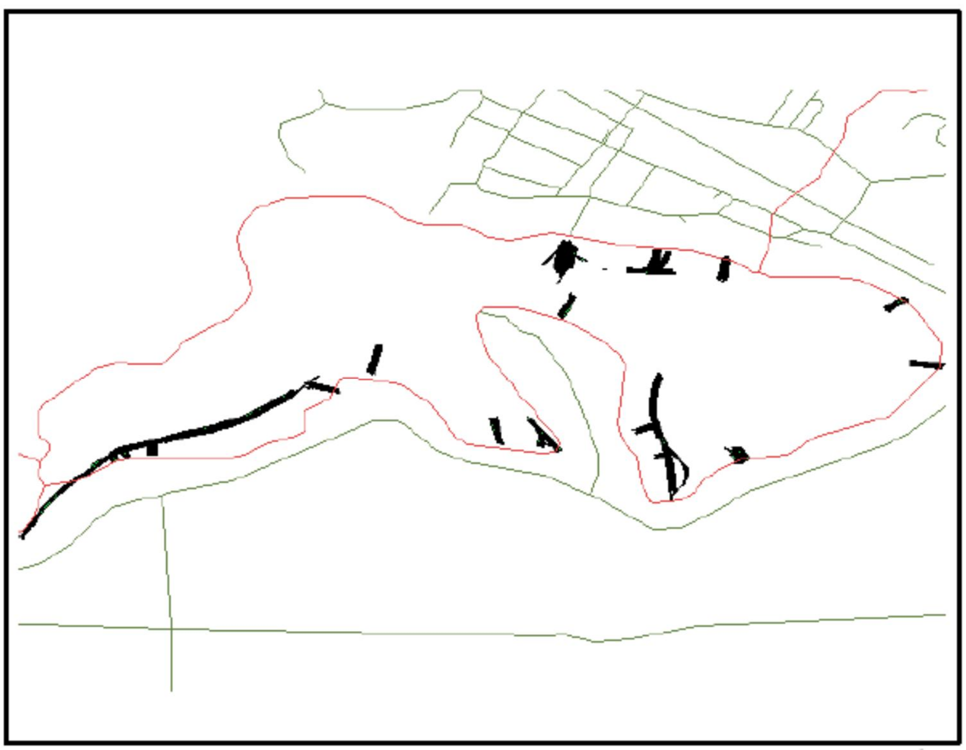

Figure 22: 2009 harvest locations-25 tons removed.

Table 7: Summary of past harvest amounts.

Year of harvest	Estimated amount removed (tons)
2004	22.5
2005	33
2006	20
2007	27.5
2008	10
2009	25

The DNR Northern Region released an Aquatic Plant Management Strategy (Appendix B) in the summer of 2007 to protect the important functions of aquatic plants in lakes. As part of this strategy, the DNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.[21] Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners must be carefully reviewed before permits are issued. The DNR will not allow removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented[22].

[21] Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.
[22] See Appendix B of the Aquatic Plant Management Strategy, Northern Region WDNR.

Plan Goals and Strategies

This section of the plan lists goals and objectives for aquatic plant management for Mercer Lake. It also presents a strategy of actions that will be used to reach aquatic plant management plan goals.

Goals are broad statements of direction.

Objectives are measurable steps toward the goal.

Actions are actions to take to accomplish objectives.

The **Implementation Plan** outlines timeline, resources needed, partners, and funding sources for each action item.

Plan Goals

1. **Stop the introduction of aquatic invasive species (AIS).**
2. **Educate residents about the importance of maintaining native species and stopping invasive species introduction.**
3. **Restore developed shorelines to native vegetation.**
4. **Preserve critical, native habitats in Mercer Lake.**
5. **Reduce the density of native plants in areas that impede navigation and recreation use of the lake.**

Considerations in management

When the committee established goals and objectives, many considerations were used to develop management practices. First was the importance of native species. Mercer Lake has a very diverse and healthy native plant community. These native plants are important for the lake ecosystem and help maintain higher water clarity. There are areas that reach nuisance levels and the committee understands there must be a balance between native plant reduction and maintaining a healthy plant community.

Introduction aquatic invasive species (AIS) is of high concern. Mercer Lake has two non-native species. Curly-leaf pondweed and Eurasian watermilfoil have not been found in Mercer Lake. Safeguards must be taken to minimize the chance of their introduction into Mercer Lake. This can include maintaining a healthy native plant community, inspecting watercraft launching in Mercer Lake, and a diligent monitoring program so any new introductions can be dealt with in a timely manner.

This plant committee has very carefully weighed the needs of lake users, lake residents and the lake ecosystem in designing aquatic plant management.

Responsible Parties for APM Implementation and Monitoring

Mercer Lake Association (MLA) – Elected officers (and MLA members) responsible for oversight of lake management district. Some actions such as hiring a contractor or consultant require a vote of the board.

APM Lead/Committee – makes day-to-day APM decisions and directs contractors in herbicide treatments and related monitoring. The director will have interns, volunteers and consultants to assist in these activities. The Board APM Lead is currently (will need to be appointed/can be more than one person)

AIS Lead – leads and coordinates volunteer AIS education activities including Clean Boats, Clean Waters monitoring and education at the boat landings and lake monitoring. The AIS Lead is currently (will need/can be committee).

Herbicide/Harvester Contractor – the contractor hired by the MLA Board to complete aquatic plant harvesting or herbicide treatment as permitted by the Wisconsin Department of Natural Resources.

APM Monitor– a consultant hired (or qualified volunteer) to complete monitoring under the direction of the APM Lead and the MLA Board. The APM monitor is currently (need one/can be AIS-APM lead if needed)

DNR – Aquatic Plant Management staff will review aquatic plant management permit applications and enforce permit conditions. Typically one DNR staff person oversees regional permit applications.

Goal 1. Stop the introduction of aquatic invasive species (AIS).

Objectives 1.1: The Clean Boats/Clean Waters monitoring program will be enhanced by adding boat launch information/monitoring volunteers.

Keeping AIS out of Mercer Lake is important. The most effective method is to educate and monitor what is coming into the lake, as this is really the only source of AIS. Diligent monitoring can be paramount in protecting Mercer Lake. Any time spent monitoring incoming boat traffic will help.

Action: The Mercer Lake Association will ask for volunteers to be trained in Clean Boats/Clean Waters (CBCW) by attending a workshop. They will then be asked to monitor boat landings on key dates based upon volunteer availability. These dates may include the first weekend of the fishing season, Memorial Day weekend, July 4th weekend and Labor Day weekend. Other busy times could be analyzed and added if needed, depending on the availability of monitors.

Objective 1.2: Mercer Lake will be monitored for AIS twice per month during the growing season.

The best way to deal with AIS is to not have any introduced to the lake. However, if they do, quick observation of the AIS is critical. The key to AIS is to act when there is a pioneer community of that plant (organism).   A pioneer population is a new, first established population and will tend to be localized to one location. If a pioneer population is located, it is much easier to reduce or even in some cases eradicate the AIS (although this is unlikely)

Routine monitoring will help located newly introduced AIS into Mercer Lake and will allow for a rapid response.

Action: Mercer Lake volunteers will be trained in aquatic invasive species (AIS) identification. The AIS monitors will periodically monitor Mercer Lake for AIS. It is recommended the monitoring occur once each month during May, June, July and August (if volunteers are available).   There will be designated areas to concentrate monitoring.

Although AIS can show up anywhere in the lake, it can make monitoring more efficient to look in areas that have a higher chance for AIS to occur. These areas include boat landings, bays that receive predominant winds, and areas near high boat traffic. A monitoring kit is recommended. This kit would include a GPS, maps of monitoring areas, data sheets, a viewing tube and ID plates.

Action: If Eurasian water milfoil (EWM) should be located (or suspected) the Rapid Response Protocol in Appendix D will be followed.

If any AIS are located, then the rapid response protocol should be followed. EWM is becoming a problem by being introduced to many lakes. It should be an emphasis while monitoring for all AIS. It is important that if EWM gets introduced into Mercer Lake that it get discovered as a pioneer community. This will help mitigation be more successful. The rapid response helps facilitate quick action.

Goal 2. Educate residents about the importance of maintaining native species and stopping invasive species introduction.

Objectives 2.1: Mercer Lake Association will take action to educate the lake residents about native plant species role and AIS over the next five years.

One key to lake protection and preservation is education. Most riparian owners and lake users want to do the right thing for lakes. However, these lake users don't always understand what is good and what is bad for the ecosystem as a whole. As a result, education is paramount.

Native plant species serve extremely important roles in the ecosystem. Since Mercer Lake is a macrophyte dominated lake, the excess nutrients are being used by plants rather than algae. As a result, a robust plant community will help maintain good water clarity in Mercer Lake. Native plants can help reduce the spread of AIS plants. Maintaining a healthy, diverse native plant community is important and therefore education is needed.

To address this need, yearly education methods will be implemented to help reach this goal.

Action: An annual newsletter will be published and distributed in each of the next five years which will contain an article on the importance of native plants species and one article on AIS.

Action: A speaker will be invited to the next three annual meetings addressing native plant species and/or AIS. This speaker may be from the Wisconsin DNR, Iron County (or other county), a consultant, or a trained Association member.

As an alternative, a speaker could be part of a presentation organized with a nearby lake organization on a date other than the annual meeting.

Goal 3. Restore developed shorelines to native vegetation.

Objectives 3.1-The shoreline habitat survey will be evaluated and enhanced (if needed) by 2015 to evaluate the degree of development and change that has occurred in the lake shoreline areas.

The riparian zone is the zone where the water meets the land, or the shoreline. This area is very important to a lake. Not only does it provide habitat for many aquatic organisms, it also can protect the lake. Natural shoreline areas can mitigate large amounts of nutrients that would otherwise runoff into the lake allowing for increased algae and aquatic plant growth. Since Mercer Lake has very dense plant growth, reduction of nutrients into the lake could help curb any density increases. Developed shorelines do little to reduce nutrient runoff into lakes. Use of fertilizer is also not good as it can lead to significant increases in plant and algae growth in the lake.

As discussed in the water quality section, the second highest source of nutrients into Mercer Lake is near-lake development. Shoreline restoration could be a good practice to mitigate this loading.

Action: The MLA will evaluate the shoreline survey that has been completed (three years ago and can be viewed in appendix F). If it is determined that more data is necessary, a volunteer group or preferably a qualified entity (based on funding availability) will conduct further analysis. This should include the delineation of natural shoreline and developed shoreline. The developed shoreline will be further delineated into rip rap, lawn, hard surface, and sea walls.

A shoreline habitat survey is an evaluation of the shoreline types and the manipulation that has taken place. A more natural/undeveloped a shoreline is the better as it provides habitat, reduces runoff and can help reduce nutrient loading into the lake. The more developed the shoreline is, the more negative the impact on the lake.

Approximately three years ago a shoreline inventory was conducted. Although the protocol for the inventory has not been provided with the data, the inventory does quantify the degree of development away from natural. This data is provided in Appendix F. The data from the shoreline inventory can be used to identify the highest priority properties for potential restoration.

More updated and possibly more detailed information may be needed to better identify properties. Evaluation of the current inventory needs to take place.

Objective 3.2- Following the shoreline survey, the owners of several of the properties identified as good candidates for restoration will be approached to discuss possible restoration opportunities.

Action: Properties that are candidates for restoration after shoreline survey will be contacted and provided information about shoreline restoration. These property owners will be encouraged and assisted to do a restoration of their shoreline[23].

There are a few strategies for shoreline restoration. One effective one is to do a cost share program. This involves giving the property owner a grant to pay for a large percent of the project. Some counties have cost share programs and this may be the case for Iron County. Iron County was awarded a DNR grant for shoreline restoration projects, so this may still be available. Also, a lake protection grant could include a shoreline restoration cost share program.

The following steps are recommended for implementing a shoreline restoration program:

1. Identify some properties that would be good candidates based upon shoreline assessment.
2. Contact owners to determine if someone may be interested in entering a cost share for a project.
3. If more than one, choose one property that would make a good showcase for restoration.
4. Work with Iron County Land and Water Conservation Dept. to get this property in a cost share. Have them help plan and implement the project.
5. Show case the project in newsletters and an open house, emphasizing the benefits of such project.

[23] Iron County Land and Water Dept. has a cost-share program that could be utilized or a Wisconsin Lake Protection Grant could be utilized to help fund a cost share program.

The following is directly from the Iron County Land and Water Conservation Dept (LWCD) website outlining shoreland restoration assistance and funding:

The Iron County Land & Water Conservation Department provides financial and technical assistance to private landowners, municipalities, and towns for a variety of conservation practices through the Land & Water Cost-Share Program. These practices focus on erosion control and water quality improvement.

In order to receive funding, the applicant signs a Cost-Share Agreement which outlines the responsibilities of the landowner and the LCWD. Upon project completion, the landowner submits paid receipts for eligible practices and the LCWD will reimburse them for 70% of their project cost. The applicant is responsible for 30% of the project cost.

Timeline *– Project installation usually occurs during the field season* ***FOLLOWING*** *sign-up:*

- *Cost-Share Agreement signed*
- *LCWD conducts survey and develops plan according to standards & applicant needs*
- *Project installation*
- *Landowner submits eligible receipts*
- *Landowner receives reimbursement for 70% of eligible costs*

Eligible Projects*-The following shoreland projects are eligible through the Cost-Share Program:*

- *Shoreland Habitat Restoration*
- *Streambank & Shoreland Stabilization*
- *Stream Crossing & Culverts*
- *Access Roads*
- *Critical Area Planting*
- *Riparian Habitat*

More information can be obtained at the following website (Iron County Land Conservation: http://ironcountylcd.org/shoreland/

The state law (NR151), which regulates shoreland has been changed recently. The law still requires a minimum of a 35 foot deep buffer back from the ordinary high watermark of natural/native vegetation. However, trees and shrubs can be removed for viewing purposes of either 30% of the shoreline or 200 feet, whichever is less. If the lake property is greater than 10 acres, removal can be increased. Removal of exotic species is also allowed. Municipalities such as the Town of Mercer, may be excluded from NR151.

Goal 4. Preserve critical, native habitats in Mercer Lake.

Objective 4.1: Critical, native habitats will be evaluated on Mercer Lake by 2014.

Action: A critical habitat analysis will be requested and if approved, conducted on Mercer Lake. This analysis may be completed by the Wisconsin DNR, Iron County Land and Water Conservation Dept. or a qualified consultant.

Critical habitat is habitat that is necessary for the successful survival of various aquatic species and species that rely on aquatic habitats. These could include various invertebrates, fish, amphibians, reptiles, birds and mammals. Habitats can be crucial for food, nesting/reproduction and rearing. The habitat survey should consider all of these issues and be designated based upon the needs of organisms found in and around Mercer Lake.

The critical habitat analysis will be done in accordance with a protocol outlined by the Wisconsin DNR, even if not conducted by the Wisconsin DNR. An emphasis on fish habitat would be desired as Mercer Lake is a robust fishery.

Action: Once critical habitats are designated, any plant management (or other management) of Mercer Lake will consider these areas and take safeguards to preserve these areas

Future projects for Mercer Lake should include analysis of key terrestrial sites around the lake. These areas could be evaluated for potential nutrient reduction practices as well as key natural areas for birds and wildlife that could become part of a conservancy. Many lakes use land purchases and/or conservancies to protect the watershed of the lake. These areas not only provide good habitat but also can reduce nutrient loading and can be important water recharge areas for the lake.

Action: The Mercer Lake Association Board will consider using critical habitat information to pursue future grants to protect the Mercer Lake water quality, fish habitat and watershed.

Goal 5. Reduce the density of native plants in areas that impede navigation and recreation use of the lake.

Objective 5.1-Areas that impede navigation will have navigation channels created to open up channels 30 feet wide with plant density less than "3."

> ***Action***: In areas defined nuisance areas that impeded navigation, a mechanical harvester, chemical herbicide or a combination can possibly be used to reduce plant density to form navigation channels 30 feet wide. This will take place prior to peak growth and no later than August 5, to allow for time of implementation.

Navigation channels may include channels for public navigation as well as access to landowners' docks or piers

The Mercer Lake Association Plant Committee has evaluated methods to reduce plant density for creating navigation channels. There are pros and cons associated with both mechanical harvesting and herbicide use. Historically mechanical harvesting has been utilized.

The method(s) used will be chosen based upon various factors associated with the navigation channel. These may include the following:

- Length of the navigation channel.
- Depth of the water.
- Plant community surrounding the navigation channel location.
- Sediment composition/characteristics of reduction location.
- Cost in consideration to effectiveness in previous year.
- Residual year to year effectiveness.
- Habitat use of the plant community at navigation channel location.

The use of chemical herbicide for native plant reduction may be considered as a viable option. The herbicide should be applied by a licensed, professional applicator that is skilled at using herbicides. Since native plants are so important, it is imperative that only those areas designated and approved for treatment get treated. As a result, the determination of chemical herbicide use may require a site visit by the Wisconsin DNR and may also be cause for a reduction in the area being reduced, as compared to a proposed harvest area. Mercer Lake should have the option of considering and using either mechanical harvesting or chemical herbicide in dealing with nuisance growth areas.

Each year, the density of the aquatic plants in areas historically meeting the nuisance threshold will be re-evaluated. If the navigation channels locations meet thresholds, then the most prudent method for reduction will be utilized. Any areas that do not meet the density threshold will not have harvesting or chemical treatment. Photo verification may be needed. If a particular area is very dense late in a growing year but is too late for reduction, that area may be considered a candidate for herbicide or harvesting application in the following growing year.

Action: A professional aquatic biologist, County Water Quality Specialist[24], or the Wisconsin DNR will delineate navigation channels each year, to assure the threshold for harvest/treatment is met in each proposed location. Photo documentation can be provided as requested by Wisconsin DNR. This will occur annually as permits are required annually.

Individuals seeking native plant reduction due to navigation and/or recreation impediment, can also have the area of concern evaluated based upon annual need or concern. The same threshold for nuisance will be utilized for riparian owner for determining any treatment and/or harvest near shore, around piers, or corridor to reach an open navigation channel.

As outlined in the water quality section, Mercer Lake is right on the threshold for eutrophic status. Eutrophic lakes tend to have either excessive macrophyte growth or excessive algae (planktonic) growth. It is evident that Mercer Lake is a macrophyte-dominated, mesotrophic/eutrophic lake. Excessive plant removal/reduction could lead to a transition from a macrophyte dominated lake to an algae dominated lake. This then could result in poor water clarity and undesirable algae blooms. This is the reason native plant reduction in Mercer Lake must be done with caution.

Rake density reference:

Density	**Criteria for rake fullness rating**
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space

[24] Presently there is a committee member that holds a similar professional position at another county. This person has agreed to volunteer this service to help reduce costs.

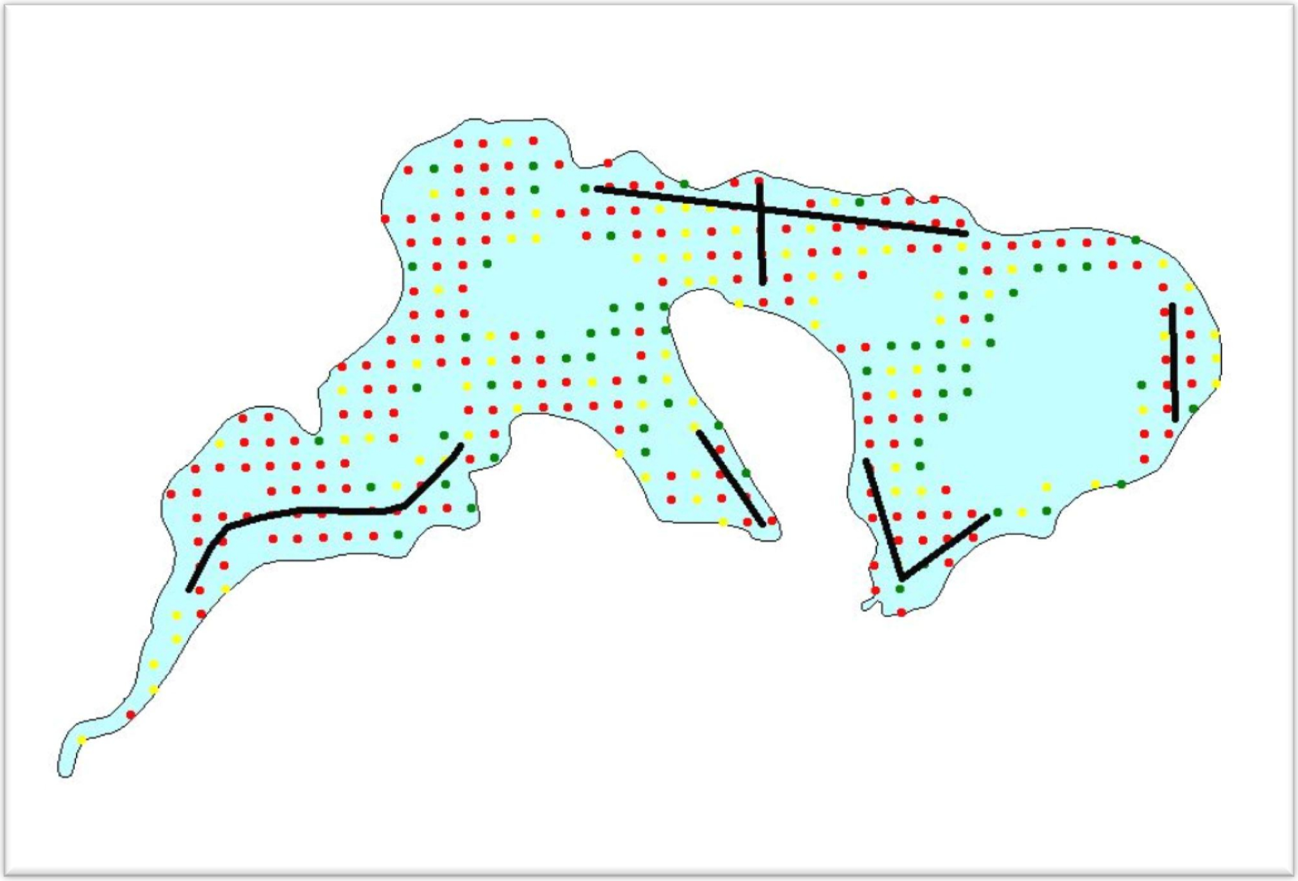

Figure 23: Proposed navigation corridor locations to be evaluated for density reduction.

Note: The navigation channel map shows maximum proposed distances. Only areas that meet or exceed the threshold for reduction will be included in the final permit application. Also, any areas that have high diversity and/or sensitive plants may be cause for no harvest in those areas.

Nuisance threshold for navigation impediment (<u>all must be met to qualify for nuisance</u>):

1. Plants have a mean density = "3" in defined area.
2. Plants at the surface that will clog a propeller.
3. Bed is at least 30 continuous feet and not convenient to go around (approximately 40 feet wide) or block access to piers.

In past years where harvesting occurred, there were some complaints over accumulations of loose plants by various riparian owners.[25] Every effort will be made by the harvester (if

[25] According to plant committee members that were associated with past management practices.

this is the method used) to reduce fragmentation. However, this is a common side effect of harvesting. Property owners will need to understand that fragmentation will occur and they will need to potentially clean up the shoreline if they feel it is necessary. Removal of plant material is not required but is recommended.

Individual Corridor Access

The only time a permit is not required to control aquatic plants is when a waterfront property owner manually removes (i.e., hand-pulls or hand rakes), or gives permission to someone to manually remove, plants (except wild rice) from his/her shoreline in an area that is 30 feet or less in width along the shore and is not within a designated sensitive area (if a sensitive area analysis has been conducted by the Wisconsin DNR). The non-native invasive plants (Eurasian watermilfoil, curlyleaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Wild rice removal always requires a permit, although no rice has been observed in Mercer Lake.

Individual Access Corridors are the openings from a waterfront property owner's shoreline out into the lake. These corridors may be a maximum of thirty feet wide and must remain in the same location from year to year. Herbicide treatment or harvesting may be permitted for individual corridors in front of waterfront property to control invasive or native plants.

Action: Individual corridors connecting or nearly connecting to main navigation channel would be opened to allow riparian owners with nuisance vegetation navigation to navigation channels (assuming the nuisance threshold is met and the individual corridor access monitoring occurs). These channels will not exceed 30 feet in width. See protocol that follows for individual corridors.

If an individual riparian owner wants to be considered to have plant reduction occur in front of their property, they will follow the protocol outlined on page 52. This protocol allows for an evaluation of the area so that no unnecessary plant removal occurs. This protocol will assure that all other options have been considered and that the area is at nuisance levels and should be considered for inclusion in the Mercer Lake Association's permit application. This will not assure permit will be accepted.

Procedure for Individual Corridor Permitting and Monitoring:

<u>Document nuisance conditions (as soon as nuisance conditions are determined to be reached or nearly reached)</u>

- Indicate when plants cause problems and how long problems persist.
- Include dated photos of nuisance conditions from previous season (or location relative to curly leaf pondweed bed map).
- List depth at end of dock.
- Provide examples of specific activities that are limited because of presence of nuisance aquatic plants.
- Describe practical alternatives to herbicide use or harvesting that were considered. These might include:
  - Hand removal/hand raking of aquatic plants
  - Extending dock to greater depth
  - Altering the route to and from the dock
  - Use of another type of watercraft or motor, i.e., is the type of watercraft used common to other sites with similar conditions on this lake?
- Aquatic Herbicide/Harvesting Contractor to provide this information in permit application based on information from the landowner.

<u>Verify/refute nuisance conditions and/or navigation impairment</u>

- Landowners will submit, no more than one season in advance, all documentation of nuisance conditions (photos recommended) for review by the APM Lead, designee or committee established by the Association.
- Landowner requests APM Lead review of their property prior to submitting a permit application to DNR.
- The APM Lead visits site, reviews documentation and provides a written opinion of navigation impairment i.e., is herbicide treatment or harvesting warranted?

<u>Submit permit request to WDNR for remediation of plant nuisance condition</u>

- MLA/Landowner/Contractor applies for permit to WDNR including information from the landowner, photographic documentation, identification of plants causing navigation problems, and MLA evaluation.
- WDNR will contact herbicide/harvesting contractor, MLA and owner with a notice to proceed with treatment or denial of permit application.

Monitoring and Assessment

Aquatic Plant Surveys

Aquatic plant (macrophyte) surveys are the primary means for tracking achievement toward plan goals. The whole lake surveys will be conducted in accordance with the guidelines established by the Wisconsin DNR. Any new species sampled will be saved, pressed, and mounted for voucher specimens.

Action. Conduct a whole lake point intercept survey every **four years if a monitoring program is in practice, otherwise every three years (and based on funding availability)**. If no management of nuisance native plants is undertaken, then this time period will be evaluated accordingly. This survey will include the same sample points and boat survey locations as the previous survey(s).

Since the implementation of a rented harvester may be part of this management, the potential for AIS introduction is increased. To help reduce the proliferation of any introduced AIS, a frequent whole lake PI survey will allow for observing any pioneer AIS communities. Chemical treatments can also increase establishment of AIS since if all plants are killed, it leaves an area with no competition for the AIS.

Aquatic Invasive Species Grants

Department of Natural Resources Aquatic Invasive Species (AIS) grants are available to assist in funding some of the action items in the implementation plan. Maintaining navigation channels to alleviate nuisance conditions are an exception. Grants provide up to 75 percent funding. Applications are accepted twice each year with postmark deadlines of February 1 and August 1. With completion and approval of the aquatic plant management plan, funds will be available not only for education and planning, but also for control of aquatic invasive species.

A small scale DNR Lake Planning Grant to the Mercer Lake Association funded the completion of an aquatic plant management survey and plan in 2003 and 2004. A 2009 large scale DNR Lake Planning Grant funded the aquatic plant survey in 2010. Other funds were utilized to fund this Aquatic Plant Management Plan.

Implementation Plan[26]

Goal 1.				
Actions[27]	**Timeline**	**Estimated $$(pontential grant application)**	**Vol. Hours**[28]	**Responsible Parties**
Clean boats/clean waters	Some have been trained, increase by 2013	$100 for expenses to send to training(DNR-AIS "education" grant)	8 hours for training each-landing monitoring TBD	APM lead/MLA Board ICLWRD
AIS monitoring team	Trained 2012 and annual monitoring May-Sept.	Training $0 if by County; ($400 if by consultant)	Estimated-4 hours each time for a total of 40 hours per summer	APM lead/MLA Board
Rapid response protocol	Established 2012 and then ongoing	$0(may consider establishing fund for rapid response grant match)	Not known until need for implentation	APMP committee/MLA Board
SUBTOTAL GOAL 1		$100 ($500)	48 hrs.	

[26] Costs are annual costs estimated for initial implementation. These costs will be reviewed each year during the budgeting process.
[27] See previous pages for action item detail.
[28] **These hours are for reference only. They may be used for grant application purposes and/or planning. They are not required in any way.**

Goal 2.				
Actions[29]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Annual newsletter	2012 and annually thereafter	$600 depending on quality	Writing and distribution 20 hours each	MLA Board/APM lead
Speaker at annual meeting	2012 and annually until 2014	$0 unless speaker fees	1 hour for arrangements	MLA Board
SUBTOTAL GOAL 2		$600	21 hrs	

[29] See previous pages for action item detail.
ICLWRD = Iron County Land and Water Resources Department
WDNR = Wisconsin Department of Natural Resources

Goal 3.				
Actions[30]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Shoreline survey evaluation and potential enhancement	By 2013	$0	8-30 hours	MLA Board/Plant Committee/Trained designee
Contacts with property owners with recommended restoration	By 2014	$0(Lake Protection Grant/County Cost share if practices installed)	5-10 hours	MLA Board Iron County LWRD
SUBTOTAL GOAL 3		$0	13-40 hours	

Goal 4.				
Actions[31]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Assessment of critical habitat	2012-13	$0 if DNR $1500 consultant	10 hours	MLA Board/APM Lead WDNR
Recognition of critical habitat in plant management	2013 and implemented ongoing	$0 (Lake Protection Grant for any land purchase)	4 hours for education and review of	MLA Board/APM Lead/Plant committee WDNR

[30] See previous pages for action item detail.
[31] See previous pages for action item detail.

Goal 4.				
Actions[31]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
			permits	
Consider future grants for lake protection (See appendix G for options)	Review 2013 Grant 2015	$0 but up to $1000 if hire grant proposal/25% cost share for grant.	8 hours-can in-kind volunteer hours	MLA Board WDNR
Subtotal GOAL 4		$0-$2500	22 hours	

Goal 5.				
Actions[32]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Density reduction for navigation channels	2012 and potential for annual reduction	$4000-$6500/yr(if maximum reduction permitted)		MLA Board Harvester proprietor/Herbicide applicator WDNR
Annual evaluation/delineation of navigation channels	2012 and annually	$1000/yr professional/$0 if trained expert volunteer	8 hours	MLA Board
Individual corridor evaluation for potential permit	2012 and potential for annual permits	$0	8 hours	MLA Board Landowner WDNR
Subtotal GOAL 5		$5000-7500/yr	16 hours	

[32] See previous pages for action item detail.

Monitoring and assessment.				
Actions[33]	**Timeline**	**$ Estimate**	**Vol. Hours**	**Responsible Parties**
Full Lake PI Survey	2018 (if herbicide application/harvesting occurs)	$3500		Consultant
APMP Update	2018	$3000	12 hours	MLA Board Consultant
Subtotal GOAL 5		$6500	12 hours	

Total All actions per year (not including assessment and APMP update)		
Goal	**$ Estimate**	**Vol. Hours**
1	$100-500	48 hrs
2	$600	21 hrs
3	$0	13-40 hours
4	$0-2500	22 hrs
5	$5000-7500*	16 hrs
Total	$5700-11,100	120-147 hrs

*If maximum reduction occurs, otherwise less depending on amount of channel produced.

[33] See previous pages for action item detail.