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AQUATIC PLANT MANAGEMENT PLAN

SHAWANO LAKE
SHAWANO COUNTY, WISCONSIN

March 12, 2009

Northern Environmental℠
Hydrologists · Engineers · Surveyors · Scientists

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1.0 EXECUTIVE SUMMARY AND AKNOWLEDGMENTS

Shawano Area Waterways Management, Inc. (SAWM) formed in 1971 to address resource management concerns on Shawano Lake. SAWM has been active in a number of lake management activities on Shawano Lake including: aquatic plant management (mechanical, chemical), water quality sampling, invasive species sampling, and community education activities. The SAWM contracted Northern Environmental Technologies, Inc. (Northern Environmental) to help develop an Aquatic Plant Management (APM) Plan for Shawano Lake and SAWM is an active participant in the planning process. The APM Plan included a review of available lake information, data analysis based on an aquatic plant survey, and an evaluation of feasible physical, mechanical, biological, and chemical management alternatives for aquatic plants. The APM Plan recommends specific management activities for the management of Eurasian watermilfoil and curly leaf pondweed and native plants in Shawano Lake.

The US Army Corps of Engineers completed an aquatic plant survey on Shawano Lake in 2005, which identified 23 aquatic plant species. The most abundant aquatic plants identified during the survey were Eurasian watermilfoil (EWM), curly-leaf pondweed (CLP), and common waterweed. The U.S. Army Corps of Engineers estimated Shawano Lake to have a presence of 2,640 acres of EWM and 1,640 acres of CLP.

The Floristic Quality Index (FQI) is an index that uses the aquatic plant community as an indicator of lake health. Plants sensitive to disturbances in the lake ecosystem are assigned a higher value than plants which can tolerate disturbances. The values of all species present are used in a formula to determine the plant community's FQI. Shawano Lake exhibited a FQI of 28.59, higher than the state average, and indicative of a diverse and healthy plant community.

Northern Environmental management recommendations for SAWM are based on restoration of native plants in Shawano Lake, control of EWM and CLP, and protection of Wisconsin Department of Natural Resources (WDNR) designated Sensitive Areas. Recommendations include action steps as well as measures of success and can be found in the end of this document (Section 6). SAWM will prepare an annual update for the WDNR on the group's progress towards meeting the targets in the recommendations section. For further information regarding this plan contact SWAM, the WDNR, or Northern Environmental.

The following people were involved in designing the Shawano Lake Aquatic Plant Management Plan by either serving on the Steering Committee or otherwise providing advice and guidance in the documents development:

2.0 INTRODUCTION

This document is the Shawano Lake Aquatic Plant Management Plan. It is designed to summarize technical data regarding Shawano Lake and to provide guidance regarding plant management on Shawano Lake. It is also intended to provide the Shawano Area Waterways Management, Inc. (SAWM) direction and necessary background information to apply for Wisconsin Department of Natural Resources (WDNR) aquatic plant management permits and grants.

SAWM formed in 1971 to address resource management concerns on Shawano Lake. SAWM has been active in a number of lake management activities on Shawano Lake including: aquatic plant management (social, mechanical, chemical), water quality sampling, invasive species sampling, and community education activities. SAWM is an active participant in the APM Plan for Shawano Lake. SAWM contracted Northern Environmental to help develop an Aquatic Plant Management (APM) Plan for Shawano Lake. The APM Plan included a review of available lake information, data analysis based on an aquatic plant survey, and an evaluation of feasible physical, mechanical, and chemical management alternatives for aquatic plants. The APM Plan recommends specific management activities for the management of Eurasian watermilfoil and curly leaf pondweed and native plants in Shawano Lake.

This document is the APM Plan for Shawano Lake and discusses the following:

- Lake morphology and lake watershed characteristics
- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2005 baseline aquatic plant survey

3.0 BACKGROUND INFORMATION

Shawano Lake is a 6,178-acre drainage lake located in northeastern Shawano County. The lake has a 74 square mile watershed. Shawano Lake exhibits fair water clarity and according to the Wisconsin Trophic State Index is a mesotrophic to sometimes eutrophic lake. The Wisconsin Department of Natural Resources (WDNR) has confirmed the presence of the aquatic plants Eurasian watermilfoil (*Myriophyllum spicatum L.* or EWM) and curly-leaf Pondweed (*Potamogeton crispus L.* of CLP) as well as the aquatic invasive species (AIS) zebra mussels (confirmed 2005). Appendix D provides additional information, including life history, on Wisconsin's most common AIS.

3.1 Lake Facts

The following summarizes the lake's physical attributes:

Lake Type	Drainage
Surface Area (acres)	6,178
Maximum depth (feet)	42
Shoreline Length (miles)	19
Public Landing	Present

Source: Wisconsin Lakes, WDNR 2005 and WDNR Lake Survey map, 1941

Shawano Lake provides year-round recreation activities ranging from, fishing, swimming, waterskiing, pleasure boating, snowmobiling, and more. Shawano Lake includes diverse aquatic habitat and the Wisconsin Department of Natural Resources (WDNR) designated Sensitive Areas for plants and wildlife on the lake (see Appendix A).

Eurasian watermilfoil (EWM) and curly-leaf Pondweed (CLP) are the two AIS that lake residents are most concerned with. These two plant are discussed in more detail in other portions this plan, but of key importance in understanding the problems these AIS cause is that both start there annual growth cycle earlier than most native aquatic plants. This jump on growing allows both EWM and CLP to grow dense and out-compete their native counterparts. The dense beds of vegetation these two species can form may be impassible to motor boaters and other recreational users, but even more important is the alteration of habitat caused by the conversion to dense monocultures of these plants (Figure 1).

Figure 1. Mats of Eurasian watermilfoil and curly-leaf pondweed on Shawano Lake (photo from the U.S. Army Corps of Engineers report Distribution and Abundances of Eurasian watermilfoil and Curly-leaf Pondweed in Shawano Lake, Wisconsin)

3.2 Lake Management History

On January 29, 2008 SAWM was granted a WDNR Chemical Aquatic Plant Control permit (permit number NER-08-006-59) for management of EWM, CLP, coontail, filamentous algae and multiple species of pondweed. The permit includes chemical management in seven navigation lanes that are 15 feet wide and accounts for the treatment of 51.22 acres of aquatic vegetation. Similar permits have been issued in the past however lanes 5, 6, and 7 were added to the 2008 permit. The cost of this treatment is approximately $25,000 dollars.

The chemicals proposed to control these species was Aquathol and Reward. Aquathol is an approximate 40% Endothall liquid concentrate soluble in water. Aquathol is a fast acting contact herbicide used to treat a broad range of aquatic leafy plants such as coontail, sago pondweed, hydrilla, milfoil, and curly-leaf pondweed. It is the chemical Northern Environmental commonly recommends for controlling curly-leaf pondweed. Promotional materials state when used as label instructs, Aquathol products dissipate quickly, leaving no residue. Manufactures have designed Aquathol not to harm the environment, fish, birds or other aquatic life if used as the label recommends. Aquathol can be used in muddy water because it does not bind to suspended sediment or organic matter. Aquathol has 7-25 day irrigation and domestic use restriction. Suggested application rates for Aquathol K (liquid) are 0.3 to 3.2 gallons per acre-foot depending on the variety and quantity of vegetation to be treated. Aquathol Super K (granular) is applied at a rate of 2.2-13.2 pounds per acre foot, also dependent on the quantity and variety of aquatic weeds.

Reward is a fast acting 37.3% diquat dibromide herbicide that desiccates plant tissue on contact. Reward stops plant photosynthesis within minutes depending on conditions. Reward herbicide is fast acting and broad spectrum on submersed, emergent and floating aquatic plants, especially effective on elodea, Eurasian watermilfoil, coontail and duckweed. Reward is not very selective. Reward has 1-5 day irrigation and domestic use restriction with no fishing and swimming restrictions. Reward has a suggested application rate of 0.5-2.0 gallons per surface acre in sufficient carrier along with 16-32 oz. per acre of an approved wetting agent. Re-treatment is suggested as necessary for densely populated weed areas.

On January 31, 2008 SAWM was granted a WDNR Mechanical / Manual Aquatic Plant Control permit (permit number NER-07-01-59M Renewal) for mechanical harvesting of 170 acres of aquatic plants. The permit is intended to provide relief from aquatic plants at nuisance levels and increase navigation and recreational opportunities in designated navigation channels. Recently SAWM invested nearly $300,000 in new harvesters in order to move away from the paddle type harvester that would allow for fragments of EWM to escape and potentially colonize new areas of the lake.

3.3 Goals and Objectives

SAWM identified the following goals for aquatic plant management on Shawano Lake. Northern Environmental has added generalized objectives that will steer SAWM towards achieving these goals.

- Educate the Shawano Lake community about the goals of the APM Plan.
  Form an Educations Committee that meets four (4) times a year and reports at the SAWM Board meeting.
- Increase citizen participation in Clean Boats Clean Waters.
  Have each member of the SAWM Education's Committee recruit 3 volunteers to monitor boat landings for a two hour shift.

- Prevent the introductions of new AIS.
  Have public boat landings monitored at least 10% of daylight hours in the summer season.
- Gather citizen input as to how the lake should be managed
  Use the Education's Committee to work with the University of Wisconsin-Extension to develop survey questions that can be used for adaptive management.
- Manage EWM and CLP in accordance with the best available technologies.
  Use WDNR protocols and work with government or private sector professionals.
- Coordinate sound aquatic plant management practices where needed within Shawano Lake.
  Outline an annual plan for management and prevention that will be approved by the SAWM Board by January 31st of each year or every 5 years.
- Create a County, Town, or Shawano Lake specific AIS Coordinator position funded in part by WDNR AIS grant dollars.
  Decide at what organizational level the AIS Coordinator will be hired, find a sponsor and apply for a WDNR Education, Prevention and Planning, AIS Control Grant.
- Maintain and improve recreational opportunities.
  Provide access through areas of dense aquatic vegetation using 9-managed navigation channels.
- Preserve native aquatic plants.
  Use aquatic chemical herbicides in May of each year so that they are designed to selectively target invasive, exotic plants.
- Protect and improve fish and wildlife habitat.
  Do not allow manipulation of native aquatic vegetation in designated Sensitive Areas.
- Identify and discuss various sources of financial assistance for aquatic plant management activities.
  Have Northern Environmental identify at least three sources of funding for aquatic plant management activities.

4.0 PROJECT METHODS

To accomplish the project goals, SAWM needs to make informed decisions regarding APM on Shawano Lake. To make informed decisions, SAWM proposed to:

- Collect, analyze, and interpret basic aquatic plant community data
- Recommend practical, scientifically-sound aquatic plant management strategies

Northern Environmental was hired to complete the tasks mentioned above using existing information utilized and compiling it into an APM plan. Other studies were conducted by separate entities but reviewed below.

4.1 Existing Data Review

A variety of background information was researched to develop a thorough understanding of the ecology of the Lake. Information sources included:

- Local and regional geologic, limnologic, and hydrologic research
- Discussions with lake members
- Available topographic maps and aerial photographs
- Information from WDNR (permits/reports)
- Other lake study reports

These sources were essential to understanding the historic, present, and potential future conditions of the lake, as well as to ensure that previously completed studies were not unintentionally duplicated.

Several lake studies providing background data on the water quality of Shawano Lake were conducted in 1974, 1990 and 1991, 2008. Recent aquatic plant surveys were conducted in 1991, following the introduction of EWM, and in 2005. Annual water quality data and reports have been comprised on Shawano Lake by the Wisconsin Citizen Lake Monitoring Program dating back to 1968. Citizen Lake Monitors measure water clarity by lowering an 8-inch disk with alternating black and white quadrants called a secchi disk. The secchi disk is lowered into the water until it is no longer visible and the depth is recorded. The secchi disk is then raised until it is again visible and that depth is recorded. The two readings are averaged providing the secchi depth or water clarity measurement. This is used to determine how far sunlight can penetrate into water; higher secchi depth readings indicate clearer water and deeper light penetration.

Clearer waters allow for deeper light penetration into the water column. Deeper light penetration, as indicated by higher secchi depths readings, increases the littoral zone (near-shore area where aquatic plants grow). As more of the lake floor receives sunlight there is a larger area and deeper depth for aquatic plants to grow. Using Citizen Lake Monitoring data Shawano Lake has an average Secchi Disk reading of just over 7 feet deep, indicating fair water quality (Figure 2).

Water Clarity	Secchi Depth (feet)
Very Poor	3
Poor	5
Fair	7
Good	10
Very Good	20
Excellent	32

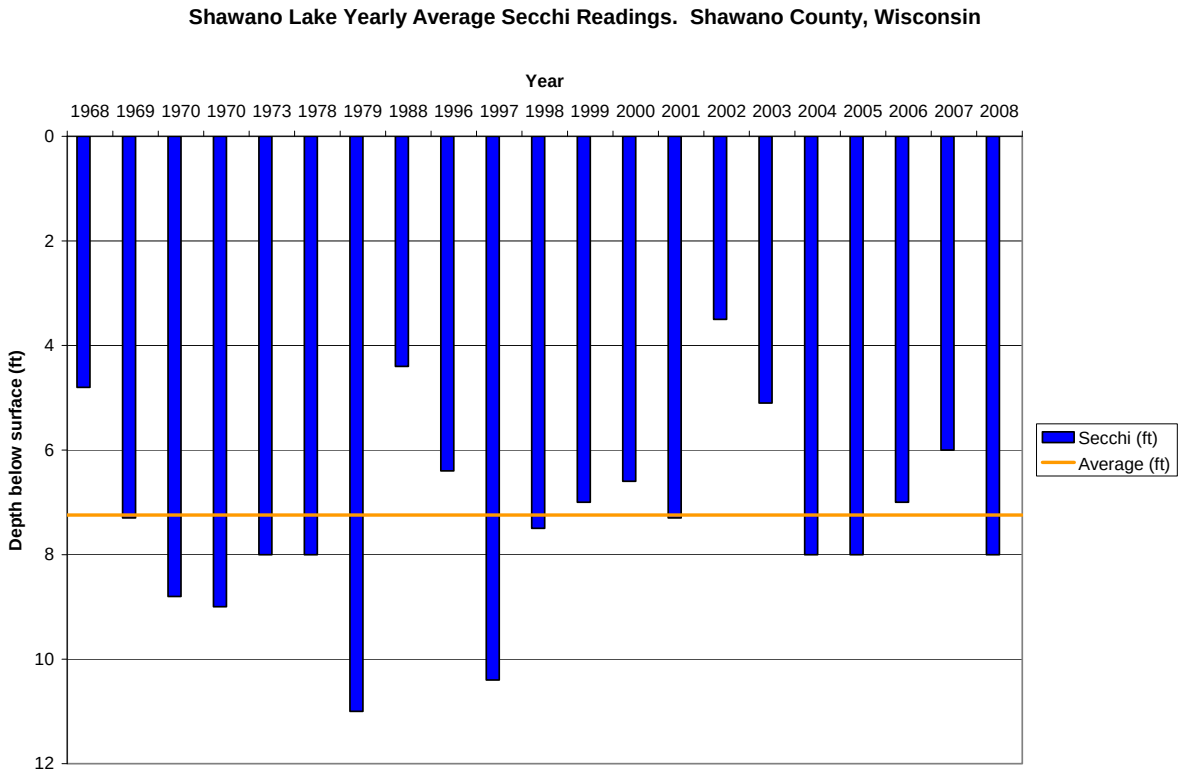

Figure 2. Trends in Secchi Disk readings over time.

For the development of this Aquatic Plant Management Plan, Northern Environmental relied heavily on the most recent aquatic plant harvesting activities permits and maps, the US Army Corps of Engineers' 2006 report Distribution and Abundance of Eurasian Watermilfoil (Myriophyllum spicatum L.) and Curly-leaf Pondweed (Potamogeton crispus L.) in Shawano Lake, Wisconsin (Chetta S. Owens and William F. James), the University of Wisconsin – Stevens Point Center for Watershed Science and Education's 2008 Watershed Assessment of Shawano Lake, Shawano County, Wisconsin (D. Hoverson, N. Turyk, K. Foster, P. McGinley), and the WDNR Shawano Lake, (Shawano County) Sensitive Area Survey Report (Crystal Olson) .

4.2 Aquatic Plant Survey and Analysis

The aquatic plant community of the lake was surveyed in 2005 by US Army Corps of Engineers. The survey was completed according to the point intercept sampling method described by Madsen (1999), as outlined in the WDNR draft guidance entitled "Aquatic Plant Management in Wisconsin" (WDNR, 2005).

The sample resolution was a 175-meter grid with 838 pre-determined intercept points (Figure 3 – *See end of this document*). Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid (Appendix B). Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected using a rake on a pole or by tossing a specialized rakehead on a rope and

dragging the rake along the bottom of the lake. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically species) and recorded on field data sheets. Water depth was also recorded on field data sheets.
The point intercept method was used to evaluate the existing emergent, submergent, floating-leaf, and free-floating aquatic plants. If a species was not collected at that point, the data field was left blank. For this APM Plan plants that were listed in the US Army Corps of Engineer's 2006 summary report as having a 0% frequency were not included in the data. The data for each sample point was entered into the WDNR "Worksheets" (i.e., a data-processing spreadsheet) to calculate the following statistics:

- **Taxonomic richness** (the total number of taxa detected)
- **Maximum depth of plant growth**
- **Community frequency of occurrence** (number of intercept points where aquatic plants were detected divided by the number of intercept points shallower than the maximum depth of plant growth)
- **Mean intercept point taxonomic richness** (the average number of taxa per intercept point)
- **Mean intercept point native taxonomic richness** (the average number of native taxa per intercept point)
- **Taxonomic frequency of occurrence within vegetated areas** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points where vegetation was present)
- **Taxonomic frequency of occurrence at sites within the photic zone** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the total number of intercept points which are equal to or shallower than the maximum depth of plant growth)
- **Relative taxonomic frequency of occurrence** (the number of intercept points where a particular taxon (e.g., genus, species, etc.) was detected divided by the sum of all species' occurrences)
- **Mean density** (the sum of the density values for a particular species divided by the number of sampling site)
- **Simpson Diversity Index (SDI)** is an indicator of aquatic plant community diversity. SDI is calculated by taking one minus the sum of the relative frequencies squared for each species present. Based upon the index of community diversity, the closer the SDI is to one, the greater the diversity within the population.

- **Floristic Quality Index (FQI)** (This method uses a predetermined Coefficient of Conservatism (C), that has been assigned to each native plant species in Wisconsin, based on that species' tolerance for disturbance. Non-native plants are not assigned conservatism coefficients. The aggregate conservatism of all the plants inhabiting a site determines its floristic quality. The mean C value for a given lake is the arithmetic mean of the coefficients of all native vascular plant species occurring on the entire site, without regard to dominance or frequency. The FQI value is the mean C times the square root of the total number of native species. This formula combines the conservatism of the species present with a measure of the species richness of the site.

4.3 Watershed Assessment Methods

The Lake Shawano Watershed Assessment (UWSP, 2008) concluded that Shawano Lake and its watershed comprise a fairly complex system. The Lake tends to have good water quality though enriched sediment and relatively shallow depths result in good growing conditions for plant life over more than half the Lake. The study included field data from 2004 to 2007 for phosphorus, nitrogen, water clarity, chlorophyll *a* and temperature for the lake itself and information from monitoring inflowing streams and groundwater.

4.4 Plant Biomass Study Methods

The following methods are described in the US Army Corps 2006 report of Shawano Lake.
"During the week of June 1-6, 2006, plant aboveground biomass and curly leaf pondweed turions were collected using a box-core sampler. The box-core sampler had a sampling area of 0.1m2. The boat containing the sampler was driven to predetermined points where curly-leaf pondweed (the primary plant of interest), had been found during the 2005 point-intercept survey. The box-core sampler was raised using a battery-powered winch, deployed into the lake where the sampler snapped closed, cutting the plants. The retrieved sample was dropped into a container, washed and all plant biomass and turions were collected and bagged. Observational data on sediment type was recorded. Fifty randomly selected sites were sampled for determination of biomass. Plant material was shipped overnight to the Lewisville Aquatic Ecosystem Research Facility (LAERF), sorted to species, dried and weighed. Eurasian watermilfoil and curly-leaf pondweed samples were finely ground using a Cyclone Sampling Mill (UDY Corp., Ft. Collins, CO). Ground plant samples were block-digested according to methods found in Allen et al. 1974, then analyzed for nitrogen, phosphorus and potassium according to Standard Methods (APHA 1995)."

5.0 PROJECT RESULTS

The following subsections cover results for the three different studies mentioned in the methods section above.

5.1 2005 Aquatic Plant Survey

The 2005 aquatic plant survey included sampling at 838 intercept points. The aquatic macrophyte community of the lake included twenty-three (23) different floating leaved, emergent, and submerged aquatic vascular plant species during 2005. Table 1 (*See end of this document*) lists the taxa identified during the 2005 aquatic plant survey. Figures 4a through Figure 4f (*See end of this document*) illustrate the locations of each species identified.

Vegetation was identified to a maximum depth of fifteen (15) feet. The area delineated by the depth at which vegetation can grow is known as the lake's photic zone. Aquatic vegetation was detected at approximately 45 percent (%) of photic zone intercept points. A diverse plant community was present in the lake during 2005. The Simpson Diversity Index value of the community was 0.93. The taxonomic richness was 23 species and there was an averages of 2.01 species identified at points that were within the photic zone. There was an average of 2.48 species present at points with vegetation present. Table 2 (*See end of this document*) summarizes these overall aquatic plant community statistics. Table 3 (*See end of this document*) includes the abundance statistics for each species. Appendix E includes descriptions of the plants identified.

Eurasian watermilfoil
Source: UW Herbarium Website

The most abundant aquatic plant identified during the aquatic plant survey was Eurasian watermilfoil (*Myriophyllum spicatum*). It exhibited a 45% frequency of occurrence (percent of photic zone intercept points at which the taxa was detected) (Figure 5 – *See end of this document*). It was present at 100% of the sites with vegetation, and had a 23% relative frequency of occurrence. The U.S. Army Corps of Engineers estimated Shawano Lake to have a presence of 2,640 acres of EWM.

Curly-leaf pondweed (*Potamogeton crispus*) was the second most abundant vascular plant species occurring at 28% of the photic zone (Figure 6 – *See end of this document*). It was present at 62% of the sites with vegetation and had a 14% relative frequency of occurrence. An estimated 1,640 acres of CLP were identified within Shawano Lake by the U.S. Army Corps of Engineers.


Elodea
Source: UW Herbarium Website

Elodea or common waterweed (*Elodea canadensis*) was the third most abundant vascular plant species occurring at 25% of the photic zone. It was present at 57% of the sites with vegetation and had a 13% relative frequency of occurrence. Elodea is an abundant native plant that is distributed statewide. It prefers soft substrate and water depths to 15 feet (Nichols, 1999). Elodea reproduces by seed and sprigs (USDA, 2002). The stems of elodea offer shelter and grazing to fish, but very dense elodea can interfere with fish movement. Elodea can be considered invasive at times and out-competes other more desirable plants.

5.1.1 Floating-Leaf Plants

The following two floating-leaf aquatic plant species were identified during the 2005 aquatic plant survey.

- *Nuphar advena* (Yellow pond lily)
- *Nymphaea odorata* (White water lily)

Table 1 (*See end of this document*) lists the taxa/species identified.

5.1.2 Submergent Plants

The following 18 submergent aquatic plant species were identified during the 2005 aquatic plant survey.

- *Ceratophyllum demersum* (coontail)
- *Chara* (Chara/muskgrass) [algal]
- *Elodea canadensis* (elodea)
- *Myriophyllum sibiricum* (northern watermilfoil)
- *Myriophyllum spicatum* (Eurasian watermilfoil)
- *Naiad spp.*
- *Najas flexes* (slender naiad / bushy pondweed)
- *Najas guadalupensis* (southern water-nymph)
- *Potamogeton amplifolius* (large-leaf pondweed)
- *Potamogeton crispus* (curly-leaf pondweed)
- *Potamogeton foliosus* (leafy pondweed)
- *Potamogeton gramineus* (variable pondweed)
- *Potamogeton illinoensis* (Illinois pondweed)
- *Potamogeton pusillus* (small pondweed)
- *Potamogeton robbinsii* (Robbins or fern pondweed)
- *Potamogeton spirillus* (spiral-fruited pondweed)
- *Potamogeton zosteriformis* (flat-stem pondweed)
- *Utricularia vulgaris* (common bladderwort)
- *Vallisneria americana* (wild celery)
- *Zannichellia palustris* (common water-meal)

5.1.3 Emergent Plants

One emergent aquatic plant species was identified during the 2005 aquatic plant survey.

- *Sagittaria sp. (arrowhead)*

5.2 Floristic Quality Index

Higher FQI numbers indicate higher floristic quality and biological integrity and a lower level of disturbance impacts to a waterbody. FQI varies around the state of Wisconsin and ranges from 3.0 to 44.6 with the average FQI of 22.2 (WDNR, 2005). The FQI calculated from the 2005 aquatic plant survey data was 28.59. This FQI value is higher than Wisconsin's median of 22.2 and suggests that Shawano Lake exhibits very good water quality when using aquatic plants as an indicator. Table 4 (*See end of this document*) summarizes the FQI values.

5.3 Watershed Assessment Summary

In the University of Wisconsin-Steven's Point Center for Limnology watershed study, total nitrogen to total phosphorus ratios indicated that phosphorus was the limiting nutrient; therefore efforts to control phosphorus

inputs would have the most direct impact to lake water quality. Water clarity ranged from 6 feet to 20 feet as measured by secchi disk and tended to correlate with algae growth. Chlorophyll *a* concentration (a measure of algal growth) correlated with late summer peaks of phosphorus and nitrogen and ranged from 2 ug/L to 45 ug/L. A concentration over 30 ug/L chlorophyll *a* is considered to indicate the potential for nuisance levels of algal growth. Total phosphorus concentrations above 30 ug/L (capable of stimulating algal blooms and excessive plant growth) were observed in the Lake in late summer between 2004 and 2007.

Each monitored inflowing stream contributed approximately 7 to 11% of the annual phosphorus load. Therefore the study concluded that lake and tributary near-shore land-management improvements would have the swiftest effect on nutrient reduction to the Lake, however long-term nutrient reduction would necessitate improvement in land management further out in Lake's watershed. The greatest single contributor of total phosphorus is internal release of sediment. When lake stratification does occur, phosphorus can be released from particulates in the lower water layer. The lifecycle of the invasive plant curly-leaf pondweed (CLP) also results in a large pulse of phosphorus into the lake following its seasonal die off in June. Therefore, water quality management strategies do address the reduction of this aquatic plant (aggressive harvest of CLP). Other management recommendations from the watershed assessment included the protection of existing native shoreline vegetation and the increase in functional shoreline vegetation buffers, aggressive action to prevent the introduction of new aquatic invasive species and continued monitoring of water quality and invasive species in Shawano Lake.

5.4 Plant Biomass Summary

In the aquatic plant biomass study conducted by the U.S. Army Corps of Engineers on Shawano Lake EWM was found at thirty of the sites sampled out of sixty-one sample sites surveyed. EWM had an average biomass of 93.99 grams per meter squared. The maximum biomass recorded at a site was 402 grams of EWM per meter squared. CLP was found at fourteen sample points was an average biomass of 43.19 grams per meter squared. CLP was found with a maximum biomass of 166.5 grams per meter squared. The number of CLP turions was recorded at twenty-three sites. An average of 84.34 turions was recorded per meter squared, with a maximum of 340 turions. The CLP turion biomass at 23 sites averaged 8.71 grams per meter squared, with a maximum of 51.9 grams per meter squared.

6.0 PROJECT DISCUSSION

Aquatic plants are vital to the health of a water body. Unfortunately, people all too often refer to rooted aquatic plants as "weeds" and ultimately wish to eradicate them. This type of attitude, and the misconceptions it breeds, must be overcome in order to properly manage a lake ecosystem. Rooted aquatic plants are extremely important for the well being of a lake community and possess many positive attributes. Despite their importance, aquatic plants sometimes grow to nuisance levels that hamper recreational activities. This is especially prevalent in degraded ecosystems or hypereutrophic systems. The introduction of certain AIS, such as EWM, often can exacerbate nuisance conditions, particularly when they compete successfully with native vegetation and occupy large portions of a lake.

When "managing" aquatic plants, it is important to maintain a species rich and diverse aquatic plant community that contains high percentages of desirable native species. For further information Appendix C includes a discussion about aquatic plant ecology, habitat types and plant relationships with water quality. Of greater importance than the nuisance that aquatic invasive plants cause to recreation, is the alteration of habitat this nuisance represents when native plant beds are converted to dense monocultures of exotic, invasive species. SAWM is interested in working towards the restoration of Shawano Lake's

plant community, while maintaining recreational access to the lake. SAWM realizes that the benefits of controlling AIS should result in increased recreational activities, easier property maintenance, and a healthier aquatic ecosystem for all native species, and require that control of native species for ease of boating may at times be a lesser priority. With approximately 2,600 acres of EWM and 1,600 acres of CLP, restoration of Shawano Lake would likely start small or in localized areas, with the whole-lake management of AIS being unaffordable to SAWM.

Managing aquatic plants can be very difficult because there are certain constraints managers must work with that include naturally occurring phenomena such as the level of nutrients, diversity of plant species present, depth of water and lake bottom substrate. Shawano Lake is a relatively shallow lake with over 50% of the lake between 3 and 10 feet deep. The lake has a nutrient rich substrate fostered by a dam on the Wolf River which has caught sediment from the fertile floodplain. The nutrient rich nature is further enhanced by the manipulation of natural shorelines and the nutrients added to Shawano Lake tributaries from the agricultural component of the watershed. All of the above conditions make Shawano Lake perfect for growing aquatic plants, sometimes to the so call "nuisance" level. Nuisance plants is not a scientific term, but rather the perceptions held by a given lake user. WDNR does not funds activities designed for managing nuisance plants. Shawano Lake should never be managed to try to create the conditions of a deep, nutrient poor (oligotrophic), northern lake because achieving such conditions is impossible. Shawano Lake must be enjoyed for what it is.

In 2002 and 2003 the WDNR conducted sensitive areas surveys on Shawano Lake. Sensitive areas are defined in Wisconsin Administrative Code NR 107.05(3.)(i.)(1.) as such: "Sensitive areas are areas of aquatic vegetation identified by the Department as offering critical or unique fish and wildlife habitat, including seasonal or life-stage requirements, or offering water quality or erosion control benefits to the body of water." Based on the surveys WDNR determined that there were 18 sensitive areas that have unique characteristics based on their aquatic plant community, as well as fish and wildlife usage. Two of the sensitive areas contained Square-stem spikerush (*Eleocharis quadrangulata*), an emergent aquatic plant that is listed as endangered. The WDNR report based on the sensitive areas surveys, Shawano Lake, (Shawano County) Sensitive Area Survey Report (author Crystal Olson; see Appendix A.), makes management recommendations as how best to protect the aquatic plant communities that makeup the Shawano Lake's Sensitive Areas. Some of these recommendations are reiterated in the following section of this plan and all have been considered when choosing the recommendations for this plan. For instance the report states that "dredging is not necessary at any location in Shawano Lake", and Northern Environmental has not considered dredging as an option. The report also states "Protect native aquatic vegetation. Allow mechanical harvesting of vegetation only in navigation channels or to control Curly-leaf pondweed. No mechanical harvesting in or near beds of Eurasian Watermilfoil. Chemical control of aquatic plants should only be allowed for navigation lanes, riparian nuisance aquatic plants and exotic invasive species control" Northern Environmental's recommendations take this WDNR Sensitive Areas report recommendation in to consideration when crafting the following section and build on it to suggest that EWM beds be treated with chemical herbicides before a harvester is run through them.

7.0 AQUATIC PLANT MANAGEMENT RECOMENDATIONS

To make sure that SAWM members were vested in this APM plan several meetings were held with the APM Plan Steering Committee. The Steering Committee included members of SAWM, WDNR, UW-Extension, the Shawano County Land Information Department, and others. Information was gathered at the project kick-off meeting, meetings were held on March 10, 2008 and on July 21, 2008, and February 2, 2009 to discuss draft APM plans and recommendations within. SAWM will submit a progress report

to the WDNR annually when they are applying for their harvesting and chemical treatment permits. The report will describe progress towards meeting the target goals outlined in this section of the APM Plan.

The management recommendations listed below are Northern Environmental's attempt to provide directions to SAWM and other lake managers based on the goals and objectives of the technical advisory and public steering committee. The recommendations are general in scope and will require work at the local level to see them through to implementation. Northern Environmental recommends that those concerned with aquatic plant management begin to work with the WDNR and SAWM to implement this plan by following the actions steps listed below. An APM plan is a living document; therefore Northern Environmental encourages lake users to get involved in preparing for a five-year rewrite of the document by keeping track of what is working, what is not and what has been left out. Greater public participation and feed back is essential to successful implementation and adaptive management.

The management recommendations in this document are based on restoration and protection of sensitive areas, as well as improvement in recreational access throughout the lake. There are 16 recommendations:

Recommendation #1: SAWM will develop an Education Committee and a Monitoring Committee that will recruit volunteers to implement certain aspects of the APM plan.

Recommendation #3: SAWM's Monitoring Committee should recruit volunteers for aquatic invasive species monitoring in near sensitive area, areas uncolonized by EWM or CLP, and near areas of chemical herbicide treatment.

Recommendation #4: SAWM's Monitoring Committee should obtain professional aquatic plant surveyors (such as Northern Environmental or a public agency such as WDNR staff) to do a 2010 full point intercept-survey of the plant community in Shawano Lake.

Recommendation #5: SAWM or the Town of Shawano should hire a full time employee to coordinate lake management activities.

Recommendation #6: Hand remove aquatic invasive plant species along privately owned properties.

Recommendation #7: Use aquatic plant harvester in select areas for nuisance aquatic plant control and to clean up floating EWM.

Recommendation #8: Use aquatic plant harvester to remove CLP in spring and early summer.

Recommendation #9: Use the chemical herbicides Aquathol and Weedar in tandem in May on areas of EWM and CLP or a 2, 4-D product such as Weedar (liquid) or Navigate (solid/granular).

Recommendation #10: Treat Sensitive Areas with the chemical herbicides Aquathol and Weedar in tandem in May for EWM and CLP control or a 2, 4-D product such as Weedar (liquid) or Navigate (solid/granular).

Recommendation #11: SAWM should work to advocate watershed phosphorus fertilizer ban from which farmers would be exempt.

Recommendation #12: SAWM should work with lakeshore property owners to install best management practices that will limit nutrient inputs.

Recommendation #13: Investigate drawdown as AIS management option and conduct feasibility study.

Recommendation #14: SAWM should apply for WDNR AIS Control grants for restoration and educational activities.
Recommendation #15: SAWM should solicit funds from local towns and Shawano County to support Shawano Lake management activities.

Recommendation #16: SAWM should create a business membership category and help promote businesses that participate in funding Shawano Lake management activities.

The following subsections explore the recommendations in greater detail with discussion provided about the recommendation's background.

7.1 Education, Prevention and Monitoring

In order to share information and educate Shawano Lake users, Northern Environmental strongly recommends that SAWM form an Education Committee. It would be easy for the Education Committee to cover most topics surrounding lake management so in order not to overwhelm members of that committee Northern Environmental also recommends that SAWM form a Monitoring Committee to look for new outbreaks of AIS, track existing AIS and work with professional monitors and chemical applicators. Both committees will report to the SAWM board and be responsible for designing additional action steps to accomplish goals.

Recommendation #1: SAWM will develop an Education Committee and a Monitoring Committee that will recruit volunteers to implement certain aspects of the APM plan.
Target*: Have two functioning committees with at least four (4) members each.*
Trigger*: Start immediately (past relevant trigger).*
Action*: Recruit committee members from SAWM, lake community, and local government agencies.*
Action*: Hold at least four (4) meetings a year and prepare summary reports for annual SAWM Board meeting.*
Measure of Success*: Annual progress reports presented at annual SAWM board meeting.*

When EWM or CLP become established in a lake it is easy for lake residents to become lackadaisical in regard to efforts to prevent the introduction of new aquatic species. Such behavior is a big mistake because the suite of invasive species pioneering an area is constantly changing. Aquatic plants like hydrilla could become established in Wisconsin and present a whole new range of problems. To prevent this, SAWM should establish a lake-wide Education Committee (see Recommendation #1) that would work to provide shoreland property owners information about aquatic invasive plant management and aquatic invasive species prevention. One such result may be more active engagement in the Clean Boats, Clean Waters program designed to monitor boat landings to inspect boats for hitchhiking aquatic invasive species when entering and leaving Shawano Lake. Northern Environmental strongly recommends that SAWM and other lake users participate in the Clean Boats, Clean Waters program. The Clean Boats, Clean Waters program and trainings are run by the University of Wisconsin-Extension Lakes Program. The following recommendation covers one boat landing. More volunteers will be needed to cover the three (3) major boat landings.

Recommendation #2: SAWM's Education Committee should recruit volunteers for Clean Boats, Clean Water watercraft inspections.
Target*: Have a public boat landings monitored at least 10% of daylight hours in the summer season.*
Trigger*: Start immediately (past relevant trigger).*
Action*: Members of the SAWM Education Committee will attend a Clean Boats, Clean Waters training.*
Action*: Each member of the SAWM Educations Committee will recruit 3 volunteers to monitor boat landings for two hour shifts, six times per summer.*
Measure of Success*: 12 hours of Clean Boats, Clean Waters monitoring will occur each week.*

Northern Environmental also recommends that SAWM work to have members practice AIS monitoring. The Wisconsin Citizen Lakes Monitoring program is run by the University of Wisconsin-Extension Lakes Program. SAWM should work with the University of Wisconsin-Extension Lakes Program to tailor a volunteer monitoring program that fits needs and interest of members and lake users and tracks AIS spread or control, as well as changes noted by professional monitoring of the aquatic plant community.

Recommendation #3: SAWM's Monitoring Committee should recruit volunteers for aquatic invasive species monitoring near sensitive areas, areas uncolonized by EWM or CLP, and near areas of chemical herbicide treatment.
Target*: Have SAWM volunteers use their boats to monitor for AIS in areas treated above twice during the summer season.*
Trigger*: Start immediately (past relevant trigger).*
Action*: Each member of the SAWM Education's Committee will recruit 3 volunteers to monitor for AIS twice a summer season.*
Action*: Volunteers will use their own boats to monitor select areas and mark a map with their AIS findings.*
Measure of Success*: Areas previously unmarked will be mapped and potentially targeted for chemical treatment.*

Recommendation #4: SAWM's Monitoring Committee should obtain professional aquatic plant surveyors (such as Northern Environmental or a public agency such as WDNR staff) to do a 2010 full point intercept-survey of the plant community in Shawano Lake.
Target*: Every 5 years update the full plant survey on Shawano Lake.*
Trigger*: Start next survey in 2010.*
Action*: Coordinate with WDNR regarding the feasibility of applying for AIS Control grant dollars for a plant survey and report.*
Action*: Hire a professional service or find public sector agency that will conduct the plant surveys.*
Measure of Success*: Tabulated aquatic plant survey results in a report by the end of 2010.*

Managing Shawano Lake is a huge responsibility for a citizen lake group. Even if SAWM forms committees, there are a few key individuals that coordinate almost all lake management activities and often this scenario leads to burn out. Because the lake is vitally important to the local economy of Shawano, Northern Environmental recommends that SAWM or the Town of Shawano seek a full-time employee to coordinate lake management activities. Such an individual could be supported by WDNR Control Grant dollars (see Recommendations 14). To make such a position worth having Northern Environmental recommends working with WDNR to see what activities will be required for comprehensive management and hire an individual that is capable of carrying out such activities. Spending money on an individual who simply works to raise awareness of AIS is probably not a benefit to SAWM and the community of Shawano.

Recommendation #5: SAWM or the Town of Shawano should hire a full time employee to coordinate lake management activities.
Target*: Have hired lake manager be responsible for activities that would be paid for or for which there are not sufficient volunteers.*
Trigger*: Hire a lake manager when volunteers are exhausted or when sufficient dollars to support a professional are being allocated on an annual basis.*
Action*: Find sponsor (SAWM, Town of Shawano or even Shawano County) to apply for a WDNR AIS Education, Planning and Prevention grant to fund position (see Recommendations 14).*
Action*: Create a job description and share it with WDNR.*
Action*: Hire a lake manger.*
Measure of Success*: Professional lake manager working to educate, monitor, and control AIS.*

7.2 Hand Removal of Aquatic Plants

Individual riparian landowners implementing site specific (their property only) weed harvesting programs to control aquatic vegetation which has floated up on shore is common on Shawano Lake. Raking this vegetation, which has a generally large component of EWM, is not detrimental to habitat and is an appropriate way to remove mats of plants from shallows and shorelines. Removing these floating vegetation mats can actually foster native aquatic plant growth because the mats shade out rooted plants trying to get established. Removal of the mats also eliminates phosphorus generated when this biomass decomposes. Removal should be conducted and thought of as a restoration activity. WDNR Aquatic Invasive Species Control Grants (see Recommendations 14) might be a source of funding for a professional service provider to remove this vegetation.

Hand pulling or raking of both native and invasive aquatic plants still growing on the lake bottom is permitted along a shoreline lot within a 30-foot wide (along shoreline) swath know as the "recreation zone". Northern Environmental does not recommend removing rooted native vegetation even in the recreation zone as this can open a niche for aggressive invasive species or inadvertently destroy habitats. Hand removal of native vegetation is also blatantly contradictory to restoration of a native plant community. Hand removal (raking or pulling) of invasive species is allowed anywhere within the lake. Hand pulling of EWM or CLP is recommended especially at the early stages of infestation in new areas (pioneer colonies). When hand pulling EWM, it is important to remove any and all floating fragments of the plant to avoid spreading or future colonization. All fragments should be disposed of upland in an area where they will not be blown back into the lake. If every riparian owner took on the responsibility of weeding aquatic invasive plants from the aquatic garden in front of their property the abundance of EWM and CLP would be substantially less.

Hand removal of EWM or CLP requires little equipment. It is helpful to have a bag or net to place the plant in once removed. In mucky sediments removal can be done with bare hands. As sediment types compacts it or become more gravely small garden trolls may be helpful. Removal of the root-wad is the goal and should be is worth the extra time spent. Water clarity quickly diminishes as plants are pulled/dug from the lake bottom substraight and for that reason working with a mask and flippers is usually just as efficient as having a SCUBA tank. A riparian land owner can dive in and remove plants for five to ten minutes and come out when the water clarity begins to hinder selectivity for target invasive plants. Repeated frequently this technique will have a cumulative effect on the EWM and CLP in Shawano Lake.

Recommendation #6: Hand remove aquatic invasive plant species along privately owned properties.
Target*: Within the next five years have 300 residents of Shawano Lake hand removing invasive plants from in front of their property.*
Trigger*: Start immediately (past relevant trigger)*
Action*: Prior to 2009 spring/summer season SAWM members will recruit ten (10) property owners to participate in an aquatic garden weeding program.*
Action*: Each new aquatic garden weeding program participant will recruit two (2) new participants for the following season.*
Measure of Success*:*

- *Year 1 (2009) = 10 participant*
- *Year 2 (2010) = 30 (10 existing and 20 new) participants*
- *Year 3 (2011) = 70 (30 existing and 40 new) participants*
- *Year 4 (2012) = 150 (70 existing and 80 new) participants*
- *Year 5 (2013) = 310 (150 existing and 160 new) participants*

7.3 Use of Harvesters to Limit Nutrients and Remove Plants

The need for reasonable boating access throughout Shawano Lake is a concern for many lake users. One past management practice was to use aquatic plant harvesters (harvesters) to clear navigation area through heavily vegetated areas of the lake. Harvesters are one method to maintain these channels. Sensitive Areas should be left undisturbed and by and large inaccessible unless management becomes part of a habitat protections project.

Harvesters have fewer potential perceived "side effects" than do chemical herbicides and once purchased they can be more affordable than long-term herbicide applications. The state of WDNR as a department is moving away from the permitting chemical herbicides to use for nuisance native aquatic plants, preferring that harvesters be used for this maintenance activity. Harvesters may also play a role in the restoration on native plant communities if used to reduce AIS or collect viable parts of AIS.

In general harvesters are not recommended for plant management in areas with EWM because cutting of this AIS could lead to fragmentation of the plant creating free floating fragments capable of spreading to uninfested parts of the lake. In fact the WDNR Sensitive Area Survey Report, recommendation four, states that "No mechanical harvesting in or near beds of Eurasian Watermilfoil." As stated above (Section 3.2 Lake Management History) SAWM was granted a WDNR Mechanical / Manual Aquatic Plant Control permit (for mechanical harvesting of 170 acres of nuisance level aquatic plants and increase navigation and recreational opportunities in designated navigation channels. While pursuing that course of action SAWM also spent $300,000 in new non-paddle type harvesters in hopes that this technology would limit fragmentation of EWM when harvesting. Such harvesters may actually be used to clean up floating fragments of EWM and or native plants that have been cut by boaters or otherwise uprooted. This is a common complaint on the east side of the lake.

Recommendation #7: Use aquatic plant harvester in select areas for nuisance aquatic plant control and to clean up floating nuisance plants.
Target*: Adaptive management is needed on an annual basis to decide location of navigation channels to provide boating access to the lake and to collect mats of fragmented EWM.*
Trigger*: Use harvesters only when motorized boating activity is hindered by nuisance levels of aquatic vegetation or when EWM fragments form mats (usually on the east side of the lake).*

***Action**: SAWM will monitor Shawano Lake and work with the WDNR to determine if harvesting is needed and to what degree (location and area).*
***Action**: SAWM will continue to file for Mechanical / Manual Aquatic Plant Control permits with the WDNR .when the organization feels it is necessary.*
***Action**: SAWM will continue management and maintenance of harvesting equipment as usual.*
***Measure of Success**: Shawano Lake should be accessible to some degree for a variety of different boating activities at different locations.*

Harvesters may also be used to limit the spread of CLP, and remove CLP biomass (a potential phosphorous source) from the lake. Within the lake itself a significant source of phosphorous comes from the die-off of CLP in late June. Given that CLP begins growing before ice out, harvesting efforts should focus on removing as much CLP as possible before the formation of the plants' turions. Turions are the nutlet like structure the plant creates as a way to seed itself in new areas. Once turions are formed the plant will begin to die off and harvesting could in fact spread the turions to other parts of the lake. Removing much of the CLP biomass prior to the formation of turions will limit the phosphorus added to the lake as the plant breaks down. Limiting phosphorous in the peak of summer will aid in limiting aquatic plant and algae growth. For this activity the harvester should be set low and brought up as natives begin to form a specific harvesting component.

Recommendation #8: Use aquatic plant harvester to remove CLP in spring and early summer.
***Target**: The harvesters will focus on areas of CLP as soon as ice comes off the lake and through early June when native plants begin to grow rapidly.*
***Trigger**: Use this technique as long as dense stands of CLP are on the lake.*
***Action**: SAWM's Monitoring Committee will survey Shawano Lake for CLP growth and work with Mary Gansberg at the WDNR to determine if harvesting permits can be issued to target CLP only.*
***Action**: SAWM will continue to file for Mechanical / Manual Aquatic Plant Control permits with the WDNR working in management of the beds of CLP.*
***Action**: SAWM will continue management and maintenance of harvesting equipment as usual.*
***Measure of Success**: Shawano Lake should experience lower levels of CLP, with less spread and reduced phosphorus (levels will have to be determined).*

7.4 Chemical Herbicide Use

Shawano Lake has an estimated 2,640 acres of milfoil and 1,640 acres of curly-leaf pondweed per the US Army Corps of Engineers survey from 2005. At approximately $500 per acre of chemical treatment SAWM most likely will not have the resources to chemically treat all the beds of these AIS with the goal of native plant restoration. Site specific restoration is possible and the basis of these recommendations. The chemical herbicide Reward (used in the past) is not a selective herbicide as used in Shawano Lake. To focus more on native plant restoration and the control of AIS, Northern Environmental makes the following recommendations. In areas of EWM, early season chemical herbicide application of 2,4-D product such as Weedar (liquid) or Navigate (solid/granular) is a good control measure. For areas where EWM and CLP are occurring together a prescription of Aquathol and Weedar in tandem is a good choice for chemical herbicide to restore the native plant community if used in early spring. Northern Environmental working as a chemical applicator with WDNR used this approach in an experimental fashion on Little Green Lake and it produced good results (natives up and AIS almost eradicated in test plots). Since this test study other chemical applicators have been using this technique throughout Wisconsin

The 2008 permits for harvesting and chemical treatment do appear to be in areas where EWM and CLP overlap and EWM certainly occurs in areas with perceived nuisance aquatic plants. In this case it would be prudent to free the harvesting lanes of as much EWM as possible to avoid fragmentation of the plant in the process of harvesting. A late May chemical herbicide application as described above could be applied to the harvest lanes prior to harvesting activities. This would reduce EWM fragmentation and open more lake bottom for native plants. The harvest areas could be considered a designated restoration area in this case even though harvesting is not a restoration activity.

Recommendation #9: Use the chemical herbicides Aquathol and Weedar in tandem in May on areas of EWM and CLP or a 2, 4-D product such as Weedar (liquid) or Navigate (solid/granular).
Target*: Chemically treat areas of EWM and CLP overlay and areas where mechanical harvesters will be used.*
Trigger*: When the harvester is used EWM should be reduced as much as possible in the harvesting area.*
Action*: SAWM will monitor Shawano Lake and work with Mary Gansberg at the WDNR to determine if chemical treatment is needed and design a chemical treatment program (location and area) that fits with the harvesting program on an annual basis.*
Action*: SAWM will continue to file for chemical herbicide aquatic plant control permits with the WDNR but include area for restoration.*
Measure of Success*: Areas where the harvesters operate will be clear of EWM and CLP prior to nuisance native plant control thereby supporting native plant restoration.*

EWM and CLP overlap with Sensitive Areas to some degree, mostly in the western part of Shawano Lake. Designated sensitive areas should be avoided by harvesters and chemical herbicide applicators unless future studies show that invasive plants are changing the structure, composition and function of Sensitive Area habitats. If the aquatic invasive plants EWM or CLP become a problem early season chemical treatment as described above would be appropriate.

Recommendation #10: Treat Sensitive Areas with the chemical herbicides Aquathol and Weedar in tandem in May for EWM and CLP control or a 2, 4-D product such as Weedar (liquid) or Navigate (solid/granular).
Target*: Early spring treatments of Sensitive Areas with selective herbicides.*
Trigger*: Chemically treat Sensitive Areas only when invasive plants threaten the habitat composition.*
Action*: SAWM will monitor Sensitive Areas and work with Mary Gansberg at the WDNR and staff ecologists to determine if chemical treatment is needed (location and area) on an annual basis.*
Action*: SAWM will file for a chemical herbicide aquatic plant control permits with the WDNR to include Sensitive Area restoration.*
Measure of Success*: Sensitive Areas free and clear of EWM, CLP or other invasive plants.*

7.5 Nutrient Management

Nutrients, particularly phosphorus and nitrogen, are the fertilizer of aquatic plants. The topic of complete nutrient inputs and management within the Shawano Lake watershed is too involved to discuss in this APM Plan, but it is discussed in great detail in the 2008 Watershed Assessment of Shawano Lake by the University of Wisconsin-Stevens Point Center for Watershed Science and Education. Northern Environmental does believe that watershed residents and the agricultural community should use best management practices to limit nutrient inputs. At a March 3rd, 2008 Shawano Lake technical team (same as Steering Committee for APM plan) meeting the Shawano County Land Information Department set the goal of reducing phosphorus input be 20% by 2020. SAWM's commitment to the implementation of the

above mentioned goal was to advocate for a local watershed phosphorus fertilizer ban form which farmers would be exempt.

Recommendation #11: SAWM should work to advocate watershed phosphorus fertilizer ban from which farmers would be exempt.
Target*: No lawn fertilizers containing phosphorus will be sold or used in the Shawano Lake watershed.*
Trigger*: Start immediately (past relevant trigger).*
Action*: SAWM will review ordinances banning lawn fertilizers containing phosphorus (such as town, county, or state) and draft one of their own.*
Action*: SAWM will work with the Shawano County Land Information Department to introduce the ordinance at the county level.*
Measure of Success*: No lawn fertilizers containing phosphorus will be sold in the Shawano Lake watershed.*

Specific to SAWM members and lakefront property owners Northern Environmental recommends maintaining or restoring a buffer of native vegetations at least 30 feet from the lakeshore, but preferably 50 to 75 feet. Such a buffer of native vegetation will serve as a filter and help capture stormwater runoff that carries nutrients. If a lawn or otherwise manicured garden landscape is to exist, fertilizers should be excluded from routine management of lawn/garden. If a soils test indicates that fertilizers are essential then phosphorus free-fertilizers should be used. Where impervious areas (hard surfaces non-penetrable by rain water such as a roof or driveway) are adjacent to steep or sloping terrain that would lead to stormwater runoff reaching the lake, best management practices such as constructed swales, rain gardens, or rain barrels should be installed. More information on installation and design of rain gardens can be found at: http://www.dnr.state.wi.us/org/water/wm/dsfm/shore/documents/rgmanual.pdf. Swale design and installation may require a professional landscaper or engineer.

Recommendation #12: SAWM should work with lakeshore property owners to install best management practices that will limit nutrient inputs.
Target*: Have vegetated buffer, rain gardens, swales, and other best management practices on shoreline properties around Shawano Lake.*
Trigger*: Start immediately (past relevant trigger).*
Action*: SAWM's Education Committee will hold an annual workshop to teach lakeshore property owners about the benefit of stormwater prevention technologies.*
Action*: SAWM will work with Shawano County to see what they have to offer as far a cost-sharing for shoreland restoration and best management practices.*
Measure of Success*: 10% of the lawns along the shoreline on Shawano Lake are restored or contain some form non-lawn shoreline.*

7.6 Water Level Manipulation (Drawdown)

Water level manipulation or drawdown should be considered as an alternative to large-scale chemical treatments or to be used in conjunction with site specific chemical treatment. The objective is to freeze or dry out the CLP and EWM roots and reduce their occurrence the following growing season. Additionally, nuisance levels of coontail and other native plants may be affected. Some emergent plants, such as bulrushes, are actually stimulated to grow and increase the areas they occupy when water levels fluctuate such as during a draw down and this can be considered a restoration activity. Bulrushes and other emergent vegetation are the primary selection mechanism for Sensitive Areas designated on Shawano Lake.

Commonly the advantages of a draw down include relatively low costs in comparison to chemical management alternatives, reduction in EWM and CLP, and compaction of the exposed sediments (depending on season of drawdown). Disadvantages include unpleasant aesthetics during the drawdown, reduced recreational use during the drawdown, potential seasonal-loss of fish habitat downstream, reimbursement for hydropower not generated, and the unpredictability of weather conditions. Reimbursement for hydropower is not an activity funded under NR 198, the Wisconsin AIS Control Grant Program (described in Recommendation 14).

The type of drawdown required is dependant on what the desired results are (see below for drawdown descriptions). If the primary goal is to be control of EWM and CLP, then a winter drawdown is needed. A summer drawdown is recommended when the primary goal is to increase lake depth (compact soils). However, if both options are to be achieved to their maximum extent, a year-long drawdown would be best fit. A brief description of drawdown types follows:

Winter Drawdown:
During winter drawdown, water will be drawn down before October 1, giving time for over-wintering amphibians and reptiles to adjust and find safe hibernating sites. Once drawn-down, water levels will remain constant throughout the winter and should be checked at least weekly to maintain proper water levels. Normal pool elevation will be resumed in late March when spring melt has begun, supplying ample water to return water levels to normal.

This process is not species specific and freezing must occur for a minimum of six weeks to be effective. Some sediment compaction may occur, but significant increase in lake depth is not expected. This process should be repeated every three to five years, when AIS may again be approaching nuisance levels.

Summer Drawdown:
For a summer drawdown, the goal is to dry out the roots and biomass of the plants. The drawdown should begin in early June, allowing targeted plants to begin growing. The drawdown should continue until late August or early September to allow ample drying time. Normal pool elevation will be restored at this time.

This process is not species specific and significant drying must occur to be effective. With the summer drawdown, higher rates of sediment compaction and decay of mucky materials will increase lake depth as compared to a winter drawdown. However, this type will have less of an effect on the plants and will have a greater limitation of recreational opportunities by limiting or preventing boat access. This process should be repeated every three to five years, when AIS may again be approaching nuisance levels. Less water will be available to re-fill the lake when compared to the winter draw-down and care should be taken not to dry out the waterway below the dam. This method is not fitting for control of phragmites species; in fact, this method would likely allow phragmites to spread rapidly.

Year-Long Drawdown:

Year-long drawdown is essentially a combination of the summer and winter drawdowns. It will begin in early June once plants have begun growing. The water will be drawn down to the chosen level and held there until mid August. Normal water level will be established for about a month, allowing for any additional AIS seed bank or plants to re-grow to be targeted during the

winter. In late September, but before October 1, the water will again be drawn down to the selected level and remain there until late March, when ample water should be available to resume normal levels.

This process is not species specific, but will provide the most effective combination to achieve both the sediment and AIS goals. However, this type will have the greatest affect on recreational activities by limiting them throughout the year.

A water level draw down of Shawano Lake is physically possible using the dam located down stream on the Wolf River. The dam is managed for hydroelectric power generation and is managed by a company known as North American Hydro. The Company holds a license to operate the dam authorized by the Federal Energy Regulatory Commission (FERC). The license has certain limitation and FERC may have to authorize any water level draw down after working with North America Hydro. WDNR would also have to authorize a draw down. WDNR manages the Wolf River for sturgeon that gather near the dam in the high water season of the spring. Any draw down would probably require that the dam limit runoff in the spring to fill the reservoir that is Shawano Lake. WDNR fisheries biologist would need to be consulted closely if this alternative is pursued.

Another hurdle when considering the draw down option is the reimbursement of funds lost to North American Hydro for the term of energy production lost as the water was refilling (North American Hydro was not able to provide a cost estimate). This reimbursement would potentially come from SAWM, the WDNR (not WDNR grants), or other partners in managing Shawano Lake. The first step in pursuing authority from North American Hydro and the agencies they answer to is to present North America Hydro with a formal letter of proposal. Going into the level of detail that such a letter would entail is not an efficient use of limited dollars when designing this management plan. That activity will need to be spearheaded by a consultant or public-sector technical expert. A draw down feasibility study could be conducted to fully assess the potential of this management option, but SAWM should work to assess the political support for this option before allocating substantial funds to the project.

Recommendation #13: Investigate drawdown as AIS management option and conduct feasibility study.
Target*: Conduct a feasibility study investigating potential for a drawdown and outlining the full process with associated costs.*
Trigger*: Public support for an approximate four (4) foot drawdown for a given period (winter, summer, year-long) of time as an AIS management option.*
Action*: SAWM will meet with local political leaders and determine if they would support the concept of a drawdown.*
Action*: SAWM will determine whether a consultant or public-sector technician should conduct a feasibility study.*
Action*: SAWM could apply for a WDNR Lake Management Planning or Protection Grant for the feasibility study.*
Measure of Success*: Either a completed feasibility study or a determination by the SAWM Board that there is no support for a drawdown as a management option.*

7.7 Potential Funding Sources

All of the activities mentioned above required time and materials for successful implementation and completion. Some of the time and materials may be donated by volunteers but certainly there is a need for money to pay professionals and run equipment. The state of Wisconsin has set up a grant funding

program called the Aquatic Invasive Species Control Grant program, managed by the WDNR under NR 198 (see Appendix G NR 198). There are two basic categories of the AIS Control Grants SAWM would be eligible for, Established Infestation Control, and Education Planning and Prevention, both will provide up to 75% of project costs. Some of the activities mentioned as recommendations may be funded through the AIS Control grant program; however nuisance native plant control activities are not eligible, only restoration activities controlling AIS. Restoration activities could be covered under the Established Infestation Control section of the AIS Control Grants if the WDNR has approved a SAWM adopted APM plan. Educational efforts such as a coordinator for Clean Boats, Clean Waters watercraft inspection, etc., may be covered under the Education, Planning and Prevention section of the AIS Control grant (pending WDNR approval of the APM plan), or incorporated in to a larger project under the Established Infestation Control section of a AIS Control Grant (again, pending WDNR approval of the APM plan) if restoration activities are occurring simultaneously.

Recommendation #14: SAWM should apply for WDNR AIS Control grants for restoration and educational activities.
Target*: Restoration and education activities on Shawano Lake supported 75% by WDNR grant dollars.*
Trigger*: SAWM Board determination to pursue restoration and education recommendations and activities.*
Action*: SAWM will determine which restoration and education recommendations and activities they would like to pursue.*
Action*: SAWM will meet with Mary Gansberg at WDNR and asks for advice and support on pursuing grant.*
Action*: SAWM will write and submit a grant application or hire a grant writer to do so, by February 1st or August 1st of 2009.*
Measure of Success*: Awarded AIS Control Grant for 75% of SAWM's restoration and education activities.*

Nuisance aquatic plants are often a matter of perception and for that reason, this APM plan was largely designed with the restoration of native plants in mind, albeit site specific. If the public at large feels nuisance aquatic vegetation must be managed, then those entities that benefit from public use of Shawano Lake should also be considered a funding source. Surrounding cities, towns, and counties should be targeted for substantial contributions to SAWM's management efforts of Shawano Lake. TLPOA, Inc., the group that voluntarily manages Tomahawk Lake, Oneida County, Wisconsin, receives funds from different towns that collect taxes from shoreland property owners on Tomahawk Lake, and businesses that benefit form proximity to that healthy lake. The Town of Minocqua is one of the towns supporting towns and it contributes over $40,000 annually to two different lake associations working to control AIS in the area. These funds help but hardly cover the total cost of management.

Recommendation #15: SAWM should solicit funds from local towns, cities, and Shawano County to support Shawano Lake management activities.
Target*: Financial support from government bodies that benefit from tax revenues due to proximity to Shawano Lake.*
Trigger*: SAWM requiring dollars beyond that in the current budget to carry out comprehensive management of Shawano Lake.*
Action*: SAWM board members will approach local town and city and county chairmen and request funds for Shawano Lake Management.*
Measure of Success*: Awarded town and county funds to support SAWM's nuisance plant control, restoration and education efforts on Shawano Lake.*

Local business, especially those that are directly tiered to recreation on Shawano Lake, should be targeted for special business memberships to SAWM. SAWM could create business membership certificate or other form of acknowledgement for businesses to display that would show their proud support of Shawano Lake Management. A business membership category could have an entry level higher than a personal membership, such as a $100-$150 entry level membership.

Recommendation #16: SAWM should create a business membership category and help promote businesses that participate in funding Shawano Lake management activities.
Target*: Financial support from businesses that benefit from the proximity to Shawano Lake.*
Trigger*: SAWM requiring dollars beyond that in the current budget to carry out comprehensive management of Shawano Lake.*
Action*: Create a poster, certificate or other display document to present to business members of SAWM.*
Action*: SAWM board members will approach local business to sequester a business membership at a premium level.*
Measure of Success*: Have 20 local business that support SAWM's restoration and education efforts on Shawano Lake.*

8.0 CONCLUSION

An Aquatic Plan Management Plan is a living document. The APM Plan should be updated approximately every five (5) years. Hopefully citizens are mobilized by having a plan and become more active with SAWM. As SAWM works to implement the plan new ideas will arise and the need for different tools will become apparent. APM plan rewrites work best when citizens are engaged in implementing a plan and then in the rewrite. New ideas can be incorporated and tools created. Perhaps issues of the day will be different; some problems solved, some new ones apparent. If there are questions regarding this plan or its implementation please contact Northern Environmental. Shawano Lake is an exceptional state resource and worth every effort SAWM has made to manage it wisely.

9.0 REFERENCES

While not all references are specifically cited, the following resources were used in preparation of this report.

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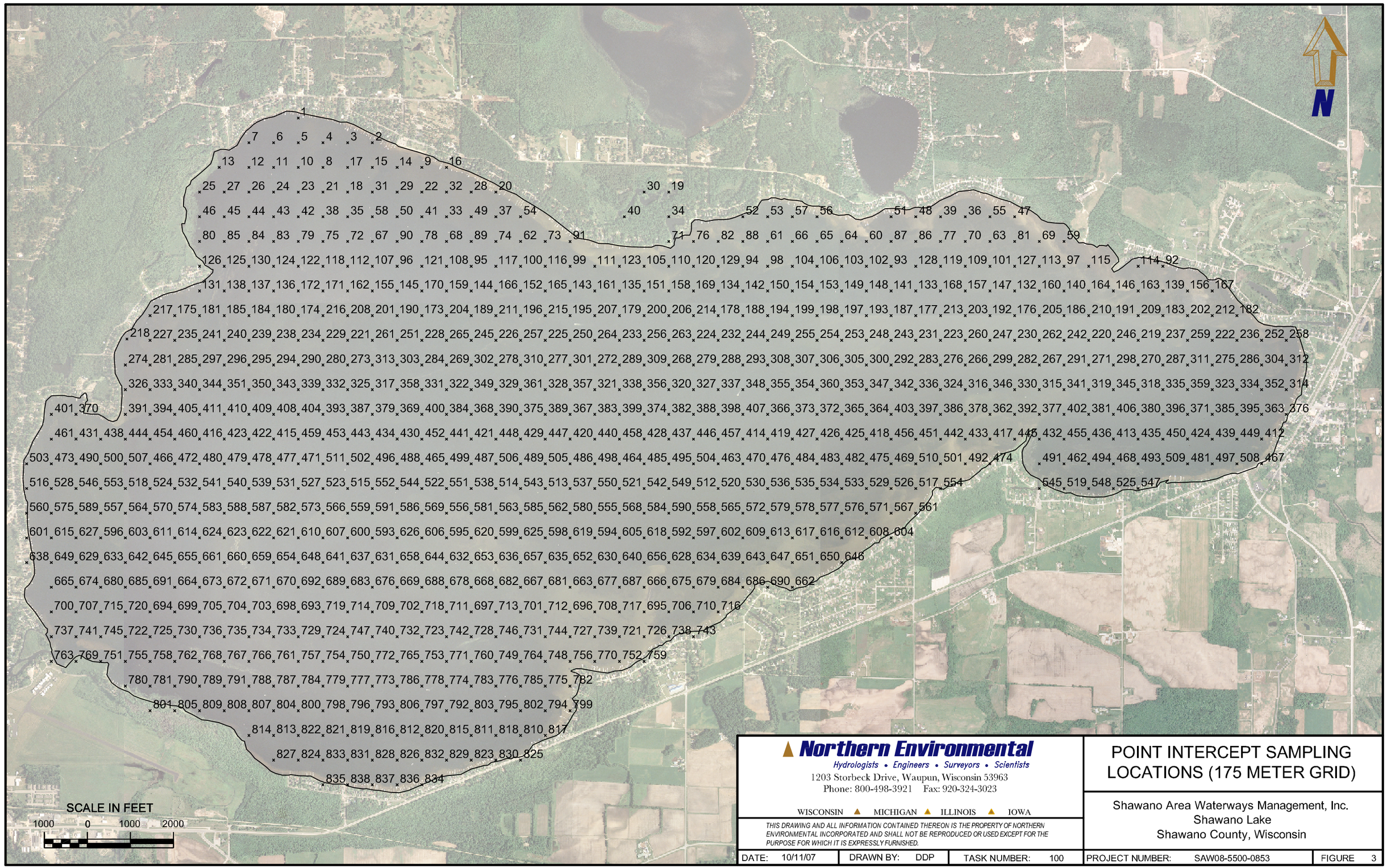

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POINT INTERCEPT SAMPLING LOCATIONS (175 METER GRID)

Shawano Area Waterways Management, Inc.
Shawano Lake
Shawano County, Wisconsin

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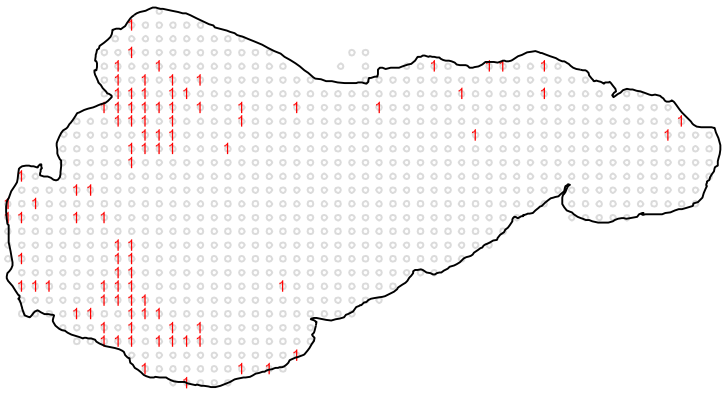
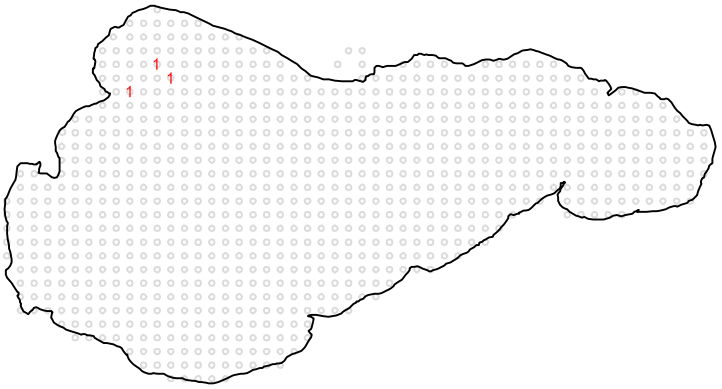
10/11/07	DDP	100	SAW08-5500-0853	3



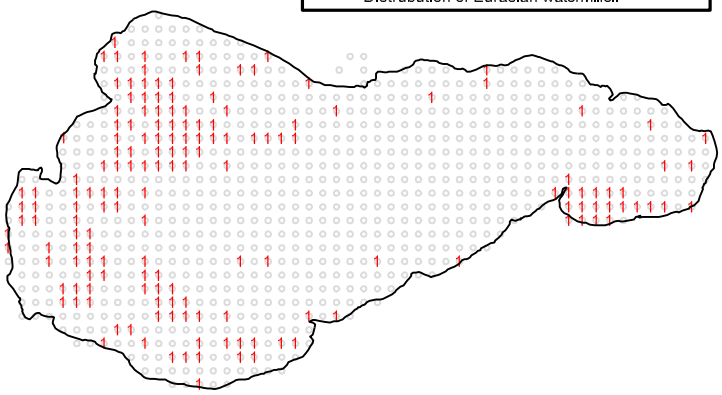
Najas flexilis, Bushy pondweed



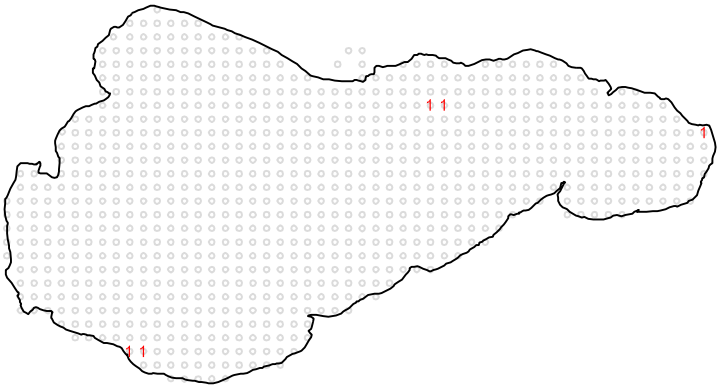
Chara, Muskgrasses

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
○		Sample Point Without Species Present

Distrubution of Eurasian watermilfoil



Potamogeton crispus, Curly-leaf pondweed



Utricularia vulgaris, Common

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DATE:	DRAWN BY:	TASK NUMBER:	PROJECT NUMBER:	FIGURE
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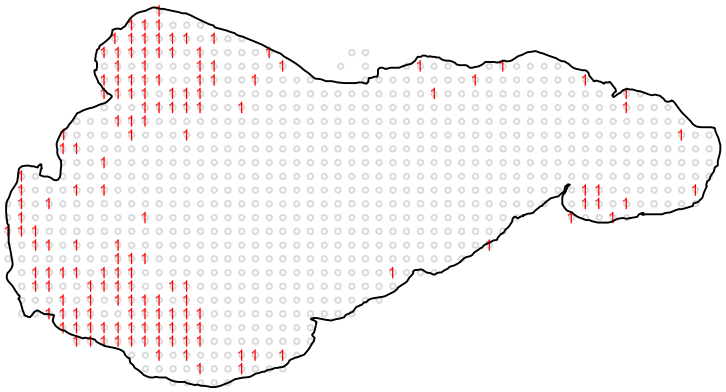
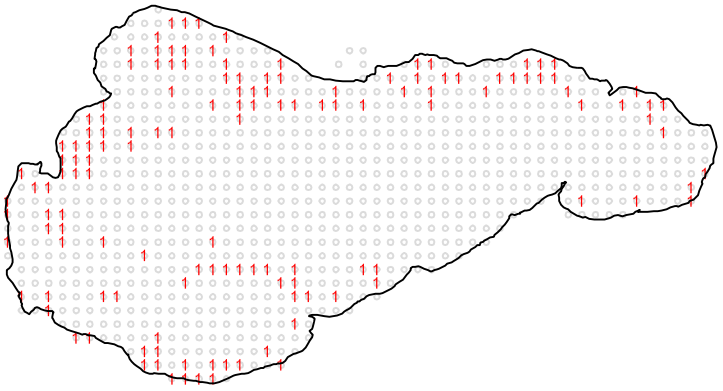


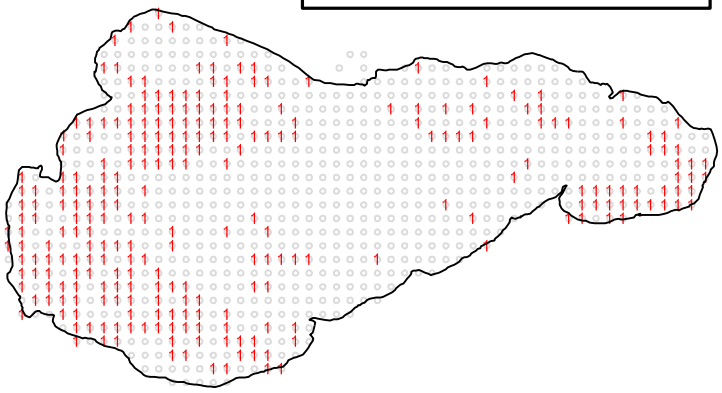
Elodea canadensis, Common waterweed



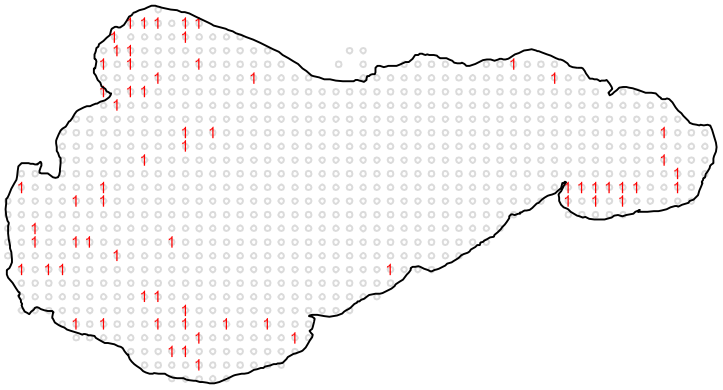
Ceratophyllum demersum, Coontail

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
○		Sample Point Without Species Present

Distrubution of Eurasian watermilfoil



Myriophyllum spicatum, Eurasian water-milfoil



Potamogeton zosteriformis, Flat-stem pondweed

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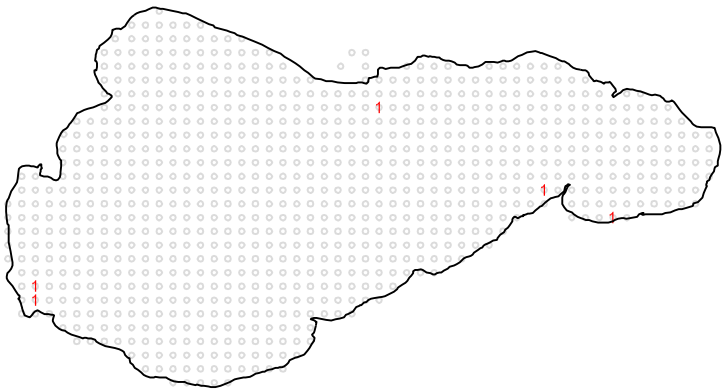
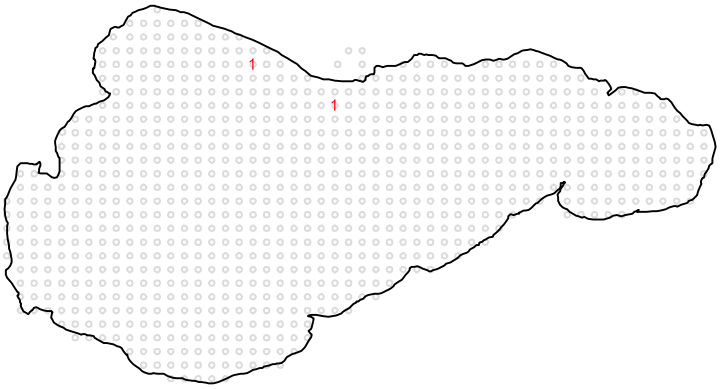


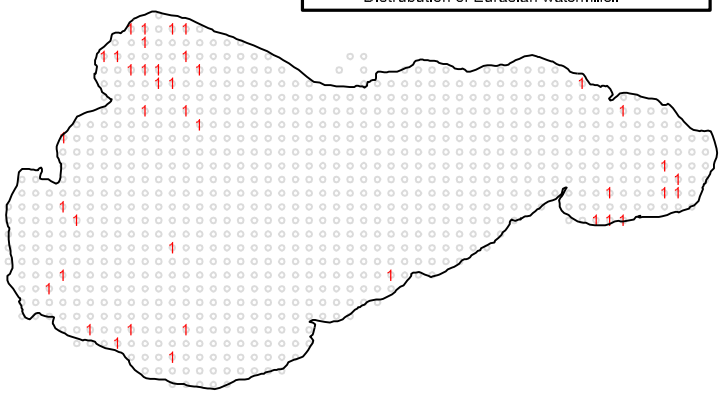
Zannichellia palustris, Horned pondweed



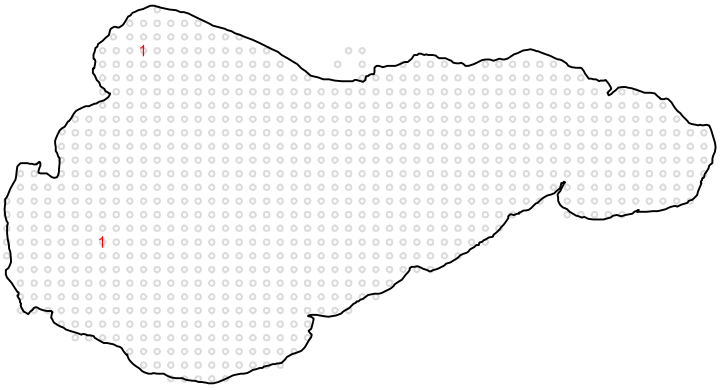
Potamogeton illinoensis, Illinois pondweed

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
○		Sample Point Without Species Present

Distrubution of Eurasian watermilfoil



Potamogeton amplifolius, Large-leaf pondweed



Potamogeton foliosus, Leafy pondweed

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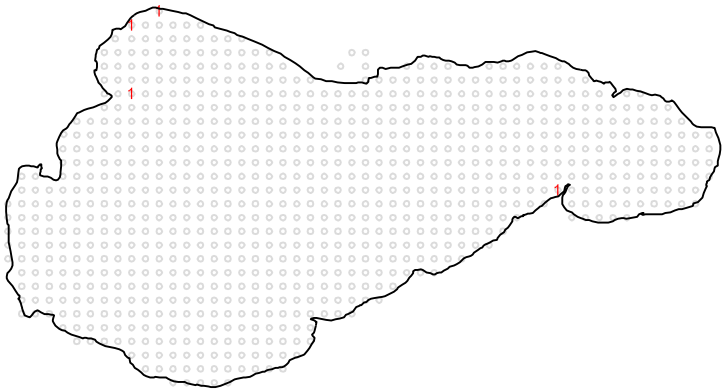
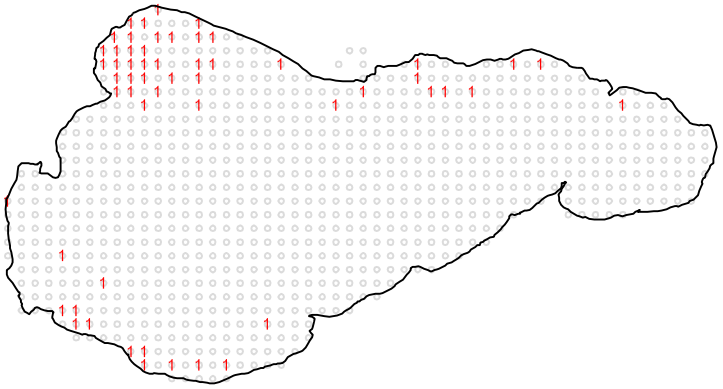


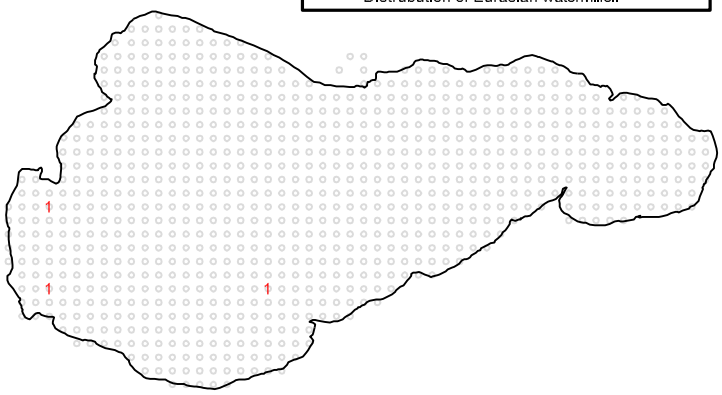
Naiad sp.



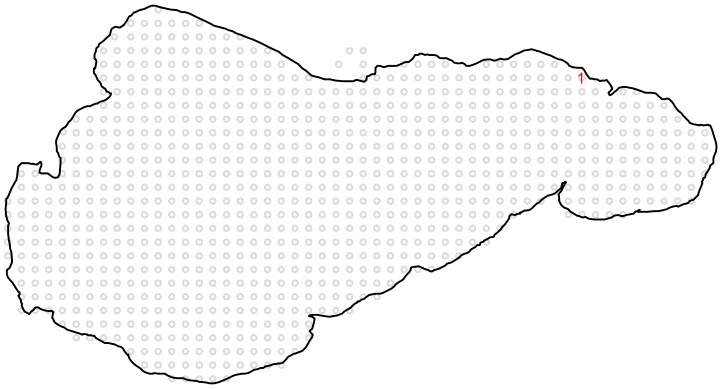
Myriophyllum sibiricum, Northern water milfoil

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
○		Sample Point Without Species Present

Distrubution of Eurasian watermilfoil



Potamogeton sp.



Lythrum salicaria, Purple loosestrife

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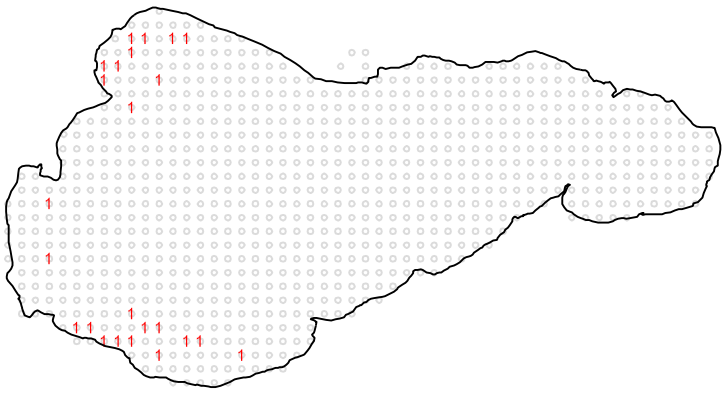
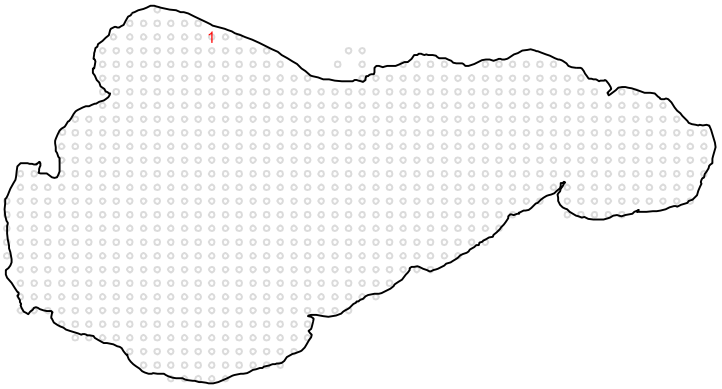
DATE:	DRAWN BY:	TASK NUMBER:	PROJECT NUMBER:	FIGURE
10/11/07	DDP	100	SAW08-5500-0853	4d

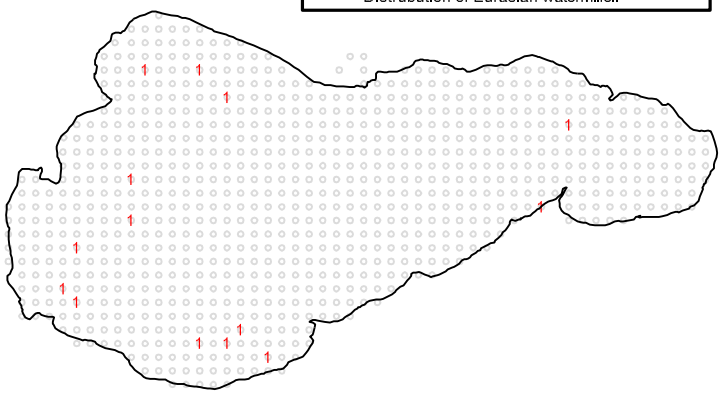


Potamogeton robbinsii,Robbins pondweed

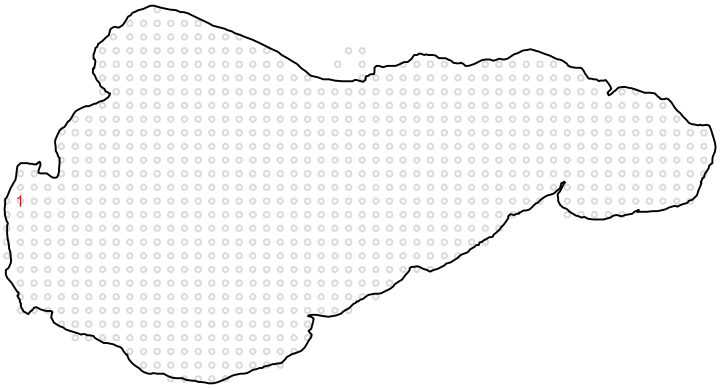


Sagittaria sp.

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
○		Sample Point Without Species Present
		Distrubution of Eurasian watermilfoil



Potamogeton pusillus, Small pondweed



Najas guadalupensis, Southern Naiad

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DATE:	DRAWN BY:	TASK NUMBER:	PROJECT NUMBER:	FIGURE
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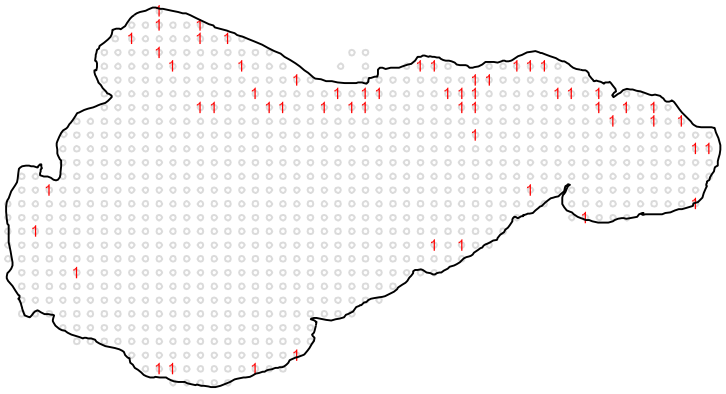
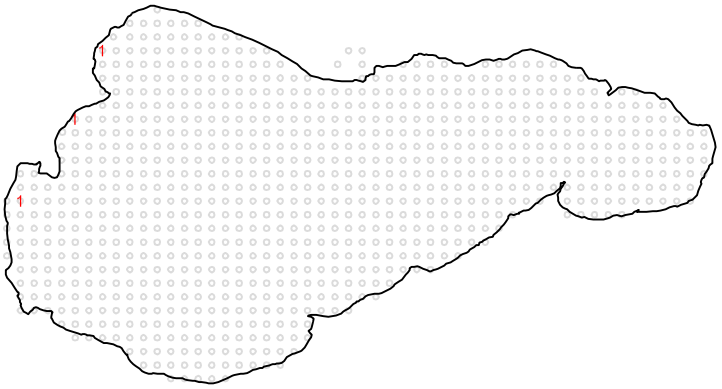
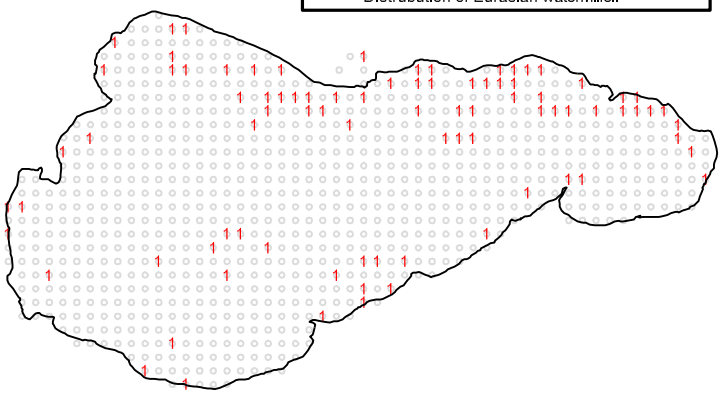


Potamogeton gramineus, Variable pondweed

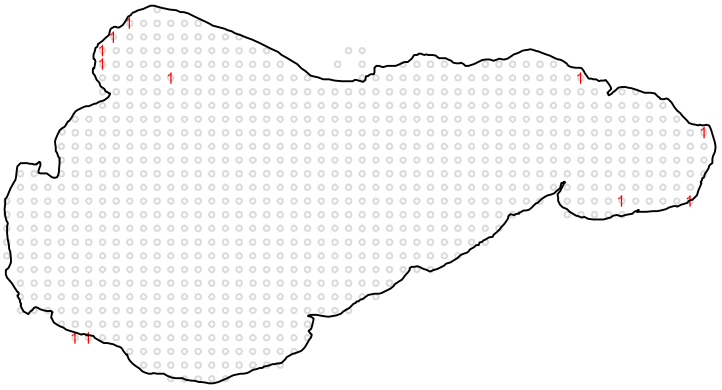


Nymphaea odorata, White water lily

Rating	Coverage	Description
1		A few plants on rake head
2		Rake head is about 1/2 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head
V		No Plants Collected On Rake Visual Observation Only
		Sample Point Without Species Present
		Distrubution of Eurasian watermilfoil



Vallisneria americana, Wild celery



Nuphar advena, Yellow pond lily

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Shawano County, Wisconsin

DATE:	DRAWN BY:	TASK NUMBER:	PROJECT NUMBER:	FIGURE
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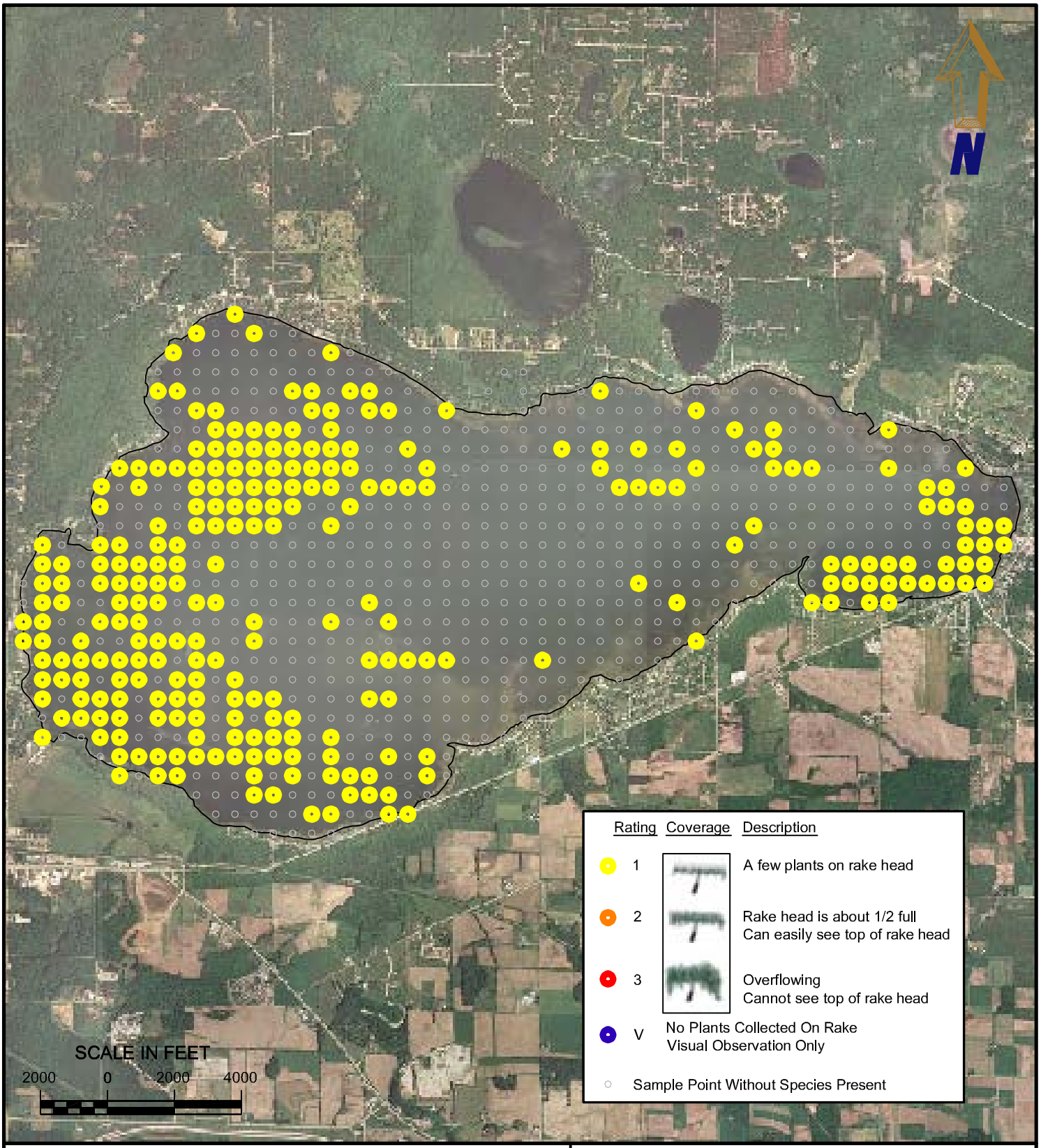

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EWM JUNE 2005

Shawano Area Waterways Management, Inc.
Shawano Lake
Shawano County, Wisconsin

DATE:	DRAWN BY:	TASK NUMBER:	PROJECT NUMBER:	FIGURE
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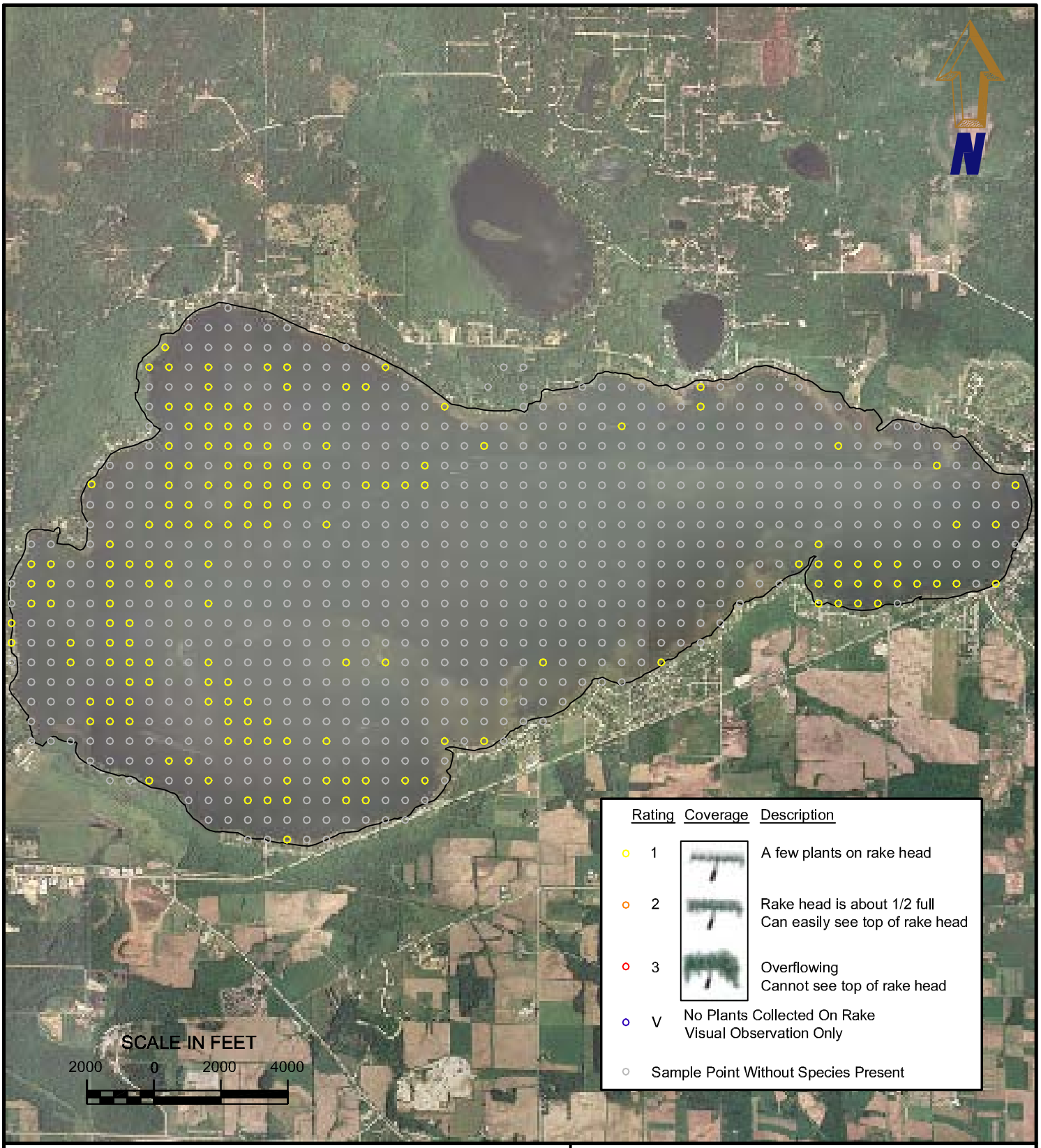

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CURLY LEAF PONDWEED
JUNE 2005

Shawano Area Waterways Management, Inc.
Shawano Lake
Shawano County, Wisconsin

DATE:	DRAWN BY:	TASK NUMBER:	PROJECT NUMBER:	FIGURE
10/11/07	DDP	100	SAW08-5500-0853	6

Table 1: Taxa Detected During 2005 Aquatic Plant Survey, Shawano Lake, Shawano County, Wisconsin

Genus	Species	ID	Common Name	Category
Ceratophyllum	*demersum*	1	coontail	Emergent
Chara	*sp.*	2	Muskgrasses	Submersed
Elodea	*canadensis*	3	Common waterweed	Submersed
Myriophyllum	*sibericum*	4	Northern water milfoil	Submersed
Myriophyllum	*spicatum*	5	Eurasian water milfoil	Submersed
Najas	*spp.*	6	Naiad	
Najas	flexilis	7	Bushy pondweed	Submersed
Najas	*guadalupensis*	8	Southern water-nymph	Submersed
Nuphar	advena	9	Yellow pond lily	Floating-leaf
Nymphaea	odorata	10	White water lily	Floating-leaf
Potamogeton	amplifolius	11	Large-leaf pondweed	Submersed
Potamogeton	crispus	12	Curly-leaf pondweed	Submersed
Potamogeton	foliosus	13	Leafy pondweed	Submersed
Potamogeton	gramineus	14	Variable pondweed	Submersed
Potamogeton	illinoensis	15	Illinois pondweed	Submersed
Potamogeton	pusillus	16	Small pondweed	Submersed
Potamogeton	robbinsii	17	Robbins pondweed	Submersed
Potamogeton	spirillus	18	Spiral-fruited pondweed	Submersed
Potamogeton	zosteriformis	19	Flat-stem pondweed	Submersed
Sagittaria	spp.	20	Arrowhead	Emergent
Utricularia	vulgaris	21	Common bladderwort	Submersed
Vallisneria	americana	22	Wild celery	Submersed
Zannichellia	pualustris	23	Common water-meal	Submersed

Table 2. Aquatic Plant Community Statistics, Shawano Lake, Shawano County, Wisconsin

Aquatic Plant Community Statistics	2005
Frequency of occurrence at sites shallower than maximum depth of plants	45.07%
Simpson Diversity Index	0.93
Maximum Depth of Plants (Feet)	15.00
Taxonomic Richness (Number Taxa)	23.00
Average Number of Species per Site (sites less than max depth of plant growth)	2.01
Average Number of Species per Site (sites with vegetation)	2.48
Average Number of NATIVE Species per Site (sites less than max depth of plant growth)	1.56
Average Number of NATIVE Species per Site (sites with vegetation)	2.10

Table 3 : 2005 Aquatic Plant Taxa-Specific Statistics, Shawano Lake, Shawano County, Wisconsin

Genus	Species	Common Name	Number of Intercept Points Where Detected	Frequency of Occurrence within vegetated areas	Frequency of Occurrence at sites shallower than max depth of plants	Relative Frequency of Occurrence	Average Density
Ceratophyllum	*demersum*	coontail	137	51.7%	23.3%	16.3%	1
Chara	*sp.*	Muskgrasses	3	1.1%	0.5%	0.4%	1
Elodea	*canadensis*	Common waterweed	150	56.6%	25.5%	17.9%	1
Myriophyllum	*sibericum*	Northern water milfoil	56	21.1%	9.5%	6.7%	1
Myriophyllum	*spicatum*	Eurasian water milfoil	265	100.0%	45.1%	31.6%	1
Najas	*spp.*	Naiad	4	1.5%	0.7%	0.5%	1
Najas	flexilis	Bushy pondweed	94	35.5%	16.0%	11.2%	1
Najas	*guadalupensis*	Southern water-nymph	1	0.4%	0.2%	0.1%	1
Nuphar	advena	Yellow pond lily	11	4.2%	1.9%	1.3%	1
Nymphaea	odorata	White water lily	2	0.8%	0.3%	0.2%	1
Potamogeton	amplifolius	Large-leaf pondweed	39	14.7%	6.6%	4.7%	1
Potamogeton	crispus	Curly-leaf pondweed	164	61.9%	27.9%	19.6%	1
Potamogeton	foliosus	Leafy pondweed	2	0.8%	0.3%	0.2%	1
Potamogeton	gramineus	Variable pondweed	57	21.5%	9.7%	6.8%	1
Potamogeton	illinoensis	Illinois pondweed	2	0.8%	0.3%	0.2%	1
Potamogeton	pusillus	Small pondweed	14	5.3%	2.4%	1.7%	1
Potamogeton	robbinsii	Robbins pondweed	24	9.1%	4.1%	2.9%	1
Potamogeton	spirillus	Spiral-fruited pondweed	3	1.1%	0.5%	0.4%	1
Potamogeton	zosteriformis	Flat-stem pondweed	66	24.9%	11.2%	7.9%	1
Sagittaria	spp.	Arrowhead	1	0.4%	0.2%	0.1%	1
Utricularia	vulgaris	Common bladderwort	5	1.9%	0.9%	0.6%	1
Vallisneria	americana	Wild celery	86	32.5%	14.6%	10.3%	1
Zannichellia	pualustris	Common Water-meal	5	1.9%	0.9%	0.6%	1

Table 4: 2005 Floristic Quality Index, Shawano Lake, Shawano County, Wisconsin

Genus	Species	Common Name	Coefficient of Conservatism C	Present	Coefficient of Conservatism C
Ceratophyllum	*demersum*	coontail	3	1	3
Chara	*sp.*	Muskgrasses	7	1	7
Elodea	*canadensis*	Common waterweed	3	1	3
Myriophyllum	*sibericum*	Northern water milfoil	7	1	7
Najas	*spp.*	Naiad	6	1	6
Najas	flexilis	Bushy pondweed	6	1	6
Najas	*guadalupensis*	Southern water-nymph	7	1	7
Nuphar	advena	Yellow pond lily	8	1	8
Nymphaea	odorata	White water lily	6	1	6
Potamogeton	amplifolius	Large-leaf pondweed	7	1	7
Potamogeton	crispus	Curly-leaf pondweed	5	1	5
Potamogeton	foliosus	Leafy pondweed	6	1	6
Potamogeton	gramineus	Variable pondweed	7	1	7
Potamogeton	illinoensis	Illinois pondweed	6	1	6
Potamogeton	pusillus	Small pondweed	7	1	7
Potamogeton	robbinsii	Robbins pondweed	8	1	8
Potamogeton	spirillus	Spiral-fruited pondweed	8	1	8
Potamogeton	zosteriformis	Flat-stem pondweed	6	1	6
Sagittaria	spp.	Arrowhead	3	1	3
Utricularia	vulgaris	Common bladderwort	7	1	7
Vallisneria	americana	Wild celery	6	1	6
Zannichellia	pualustris	Common water-meal	7	1	7

N	22
Mean C	6.1818182
Floristic Quality Index (FQI)	**28.995297**

Please note: There is no Coefficient of Conservatism for exotic species such as Eurasian Water-Milfoil.

Coefficient of Conservatism C

0-3 taxa found in wide variety of plant communities and very tolerant of disturbance.
4-6 taxa typically associated with specific plant communities and tolerate moderate disturbance.
7-8 taxa found in narrow range of plant communities and tolerate minor disturbance.
9-10 taxa restricted to a narrow range of synecological conditions, with low tolerance of disturbance.

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APPENDIX A

AQUATIC INVASIVE SPECIES INFORMATION

Invasive Aquatic Plants

Invasive species have invaded our backyards, forests, prairies, wetlands, and waters. Invasive species are often transplanted from other regions, even from across the globe. "A species is regarded as invasive if it has been introduced by human action to a location, area, or region where it did not previously occur naturally (i.e., is not native), becomes capable of establishing a breeding population in the new location without further intervention by humans, and spreads widely throughout the new location " (Source: WDNR website, Invasive Species, 2006). AIS include plants and animals that affect our lakes, rivers, and wetlands in negative ways. Once in their new environment, AIS often lack natural control mechanisms they may have had in their native ecosystem and may interfere with the native plant and animal interactions in their new "home". Some AIS have aggressive reproductive potential and contribute to ecological declines and problems for water based recreation and local economies. AIS often quickly become a problem in already disturbed lake ecosystems (i.e. one with relatively few native plant species). While native plants provide numerous benefits, AIS can contribute to ecological decline and financial constraints to manage problem infestations.

EWM - Eurasian Watermilfoil *(Myriophyllum spicatum)*

EWM is the most common AIS found in Wisconsin lakes. EWM was first discovered in southeast Wisconsin in the 1960's. During the 1980's, EWM began to spread to other lakes in southern Wisconsin and by 1993 it was common in 39 Wisconsin counties. EWM continues to spread across Wisconsin and is now found in the farthest northern portions of the state.

Past perception was that unlike many other plants, EWM does not rely on seed for reproduction and that its seeds germinate poorly under natural conditions. EWM's reproductive potential from seed is currently being investigated and seeds may prove to play a larger reproductive role than previously believed. EWM is very successful in reproducing vegetatively through a process of fragmentation, which allows it to disperse over long distances. The plant breaks apart (auto-fragments) after fruiting once or twice during the summer. These fragments may then be carried by water currents or inadvertently picked up by boaters. EWM is readily dispersed across landscapes and within lakes by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks out of water if kept moist (WDNR website, 2006).

Once established in an aquatic community, EWM reproduces from seed, shoots growing off rooted fragments and stolons (runners that creep along the lake bed). As an opportunistic species, EWM is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help EWM get a jump start early in spring. This early start can allow EWM to form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl (WDNR website, 2006), or perhaps allowing larger predators such as snapping turtles more cover when foraging.

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by EWM may lead to deteriorating water quality and algae blooms of infested lakes (WDNR website, 2006).

CLP - Curly leaf pondweed *(Potamogeton crispus)*

Curly leaf pondweed (CLP) spreads through burr-like winter buds (turions), which float across waterbodies or are moved along waterways. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making CLP one of the first aquatic plants to emerge in the spring.

The leaves of curly-leaf pondweed are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. The plant usually dies and drops to the lake bottom by early July.

CLP becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out-compete native plants in the spring. CLP forms surface mats that interfere with aquatic recreation in mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches (WDNR website, 2006).

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth form. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state. Low densities in most areas of the state suggest that the plant is still in the pioneering stage of establishment. Areas of heaviest infestation are sections of the Wisconsin River, the extreme southeastern part of the state, and the Wolf and Fox River drainage systems.

This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our

wetlands, lakes, and rivers. Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Mature plants with up to 50 shoots grow over 2 meters high and produce more than two million seeds a year. Germination is restricted to open, wet soils and requires high temperatures, but seeds remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months (WDNR website, 2006).

Other Aquatic Invasive Species

The following AIS are not plants, but are mentioned here because they also can significantly disrupt healthy aquatic ecosystems.

Rusty Crayfish *(Orconectes rusticus)* are large crustaceans that feed aggressively on aquatic plants, small invertebrates, small fish, and fish eggs. They can remove nearly all the aquatic vegetation from a lake, offsetting the balance of a lake ecosystem. More information about this invader can be found at http://dnr.wi.gov/invasives/fact/rusty.htm.

Zebra Mussels *(Dreissena polymorpha)* are small freshwater clams that can attach to hard substrates in water bodies, often forming large of thousands of individual mussels. They are prolific filter feeders, removing valuable phytoplankton from the water, which is the base of the food chain in an aquatic ecosystem. More information about this invader can be found at http://dnr.wi.gov/invasives/fact/zebra.htm.

Spiny Water Fleas (*Bythotrephes cederstoemi*) are predatory zooplankton (tiny aquatic animals) that have a barbed tail making up most of their body length (one centimeter average). They compete with small fish for food supplies (zooplankton) and small fish cannot swallow the spiny water flea due to the long spiny appendage. More research is being completed to determine the potential impacts of the spiny water flea. More information about this invader can be found at http://dnr.wi.gov/invasives/fact/spiny.htm.

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APPENDIX B

SHAWANO LAKE, (SHAWANO COUNTY) SENSITIVE AREA SURVEY REPORT

Shawano Lake, (Shawano County)
Sensitive Area Survey Report

Date of Survey: June 5, 2002 & August 20, 2003
Number of Sensitive Areas: 18

Site Evaluators:

Scott Koehnke, Water Management Specialist (Shawano)
Crystal Olson, Water Resource Management Specialist (Shawano)
Ross Langhurst, Fisheries Biologists (Shawano)
Mary Gansberg, Water Resource Management Specialist (Green Bay)

Author: Crystal Olson

General Lake Information:
Shawano Lake is a hard water drainage lake with multiple inlets and one major outlet, the Wolf River. A dam on the Wolf River located in the City of Shawano raises the water levels of Shawano Lake. Shawano Lake is approximately 6,043 acres. The Town of Wescott, Town of Washington and the Village of Cecil border Shawano Lake. The average depth is approximately 9 feet with a maximum depth of approximately 40 feet. The shoreline length is estimated at 18 miles. Shawano Lake is a popular recreation lake for fishing, boating, swimming, water skiing, bird watching, hunting, etc. Shawano Lake is currently a eutrophic lake with elevated levels of algae blooms, nutrients, and nuisance aquatic plants. Aquatic plant management is a major management objective for Shawano Lake. Shawano Lake is heavily developed with dense residential housing surrounding the majority of the shoreline. Shawano Lake is within the Shawano Lake Sanitary District and all dwellings have sanitary sewers and public water supply.

Shawano Lake is managed as a warm water fishery. The primary gamefish species are northern pike, largemouth bass, and walleye. The predominate panfish are bluegill, black crappie, yellow perch and pumpkinseed. Good natural reproduction supports this fine fishery. Over the last ten years a musky population has been established and is maintained by annual stocking. A walleye spawning reef was developed on Shawano Lake in the mid 1980's. Annual fall electrofishing surveys are done on the lake to monitor the reproduction success of walleye and largemouth bass with periodic spring fyke netting surveys conducted to monitor the overall fishery.

Shawano Lake is one of the most heavily fished lakes in the area. The lake receives consistent fishing pressure throughout the year with open water anglers pursuing predominately walleye, largemouth bass and panfish in the early season and ice fisherman concentrating on northern pike and panfish. Fishing tournaments are a common occurrence on the lake.

Shawano Lake is important for migrating waterfowl as a resting stop. Numerous species of wildlife inhabit shoreland areas where the shoreline is undeveloped. Standing dead and dying trees (snags) on the uplands provide habitat for various species of birds and insects, including bald eagles, bats, woodpeckers and songbirds. Several species of mammals and birds use cavities in trees for den sites. Salamanders, small mammals and invertebrates use downed and rotting logs for protection, feeding and breeding sites. Down trees in or at the water's edge (woody cover) are especially valuable for resting and feeding areas.

Aquatic and wetland vegetation present at or near the waters' edge provides critical habitat for small mammals, amphibians, reptiles, birds and fish at all life stages.

Shawano Lake provides the best wildlife habitat where the shoreline is undeveloped or the shoreline buffer is intact. Much of the woody cover, if not all, has been removed along developed shorelines, both in the water and on the upland. The understory or brush layer is also absent on developed shorelines. This layer provides habitat for small mammals and numerous species of birds. Management recommendations include maintaining the undeveloped shorelines and effectively restoring the developed and disturbed shorelines.

Shawano Lake demonstrates good plant diversity with approximately 22 species present. Plant densities vary depending on recreational use and areas of harvester operation, aquatic herbicide application and human disturbance. Generally speaking, the lower the recreational use, the higher the plant density and diversity. Aquatic plant management permits are required for chemical, mechanical and manual harvesting of aquatic plants. A permit is not required for manual removal of plants in a 30-foot wide zone along the shoreline per property. Please contact aquatic plant manager, Crystal Olson (715) 526-4220 before conducting any aquatic plant control in Shawano Lake.

There are approximately 24 access points on Shawano Lake. The boat landings and access points are a combination of public and private landings, along with township owned fire lanes. A county park is located on Shawano Lake with a swimming beach and boat launch. A second park is located within the Village of Cecil.

Introduction:
The survey was conducted on June 5, 2002 and August 20, 2003 using the Wisconsin Department of Natural Resources protocol guidelines for conducting and implementing sensitive area surveys. The purpose of the survey is to identify areas within the lake that have unique characteristics based on their aquatic plant community, fish and wildlife use. Sensitive area designations provide lake organizations, shoreline property owners, county zoning officials, DNR personnel and other interested individuals with specific management recommendations to protect and improve the health of the lake.

The companion document "**Guidelines for protecting, maintaining, and understanding lake sensitive area"** (contact DNR lakes coordinator, Crystal Olson, (715) 526-4220, for a copy) may be used for additional information to help understand lake sensitive area designations. This document contains information to help understand the factors that influence the health of the lake.

Eighteen sites on Shawano Lake contain critical habitat and were designated as sensitive areas (see Map 1). These areas are highly recommended for additional protection.

Overview of Sensitive Area Designations:
Sensitive areas are defined in Wisconsin Administrative Code NR 107.05(3.)(i.)(1.)-*Sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or life-stage requirements, or offering water quality or erosion control benefits to the body of water.* These areas may consist of valuable aquatic/wetland vegetation, terrestrial vegetation, gravel/rubble substrate, downed woody cover and water quality buffer areas.

The purpose of determining sensitive areas in lakes is to provide a tool for the goals listed below and to provide baseline field survey data for lake management records. The main goals of a sensitive area designation include:

- Use by managers to guide permitting processes of aquatic plant management, water regulations, fisheries management, wildlife management and local zoning activities
- Use to assist in the planning of various lake management projects
- Use as a tool in aquatic habitat protection activities
- Use by local lake organizations to help guide lake use and management activities
- Use as a compliment to local land-use planning activities
- Provide a guide to potential shoreland buyers and existing shoreland owners with development and lake use issues
- Provide baseline data for various resource management decisions
- Provide an educational tool to the public about natural areas and to initiate stewardship for lake and habitat protection

Exotic Species:
During this survey three species of exotic plants were documented. Purple Loosestrife was observed in several isolated locations along the shoreline, including one sensitive area (Site #2) along the State of Wisconsin land at the northwest corner of the lake. Management options include pulling of plants by hand, biological control with beetles and chemical treatment with herbicides such as Rodeo. Opportunities exist for the Shawano Area Waterways Management, Inc. and shoreline property owners to be actively involved in the control of Purple Loosestrife. (Contact DNR aquatic plant manager, Crystal Olson, (715) 526-4220). Curly-leaf pondweed is another exotic plant observed in several locations throughout the lake. Curly-leaf pondweed can be controlled through chemical herbicide treatment and early-season mechanical harvesting. Eurasian Watermilfoil was observed at all sites throughout the lake. This plant is most easily spread through boating activity. Eurasian Watermilfoil is a difficult plant to control and has shown only limited response to long-term herbicide control. Cleaning all plant material from watercraft before moving to other parts of the lake can prevent the spread of this plant.

Endangered and Threatened Species:
Several species of state-listed endangered or threatened animals and plants are found in Shawano Lake. *Eleocharis quadrangulata* (Square-stem spikerush), an emergent aquatic plant was observed in several locations throughout the lake, including 2 sensitive areas. *Fundulus diaphanus* (Banded Killifish), a species of Special Concern is also found in Shawano Lake. The banded killifish inhabits the shallow areas of large lakes and quiet backwaters. It has a strong preference for broad, sandy shallows during the warm season of the year in the vicinity of vegetation. A second fish species of Special Concern, *Notropis texanus* (Weed Shiner) is also found in Shawano Lake. Shawano Lake is also home to an active bald eagle nest. An osprey nest is located adjacent to Shawano Lake at the golf course with an active nest. Ospreys are listed as threatened species in Wisconsin. The red-necked grebe, an endangered waterfowl species, is a migratory bird that can be found on Shawano Lake.

Emergent Aquatic Plants:
Several of the sensitive areas designated in Shawano Lake were selected based primarily on the presence of an emergent aquatic plant community. Emergent aquatic plants are defined as plants that have the majority of their vegetative material above the surface of the water. Examples include cattails, bulrush, blue-flag iris, bottle brush sedge, pickerelweed and arrowhead. Emergent plants can tolerate fluctuating water levels and their dense stands can dampen shoreline waves. Emergent plants are highly valuable in

aquatic communities for several reasons. The leaves have extensive spongy tissue and air spaces. This makes them great nesting material for ducks, shorebirds and muskrats. Nest made of these buoyant leaves float up and down with changing water levels. The roots of emergent plants spread horizontally creating an interlocking network like a jute-backed carpet. This growth pattern is very important for stabilizing sediment. It also helps these plants withstand wave action and dissipate the force of upland runoff. Flexible reproductive strategies allow emergents to take advantage of variable conditions. When water levels are low, they reproduce from seeds that germinate on exposed mud flats. When water levels are high, they are equally successful at staking out territory with spreading roots and horizontal buried stems, called rhizomes that send up new shoots. (Through the Looking Glass, Borman, Korth, Temte, 1997)

Emergent plants are also valuable for invertebrate production. Invertebrates will utilize the surface areas of these plants for laying eggs. Several fish species utilize the stems of emergent plants for spawning.

Shawano Lake was once home to vast and extensive stands of emergent vegetation. The remaining stands have been designated as sensitive areas in order to protect against further degradation. The resource values of emergent vegetation have been pointed out but there are several values to the riparian landowner. A common complaint on Shawano Lake is the floating mats of dead and decaying vegetation that accumulate along the shoreline. Stands of emergent vegetation prevent these mats from reaching the shoreline, thus preventing the nuisance to the landowner. Emergent vegetation also protects against shoreline erosion, thus reducing the need for shoreline protection such as rock riprap or concrete seawalls.

Shoreland Management:
Wisconsin's Shoreland Management Program, a partnership between state and local government, works to protect clean water, habitat for fish and wildlife, and natural scenic beauty. The Program establishes minimum standards for lot sizes, structural setbacks, shoreland buffers, vegetation removal and other activities within the shoreland zone. The shoreland zone includes land within 1,000 feet of lakes, 300 feet of rivers and floodplains.

A critical part of protecting our water resources is the establishment and protection of an adequate buffer. A shoreland buffer should extend from the water onto the land at least 35 to 50 feet. Recent studies have shown that many species of wildlife may require up to 500 feet of buffer for habitat. Buffers of 50 feet and more help filter pollutants from runoff associated with impervious surfaces such as driveways, rooftops, roads and fertilized lawns.

Shoreland restorations should focus on native plant communities and should include aquatic vegetation and all layers of the canopy, herbaceous, shrub and tree layers. Please contact DNR lake coordinator, Crystal Olson (715) 526-4220, to learn more shoreland restoration.

Whole Lake Management Recommendations:
Resource managers made several recommendations on a whole lake basis.

1. Obey all slow no-wake areas. Establish specific navigation lanes through emergent stands of aquatic plants. Restrict boating traffic to these navigation lanes and to the near-shore area for private access via piers to allow for emergent vegetation expansion.
2. Eliminate or reduce chemicals and fertilizers on lawns. Phosphorus-free fertilizers should be used if fertilization is necessary. Have soils tested prior to fertilization to determine appropriate fertilizers and dosages.
3. Restore shoreland buffers with native vegetation on developed sites with small viewing and access corridors. Viewing corridors should be no wider than 35 feet.

4. Protect native aquatic vegetation. Allow mechanical harvesting of vegetation only in navigation channels or to control Curly-leaf pondweed. No mechanical harvesting in or near beds of Eurasian Watermilfoil. Chemical control of aquatic plants should only be allowed for navigation lanes, riparian nuisance aquatic plants and exotic invasive species control. Limit manual removal of native aquatic vegetation to no more than 30 feet along the shoreline per property.
5. Dredging is not necessary at any location in Shawano Lake.
6. Remove any oversized docks and minimize all structures in the littoral zone.
7. Bioengineering or other soft engineering techniques should be used in place of rock riprap or seawalls.
8. Eliminate the placement of sand below the ordinary high water mark. Placing fill material below the ordinary high water mark violates Chapter 30.12, Wisconsin State Statute. Eliminate the placement of sand in the shoreland zone. The placement of sand in the shoreland zone eliminates the vital shoreland buffer areas and eventually runs off into the lake, destroying the littoral zone habitat.
9. Do not remove coarse woody cover both in the water and in the shoreland zone.
10. Prevent the spread and establishment of exotic species such as Eurasian Watermilfoil, Curly-leaf pondweed and zebra mussels by posting signs and education. Prevent the spread of Curly-leaf pondweed and Eurasian Watermilfoil by removing all plant material from watercraft before moving to other parts of the lake.
11. Eliminate disturbance of the bank for construction of beach areas.

Resource Value of Site 1

This site is located adjacent to the Whispering Pines location along the north shore. The site consists of an area approximately 8.5 acres in size. The average water depth is approximately 2-3 feet. Primary reasons for site selection were aquatic vegetation and fishery values. Terrestrial plants including white pines, paper birch, oaks, maple and various species of shrubs and grasses act as a vegetative buffer, taking up nutrients before they reach the water, thus reducing nuisance algae blooms. Sediments are composed of mainly sand and silt. The shoreland buffer type is comprised of the shrub layer (26-50%) and tree layer (50-75%). Coarse woody cover was estimated at 1-2 pieces/30 meters of shoreline. The Natural Scenic Beauty rating, herein referenced to as NSB, was average, with minimal human influence.

As mentioned above, fisheries values were one of the primary reasons for site selection. This site offers several important habitat components for fish including emergent, submerged and floating-leaf vegetation. Centrarchids (sunfish family), Esocids (northern pike and musky), Large-mouth bass, Perch, Banded Killifish and forage species utilize this area for spawning, rearing, feeding and protective cover. The emergent vegetation at this site is essential for all life activities of these fish species.

The substrate and aquatic vegetation present provides for excellent habitat for the production of macroinvertebrates. The invertebrates are an essential part of the food chain. They provide food for several fish species, amphibians, reptiles, birds and larger insects.

This site also offers several important wildlife habitat components for a variety of species. Although wildlife values were not a primary reason for site selection, several species will utilize this area. Furbearers including muskrats and beavers utilize this area for feeding. Upland wildlife including deer, several species of birds including ducks, geese, songbirds and herons use this area for feeding, breeding, cover and nesting. Emergent vegetation, floating leaf vegetation, shrubs/brush and snag trees were all present on this site and offer habitat. The emergent vegetation at this site is extremely important for waterfowl. Waterfowl of all types utilize this vegetation for feeding, cover and a nursery area.

Aquatic vegetation was one of the primary reasons for site selection based on the type of vegetation present. The existence of native plants at this site protects against the likelihood of exotic species. Also, the existing vegetation provides protection against shoreline erosion and plant fragmentation. The emergent vegetation acts like a shoreline buffer and protects the shoreline from erosion. (See Table 1.)

Management Recommendations:

1. Create and protect shoreline/bank vegetation buffers.
2. Limit aquatic plant removal to navigation channels. Establish specific navigation lanes and restrict boat traffic to these lanes.
3. Protect emergent aquatic plants to prevent erosion and nutrient runoff.
4. Protect all existing plant communities to prevent the spread of exotic plant species.

Resource Value of Site 2
State of Wisconsin Land-West Shore

This site is located adjacent to the State of Wisconsin land along the west shore. The Department of Natural Resources owns 22 acres adjacent to this site. The site is approximately 4,000 feet long forming an area approximately 25 acres. Primary reasons for site selection include fishery, aquatic vegetation, wildlife values, terrestrial vegetation, NSB and water quality. Terrestrial plants including white pines, paper birch, oaks, maple and various species of shrubs and grasses act as a vegetative buffer, taking up nutrients before they reach the water, thus reducing nuisance algae blooms. Sediments are composed of sand and silt. The shoreland buffer type is 50% wetland and 50% wooded. The layers of the shoreland buffer are herbaceous (1-25%), shrub (1-25%), and trees (50-75%). The wetland type within the littoral zone and shoreland buffer is a deep marsh composed of cattail, yellow water lilies, wild rice and a shallow marsh composed of soft stem bulrush, arrowhead and pickerelweed. Large woody cover is common and averages 3-6 pieces/30 meters of shoreline. The NSB rating of this site is outstanding with no human influence and unique aesthetics.

Fisheries values were outstanding on this site. Species present include Esocids (northern pike and muskies), Centrarchids (sunfish family), perch, large mouth bass and forage species. This site offers a spawning, nursery, feeding and protective cover area. Important habitat components include emergent vegetation, submergent vegetation, floating leaf vegetation and over-hanging vegetation.

The substrate and aquatic vegetation present provides for excellent habitat for the production of macroinvertebrates. The invertebrates are an essential part of the food chain. They provide food for several fish species, amphibians, reptiles, birds and larger insects.

Wildlife habitat is also excellent on this site. Furbearers utilizing this area include muskrats, mink and beavers. Squirrels, opossums, raccoons, and fox are also present. Several species of birds including ducks, geese, songbirds and shorebirds such as herons and kingfishers utilize this area for shelter/cover, nesting and feeding areas. Deer utilize the upland areas for all life activities. Amphibians and reptiles depend on this site for cover, breeding and nesting. This site is also home to a bald eagle nest, a threatened species in Wisconsin. Important habitat components of this site include emergent vegetation, floating leaf vegetation, shrubs/brush and snag trees.

Water quality was another reason for site selection. This area includes dense plant beds that allow for nutrients to settle out, thus preventing nuisance algae blooms in other parts of the lake. The terrestrial vegetation on the upland also allows for nutrient filtration and prevents runoff. Aquatic vegetation diversity and density are exceptional at this site. This site has the highest diversity of any plant community within Shawano Lake. The existence of native plants at this site protects against the likelihood of exotic species. Also, the existing vegetation provides protection against shoreline erosion and plant fragmentation. (See Table 2.)

Another important component of this site is a stabilized shoreline due to the ice heave. The established ice ridges do not move from year to year and protects against shoreland runoff and buffers the adjacent wetland from ice and wave action.

Management Recommendations:

1. Protect upland buffer areas.
2. Protect emergent vegetation to prevent erosion and nutrient runoff.
3. Limit aquatic plant removal to the adjacent navigation channel. Protect all existing plant communities to prevent the spread of Eurasian Watermilfoil and Curly-Leaf Pondweed.
4. Establish a program to eradicate Purple Loosestrife.
5. Establish a slow no-wake buffer zone in entire sensitive area.
6. Minimize all activity to reduce disturbance to adult and juvenile bald eagles.

Resource Value of Site 3
South Shore

This site is located along the south shore, east of the Shawano Seaplane Base. The site is approximately 6,900 feet long, encompassing roughly 54 acres. The site includes all of the undeveloped shoreline currently under State of Wisconsin ownership. Primary reasons for site selection include fishery values, aquatic vegetation, natural scenic beauty, wildlife values and terrestrial vegetation. Sediments are composed mainly of sand and silt. The shoreland buffer type is 25% wetland and 75% wooded. The buffer consists of the herbaceous layer (1-25%), shrub layer (25-50%), and the tree layer (50-75%). Terrestrial vegetation includes paper birch, maple and oak trees. The wetland type within the littoral zone is characterized as a deep marsh with cattail, yellow water lilies and a shallow marsh with soft stem bulrush and arrowhead. The near-shore wetland is considered shrub carr with willows and tag alder present. Coarse woody cover was estimated at 1-2 pieces/30 meters of shoreline. The NSB rating is outstanding with no human influence and unique aesthetics.

Fishery values were one of the primary reasons for site selection. Species present include largemouth bass, Esocids (northern pike and musky), Centrachrids (sunfish family), perch, and forage fish. This site provides spawning, nursery and feeding areas, as well as protective cover for all species present. Habitat components at this site include large woody cover, emergent, submerged, floating leaf and over-hanging vegetation. This site includes the inlet, Murray Creek, which provides excellent spawning habitat for northern pike.

The substrate and aquatic vegetation present provides for excellent habitat for the production of macroinvertebrates. The invertebrates are an essential part of the food chain. They provide food for several fish species, amphibians, reptiles, birds and larger insects.

Wildlife habitat is also excellent on this site. This site is excellent habitat for muskrats, mink and raccoon. Several species of birds including ducks, geese, songbirds and shorebirds such as herons utilize this area for shelter/cover, nesting and feeding areas. Deer and ruffed grouse utilize the upland areas for all life activities. Amphibians and reptiles depend on this site for cover, breeding and nesting. Important habitat components of this site include emergent vegetation, floating leaf vegetation, shrubs/brush and snag trees. A belted kingfisher was observed utilizing this site.

Water quality was another reason for site selection. The terrestrial vegetation on the upland allows for nutrient filtration and prevents runoff. The dense plant beds help to stabilize the sediments and reduce nutrient recycling and the likelihood of algae blooms.

Aquatic vegetation was another primary reason for site selection. The existence of native plants at this site protects against the spread of exotic species. Also, the existing vegetation provides protection against shoreline erosion and plant fragmentation. (See Table 3.)

Management Recommendations:

1. Protect upland buffer area.
2. Protect emergent vegetation to prevent erosion and nutrient runoff.
3. Limit aquatic plant removal to the adjacent navigation channel. Protect all existing native plant communities to prevent the spread of exotic plant species.
4. Establish a slow no-wake buffer zone in entire sensitive area.
5. Establish a seasonal fish refuge near and in Murray Creek to protect northern pike spawning.

Resource Value of Site 4
NE of Rosenow Point

This site consists of emergent stands of vegetation northeast of Rosenow Point. The site totals approximately 52 acres in size and is roughly 1,300 feet long. Primary reasons for site selection were fishery and aquatic plant values. Sediments are primarily of sand. The shoreland is 100% developed. The buffer is 100% lawn with a few mature trees. No large woody cover is present within this site and the NSB rating is very poor, with major human disturbance.

Fishery values were one of the primary reasons site selection. Species present include Esocids (northern pike), largemouth bass, Centrarchids (sunfish family), perch, and forage fish. Other species of fish use this site for spawning, nursery and feeding areas, as well as protective cover for all species present. Habitat components at this site include emergent and submerged vegetation. The emergent vegetation is essential for fish habitat. The vegetation is also necessary to prevent shoreline erosion. (See Table 4)

The substrate and aquatic vegetation present provides for excellent habitat for the production of macroinvertebrates. The invertebrates are an essential part of the food chain. They provide food for several fish species, amphibians, reptiles, birds and larger insects. The vegetation is also extremely important for waterfowl.

Management Recommendations:

1. Strictly enforce no-wake zones.
2. Limit aquatic plant removal to navigation channels. Establish specific navigation lanes and restrict boat traffic to these lanes. Protect all existing plant communities to prevent the spread of exotic plant species.

3. No chemical control of native aquatic vegetation.
4. Protect emergent vegetation to prevent erosion and nutrient runoff and to provide habitat for spawning fish.

Resource Value of Site 5
West of Zimmerman Point

This site is located west of Zimmermann's Point. The total length is approximately 2,200 feet encompassing roughly 40 acres. Primary reasons for site selection were fishery values and aquatic vegetation. The dominant substrate type is sand. The shoreland buffer is 90% developed. The large woody cover is estimated at 3-6 pieces per 30 meters of shoreline. The NSB is rated as very poor with major human disturbance.

Aquatic vegetation was one of the primary reasons for site selection based on the diversity present. The emergent plant community provides several resources values previously discussed. The existence of native plants at this site protects against the likelihood of exotic species. Also, the existing vegetation provides protection against shoreline erosion and plant fragmentation. (See Table 5.)

All species of fish found in Shawano Lake will utilize this area for all life activities. The aquatic plant community provides spawning, nursery, feeding and a protective cover area.

Management Recommendations:

1. Strictly enforce no-wake zone
2. Limit aquatic plant removal to navigation channels. Establish specific navigation lanes and restrict boat traffic to these lanes. Protect all existing plant communities to prevent the spread of exotic plant species.
3. No chemical control of native aquatic vegetation.
4. Protect emergent vegetation to prevent erosion and nutrient runoff and to provide habitat for spawning northern pike.

Resource Value of Site 6
Northeast Shore

This site is located along the northeast shore of Shawano Lake. The site is approximately 9,500 feet long and encompasses an area roughly 114 acres in size. This site is the largest sensitive area within Shawano Lake and provides for a large variety of resource values. This site was chosen primarily for its emergent aquatic plant community. Due to the extensive emergent plants, fisheries values for this site were also exceptionally high. The shoreline is extensively developed except the area adjacent to the mouth of Duchess Creek. This area provides for high recreational use, primarily waterfowl hunting. The shoreland buffer type is dominantly lawn (76-100%). The estimate of large woody cover is none. The NSB is rated as very poor, with major human disturbance.

The emergent plant community is the primary reason for site selection. The emergent and submergent plants are a diverse community of native plants. (See Table 6) This large area of native plants protects against the spread of exotic species such as Eurasian Watermilfoil and Curly-leaf pondweed. The emergent plants also protect against shoreline erosion by dissipating wave energy and boat wakes. They also help trap floating mats of vegetation before these mats reach the shore, causing a problem for

shoreline residents. The plant community provides for extensive aquatic habitat including fishery and wildlife values.

The fish community within this site includes Esocids (northern pike), largemouth bass, Centrachrids (sunfish family), Walleyes, Musky, Banded Killifish and forage fish. All species utilize this area for feeding, spawning, protective cover and as a nursery area. This site is likely one of the most productive sites within Shawano Lake for fish reproduction. Important habitat components at this site include the emergent and submergent vegetation.

Wildlife values at this site are also high due to the plant community. Waterfowl utilize this site for all life activities. Woodducks and mallards use this area extensively for nesting. As previously mentioned, this site is recreationally popular for waterfowl hunting. The important habitat components include the plant community and the relatively shallow water.

This site also offers water quality benefits to the lake. Duchess Creek flows into Shawano Lake in this area. The plant community allows for sediment stabilization and nutrient filtration before this inlet water enters the lake.

Management Recommendations:

1. No chemical control of native aquatic vegetation.
2. Protect emergent vegetation to prevent erosion and nutrient runoff and to provide habitat for spawning northern pike.
3. Do not remove coarse woody cover in both the water and in the shoreland areas.
4. Establish shoreland restoration sites.
5. Limit aquatic plant removal to navigation channels. Establish specific navigation lanes and restrict boat traffic to these lanes. Protect all existing plant communities to prevent the spread of Eurasian Watermilfoil and Curly-Leaf Pondweed.

Resource Value of Site 7, 8,9,10
West of Washington Lake Channel (Sites 7 & 8)
Northeast of Zimmermann's Point (Site 9)
West of Duchess Creek Inlet (Site 10)

Sites 7, 8,9,10 are similar habitats within Shawano Lake. The sites were chosen based primarily on the aquatic plant communities. Site 7 includes the area of Site 15 and is approximately 950 feet long, encompassing roughly 12 acres. Site 8 includes 2,700 feet of shoreline, roughly 55 acres. Site 9 is an isolated stand of emergent vegetation totaling 3.7 acres. Site 10 includes 1.5 acres. The dominant substrate for each site is sand. The average water depth is 3 feet. The shoreland buffer type is almost 100% developed. The shore is dominantly lawn (76-100%) with a few trees (1-25%). The estimate of large woody cover is none. The NSB is rated as very poor, with major human disturbance.

The resource values are very similar to Site 6. Please reference the descriptions for that site as they apply to Sites 7, 8, 9, 10. (See Tables 7, 8,9,10 for the plant communities)

The management recommendations for Site 6 are also applicable for Sites 7, 8,9,10.

Resource Value of Site # 11
Schumacher Island

This site includes Schumacher Island and its associated emergent aquatic plant buffer. The total acreage of the site is 77 acres. This site was selected primarily for its fisheries values. The dominant substrate types are rubble and sand. The shoreland buffer type around the island is 95% wooded. Large woody cover is estimated at 1-2 pieces/30meters of shoreline. The NSB is rated at average, with minimal human disturbance.

Fisheries values were the primary reason for site selection. All species present within Shawano Lake can be found within this site. However, this site is the primary walleye production site for Shawano Lake. The substrate, location and emergent plant community provide the necessary elements for successful walleye reproduction.

Wildlife values were also high for this site. The island provides suitable habitat for waterfowl reproduction. Ducks and geese commonly nest on the island. The island also provides for a refuge from predators. Migrant species of waterfowl also use the island for feeding and resting. The adjacent plant community offers protective cover as well as feeding areas. Raptor such as bald eagles and ospreys may use islands as perch sites while feeding.

The plant community around the island is a diverse combination of emergent and submergent plants. (See Table 11). The plants offer shelter for all fish species and waterfowl. The emergent plants also protect the shoreline of the island from erosion by dissipating wave energy and boat wakes.

Management Recommendations

1. No chemical control of native aquatic vegetation.
2. Protect emergent vegetation to prevent erosion and nutrient runoff and to provide habitat for spawning fish.
3. Maintain slow no-wake speeds near the island.
4. Establish a seasonal fish spawning refugee site around the island to protect spawning walleyes.

Resource Value of Site 12, 13, 14
West Shore

Sites 12, 13, 14 are located near the west shore of Shawano Lake and are a group of stands of emergent vegetation. Site 12 totals 3 acres; Sites 13 &14 are approximately 1 acre each. These sites were chosen due to the emergent aquatic plant community with these areas. The average water depth is approximately 3 feet. Sand is the dominant substrate type. The adjacent shoreline to the west is 100% developed with the buffer dominantly lawn. There is no large woody cover near the shoreline and the NSB is rated at very poor with major human disturbance.

Emergent aquatic plants within these areas provide for fish cover, waterfowl protective cover and may reduce shoreline erosion. The diverse community provides for protection against the spread of Eurasian Watermilfoil and Curly-leaf pondweed. (See Tables 12, 13, 14).

All species of fish found in Shawano Lake will utilize this site for feeding and cover.

Management Recommendations

1. No chemical control of emergent aquatic vegetation.
2. Protect emergent vegetation to prevent erosion and nutrient runoff and to provide habitat for spawning fish.
3. Maintain slow no-wake speeds near the plant stands.

Resource Values of Sites 16, 17, 18
Near Cattau Beach Road

This site is located on the west shore adjacent to Cattau Beach Road. These sites consist of three stands of emergent vegetation. Site 16 is approximately 19 acres, Site 17 is 6 acres and Site 18 is roughly 1 acre. The average water depth is 2 feet and sand is the dominant substrate. The shoreland is 100 % developed and lawns dominated the buffer (76-100%). All woody cover has been removed and the NSB is rated as very poor due to major human disturbance.

The resource values are similar to Sites 12, 13, 14 and the management recommendations are identical.

Conclusion

In conclusion, eighteen sensitive areas were designated on Shawano Lake. This report identified important areas of habitat and management recommendations for each site. Lakes are one of the state's most valuable resources and without proper protection the water quality of our lakes will quickly deteriorate, resulting in degradation of fish and wildlife habitat. All lake ecosystems are sensitive to change and man's impact. It is critical that we protect and restore these valuable resources.

All the data that was used to complete this report can be obtained at the Shawano DNR service center.

Northern Environmental℠
Hydrologists • Engineers • Surveyors • Scientists

APPENDIX C

POINT INTERECEPT SAMPLE COORDINATES

sample point number	Xcoord	Ycoord
1	378000.02	4964749.97
2	378524.98	4964575.01
3	378349.97	4964574.99
4	378175.03	4964574.97
5	378000.02	4964574.96
6	377825	4964574.95
7	377649.99	4964574.95
8	378175.03	4964400.05
9	378875.03	4964400.04
10	378000.02	4964400.04
11	377824.99	4964400.03
12	377649.98	4964400.03
13	377440	4964400.03
14	378700	4964400.01
15	378524.99	4964399.98
16	379049.96	4964399.97
17	378349.97	4964399.96
18	378349.98	4964225.06
19	380625.01	4964225.05
20	379400.03	4964225.04
21	378175.04	4964225.04
22	378874.97	4964225.03
23	378000.02	4964225.02
24	377824.99	4964225.02
25	377300	4964225.02
26	377649.96	4964225.01
27	377475.02	4964225.01
28	379225.01	4964224.99
29	378700.03	4964224.99
30	380450	4964224.97
31	378525.01	4964224.97
32	379049.99	4964224.95
33	379050.02	4964050.05
34	380625.01	4964050.04
35	378349.99	4964050.04
36	382724.96	4964050.03
37	379399.99	4964050.02
38	378174.96	4964050.02
39	382550.02	4964050.01
40	380310	4964050.01
41	378874.99	4964050.01
42	378000.01	4964050.01
43	377824.99	4964050
44	377650.04	4964050
45	377475.01	4964050
46	377299.97	4964050
47	383075	4964049.99
48	382374.99	4964049.98
49	379224.97	4964049.98
50	378699.96	4964049.98

51	382199.98	4964049.97
52	381150	4964049.97
53	381325.02	4964049.96
54	379575.01	4964049.96
55	382899.98	4964049.95
56	381674.99	4964049.95
57	381499.97	4964049.95
58	378525.01	4964049.95
59	383425.03	4963875.05
60	382024.99	4963875.05
61	381325.03	4963875.05
62	379574.98	4963875.05
63	382900.03	4963875.04
64	381850.04	4963875.04
65	381675.01	4963875.04
66	381499.98	4963875.04
67	378525.03	4963875.04
68	379049.97	4963875.02
69	383250	4963875.01
70	382725.01	4963875.01
71	380625	4963875.01
72	378350	4963875.01
73	379750.01	4963875
74	379400.02	4963875
75	378174.97	4963875
76	380800.03	4963874.99
77	382549.98	4963874.98
78	378875.01	4963874.98
79	378000.01	4963874.98
80	377300.04	4963874.98
81	383074.98	4963874.97
82	380974.98	4963874.97
83	377824.98	4963874.97
84	377650.02	4963874.97
85	377474.99	4963874.97
86	382375.03	4963874.96
87	382200.01	4963874.95
88	381150	4963874.95
89	379224.99	4963874.95
90	378699.98	4963874.95
91	379925.04	4963874.94
92	384124.97	4963700.05
93	382199.96	4963700.05
94	381150.01	4963700.05
95	379225.03	4963700.05
96	378700	4963700.05
97	383425.02	4963700.04
98	381324.97	4963700.04
99	379925.01	4963700.04
100	379575.02	4963700.04
101	382900	4963700.03

102	382025.01	4963700.03
103	381849.98	4963700.03
104	381500	4963700.03
105	380450.03	4963700.03
106	381675.03	4963700.02
107	378524.96	4963700.02
108	379049.99	4963700.01
109	382724.97	4963700
110	380624.99	4963700
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112	378350.01	4963700
113	383249.99	4963699.99
114	383950.02	4963699.98
115	383599.97	4963699.98
116	379749.98	4963699.98
117	379399.98	4963699.98
118	378174.97	4963699.98
119	382550.02	4963699.97
120	380800.02	4963699.97
121	378875.04	4963699.97
122	378000.01	4963699.97
123	380275	4963699.96
124	377824.97	4963699.96
125	377474.97	4963699.96
126	377300.01	4963699.96
127	383075.04	4963699.95
128	382374.99	4963699.95
129	380974.98	4963699.95
130	377650.01	4963699.95
131	377300	4963525.06
132	383075.02	4963525.05
133	382375.03	4963525.05
134	380974.98	4963525.05
135	380274.98	4963525.05
136	377824.97	4963525.05
137	377650	4963525.05
138	377474.96	4963525.05
139	384124.98	4963525.04
140	383425.01	4963525.03
141	382200	4963525.03
142	381150.02	4963525.03
143	379924.99	4963525.03
144	379224.98	4963525.03
145	378700.02	4963525.03
146	383775	4963525.02
147	382899.98	4963525.02
148	382025.04	4963525.02
149	381850	4963525.02
150	381324.98	4963525.02
151	380450.02	4963525.02
152	379574.98	4963525.02

153	381674.96	4963525.01
154	381500.01	4963525.01
155	378524.98	4963525.01
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157	382725.02	4963524.99
158	380624.98	4963524.99
159	379050.02	4963524.99
160	383249.97	4963524.98
161	380100.03	4963524.98
162	378350.02	4963524.98
163	383950.03	4963524.97
164	383599.96	4963524.97
165	379750.02	4963524.97
166	379400.02	4963524.97
167	384474.97	4963524.96
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169	380800.02	4963524.96
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171	378174.98	4963524.96
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175	377125.01	4963350.05
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244	381150.03	4963175
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247	382900.01	4963174.99
248	382025.02	4963174.99
249	381324.99	4963174.99
250	379925.01	4963174.99
251	378699.98	4963174.99
252	384825.01	4963174.98
253	381849.98	4963174.98
254	381675.01	4963174.98

255	381499.97	4963174.98
256	380450	4963174.98
257	379574.99	4963174.98
258	384999.97	4963174.96
259	384300.04	4963174.96
260	382724.97	4963174.96
261	378525.01	4963174.96
262	383250.02	4963174.95
263	380624.96	4963174.95
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265	379050	4963174.95
266	382725.01	4963000.06
267	383250	4963000.05
268	380625.04	4963000.05
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272	380100.03	4963000.04
273	378349.97	4963000.04
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275	384475.03	4963000.03
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277	379750.01	4963000.03
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283	382374.99	4963000.01
284	378874.97	4963000.01
285	377124.96	4963000.01
286	384649.99	4963000
287	384125	4963000
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289	380275.01	4963000
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305	381850	4962999.97

306	381675.03	4962999.97
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325	378349.97	4962825.02
326	376774.97	4962825.02
327	380800	4962825.01
328	379749.98	4962825.01
329	379400.02	4962825.01
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334	384650.02	4962824.99
335	384125.01	4962824.99
336	382375.03	4962824.99
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340	377125.02	4962824.99
341	383424.96	4962824.98
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346	382899.96	4962824.97
347	382025	4962824.97
348	381149.96	4962824.97
349	379225.03	4962824.97
350	377649.96	4962824.97
351	377474.98	4962824.97
352	384824.98	4962824.96
353	381850.03	4962824.96
354	381500	4962824.96
355	381325.02	4962824.96
356	380449.97	4962824.96

357	379925.04	4962824.96
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361	379575	4962824.95
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364	382025.04	4962650.05
365	381849.98	4962650.05
366	381325.03	4962650.05
367	379925.01	4962650.05
368	379224.99	4962650.05
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374	380449.96	4962650.04
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376	384999.99	4962650.03
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381	383600.01	4962650.01
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386	382549.97	4962650
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396	384125.02	4962649.97
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400	378875.02	4962649.97
401	376249.97	4962649.97
402	383425.03	4962649.96
403	382200.02	4962649.96
404	378000.01	4962649.96
405	377124.99	4962649.96
406	383774.99	4962649.95
407	381149.97	4962649.95

408	377825.02	4962649.95
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413	383774.99	4962475.05
414	381149.98	4962475.05
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416	377299.97	4962475.05
417	382900	4962475.04
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419	381324.97	4962475.04
420	379924.99	4962475.04
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422	377650.03	4962475.04
423	377475.04	4962475.04
424	384300.02	4962475.03
425	381850	4962475.03
426	381675.01	4962475.03
427	381500.03	4962475.03
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538	379225.02	4962125
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837	378524.99	4960024.98
838	378350.02	4960024.95

Northern Environmental℠
Hydrologists • Engineers • Surveyors • Scientists

APPENDIX D

DESCRIPTIONS OF SHAWANO LAKE AQUATIC PLANT SPECIES

Floating-leaf Plants

Nuphar advena (Yellow Pond Lily), shows a preference for soft sediment and water that is 6 feet or less in depth. Floating leaves emerge in early summer from rhizomes that are actively growing in the soft sediments. Flowering occurs throughout the summer and supports a yellow flower. Floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

Yellow Pond Lily
Source: University of Florida Website

Nymphaea odorata (White Water Lily) has a flexible stalk with a round floating leaf. White Water Lily can be found growing in a variety of sediment types in less than 6 feet of water. Fragrant white flowers occur throughout the summer. The floating leaves provide shelter and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

White Water Lily
Source: UW Herbarium Website

Submergent Plants

Ceratophyllum demersum (Coontail) is one of the most widely distributed aquatic plants within Wisconsin. The plant lacks true roots and can be found in water up to 16 feet deep. The leaves are arranged in a whorled fashion and are stiff and located closer together at the tip of the plant, giving it the appearance of a raccoon tail. Coontail is excellent habitat for invertebrates, especially in the winter when most other plants have died. The plant itself is food for waterfowl and provides shelter and foraging opportunities for fish (Borman, et al., 1997). Coontail may be mistaken for EWM.

Coontail
Source: UW Herbarium Website

Chara, sp. (Muskgrass / Chara) looks like a vascular plant; it actually is a multi-celled algae (macroalgae). Muskgrass is usually found in hard waters and prefers muddy or sandy substrate and can often be found in deeper water than other submergent plants. Muskgrass beds provide valuable habitat for small fish and invertebrates. Muskgrass is also a favorite waterfowl food. Its rhizoids slow the movement and suspension of sediments and benefit water quality in the ability to stabilize the lake bottom (Borman, et al., 1997). It can easily be identified by its characteristic "musty" odor.

Chara sp.
Source: UW Herbarium Website

Elodea
Source: UW Herbarium Website

Elodea canadensis (Elodea or common waterweed) is an abundant native plant species that is distributed statewide. It prefers soft substrate and water depths to 15 feet (Nichols, 1999). Elodea reproduces by seed and sprigs (USDA, 2002). The stems of elodea offer shelter and grazing to fish, but very dense elodea can interfere with fish movement. Elodea can be considered invasive at times and out-competes other more desirable plants.

Myriophyllum sibiricum (Northern watermilfoil) is usually found growing in soft sediment in fairly clear-water lakes. Leaves are divided like a feather, with five to twelve pairs of thread-like leaflets. Leaves are arranged in whorls. Northern watermilfoil is more desirable than its invasive cousin, Eurasian watermilfoil. Waterfowl eat the foliage and fruit, while beds of this plant provide cover and foraging opportunities for fish and invertebrates (Borman, et al., 1997).

Northern watermilfoil
Source: UW Herbarium Website

Eurasian watermilfoil
Source: UW Herbarium Website

Myriophyllum spicatum (Eurasian watermilfoil or EWM) is a submersed aquatic plant native to Europe, Asia and northern Africa. It was introduced to the United States by early European settlers. EWM was first detected in Wisconsin lakes during the 1960's. In the past three decades, this AIS has significantly expanded its range to about 61 of Wisconsin's 72 counties and continues to infest new water bodies every year. Because of its potential for explosive growth and its incredible ability to regenerate, EWM can successfully out-compete most native aquatic plants, especially in disturbed areas.

Eurasian watermilfoil shows no substrate preference in most instances and can grow in water depths greater than 4 meters (Nichols, 1999). Dense beds of EWM are usually identified in soft/organic rich sediments in many lakes. Eurasian watermilfoil can reproduce by seeds, but its

main form of reproduction is vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried by water currents or inadvertently picked up by boaters. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist. Once established in an aquatic community, EWM reproduces from shoot fragments and stolons (runners that creep along the substrate).

EWM is an opportunistic species and is adapted for rapid growth early in spring which can form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways. For example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl (DNR, 2002).

Slender Naiad
Source: UW Herbarium Website

Najas flexilis (Slender Naiad) is sometimes called bushy pondweed and has fine branched stems that emerge from a slight rootstalk. Slender Naiad can grow in both shallow and deep water. Waterfowl, marsh birds, and muskrats consume the stems, leaves, and seeds of naiad. The foliage produces forage and shelter opportunities for fish and invertebrates (Borman, et al., 1997).

Potamogeton amplifolius (Large-leaf Pondweed) is also often referred to as musky weed or cabbage by anglers. Large leaf pondweed has robust stems and broad submersed leaves, which are slightly folded and lined with many veins. Floating leaves are oval and on long stalks. It is found mainly in soft sediments in water one to several feet deep and is sensitive to increased turbidity. The plant is commonly grazed by waterfowl, offers habitat for invertebrates, and foraging opportunities for fish (Borman, e al., 1997).

Large-leaf Pondweed
Source: UW Herbarium Website

Potamogeton crispus (Curly leaf pondweed) spreads through burr-like winter buds (turions), which are moved among waterways. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making CLP one of the first nuisance aquatic plants to emerge in the spring. The leaves of curly-leaf pondweed are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. The plant usually drops to the lake bottom by early July.

CLP becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and out-compete native plants in the spring. CLP forms surface mats that interfere with aquatic recreation in mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches (WDNR website, 2006).

Pomatogeton foliosus (Leafy Pondweed) has freely branched stems that emerge from slender rhizomes. This plant is easily identifiable by a stipule that is found wrapped around the stem. However, leafy pondweed can be confused with small pondweed. Leafy pondweed tends to bloom early in the season with a short flower stalk and a tight cluster of flowers. It is also identifiable due to the absence of glands that are found at the leaf nodes. Waterfowl eat the fruits of this early to mature aquatic and can be of local importance. Muskrat, beaver, and deer eat the foliage and fruit. Invertebrates and fish also forage and hide in the foliage (Borman, et al., 1997).

Leafy Pondweed
Source: UW Herbarium Website

Variable Pondweed
Source: UW Herbarium Website

Pomatogeton gramineus (Variable Pondweed) is usually found in more firm sediment in water that is about 3 feet deep. Variable pondweed overwinters by hardy rhizomes and winter buds. Flowering usually occurs early in the growing season and fruit is produced during mid summer. The fruits and tubers are grazed by waterfowl and the extensive network of leafy branches offers invertebrate habitat and foraging opportunities for fish (Borman, et al., 1997).

Potamogeton illinoensis (Illinois Pondweed) has stout stems that emerge from thick rhizomes. Most of the submersed leaves are lance-shaped to oval and either attach directly to the stem or have a short stalk. The leaves often have a sharp, needle like tip. Floating leaves which have a thick stalk and ellipse shaped blade are sometimes produced. Illinois pondweed is usually found in water with moderate to high pH and fairly good water clarity. The fruit produced by Illinois pondweed can be locally important to ducks and geese. The plant may also be grazed by muskrat, deer and beaver. This pondweed also offers excellent shade and cover for fish and good surface area for invertebrates.

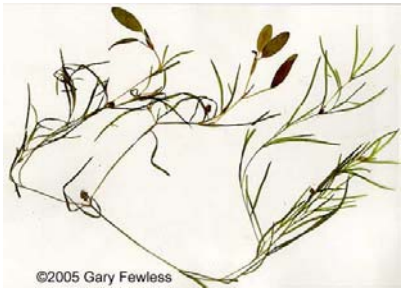
Illinois Pondweed
Source: University of Florida Website

Small Pondweed
Source: UW Herbarium Website

Potamogeton pusillus (Small Pondweed) has small slender stems, and branches repeatedly near its ends. There is some limited reproduction by seed. Small pondweed can be locally important as a food source for a variety of wildlife. Waterfowl feed on small pondweed as well as deer, muskrat, and some small fish (Borman, et al., 1997).

Potamogeton robbinsii (Fern Pondweed) is a submergent pondweed with robust stems and strongly two-ranked leaves, creating a feather or fern-like appearance while in the water. Fern pondweed sprouts in the spring and thrive in deeper water. Fern pondweed provides habitat for invertebrates that are grazed by waterfowl and also offers good cover for fish, particularly northern pike (Borman, et al., 1997).

Fern Pondweed
Source: UW Herbarium Website



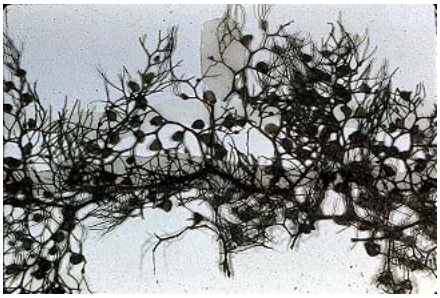
Spiral-Fruited Pondweed
Source: UW-Green Bay website

Potamogeton spirillus (Spiral-Fruited Pondweed) is another pondweed with frequently branched stems and narrow, submersed leaves. When present, the floating leaves are elliptical in shape. This can be easily distinguished from other narrow-leaved pondweeds by its spiral-shaped fruit. Spiral-fruited pondweed grows abundantly when present and is important in stabilizing the sediment in shallow water. It also provides a food source for waterfowl, habitat for invertebrates, and foraging opportunities for fish (Borman, et al., 1997).

Flat- Stem Pondweed
Source: UW Herbarium Website

Potamogeton zosteriformis (Flat-Stem Pondweed) is a submergent pondweed with freely-branched flattened stems. Flat stem pondweed is commonly confused with water stargrass (*Zosterella dubia*) but Flat-stem Pondweed can be distinguished by its prominent mid-vein and many fine, parallel veins.

Utriculari vulgaris (Common bladderwort) has floating stems that can reach 2-3 meters in length. Along the stem are leaf-like branches. On these branches are the bladders that trap prey. The branches also have fine spines (spicules) scattered along their margins. Yellow, two-lipped flowers are produced on stalks that protrude above the water surface. Common bladderwort is free-floating and can be found in water ranging from a few inches to several metes deep. The trailing stems of common bladderwort provide food and cover for fish. Because they are free-floating, they can grow in areas of very loosely consolidated sediment. This provides needed fish habitat in areas that are not readily colonized by rooted plants (Borman, et al., 1997).



Common bladderwort
Source: UW-Herbarium Website

Valisneria americana (Wild Celery) also known as eel-grass or tape-grass, and has ribbon-like leaves that tend to grow until they emerge in clusters along the waters surface. Wild celery is a premiere source of food for waterfowl. All portions of the plant are consumed. Beds of wild celery are also considered good fish habitat providing shade, shelter and feeding opportunities (Borman, et al., 1997).

Wild Celery
Source: UW Herbarium Website

Zannichellia palustris (horned-pondweed) is a turbidity tolerant species that prefers hard substrate. It can be confused with Potamogeton spp, but can be differentiated by its opposite branching stems.(Nichols, 1999) It is found in silty muddy substrates and can be found in water several meters deep. The fruit and foliage are grazed by waterfowl and is considered a fair food producer for trout. (Borman et al, 1997)

Horned-pondweed
Source: UW Herbarium Website

Emergent Plants

Sagittaria spp.
Source: UW Herbarium website

Sagittaria spp. (Arrowhead) is an emergent plant that usually produces leaves that are true to its name – shaped like an arrowhead. The size and shape of the leaf is highly variable with blades that range form a slender "A" shape to a broad wedge. Arrowhead is found in the shallow water of lakes, ponds, streams and marshes and usually found in water only ankle-deep, but will sometimes grow in water about 1 meter deep. Arrowhead is one of the highest value aquatic plants for wildlife and waterfowl depend on the high-energy tubers during migration. The seeds are also consumed by a wide variety of ducks, geese, marsh birds and shore birds. (Borman, et al., 1997).

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APPENDIX E

IMPORTANCE OF AQUATIC PLANTS TO LAKE ECOSYSTEM

Aquatic Plant Types and Habitat

Aquatic plants can be divided into two major groups: microphytes (phytoplankton and epiphytes) composed mostly of single-celled algae, and macrophytes that include macro algae, flowering vascular plants, and aquatic mosses and ferns. Wide varieties of microphytes co-inhabit all habitable areas of a lake. Their abundance depends on light, nutrient availability, and other ecological factors.

In contrast, macrophytes are predominantly found in distinct habitats located in the littoral (i.e., shallow near shore) zone where light sufficient for photosynthesis can penetrate to the lake bottom. The littoral zone is subdivided into four distinct transitional zones: the eulittoral, upper littoral, middle littoral, and lower littoral (Wetzel, 1983).

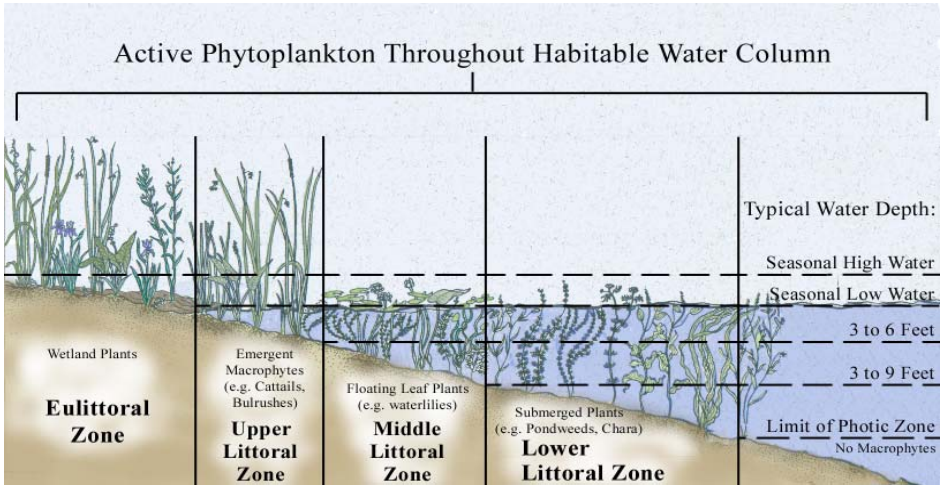
Eulittoral Zone: Includes the area between the highest and lowest seasonal water levels, and often contains many wetland plants.

Upper Littoral Zone: Dominated by emergent macrophytes and extends from the shoreline edge to water depths between 3 and 6 feet.

Middle Littoral Zone: Occupies water depths of 3 to 9 feet, extending deeper from the upper littoral zone. The middle littoral zone is often dominated by floating-leaf plants.

Lower Littoral Zone: Extends to a depth equivalent to the limit of the photic zone, which is the maximum depth that sufficient light can support photosynthesis. This area is dominated by submergent aquatic plant types.

The following illustration depicts these particular zones and aquatic plant communities.



Aquatic Plant Communities Schematic

The abundance and distribution of aquatic macrophytes are controlled by light availability, lake trophic status as it relates to nutrients and water chemistry, sediment characteristics, and wind energy. Lake morphology and watershed characteristics relate to these factors independently and in combination (NALMS, 1997).

Aquatic Plants and Water Quality

In many instances aquatic plants serve as indicators of water quality due to the sensitive nature of plants to water quality parameters such as water clarity and nutrient levels. To grow, aquatic plants must have adequate supplies of nutrients. Microphytes and free-floating macrophytes (e.g., duckweed) derive all their nutrients directly from the water. Rooted macrophytes can absorb nutrients from water and/or sediment. Therefore, the growth of phytoplankton and free-floating aquatic plants is regulated by the supply of critical available nutrients in the water column. In contrast, rooted aquatic plants can normally continue to grow in nutrient-poor water if lake sediment contains adequate nutrient concentrations. Nutrients removed by rooted macrophytes from the lake bottom may be returned to the water column when the plants die. Consequently, killing too many aquatic macrophytes may increase nutrients available for algal growth.

In general, an inverse relationship exists between water clarity and macrophyte growth. That is, water clarity is usually improved with increasing abundance of aquatic macrophytes. Two possible explanations are postulated. The first is that the macrophytes and epiphytes out-compete phytoplankton for available nutrients. Epiphytes derive essentially all of their nutrient needs from the water column. The other explanation is that aquatic macrophytes stabilize bottom sediment and limit water circulation, preventing re-suspension of solids and nutrients (NALMS, 1997).

If aquatic macrophyte abundance is reduced, then water clarity may suffer. Water clarity reductions can further reduce the vigor of macrophytes by restricting light penetration. Studies have shown that if 30 percent or less of a lake areas occupied by aquatic plants is controlled, water clarity will generally not be affected. However, lake water clarity will likely be reduced if 50 percent or more of the macrophytes are controlled (NALMS, 1997).

Aquatic plants also play a key role in the ecology of a lake system. Aquatic plants provide food and shelter for fish, wildlife and invertebrates. Plants also improve water quality by protecting shorelines and the lake bottom, improving water quality, adding to the aesthetic quality of the lake and impacting recreational activities.

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APPENDIX F

GENERAL SUMMARY OF AQUATIC PLANT MANAGEMENT ALTERNATIVES

Management Options for Aquatic Plants

Option	Permit Needed?	How it Works	PROS	CONS
No treatment	N	Do not treat plants	Protects native species that can prevent spread of invasive or exotic species, enhance water quality, and provide habitat for aquatic fauna	May allow small population of invasive plants to become larger, more difficult to control later
			No financial cost	
			No system disturbance	
			No harmful effects of chemicals	
			Permit not required	
Mechanical Control	Required under NR 109	Plants reduced by mechanical means	Flexible control	Must be repeated, often more than once per season
		Wide range of techniques, from manual to highly mechanized	Can balance habitat and recreational needs	Can suspend sediments and increase turbidity and nutrient release
a. Handpulling/Manual raking	Y/N	SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake	Little to no damage done to lake or to native plant species	Very labor intensive
		Works best in soft sediments	Can be highly selective	Needs to be carefully monitored
			Can be done by shoreline property owners without permits within an area <30 ft wide OR where selectively removing EWM or CLP	Roots, runners, and even fragments of some species (including EWM) will start new plants, so all of plant must be removed
			Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species	Small-scale control only

b.	Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore	Immediate results	Not selective in species removed
			Harvest invasives only if invasive is already present throughout the lake	EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting	Fragments of vegetation can re-root
				Usually minimal impact to the lake	Can remove some small fish and reptiles from lake
				Harvested lanes through dense weed beds can increase growth and survival of some fish	Initial cost of harvester expensive
				Can remove some nutrients from lake	
Biological Control		Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year	Effectiveness will vary as control agent's population fluctates
				Lowers density of problem plant to allow growth of natives	Provides moderate control - complete control unlikely
					Control response may be slow
					Must have enough control agent to be effective
a.	Weevils on EWM*	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem	Need to stock large numbers, even if some already present
				Selective control of target species	Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines
				Longer-term control with limited management	Bluegill populations decrease densities through predation
b.	Pathogens	Y	Fungal/bacterial/viral pathogen introduced to target species to induce mortalitiy	May be species specific	Largely experimental; effectiveness and longevity unknown
				May provide long-term control	Possible side effects not understood
				Few dangers to humans or animals	

c.	Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long-term, maintenance-free control	Initial transplanting slow and labor-intensive
				Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermilfoil growth	Spikerushes native to WI, and have not effectively limited EWM growth
					Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d.	Restoration of native plants	N; strongly recommend plan and consultation with DNR	Diverse native plant community established to repel invasive species	Native plants provide food and habitat for aquatic fauna	Initial transplanting slow and labor-intensive
				Diverse native community more repellant to invasive species	Nuisance invasive plants may outcompete plantings
				Supplements removal techniques	Largely experimental; few well-documented cases

Physical Control		Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a.	Drawdown	Y, May require Environmental Assessment	Lake water lowered; plants killed when sediment dries, compacts or freezes	Can be effective, especially when done in winter, provided drying and freezing occur. Sediment compaction is possible over winter	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling
			Must have a water level control device or siphon	Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction	Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced
			Season or duration of drawdown can change effects	Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality	May impact attached wetlands and shallow wells near shore
				Success for EWM, variable success for CLP*	Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning
				Restores natural water fluctuation important for all aquatic ecosystems	Winter drawdawn must start in early fall or will kill hibernating reptiles and amphibians
					Controversial
b.	Dredging	Y	Plants are removed along with sediment	Increases water depth	Expensive
			Most effective when soft sediments overlay harder substrate	Removes nutrient rich sediments	Increases turbidity and releases nutrients
			For extremely impacted systems	Removes soft bottom sediments that may have high oxygen demand	Exposed sediments may be recolonized by invasive species
			Extensive planning required		Sediment testing is expensive and may be necessary
					Removes benthic organisms
					Dredged materials must be disposed of
					Severe impact on lake ecosystem

c.	Dyes	Y	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity	Appropriate for very small water bodies
				Usually non-toxic, degrades naturally over a few weeks.	Should not be used in pond or lake with outflow
					Impairs aesthetics
					Affects to microscopic organisms unknown
d.	Mechanical circulation (Solarbees)	Y	Water is circulated and oxygenated	Reduces blue-green algae	Method is experimental; no published studies have been done
			Oxygenation of water decreases ammonium-nitrogen, which is a preferred nutrient source of EWM, theoretically limiting EWM growth (has not been demonstrated scientifically)	May reduce levels of ammonium-nitrogen in the water and at the sediment interface, which could reduce EWM growth	Although EWM prefers ammonium-nitrogen to nitrate, it will uptake nitrate efficiently, so EWM growth may not be affected
				Oxygenated water may reduce phosphorus release from sediments if mixing is complete	Units are aesthetically unpleasing
				Reduces chance of fish kills by aerating water	Units could be a navigational hazard
e.	Non-point source nutrient control	N	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use)	Attempts to correct source of problem, not treat symptoms	Results can take years to be evident due to internal recycling of already-present lake nutrients
				Could improve water clarity and reduce occurrences of algal blooms	Expensive
				Native plants may be able to compete invasive species better in low-nutrient conditions	Requires landowner cooperation and regulation
					Improved water clarity may increase plant growth

Chemical Control		Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae Results usually within 10 days of treatment, but repeat treatments usually needed	Some flexibility for different situations Some can be selective if applied correctly Can be used for restoration activities	Possible toxicity to aquatic animals or humans, especially applicators May kill desirable plant species, e.g. native water-milfoil or native pondweeds Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape Controversial
a.	2,4-D (Weedar, Navigate)	Y	Systemic[1] herbicide selective to broadleaf[2] plants that inhibits cell division in new tissue Applied as liquid or granules during early growth phase	Moderately to highly effective, especially on EWM Monocots, such as pondweeds (e.g. CLP) and many other native species not affected. Can be used in synergy with endotholl for early season CLP and EWM treatments Widely used aquatic herbicide	May cause oxygen depletion after plants die and decompose Cannot be used in combination with copper herbicides (used for algae) Toxic to fish
b.	Endothall (Aquathol)	Y	Broad-spectrum[3], contact[4] herbicide that inhibits protein synthesis Applied as liquid or granules	Especially effective on CLP and also effective on EWM May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring Can be selective depending on concentration and seasonal timing Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds Limited off-site drift	Kills many native pondweeds Not as effective in dense plant beds Not to be used in water supplies Toxic to aquatic fauna (to varying degrees) 3-day post-treatment restriction on fish consumption

c.	Diquat (Reward)	Y	Broad-spectrum, contact herbicide that disrupts cellular functioning	Mostly used for water-milfoil and duckweed	May impact non-target plants, especially native pondweeds, coontail, elodea, naiads
			Applied as liquid, can be combined with copper treatment	Rapid action	Toxic to aquatic invertebrates
				Limited direct toxicity on fish and other animals	Needs to be reapplied several years in a row
					Ineffective in muddy or cold water (<50°F)
d.	Fluridone (Sonar or Avast)	Y; special permit and Environmental Assessment may be required	Broad-spectrum, systemic herbicide that inhibits photosynthesis; some reduction in non-target effects can be achieved by lowering dosage	Effective on EWM for 1 to 4 years with aggressive follow-up treatments	Affects many non-target plants, particularly native milfoils, coontails, elodea, and naiads, even at low concentrations. These plants are important to combat invasive species
			Must be applied during early growth stage	Applied at very low concentration	Requires long contact time: 60-90 days
			Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107	Slow decomposition of plants may limit decreases in dissolved oxygen	Demonstrated herbicide resistance in hydrilla subjected to repeat treatments, EWM has the potential to develop resistance
				Low toxicity to aquatic animals	Unknown effect of repeat whole-lake treatments on lake ecology
e.	Glyphosate (Rodeo)	Y	Broad-spectrum, systemic herbicide that disrupts enzyme formation and function	Effective on floating and emergent plants such as purple loosestrife	Effective control for 1-5 years
			Usually used for purple loosestrife stems or cattails	Selective if carefully applied to individual plants	Ineffective in muddy water
			Applied as liquid spray or painted on loosetrife stems	Non-toxic to most aquatic animals at recommended dosages	Cannot be used near potable water intakes
					RoundUp is often illegally substituted for Rodeo
					Associated surfactants of RoundUp believed to be toxic to reptiles and amphibians
					No control of submerged plants

f.	Triclopyr (Renovate)	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher doses (e.g. coontail)
			Applied as liquid spray or liquid	More effective on dicots, such as purple loosestrife; may be more effective than glyphosate	May be toxic to sensitive invertebrates at higher concentrations
				Results in 3-5 weeks	Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)
				Low toxicity to aquatic animals	Sensitive to UV light; sunlight can break herbicide down prematurely
				No recreational use restrictions following treatment	Relatively new management option for aquatic plants (since 2003)
g.	Copper compounds (Cutrine Plus)	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
			Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment	Short-term results
				Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Precipitates rapidly in alkaline waters
					Small-scale control only, because algae are easily windblown
					Toxic to invertebrates, trout and other fish, depending on the hardness of the water
					Long-term effects of repeat treatments to benthic organisms unknown
					Clear water may increase plant growth

h.	Lime slurry	Y	Applications of lime temporarily raise water pH, which limits the availablity of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP	Relatively new technique, so effective dosage levels and exposure requirements are not yet known
				Prevents release of sediment phosphorus, which reduces algal growth	Short-term increase in turbidity due to suspended lime particles
				Increases growth of native plants beneficial as fish habitat	High pH detrimental to aquatic invertebrates
					May restrict growth of some native plants
i.	Alum (aluminum sulfate)	Y	Removes phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus	Most often used against algal problems	Must not eat fish for 30 days from treatment area
			Dosage must consider pH, hardness and water volume	Improves water clarity	Minimal effect on aquatic plants, or increased light penetration may increase aquatic plants
					Toxic to aquatic animals, including fish at some concentrations

***EWM - Eurasian water-milfoil**
***CLP - Curly-leaf pondweed**
[1]Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.
[2]Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.
[3]Broad-spectrum herbicide - Affects both monocots and dicots.
[4]Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

	Option	How it Works	PROS	CONS
Biological Control				
a.	Carp	Plants eaten by stocked carp	Effective at removing aquatic plants	Illegal to transport or stock carp in Wisconsin
			Involves species already present in Madison lakes	Carp cause resuspension of sediments, increased water temperature, lower dissolved oxygen levels, and reduction of light penetration
				Widespread plant removal deteriorates habitat for other fish and aquatic organisms
				Complete alteration of fish assemblage possible
				Dislodging of plants such as EWM or CLP turions can lead to accelerated spreading of plants
b.	Crayfish	Plants eaten by stocked crayfish	Reduces macrophyte biomass	Illegal to transport or stock crayfish in Wisconsin
				Control not selective and may decimate plant community
				Not successful in productive, soft-bottom lakes with many fish predators
				Complete alteration of fish assemblage possible
Mechanical Control				
a.	Cutting (no removal)	Plants are "mowed" with underwater cutter	Creates open water areas rapidly	Root system remains for regrowth
			Works in water up to 25 ft	Fragments of vegetation can re-root and spread infestation throughout the lake
				Nutrient release can cause increased algae and bacteria and be a nuisance to riparian property owners
				Not selective in species removed
				Small-scale control only
b.	Rototilling	Sediment is tilled to uproot plant roots and stems	Decreases stem density, can affect entire plant	Creates turbidity
		Works in deep water (17 ft)	Small-scale control	Not selective in species removed
			May provide long-term control	Fragments of vegetation can re-root
				Complete elimination of fish habitat
				Releases nutrients
				Increased likelihood of invasive species recolonization

c.	Hydroraking	Mechanical rake removes plants from lake Works in deep water (14 ft)	Creates open water areas rapidly	Fragments of vegetation can re-root May impact lake fauna Creates turbidity Plants regrow quickly Requires plant disposal
Physical Control				
a.	Fabrics/ Bottom Barriers	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas Useful for small areas	Eliminates all plants, including native plants important for a healthy lake ecosystem May inhibit spawning by some fish Need maintenance or will become covered in sediment and ineffective Gas accumulation under blankets can cause them to dislodge from the bottom Affects benthic invertebrates Anaerobic environment forms that can release excessive nutrients from sediment

Aquatic Plant Management

Aquatic plants are a critical component in an aquatic ecosystem. Any management of an ecosystem can have negative or even detrimental effects on the whole ecosystem. Therefore, the practice of managing aquatic plants should not be taken lightly. The concept of Aquatic Plant Management (APM) is highly variable since different aquatic resource users want different things. Ideal management to one individual may mean providing prime fish habitat, for another it may be to remove surface vegetation for boating. The practice of APM is also highly variable. There are numerous APM strategies designed to achieve different plant management goals. Some are effective on a small scale, but ineffective in larger situations. Others can only be used for specific plants or during certain times of the growing season. Of course, the types of plants that are to be managed will also help determine which APM alternatives are feasible. The following paragraphs discuss the APM methods used today. The discussion is largely adopted from *Managing Lakes and Rivers, North American Lake Management Society, 2001*, supplemented with other applicable current resources and references. The methods summarized here are largely for management of rooted aquatic plants, not algae. While some methods may also have effects on nuisance algae blooms, the focus is submergent rooted aquatic macrophytes. This information is provided to allow the user to gain a basic understanding of the APM method, it is not designed to an all-inclusive APM decision-making matrix. APM alternatives can be divided into the following categories: Physical Controls, Chemical Controls, and Biological Controls.

Physical Controls

Physical APM controls include various methods to prevent growth or remove part or all of the aquatic plant. Both manual and mechanical techniques are employed. Physical APM methods include:

- Hand pulling
- Hand cutting
- Bottom barriers
- Light limitation (dyes, covers)
- Mechanical harvesting
- Hydroraking/rototilling
- Suction Dredging
- Dredging
- Drawdown

Each of these methods are described below. The costs, benefits, and drawbacks of each APM strategy are provided.

Hand Pulling: This method involves digging out the entire unwanted plant including stems and roots with a hand tool such as a spade. This method is highly selective and suitable for shallow areas for removing invasive species that have not become well established. This technique is obviously not for use on large dense beds of nuisance aquatic plants. It is best used in areas less than 3 feet, but can be used in deeper areas with divers using scuba and snorkeling equipment. It can also be used in combination with the suction dredge method. In Wisconsin, hand pulling may be completed outside a designated sensitive area without a permit but is limited to 30 feet of shoreline frontage. Removal of exotic species is not limited to 30 feet.

Advantages: This technique results in immediate clearing of the water column of nuisance plants. When a selective technique is desired in a shallow, small area, hand pulling is a good choice. It is also useful in sensitive areas where disruption must be minimized.

Disadvantages: This method is labor intensive. Disturbing the substrate may affect fish habitat, increase turbidity, and may promote phosphorus re-suspension and subsequent algae blooms.

Costs: The costs are highly variable. There is practically no cost using volunteers or lakeshore landowners to remove unwanted plants, however, using divers to remove plants can get relatively expensive. Hand pulling labor can range from $400 to $800 per acre.

Hand Cutting: This is another manual method where the plants are cut below the water surface. Generally the roots are not removed. Tools such as rakes, scythes or other specialized tools are pulled through the plant beds by boat or several people. This method is not as selective as hand pulling. This method is well suited for small areas near docks and piers. Plant material must be removed from the water. In Wisconsin, hand cutting may be completed outside a designated sensitive area without a permit but is limited to 30 feet of shoreline frontage. Removal of exotic species is not limited to 30 feet.

Advantages: This technique results in immediate clearing of the water column of nuisance plants. Costs are minimal.

Disadvantages: This is also a fairly time consuming and labor intensive option. Since the technique does not remove the entire plant (leaves root system and part of plant), it may not result in long-term reductions in growth. This technique is not species specific and results in all aquatic plants being removed from the water column.

Costs: The costs range from minimal for volunteers using hand equipment up to over $1,000 for a hand-held mechanized cutting implement. Hand cutting labor can range from $400 to $800 per acre.

Bottom Barriers: A barrier material is applied over the lake bottom to prevent rooted aquatics from growing. Natural barriers such as clay, silt, and gravel can be used although eventually plants may root in these areas again. Artificial materials can also be used for bottom barriers and anchored to the substrate. Barrier materials include burlap, nylon, rubber, polyethylene, polypropylene, and fiberglass. Barriers include both solid and porous forms. A permit is required to place any fill or barrier structure on the substrate of a waterbody. This method is well suited for areas near docks, piers, and beaches. Periodic maintenance may be required to remove accumulated silt or rooting fragments from the barrier.

Advantages: This technique does not result in production of plant fragments. Properly installed, it can provide immediate and multiple year relief.

Disadvantages: This is a non-selective option, all plants beneath the barrier will be affected. Some materials are costly and installation is labor intensive. Other disadvantages include limited material durability, gas accumulation beneath the cover, or possible re-growth of plants from above or below the cover. Fish and invertebrate habitat is disrupted with this technique. Anchored barriers can be difficult to remove.

Costs: A 20 foot x 60 foot panel cost $265, while a 30 foot x 50 foot panel cost $375 (this does not include installation costs). Costs for materials vary from $0.15 per square foot ($ft^2$) to over $0.35/ ft^2. The costs for installation range from $0.25 to $0.50/ ft^2. Barriers can cost $20,000 to $50,000 per acre.

Light Limitation: Limiting the available light in the water column can prevent photosynthesis and plant growth. Dark colored dyes and surface covers have been used to accomplish light limitation. Dyes are effective in shallow water bodies where their concentration can be kept at a desired concentration and loss through dilution is less. This method is well suited for small, shallow water bodies with no outlets such as private ponds.

Surface covers can be a useful tool in small areas such as docks and beaches. While they can interfere with aquatic recreation, they can be timed to produce results and not affect summer recreation uses.

Advantages: Dyes are non-toxic to humans and aquatic organisms. No special equipment is required for application. Light limitation with dyes or covers method may be selective to shade tolerant species. In addition to submerged macrophyte control, it can also control the algae growth.

Disadvantages: The application of water column dyes is limited to shallow water bodies with no outlets. Repeated dye treatments may be necessary. The dyes may not control peripheral or shallow-water rooted plants. This technique must be initiated before aquatic plants start to grow. Covers inhibit gas exchange with the atmosphere.

Costs: Costs for a commercial dye and application range from $100 to $500 per acre.

Mechanical Harvesting: Mechanical harvesters are essentially cutters mounted on barges that cut aquatic plants at a desired depth. Maximum cutting depths range from 5 to 8 feet with a cutting width of 6.5 to 12 feet. Cut plant materials require collection and removal from the water. Conventional harvesters combine cutting, collecting, storing, and transporting cut vegetation into one piece of equipment. Transport barges and shoreline conveyors are also available to remove the cut vegetation. The cut plants must be removed from the water body. The equipment needs are dictated by severity of the aquatic plant problem. Contract harvesting services are available in lieu of purchasing used or new equipment. Trained staff will be necessary to operate a mechanical harvester. To achieve maximum removal of plant material, harvesting is usually completed during the summer months while submergent vegetation is growing to the surface. The duration of control is variable and re-growth of aquatic plants is common. Factors such as timing of harvest, water depth, depth of cut, and timing can influence the effectiveness of a harvesting operation. Harvesting is suited for large open areas with dense stands of exotic or nuisance plant species. Permits are now required in Wisconsin to use a mechanical harvester.

Advantages: Harvesting provides immediate visible results. Harvesting allows plant removal on a larger scale than other options. Harvesting provides flexible area control. In other words, the harvester can be moved to where it is needed and used to target problem areas. This technique has the added benefit of removing the plant material from the water body and therefore also eliminates a possible source of nutrients often released during fall decay of aquatic plants. While removal of nutrients through plant harvesting has not been quantified, it can be important in aquatic ecosystem with low nutrient inputs.

Disadvantages: Drawbacks of harvesting include: limited depth of operation, not selective within the application area, and expensive equipment costs.

Harvesting also creates plant fragments, which can be a concern since certain plants have the ability to reproduce from a plant fragment (e.g. Eurasian watermilfoil). Plant fragments may re-root and spread a problem plant to other areas. Harvesting can have negative effects on non-target plants, young of year fish, and invertebrates. The harvesting will require trained operators and maintenance of equipment. Also, a disposal site or landspreading program will be needed for harvested plants.

Costs: Costs for a harvesting operation are highly variable dependant on program scale. New harvesters range from $40,000 for small machines to over $100,000 for large, deluxe models. Costs vary considerably, depending on the model, size, and options chosen. Specially designed units are available, but may cost more. The equipment can last 10 to 15 years. A grant for ½ the equipment cost can be obtained from the Wisconsin Waterways Commission and a loan can be obtained for the remaining capital investment. Operation costs include insurance, fuel, spare parts, and payroll. Historical harvesting values have been reported at $200 up to $1,500 per acre. A survey of recent Wisconsin harvesting operations reported costs to be between $100/acre and $200/acre.

A used harvester can be purchased for $10,000 to $20,000. Maintenance costs are typically higher.

Contract harvesting costs approximately $125/per hour plus mobilization to the water body. Contractors can typically harvest ¼ to ½ acre per hour for an estimated cost of $250 to $500/per acre.

Hydroraking/rototilling: Hydroraking is the use of a boat or barge mounted machine with a rake that is lowered to the bottom and dragged. The tines of the rake rip out roots of aquatic plants. Rototilling, or rotovation, also rips out root masses but uses a mechanical rotating head with tines instead of a rake. Harvesting may need to be completed in conjunction with these methods to gather floating plant fragments. This application would best be used where nuisance populations are well established and prevention of stem fragments is not critical. A permit would be required for this type of aquatic plant management and would only be issued in limited cases of extreme infestations of nuisance vegetation. In Wisconsin, this method is not looked upon favorably or at all by the WDNR.

Advantages: These methods have the potential for significant reductions in aquatic plant growth. These methods can remove the plant stems and roots, resulting in thorough plant disruption. Hydroraking/rototilling can be completed in "off season" months avoiding interference with summer recreation activities.

Disadvantages: Hydroraking/rototilling are not selective and may destroy substrate habitat important to fish and invertebrates. Suspension of sediments will increase turbidity and release nutrients trapped in bottom sediments into the water column potentially causing algal blooms. These methods can cause floating plant and root fragments, which may re-root and spread the problem. Hydroraking/rototilling are expensive and not likely to be permitted by regulatory agencies.

Costs: Bottom tillage costs vary according to equipment, treatment scale, and plant density. For soft vegetation costs can range from $2,000 to $4,000 per acre. For dense, rooted masses, costs can be up to $10,000 per acre. Contract bottom tillage reportedly ranges from $1,200 to $1,700 per acre (Washington Department of Ecology, 1994).

Suction Dredging: Suction dredging uses a small boat or barge with portable dredges and suction heads. Scuba divers operate the suction dredge and can target removal of whole plants, seeds, and roots. This method may be applied in conjunction with hand cutting where divers dislodge the plants. The plant/sediment slurry is hydraulically pumped to the barge through hoses carried by the diver. Its effectiveness is dependent on sediment composition, density of aquatic plants, and underwater visibility. Suction dredging may be best suited for localized infestations of low plant density where fragmentation must be controlled. A permit will be required for this activity.

Advantages: Diver suction dredging is species –selective. Disruption of sediments can be minimized. These methods can remove the plant stems and roots, resulting in thorough plant disruption and potential longer term control. Fragmentation of plants is minimized. This activity can be completed near and around obstacles such as piers or marinas where a harvester could not operate.

Disadvantages: Diver suction dredging is labor intensive and costly. Upland disposal of dredged slurry can require additional equipment and costs. Increased turbidity in the area of treatment can be a problem. Release of nutrients and other pollutants can also be a problem.

Costs: Suction dredging costs can be variable depending on equipment and transport requirements for slurry. Costs range from $5,000 per acre to $10,000 per acre.

Dredging

Sediment removal through dredging can work as a plant control technique by limiting light through increased water depth or removing soft sediments that are a preferred habitat to nuisance rooted plants. Soft sediment removal is accomplished with drag lines, bucket dredges, long reach backhoes, or other specialized dredging equipment. Dredging has had mixed results in controlling aquatic plant, however it can be highly effective in appropriate situations. Dredging is most often applied in a major restructuring of a severely degraded system. Generally, dredging is an activity associated with other restoration efforts. Comprehensive pre-planning will be necessary for these techniques and a dredging permit would be required.

Advantages: Dredging can remove nutrient reserves which result in nuisance rooted aquatic plant growth. Dredging, when completed, can also actually improve substrate and habitat for more desirable species of aquatic plants, fish, and invertebrates. It allows the complete renovation of an aquatic ecosytem. This method has the potential for significant reductions in aquatic plant growth. These methods can be completed in "off season" months avoiding interference with summer recreation activities.

Disadvantages: Dredging can temporarily destroy important fish and invertebrate habitat. Suspension of sediments usually increases turbidity significantly and can possibly releases nutrients causing algae blooms. Dredging is extremely expensive and requires significant planning. Dredged materials may contain toxic materials (metals, PCBs). Dredged material transportation and disposal of toxic materials are additional management considerations and are potentially expensive. It could be difficult and costly to secure regulatory permits and approvals.

Costs: Dredging costs depend upon the scale of the project and many other factors. It is generally an extremely expensive option.

Drawdown: Water level drawdown exposes the plants and root systems to prolonged freezing and drying to kill the plants. It can be completed any time of the year, however is generally more effective in winter, exposing the lake bed to freezing temperatures. If there is a water level control structure capable of drawdown, it can be an in-expensive way to control some aquatic plants. Aquatic plants vary in their susceptibility to drawdown, therefore, accurate identification of problem species is important. Drawdown is often used for other purposes of improving waterfowl habitat or fishery management, but sometimes has the added benefit of nuisance rooted aquatic plant control. This method can be used in conjunction with a dredging project to excavate nutrient-rich sediments. This method is best suited for use on reservoirs or shallow man-made lakes. A drawdown would require regulatory permits and approvals.

Advantages: A drawdown can result in compaction of certain types of sediments and can be used to facilitate other lake management activities such as dam repair, bottom barrier, or dredging projects. Drawdown can significantly impact populations of aquatic plants that propagate vegetatively. It is inexpensive.

Disadvantages: This method is limited to situations with a water level control structure. Pumps can be used to de-water further if groundwater seepage is not significant. This technique may also result in the removal of beneficial plant species. Drawdowns can decrease bottom dwelling invertebrates and overwintering reptiles and amphibians. Drawdowns can affect adjacent wetlands, alter downstream flows, and potentially impair well production. Drawdowns and any water level manipulation are often highly controversial since shoreline landowners access and public recreation are limited during the drawdown. Fish populations are vulnerable during a drawdown due to over-harvesting by fisherman in decreased water volumes.

Costs: If a suitable outlet structure is available then costs should be minimal. If dewatering pumps would be required or additional management projects such as dredging are completed, additional costs would be incurred. Other costs would include recreational losses and perhaps loss in tourism revenue.

Chemical Controls

Using chemical herbicides to kill nuisance aquatic plants is the oldest APM method. However, past pesticides uses being linked to environmental or human health problems have led to public wariness of chemicals in the environment. Current pesticide registration procedures are more stringent than in the past. While no chemical pesticide can be considered 100 percent safe, federal pesticide regulations are based on the premise that if a chemical is used according to its label instructions it will not cause adverse environmental or human health effects.

Chemical herbicides for aquatic plants can be divided into two categories, systemic and contact herbicides. Systemic herbicides are absorbed by the plant, translocated throughout the plant, and are capable of killing the entire plant, including the roots and shoots. Contact herbicides kill the plant surface in which in comes in contact, leaving roots capable of re-growth. Aquatic herbicides exist under various trade names, causing some confusion. Aquatic herbicides include the following:

- Endothall Based Herbicide
- Diquat Based Herbicide
- Fluridone Based Herbicide
- 2-4 D Based Herbicide
- Glyophosate Based Herbicide
- Triclopyr Based Herbicide
- Phosphorus Precipitation

Each of these methods are described below. The costs, benefits, and drawbacks of each chemical APM alternative are provided.

Endothall Based Herbicide: Endothall is a contact herbicide, attacking a wide range of plants at the point of contact. The chemical is not readily transferred to other plant tissue, therefore regrowth can be expected and repeated treatments may be needed. It is sold in liquid and granular forms under the trade names of Aquathol® or Hydrothol®. Hydrothol is also an algaecide. Most endothall products break down easily and do not remain in the aquatic environment. Endothall products can result in plant reductions for a few weeks to several months. Multi-season effectiveness is not typical. A permit is required for use of this herbicide.

Advantages: Endothall products work quickly and exhibit moderate to highly effective control of floating and submersed species. This herbicide has limited toxicity to fish at recommended doses.

Disadvantages: The entire plant is not killed when using endothall. Endothall is non-selective in the treatment area. High concentrations can kill fish easily. Water use restrictions (time delays) are necessary for recreation, irrigation, and fish consumption after application.

Costs: Costs vary with treatment area and dosage. Average costs for chemical application range between $400 and $700 per acre.

Diquat Based Herbicide: Diquat is a fast-acting contact herbicide effective on a broad spectrum of aquatic plants. It is sold under the trade name Reward®. Diluted forms of this product are also sold as private label products. Since Diquat binds to sediments readily, its effectiveness is reduced by turbid water. Multi-season effectiveness is not typical. A permit is required for use of this herbicide.

Advantages: Diquat works quickly and exhibit moderate to highly effective control of floating and submersed species. This herbicide has limited toxicity to fish at recommended doses.

Disadvantages: The entire plant is not killed when using diquat. Diquat is non-selective in the treatment area. Diquat can be inactivated by suspended sediments. Diquat is sometimes toxic to zooplankton at the recommended dose. Limited water used restrictions (water supply, agriculture, and contact recreation) are required after application.

Costs: Costs vary with treatment area and dosage. A general cost estimate for treatment is between $200 and $500 per acre.

Fluoridone Based Herbicide: Fluoridone is a slow-acting systemic herbicide, which is effectively absorbed and translocated by both plant roots and stems. Sonar® and Avast!® is the trade name and it is sold in liquid or granular form. Fluoridone requires a longer contact time and demonstrates delayed toxicity to target plants. Eurasian watermilfoil is more sensitive to fluoridone than other aquatic plants. This allows a semi-selective approach when low enough doses are used. Since the roots are also killed, multi-season effectiveness can be achieved. It is best applied during the early growth phase of the plants. A permit and extensive planning is required for use of this herbicide.

Advantages: Fluoridone is capable of killing roots, therefore producing a longer lasting effect than other herbicides. A variety of emergent and submersed aquatics are susceptible to this herbicide. Fluoridine can be used selectively, based on concentration. A gradual killing of target plants limits severe oxygen depletion from dead plant material. It has demonstrated low toxicity to aquatic fauna such as fish and invertebrates. 3 to 5 year control has been demonstrated. Extensive testing has shown that, when used according to label instructions, it does not pose negative health affects.

Disadvantages: Fluoridine is a very slow-acting herbicide sometimes taking up to several months for visible effects. It requires a long contact time. Fluoridine is extremely soluble and mixable, therefore, not effective in flowing water situations or for treating a select area in a large open lake. Impacts on non-target plants are possible at higher doses. Time delays are necessary on use of the water (water supply, irrigation, and contact recreation) after application.

Costs: Costs vary with treatment area and dosage. Treatment costs range from $500 to $2,000 per acre.

2,4-D Based Herbicide: 2,4-D based herbicides are sold in liquid or granular forms under various trade names. Common granular forms are sold under the trade names Navigate® and Aqua Kleen®. Common liquid forms include DMA 4® and Weedar 64®. 2,4-D is a systemic herbicide that affects broad leaf plants. It has been demonstrated effective against Eurasian watermilfoil, but it may not work on many aquatic plants. Since the roots are also killed, multi-season effectiveness may be achieved. It is best applied during the early growth phase of the plants. Visible results are evident within 10 to 14 days. A permit is required for use of this herbicide.

Advantages: 2,4-D is capable of killing roots, therefore producing a longer lasting effect than some other herbicides. It is fairly fast and somewhat selective, based on application timing and concentration. 2,4-D containing products are moderately to highly effective on a few emergent, floating, or submersed plants.

Disadvantages: 2,4-D can have variable toxicity effects to aquatic fauna, depending on formulation and water chemistry. 2,4-D lasts only a short time in water, but can be detected in sediments for months after application. Time delays are necessary on use of the water (agriculture and contact recreation) after application. The label does not permit use of this product in water used for drinking, irrigation, or livestock watering.

Costs: Costs vary with treatment area and dosage. Treatment costs range from $300 to $800 per acre.

Glyophosate Based Herbicide: Glyophosate has been categorized as both a contact and a systemic herbicide. It is applied as a liquid spray and is sold under the trade name Rodeo® or Pondmaster®. It is a non-selective, broad based herbicide effective against emergent or floating leaved plants, but not submergents. It's effectiveness can be reduced by rain. A permit is required for use of this herbicide.

Advantages: Glyophoshate is moderately to highly effective against emergent and floating-leaf plants resulting in rapid plant destruction. Since it is applied by spraying plants above the surface, the applicator can apply it selectively to target plants. Glyophosate dissipates quickly from natural waters, has a low toxicity to aquatic fauna, and carries no restrictions or time delays for swimming, fishing, or irrigation.

Disadvantages: Glyophoshate is non-selective in the treatment area. Wind can dissipate the product during the application reducing it's effectiveness and cause damage to non-target organisms. Therefore, spray application should only be completed when wind drift is not a problem. This compound is highly corrosive, therefore storage precautions are necessary.

Costs: Costs average $500 to $1,000 per acre depending on the scale of treatment.

Triclopyr Based Herbicide: Triclopyr is a systemic herbicide. It is registered for experimental aquatic use in selected areas only. It is applied as a liquid spray or injected into the subsurface as a liquid. Triclopyr is sold under the trade name Renovate® or Restorate®. Triclopyr has shown to be an effective control to many floating and submersed plants. It has been demonstrated to be highly effective against Eurasian watermilfoil, having little effect on valued native plants such as pondweeds. Triclopyr is most effective when applied during the active growth period of younger plants.

Advantages: This herbicide is fast acting. Triclopyr can be used selectively since it appears more effective against dicot plant species, including several difficult nuisance plants. Testing has demonstrated low toxicity to aquatic fauna.

Disadvantages: At higher doses, there are possible impacts to non-target species. Some forms of this herbicide are experimental for aquatic use and restrictions on use of the treated water are not yet certain.

Biological Controls

There has been recent interest in using biological technologies to control aquatic plants. This concept stems from a desire to use a "natural" control and reduce expenses related to equipment and/or chemicals. While use of biological controls is in its infancy, potentially useful technologies have been identified and show promise for integration with physical and chemical APM strategies. Several biological controls that are in use or are under experimentation include the following:

- Herbivorous Fish
- Herbivorous Insects
- Plant Pathogens
- Native Plants

Each of these methods are described below. The costs, benefits, and drawbacks of each biologic APM method are provided.

Herbivorous Fish: A herbivorous fish such as the non-native grass carp can consume large quantities of aquatic plants. These fish have high growth rates and a wide range of plant food preferences. Stocking rates and effectiveness will depend on many factors including climate, water temperature, type and extent of aquatic plants, and other site-specific issues. Sterile (triploid) fish have been developed resulting in no reproduction of the grass carp and population control. This technology has demonstrated mixed results and is most appropriately used for lake-wide, low intensity control of submersed plants. Some states do not allow stocking of herbivorous fish. In Wisconsin, stocking of grass carp is prohibited.

Advantages: This technology can provide multiple years of aquatic plant control from a single stocking. Compared to other long-term aquatic plant control techniques such as bottom tillage or bottom barriers, costs may be relatively low.

Disadvantages: Sterile grass carp exhibit distinct food preferences, limiting their applicability. Grass carp may feed selectively on the preferred plants, while less preferred plants, including milfoil, may increase. The effects of using grass carp may not be immediate. Overstocking may result in an impact on non-target plants or eradication of beneficial plants, altering lake habitat. Using grass carp may result in algae blooms and increased turbidity. If precautions are not taken (i.e. inlet and outlet control structures to prevent fish migration) the fish may migrate and have adverse effects on non-target vegetation.

Costs: Costs can range from $50/acre to over $2,000/acre, at stocking rates of 5 fish/acre to 200 fish/acre.

Herbivorous Insects: Non-native and native insect species have been used to control rooted plants. Using herbivorous insects is intended to selectively control target species. These aquatic larvae of moths, beetles, and thrips use specific host aquatic plants. Several non-native species have been imported under USDA approval and used in integrated pest management programs, a combination of biological, chemical, and mechanical controls.

These non-native insects are being used in southern states to control nuisance plant species and appear climate-limited, their northern range being Georgia and North Carolina. While successes have been demonstrated, non-native species have not established themselves for solving biological problems, sometimes creating as many problems as they solve. Therefore, government agencies prefer alternative controls.

Native insects such as the larvae of midgeflies, caddisflies, beetles, and moths may be successful APM controls in northern states. Recently however, the native aquatic weevil *Euhrychiopsis lecontei* has received the most attention. This weevil has been associated with native northern water milfoil. The weevil can switch plant hosts and feed on Eurasian watermilfoil, destroying it's growth points. While the milfoil weevil is gaining popularity, it is still experimental.

Advantages: Herbivorous insects are expected to have no negative effects on non-target species. The insects have shown promise for long term control when used as part of integrated aquatic plant management programs. The milfoil weevils do not use non-milfoil plants as hosts.

Disadvantages: Natural predator prey cycles indicate that incomplete control is likely. An oscillating cycle of control and re-growth is more likely. Fish predation may complicate controls. Large numbers of milfoil weevils may be required for a dense stand and can be expensive. The weevil leaves the water during the winter, may not return to the water in the spring, and are subject to bird predation in their terrestrial habitat. Application is manual and extremely time consuming. Introducing any species, especially non-native ones, into an aquatic ecosystem may have undesirable effects. Therefore, it is extremely important to understand the life cycles of the insects and the host plants.

Costs: Reported costs of herbivorous insects rang from $300/acre to $3,000/acre.

Specifically, the native milfoil weevils cost approximately $1.00 per weevil. It is generally considered appropriate to use 5 to 7 weevils per stem. Dense stands of milfoil may contain 1 to 2 million stems per acre. Therefore, costs of this new technology are currently prohibitive.

Plant Pathogens: Using a plant pathogen to control nuisance aquatic plants has been studied for many years, however, plant pathogens still remain largely experimental. Fungi are the most common pathogens, while bacteria and viruses have also been used. There is potential for highly specific plant applications.

Advantages: Plant pathogens may be highly species specific. They may provide substantial control of a nuisance species.

Disadvantages: Pathogens are experimental. The effectiveness and longevity of control is not well understood. Possible side effects are also unknown.

Costs: These techniques are experimental therefore a supply of specific products and costs are not established.

Native Plants: This method involves removing the nuisance plant species through chemical or physical means and re-introducing seeds, cuttings, or whole plants of desirable species. Success has been variable. When using seeds, they need to be planted early enough to encourage the full growth and subsequent seed production of those plants. Transplanting mature plants may be a better way to establish seed producing populations of desirable aquatics. Recognizing that a healthy, native, desirable plant community may be resistant to infestations of nuisance species, planting native plants should be encouraged as an APM alternative. Non-native plants can not be translocated.

Advantages: This alternative can restore native plant communities. It can be used to supplement other methods and potentially prevent future needs for costly repeat APM treatments.

Disadvantages: While this appears to be a desirable practice, it is experimental at this time and there are not many well documented successes. Nuisance species may eventually again invade the areas of native plantings. Careful planning is required to ensure that the introduced species do not themselves become nuisances. Hand planting aquatic plants is labor intensive.

Costs: Costs can be highly variable depending on the selected native species, numbers of plants ordered, and the nearest dealer location.

Aquatic Plant Prevention

The phrase "an ounce of prevention is worth a pound of cure" certainly holds true for APM. Prevention is the best way to avoid nuisance aquatic plant growth. Prevention of the spread of invasive aquatic plants must also be achieved. Inspecting boats, trailers, and live wells for live aquatic plant material is the best way to prevent nuisance aquatic plants from entering a new aquatic ecosystem. Protecting the desirable native plant communities is also important in maintaining a healthy aquatic ecosystem and preventing the spread of nuisance aquatics once they are present.

Prolific growth of nuisance aquatic plants can be prevented by limiting nutrient (i.e. phosphorus) inputs to the water body. Aeration or phosphorus precipitation can achieve controls of in-lake cycling of phosphorus, however, if there are additional outside sources of nutrients, these methods will be largely ineffective in controlling algae blooms or intense aquatic macrophyte infestations. Watershed management activities to control nutrient laden storm water runoff are critical to controlling excessive nutrient loading to the water bodies. Nutrient loading can be prevented/minimized by the following:

- Shoreline buffers
- Using non-phosphorus fertilizers on lawns
- Settling basins for storm water effluents

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APPENDIX G

NR 107 AND NR 109 WISCONSIN ADMINISTRATIVE CODES

Chapter NR 107

AQUATIC PLANT MANAGEMENT

Note: Chapter NR 107 as it existed on February 28, 1989 was repealed and a new Chapter NR 107 was created effective March 1, 1989.

NR 107.01 Purpose. The purpose of this chapter is to establish procedures for the management of aquatic plants and control of other aquatic organisms pursuant to s. 227.11 (2) (a), Stats., and interpreting s. 281.17 (2), Stats. A balanced aquatic plant community is recognized to be a vital and necessary component of a healthy aquatic ecosystem. The department may allow the management of nuisance–causing aquatic plants with chemicals registered and labeled by the U.S. environmental protection agency and labeled and registered by firms licensed as pesticide manufacturers and labelers with the Wisconsin department of agriculture, trade and consumer protection. Chemical management shall be allowed in a manner consistent with sound ecosystem management and shall minimize the loss of ecological values in the water body.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **correction made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.02 Applicability. Any person sponsoring or conducting chemical treatment for the management of aquatic plants or control of other aquatic organisms in waters of the state shall obtain a permit from the department. Waters of the state include those portions of Lake Michigan and Lake Superior, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other ground or surface water, natural or artificial, public or private, within the state or its jurisdiction as specified in s. 281.01 (18), Stats.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **correction made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.03 Definitions. (1) "Applicator" means the person physically applying the chemicals to the treatment site.

(2) "Chemical fact sheet" means a summary of information on a specific chemical written by the department including general aquatic community and human safety considerations applicable to Wisconsin sites.

(3) "Department" means the department of natural resources.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.04 Application for permit. (1) Permit applications shall be made on forms provided by the department and shall be submitted to the district director for the district in which the project is located. Any amendment or revision to an application shall be treated by the department as a new application, except as provided in s. NR 107.04 (3) (g).

Note: The DNR district headquarters are located at:

1. Southern — 3911 Fish Hatchery Road, Fitchburg 53711
2. Southeast — 2300 N. Dr. Martin Luther King Jr. Dr., Box 12436, Milwaukee 53212
3. Lake Michigan — 1125 N. Military Ave., Box 10448, Green Bay 54307
4. North Central — 107 Sutliff Ave., Box 818, Rhinelander 54501
5. Western — 1300 W. Clairemont Ave., Call Box 4001, Eau Claire 54702
6. Northwest — Hwy 70 West, Box 309, Spooner 54801

(2) The application shall be accompanied by:

(a) A nonrefundable permit application fee of $20, and, for proposed treatments larger than 0.25 acres, an additional refundable acreage fee of $25.00 per acre, rounded up to the nearest whole acre, applied to a maximum of 50.0 acres.

1. The acreage fee shall be refunded in whole if the entire permit is denied or if no treatment occurs on any part of the permitted treatment area. Refunds will not be prorated for partial treatments.

2. If the permit is issued with the proposed treatment area partially denied, a refund of acreage fees shall be given for the area denied.

(b) A legal description of the body of water proposed for treatment including township, range and section number;

(c) One copy of a detailed map or sketch of the body of water with the proposed treatment area dimensions clearly shown and with pertinent information necessary to locate those properties, by name of owner, riparian to the treatment area, which may include street address, local telephone number, block, lot and fire number where available. If a local address is not available, the home address and phone number of the property owner may be included;

(d) A description of the uses being impaired by plants or aquatic organisms and reason for treatment;

(e) A description of the plant community or other aquatic organisms causing the use impairment;

(f) The product names of chemicals proposed for use and the method of application;

(g) The name of the person or commercial applicator, and applicator certification number, when required by s. NR 107.08 (5), of the person conducting the treatment;

(h) A comparison of alternative control methods and their feasibility for use on the proposed treatment site.

(3) In addition to the information required under sub. (2), when the proposed treatment is a large–scale treatment exceeding 10.0 acres in size or 10% of the area of the water body that is 10 feet or less in depth, the application shall be accompanied by:

(a) A map showing the size and boundaries of the water body and its watershed.

(b) A map and list identifying known or suspected land use practices contributing to plant–related water quality problems in the watershed.

(c) A summary of conditions contributing to undesirable plant growth on the water body.

(d) A general description of the fish and wildlife uses occurring within the proposed treatment site.

(e) A summary of recreational uses of the proposed treatment site.

(f) Evidence that a public notice of the proposed application has been made, and that a public informational meeting, if required, has been conducted.

1. Notice shall be given in 2 inch x 4 inch advertising format in the newspaper which has the largest circulation in the area affected by the application.

2. The notice shall state the size of the proposed treatment, the approximate treatment dates, and that the public may request within 5 days of the notice that the applicant hold a public informational meeting on the proposed application.

a. The applicant will conduct a public informational meeting in a location near the water body when a combination of 5 or more individuals, organizations, special units of government, or local units of government request the meeting in writing to the applicant

with a copy to the department within 5 days after the notice is made. The person or entity requesting the meeting shall state a specific agenda of topics including problems and alternatives to be discussed.

b. The meeting shall be given a minimum of one week advance notice, both in writing to the requestors, and advertised in the format of subd. 1.

(g) The provisions of pars. (a) to (e) shall be repeated once every 5 years and shall include new information. Annual modifications of the proposed treatment within the 5–year period which do not expand the treatment area more than 10% and cover a similar location and target organisms may be accepted as an amendment to the original application. The acreage fee submitted under sub. (2) (a) shall be adjusted in accordance with any proposed amendments.

(4) The applicant shall certify to the department that a copy of the application has been provided to any affected property owners' association, inland lake district, and, in the case of chemical applications for rooted aquatic plants, to any riparian property owners adjacent to and within the treatment area.

(5) A notice of the proposed treatment shall be provided by the department to any person or organization indicating annually in writing a desire to receive such notification.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.05 Issuance of permit. (1) The department shall issue or deny issuance of the requested permit between 10 and 15 working days after receipt of an acceptable application, unless:

(a) An environmental impact report or statement is required under s. 1.11, Stats. Notification to the applicant shall be in writing within 10 working days of receipt of the application and no action may be taken until the report or statement has been completed; or

(b) A public hearing has been granted under s. 227.42, Stats.

(2) If a request for a public hearing is received after the permit is issued but prior to the actual treatment allowed by the permit, the department is not required to, but may, suspend the permit because of the request for public hearing.

(3) The department may deny issuance of the requested permit if:

(a) The proposed chemical is not labeled and registered for the intended use by the United States environmental protection agency and both labeled and registered by a firm licensed as a pesticide manufacturer and labeler with the Wisconsin department of agriculture, trade and consumer protection;

(b) The proposed chemical does not have a current department aquatic chemical fact sheet;

(c) The department determines the proposed treatment will not provide nuisance relief, or will place unreasonable restrictions on existing water uses;

(d) The department determines the proposed treatment will result in a hazard to humans, animals or other nontarget organisms;

(e) The department determines the proposed treatment will result in a significant adverse effect on the body of water;

(f) The proposed chemical application is for waters beyond 150 feet from shore except where approval is given by the department to maintain navigation channels, piers or other facilities used by organizations or the public including commercial facilities;

(g) The proposed chemical applications, other than those conducted by the department pursuant to ss. 29.421 and 29.424, Stats., will significantly injure fish, fish eggs, fish larvae, essential fish food organisms or wildlife, either directly or through habitat destruction;

(h) The proposed chemical application is in a location known to have endangered or threatened species as specified pursuant to s. 29.604, Stats., and as determined by the department;

(i) The proposed chemical application is in locations identified by the department as sensitive areas, except when the applicant demonstrates to the satisfaction of the department that treatments can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

1. Sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water.

2. The department shall notify any affected property owners' association, inland lake district, and riparian property owner of locations identified as sensitive areas.

(4) New applications will be reviewed with consideration given to the cumulative effect of applications already approved for the body of water.

(5) The department may approve the application in whole or in part consistent with the provisions of subs. (3) (a) through (i) and (4). Denials shall be in writing stating reasons for the denial.

(6) Permits may be issued for one treatment season only.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **corrections in (3) (g) and (h) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

NR 107.06 Chemical fact sheets. (1) The department shall develop a chemical fact sheet for each of the chemicals in present use for aquatic nuisance control in Wisconsin.

(1m) Chemical fact sheets for chemicals not previously used in Wisconsin shall be developed within 180 days after the department has received notice of intended use of the chemical.

(2) The applicant or permit holder shall provide copies of the applicable chemical fact sheets to any affected property owners' association and inland lake district.

(3) The department shall make chemical fact sheets available upon request.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.07 Supervision. (1) The permit holder shall notify the district office 4 working days in advance of each anticipated treatment with the date, time, location, and proposed size of treatment. At the discretion of the department, the advance notification requirement may be waived.

(2) Supervision by a department representative may be required for any aquatic nuisance control project involving chemicals. Supervision may include inspection of the proposed treatment area, chemicals, and application equipment before, during or after treatment. The inspection may result in the determination that treatment is unnecessary or unwarranted in all or part of the proposed area, or that the equipment will not control the proper dosage.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.08 Conditions of the permit. (1) The department may stop or limit the application of chemicals to a body of water if at any time it determines that chemical treatment will be ineffective, or will result in unreasonable restrictions on current water uses, or will produce unnecessary adverse side effects on nontarget organisms. Upon request, the department shall state the reason for such action in writing to the applicant.

(2) Chemical treatments shall be performed in accordance with label directions, existing pesticide use laws, and permit conditions.

(3) Chemical applications on lakes and impoundments are limited to waters along developed shoreline including public parks except where approval is given by the department for projects of public benefit.

(4) Treatment of areas containing high value species of aquatic plants shall be done in a manner which will not result in adverse long–term or permanent changes to a plant community in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in spe-

cific aquatic ecosystems, including *Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Potamogeton pectinatus, Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania aquatica, Zannichellia palustris* and *Brasenia schreberi.*

(5) Treatment shall be performed by an applicator currently certified by the Wisconsin department of agriculture, trade and consumer protection in the aquatic nuisance control category whenever:

(a) Treatment is to be performed for compensation by an applicator acting as an independent contractor for hire;

(b) The area to be treated is greater than 0.25 acres;

(c) The product to be used is classified as a "restricted use pesticide"; or

(d) Liquid chemicals are to be used.

(6) Power equipment used to apply liquid chemicals shall include the following:

(a) Containers used to mix and hold chemicals shall be constructed of watertight materials and be of sufficient size and strength to safely contain the chemical. Measuring containers and scales for the purpose of measuring solids and liquids shall be provided by the applicator;

(b) Suction hose used to deliver the chemical to the pump venturi assembly shall be fitted with an on–off ball–type valve. The system shall also be designed to prevent clogging from chemicals and aquatic vegetation;

(c) Suction hose used to deliver surface water to the pump shall be fitted with a check valve to prevent back siphoning into the surface water should the pump stop;

(d) Suction hose used to deliver a premixed solution shall be fitted with an on–off ball–type valve to regulate the discharge rate;

(e) Pressure hose used to discharge chemicals to the surface water shall be provided with an on–off ball–type valve. This valve will be fitted at the base of the hose nozzle or as part of the nozzle assembly;

(f) All pressure and suction hoses and mechanical fittings shall be watertight;

(g) Equipment shall be calibrated by the applicator. Evidence of calibration shall be provided at the request of the department supervisor.

(h) Other equipment designs may be acceptable if capable of equivalent performance.

(7) The permit holder shall be responsible for posting those areas of use in accordance with water use restrictions stated on the chemical label, but in all cases for a minimum of one day, and with the following conditions:

(a) Posting signs shall be brilliant yellow and conspicuous to the nonriparian public intending to use the treated water from both the water and shore, and shall state applicable label water use restrictions of the chemical being used, the name of the chemical and date of treatment. For tank mixes, the label requirements of the most restrictive chemical will be posted;

(b) Minimum sign dimensions used for posting shall be 11 inches by 11 inches or consistent with s. ATCP 29.15. The department will provide up to 6 signs to meet posting requirements. Additional signs may be purchased from the department;

(c) Signs shall be posted at the beginning of each treatment by the permit holder or representing agent. Posting prior to treatment may be required as a permit condition when the department determines that such posting is in the best interest of the public;

(d) Posting signs shall be placed along contiguous treated shoreline and at strategic locations to adequately inform the public. Posting of untreated shoreline located adjacent to treated shoreline and noncontiguous shoreline shall be at the discretion of the department;

(e) Posting signs shall be made of durable material to remain up and legible for the time period stated on the pesticide label for water use restrictions, after which the permit holder or representing agent is responsible for sign removal.

(8) After conducting a treatment, the permit holder shall complete and submit within 30 days an aquatic nuisance control report on a form supplied by the department. Required information will include the quantity and type of chemical, and the specific size and location of each treatment area. In the event of any unusual circumstances associated with a treatment, or at the request of the department, the report shall be provided immediately. If treatment did not occur, the form shall be submitted with appropriate comment by October 1.

(9) Failure to comply with the conditions of the permit may result in cancellation of the permit and loss of permit privileges for the subsequent treatment season. A notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder accompanied by a statement of appeal rights.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89**;** correction in (7) (b) made under s. 13.93 (2m) (b) 7., Stats., Register, September, 1995, No. 477.

NR 107.09 Special limitation. Due to the significant risk of environmental damage from copper accumulation in sediments, swimmer's itch treatments performed with copper sulfate products at a rate greater than 10 pounds of copper sulfate per acre are prohibited.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.10 Field evaluation use permits. When a chemical product is considered for aquatic nuisance control and does not have a federal label for such use, the applicant shall apply to the administrator of the United States environmental protection agency for an experimental use permit under section 5 of the federal insecticide, fungicide and rodenticide act as amended (7 USC 136 et seq.). Upon receiving a permit, the permit holder shall obtain a field evaluation use permit from the department and be subject to the requirements of this chapter. Department field evaluation use permits shall be issued for the purpose of evaluating product effectiveness and safety under field conditions and will require in addition to the conditions of the permit specified in s. NR 107.08 (1) through (9), the following:

(1) Treatment shall be limited to an area specified by the department.

(2) The permit holder shall submit to the department a summary of treatment results at the end of the treatment season. The summary shall include:

(a) Total chemical used and distribution pattern, including chemical trade name, formulation, percent active ingredient, and dosage rate in the treated water in parts per million of active ingredient;

(b) Description of treatment areas including the character and the extent of the nuisance present;

(c) Effectiveness of the application and when applicable, a summary comparison of the results obtained from past experiments using the same chemical formulation;

(d) Other pertinent information required by the department; and

(e) Conclusions and recommendations for future use.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89.

NR 107.11 Exemptions. (1) Under any of the following conditions, the permit application fee in s. NR 107.04 (2) (a) will be limited to the basic application fee:

(a) The treatment is made for the control of bacteria on swimming beaches with chlorine or chlorinated lime;

(b) The treatment is intended to control algae or other aquatic nuisances that interfere with the use of the water for potable purposes;

(c) The treatment is necessary for the protection of public health, such as the control of disease carrying organisms in sanitary sewers, storm sewers, or marshes, and the treatment is sponsored by a governmental agency.

(2) The treatment of purple loosestrife is exempt from ss. NR 107.04 (2) (a) and (3), and 107.08 (5).

(3) The use of chemicals in private ponds is exempt from the provisions of this chapter except for ss. NR 107.04 (1), (2), (4) and (5), 107.05, 107.07, 107.08 (1), (2), (8) and (9), and 107.10.

(a) A private pond is a body of water located entirely on the land of an applicant, with no surface water discharge or a discharge that can be controlled to prevent chemical loss, and without access by the public.

(b) The permit application fee will be limited to the non–refundable $20 application fee.

(4) The use of chemicals in accordance with label instructions is exempt from the provisions of this chapter, when used in:

(a) Water tanks used for potable water supplies;

(b) Swimming pools;

(c) Treatment of public or private wells;

(d) Private fish hatcheries licensed under s. 95.60, Stats.;

(e) Treatment of emergent vegetation in drainage ditches or rights–of–way where the department determines that fish and wildlife resources are insignificant; or

(f) Waste treatment facilities which have received s. 281.41, Stats., plan approval or are utilized to meet effluent limitations set forth in permits issued under s. 283.31, Stats.

History: Cr. Register, February, 1989, No. 398, eff. 3–1–89; **corrections in (4) (d) and (f) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 2000, No. 540.**

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

NR 109.01 Purpose. The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.715, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. This chapter identifies other permits issued by the department for aquatic plant management that contain the appropriate conditions as required under this chapter for aquatic plant management, and for which no separate permit is required under this chapter**.** Introduction and control of aquatic plants shall be allowed in a manner consistent with sound ecosystem management, shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water. The purpose of this chapter is also to prevent the spread of invasive and non–native aquatic organisms by prohibiting the launching of watercraft or equipment that has any aquatic plants or zebra mussels attached.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.02 Applicability. A person sponsoring or conducting manual removal, burning or using mechanical means or aquatic plant inhibitors to control aquatic plants in navigable waters, or introducing non–native aquatic plants to waters of this state shall obtain an aquatic plant management permit from the department under this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.03 Definitions. In this chapter:

(1) "Aquatic community" means lake or river biological resources.

(2) "Beneficial water use activities" mean angling, boating, swimming or other navigational or recreational water use activity.

(3) "Body of water" means any lake, river or wetland that is a water of this state.

(4) "Complete application" means a completed and signed application form, the information specified in s. NR 109.04 and any other information which may reasonably be required from an applicant and which the department needs to make a decision under applicable provisions of law.

(5) "Department" means the Wisconsin department of natural resources.

(6) "Manual removal" means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.

(7) "Navigable waters" means those waters defined as navigable under s. 30.10, Stats.

(8) "Permit" means aquatic plant management permit.

(9) "Plan" means aquatic plant management plan.

(10) "Wetlands" means an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.04 Application requirements and fees. **(1)** Permit applications shall be made on forms provided by the department and shall be submitted to the regional director or designee for the region in which the project is located. Permit applications for licensed aquatic nursery growers may be submitted to the department of agriculture, trade and consumer protection.

Note: Applications may be obtained from the department's regional headquarters or service centers. DATCP has agreed to send application forms and instructions provided by the department to aquatic nursery growers along with license renewal forms. DATCP will forward all applications to the department for processing.

(2) The application shall be accompanied by all of the following unless the application is made by licensed aquatic nursery growers for selective harvesting of aquatic plants for nursery stock. Applications made by licensed aquatic nursery growers for harvest of nursery stock do not have to include the information required by par. (d), (e), (h), (i) or (j).

(a) A nonrefundable application fee. The application fee for an aquatic plant management permit is:

1. $30 for a proposed project to manage aquatic plants on less than one acre.

2. $30 per acre to a maximum of $300 for a proposed project to manage aquatic plants on one acre or larger. Partial acres shall be rounded up to the next full acre for fee determination. An annual renewal of this permit may be requested with an additional application fee of one–half the original application fee, but not less than $30.

(b) A legal description of the body of water including township, range and section number.

(c) One copy of a detailed map of the body of water with the proposed introduction or control area dimensions clearly shown. Private individuals doing plant introduction or control shall provide the name of the owner riparian to the management area, which includes the street address or block, lot and fire number where available and local telephone number or other pertinent information necessary to locate the property.

(d) One copy of any existing aquatic management plan for the body of water, or detailed reference to the plan, citing the plan references to the proposed introduction or control area, and a description of how the proposed introduction or control of aquatic plants is compatible with any existing plan.

(e) A description of the impairments to water use caused by the aquatic plants to be managed.

(f) A description of the aquatic plants to be controlled or removed.

(g) The type of equipment and methods to be used for introduction, control or removal.

(h) A description of other introduction or control methods considered and the justification for the method selected.

(i) A description of any other method being used or intended for use for plant management by the applicant or on the area abutting the proposed management area.

(j) The area used for removal, reuse or disposal of aquatic plants.

(k) The name of any person or commercial provider of control or removal services.

(3) (a) The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long–term sustainability of beneficial water use activities.

(b) Within 30 days of receipt of the plan, the department shall notify the applicant of any additional information or modifications to the plan that are required. If the applicant does not submit the additional information or modify the plan as requested by the department, the department may dismiss the aquatic plant management permit application.

(c) The department shall approve the aquatic plant management plan before an application may be considered complete.

(4) The permit sponsor may request an annual renewal in writing from the department under s. NR 109.05 if there is no change proposed in the conditions of the original permit issued.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.05 Permit issuance. (1) The department shall issue or deny issuance of the requested permit within 15 working days after receipt of a completed application and approved plan as required under s. NR 109.04 (3).

(2) The department may specify any of the following as conditions of the permit:

(a) The quantity of aquatic plants that may be introduced or controlled.

(b) The species of aquatic plants that may be introduced or controlled.

(c) The areas in which aquatic plants may be introduced or controlled.

(d) The methods that may be used to introduce or control aquatic plants.

(e) The times during which aquatic plants may be introduced or controlled.

(f) The allowable methods used for disposing of or using aquatic plants that are removed or controlled.

(g) Annual or other reporting requirements to the department that may include information related to pars. (a) to (f).

(3) The department may deny issuance of the requested permit if the department determines any of the following:

(a) Aquatic plants are not causing significant impairment of beneficial water use activities.

(b) The proposed introduction or control will not remedy the water use impairments caused by aquatic plants as identified as a part of the application in s. NR 109.04 (2) (e).

(c) The proposed introduction or control will result in a hazard to humans.

(d) The proposed introduction or control will cause significant adverse impacts to threatened or endangered resources.

(e) The proposed introduction or control will result in a significant adverse effect on water quality, aquatic habitat or the aquatic community including the native aquatic plant community.

(f) The proposed introduction or control is in locations identified by the department as sensitive areas, under s. NR 107.05 (3) (i) 1., except when the applicant demonstrates to the satisfaction of the department that the project can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

(g) The proposed management will result in significant adverse long–term or permanent changes to a plant community or a high value species in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in specific aquatic ecosystems, including Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Stuckenia pectinata (Potamogeton pectinatus), Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania spp., Zannichellia palustris and Brasenia schreberi.

(h) If wild rice is involved, the stipulations incorporated by *Lac Courte Oreilles v. Wisconsin*, 775 F. Supp. 321 (W.D. Wis. 1991) shall be complied with.

(i) The proposed introduction or control will interfere with the rights of riparian owners.

(j) The proposed management is inconsistent with a department approved aquatic plant management plan for the body of water.

(4) The department may approve the application in whole or in part consistent with the provisions of sub. (3). A denial shall be in writing stating the reasons for the denial.

(5) (a) The department may issue an aquatic plant management permit on less than one acre in a single riparian area for a 3–year term.

(b) The department may issue an aquatic plant management permit for a one–year term for more than one acre or more than one riparian area. The permit may be renewed annually for up to a total of 3 years in succession at the written request of the permit holder, provided no modifications or changes are made from the original permit.

(c) The department may issue an aquatic plant management permit containing a department–approved plan for a 3 to 5 year term.

(d) The department may issue an aquatic plant management permit to a licensed nursery grower for a 3–year term for the harvesting of aquatic plants from a publicly owned lake bed or for a 5–year term for harvesting of aquatic plants from privately owned beds with the permission of the property owner.

(6) The approval of an aquatic plant management permit does not represent an endorsement of the permitted activity, but represents that the applicant has complied with all criteria of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03**; reprinted to restore dropped language from rule order, Register October 2003 No. 574.**

NR 109.06 Waivers. The department waives the permit requirements under this chapter for any of the following:

(1) Manual removal or use of mechanical devices to control or remove aquatic plants from a body of water 10 acres or less that is entirely confined on the property of one person with the permission of that property owner.

Note: A person who introduces native aquatic plants or removes aquatic plants by manual or mechanical means in the course of operating an aquatic nursery as authorized under s. 94.10, Stats., on privately owned non–navigable waters of the state is not required to obtain a permit for the activities.

(2) A riparian owner who manually removes aquatic plants from a body of water or uses mechanical devices designed for cutting or mowing vegetation to control plants on an exposed lake bed that abuts the owner's property provided that the removal meets all of the following:

(a) 1. Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the

shoreline provided that any piers, boatlifts, swimrafts and other recreational and water use devices are located within that 30–foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method; or

2. Removal of nonnative or invasive aquatic plants as designated under s. NR 109.07 when performed in a manner that does not harm the native aquatic plant community; or

3. Removal of dislodged aquatic plants that drift on–shore and accumulate along the waterfront.

(b) Is not located in a sensitive area as defined by the department under s. NR 107.05 (3) (i) 1., or in an area known to contain threatened or endangered resources or floating bogs.

(c) Does not interfere with the rights of other riparian owners.

(d) If wild rice is involved, the procedures of s. NR 19.09 (1) shall be followed.

(4) Control of purple loosestrife by manual removal or use of mechanical devices when performed in a manner that does not harm the native aquatic plant community or result in or encourage re–growth of purple loosestrife or other nonnative vegetation.

(5) Any aquatic plant management activity that is conducted by the department and is consistent with the purposes of this chapter.

(6) Manual removal and collection of native aquatic plants for lake study or scientific research when performed in a manner that does not harm the native aquatic plant community.

Note: Scientific collectors permit requirements are still applicable.

(7) Incidental cutting, removal or destroying of aquatic plants when engaged in beneficial water use activities.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.07 Invasive and nonnative aquatic plants. (1) The department may designate any aquatic plant as an invasive aquatic plant for a water body or a group of water bodies if it has the ability to cause significant adverse change to desirable aquatic habitat, to significantly displace desirable aquatic vegetation, or to reduce the yield of products produced by aquaculture.

(2) The following aquatic plants are designated as invasive aquatic plants statewide: Eurasian water milfoil, curly leaf pondweed and purple loosestrife.

(3) Native and nonnative aquatic plants of Wisconsin shall be determined by using scientifically valid publications and findings by the department.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.08 Prohibitions. (1) No person may distribute an invasive aquatic plant, under s. NR 109.07.

(2) No person may intentionally introduce Eurasian water milfoil, curly leaf pondweed or purple loosestrife into waters of this state without the permission of the department.

(3) No person may intentionally cut aquatic plants in public/navigable waters without removing cut vegetation from the body of water.

(4) (a) No person may place equipment used in aquatic plant management in a navigable water if the person has reason to believe that the equipment has any aquatic plants or zebra mussels attached.

(b) This subsection does not apply to equipment used in aquatic plant management when re–launched on the same body of water without having visited different waters, provided the re–launching will not introduce or encourage the spread of existing aquatic species within that body of water.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.09 Plan specifications and approval. (1) Applicants required to submit an aquatic plant management plan, under s. NR 109.04 (3), shall develop and submit the plan in a format specified by the department.

(2) The plan shall present and discuss each of the following items:

(a) The goals and objectives of the aquatic plant management and protection activities.

(b) A physical, chemical and biological description of the waterbody.

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

(e) An evaluation of chemical, mechanical, biological and physical aquatic plant control methods.

(f) Recommendations for an integrated aquatic plant management strategy utilizing some or all of the methods evaluated in par. (e).

(g) An education and information strategy.

(h) A strategy for evaluating the efficacy and environmental impacts of the aquatic plant management activities.

(i) The involvement of local units of government and any lake organizations in the development of the plan.

(3) The approval of an aquatic plant management plan does not represent an endorsement for plant management, but represents that adequate considerations in planning the actions have been made.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.10 Other permits. Permits issued under s. 30.12, 30.20, 31.02 or 281.36, Stats., or under ch. NR 107 may contain provisions which provide for aquatic plant management. If a permit issued under one of these authorities contains the appropriate conditions as required under this chapter for aquatic plant management, a separate permit is not required under this chapter. The permit shall explicitly state that it is intended to comply with the substantive requirements of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.11 Enforcement. (1) Violations of this chapter may be prosecuted by the department under chs. 23, 30 and 31, Stats.

(2) Failure to comply with the conditions of a permit issued under or in accordance with this chapter may result in cancellation of the permit and loss of permit privileges for the subsequent year. Notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

NR 109.01 Purpose. The purpose of this chapter is to establish procedures and requirements for the protection and regulation of aquatic plants pursuant to ss. 23.24 and 30.715, Stats. Diverse and stable communities of native aquatic plants are recognized to be a vital and necessary component of a healthy aquatic ecosystem. This chapter establishes procedures and requirements for issuing aquatic plant management permits for introduction of aquatic plants or control of aquatic plants by manual removal, burning, use of mechanical means or plant inhibitors. This chapter identifies other permits issued by the department for aquatic plant management that contain the appropriate conditions as required under this chapter for aquatic plant management, and for which no separate permit is required under this chapter**.** Introduction and control of aquatic plants shall be allowed in a manner consistent with sound ecosystem management, shall consider cumulative impacts, and shall minimize the loss of ecological values in the body of water. The purpose of this chapter is also to prevent the spread of invasive and non–native aquatic organisms by prohibiting the launching of watercraft or equipment that has any aquatic plants or zebra mussels attached.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.02 Applicability. A person sponsoring or conducting manual removal, burning or using mechanical means or aquatic plant inhibitors to control aquatic plants in navigable waters, or introducing non–native aquatic plants to waters of this state shall obtain an aquatic plant management permit from the department under this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.03 Definitions. In this chapter:

(1) "Aquatic community" means lake or river biological resources.

(2) "Beneficial water use activities" mean angling, boating, swimming or other navigational or recreational water use activity.

(3) "Body of water" means any lake, river or wetland that is a water of this state.

(4) "Complete application" means a completed and signed application form, the information specified in s. NR 109.04 and any other information which may reasonably be required from an applicant and which the department needs to make a decision under applicable provisions of law.

(5) "Department" means the Wisconsin department of natural resources.

(6) "Manual removal" means the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.

(7) "Navigable waters" means those waters defined as navigable under s. 30.10, Stats.

(8) "Permit" means aquatic plant management permit.

(9) "Plan" means aquatic plant management plan.

(10) "Wetlands" means an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.04 Application requirements and fees. **(1)** Permit applications shall be made on forms provided by the department and shall be submitted to the regional director or designee for the region in which the project is located. Permit applications for licensed aquatic nursery growers may be submitted to the department of agriculture, trade and consumer protection.

Note: Applications may be obtained from the department's regional headquarters or service centers. DATCP has agreed to send application forms and instructions provided by the department to aquatic nursery growers along with license renewal forms. DATCP will forward all applications to the department for processing.

(2) The application shall be accompanied by all of the following unless the application is made by licensed aquatic nursery growers for selective harvesting of aquatic plants for nursery stock. Applications made by licensed aquatic nursery growers for harvest of nursery stock do not have to include the information required by par. (d), (e), (h), (i) or (j).

(a) A nonrefundable application fee. The application fee for an aquatic plant management permit is:

1. $30 for a proposed project to manage aquatic plants on less than one acre.

2. $30 per acre to a maximum of $300 for a proposed project to manage aquatic plants on one acre or larger. Partial acres shall be rounded up to the next full acre for fee determination. An annual renewal of this permit may be requested with an additional application fee of one–half the original application fee, but not less than $30.

(b) A legal description of the body of water including township, range and section number.

(c) One copy of a detailed map of the body of water with the proposed introduction or control area dimensions clearly shown. Private individuals doing plant introduction or control shall provide the name of the owner riparian to the management area, which includes the street address or block, lot and fire number where available and local telephone number or other pertinent information necessary to locate the property.

(d) One copy of any existing aquatic management plan for the body of water, or detailed reference to the plan, citing the plan references to the proposed introduction or control area, and a description of how the proposed introduction or control of aquatic plants is compatible with any existing plan.

(e) A description of the impairments to water use caused by the aquatic plants to be managed.

(f) A description of the aquatic plants to be controlled or removed.

(g) The type of equipment and methods to be used for introduction, control or removal.

(h) A description of other introduction or control methods considered and the justification for the method selected.

(i) A description of any other method being used or intended for use for plant management by the applicant or on the area abutting the proposed management area.

(j) The area used for removal, reuse or disposal of aquatic plants.

(k) The name of any person or commercial provider of control or removal services.

(3) (a) The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long–term sustainability of beneficial water use activities.

(b) Within 30 days of receipt of the plan, the department shall notify the applicant of any additional information or modifications to the plan that are required. If the applicant does not submit the additional information or modify the plan as requested by the department, the department may dismiss the aquatic plant management permit application.

(c) The department shall approve the aquatic plant management plan before an application may be considered complete.

(4) The permit sponsor may request an annual renewal in writing from the department under s. NR 109.05 if there is no change proposed in the conditions of the original permit issued.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.05 Permit issuance. (1) The department shall issue or deny issuance of the requested permit within 15 working days after receipt of a completed application and approved plan as required under s. NR 109.04 (3).

(2) The department may specify any of the following as conditions of the permit:

(a) The quantity of aquatic plants that may be introduced or controlled.

(b) The species of aquatic plants that may be introduced or controlled.

(c) The areas in which aquatic plants may be introduced or controlled.

(d) The methods that may be used to introduce or control aquatic plants.

(e) The times during which aquatic plants may be introduced or controlled.

(f) The allowable methods used for disposing of or using aquatic plants that are removed or controlled.

(g) Annual or other reporting requirements to the department that may include information related to pars. (a) to (f).

(3) The department may deny issuance of the requested permit if the department determines any of the following:

(a) Aquatic plants are not causing significant impairment of beneficial water use activities.

(b) The proposed introduction or control will not remedy the water use impairments caused by aquatic plants as identified as a part of the application in s. NR 109.04 (2) (e).

(c) The proposed introduction or control will result in a hazard to humans.

(d) The proposed introduction or control will cause significant adverse impacts to threatened or endangered resources.

(e) The proposed introduction or control will result in a significant adverse effect on water quality, aquatic habitat or the aquatic community including the native aquatic plant community.

(f) The proposed introduction or control is in locations identified by the department as sensitive areas, under s. NR 107.05 (3) (i) 1., except when the applicant demonstrates to the satisfaction of the department that the project can be conducted in a manner that will not alter the ecological character or reduce the ecological value of the area.

(g) The proposed management will result in significant adverse long–term or permanent changes to a plant community or a high value species in a specific aquatic ecosystem. High value species are individual species of aquatic plants known to offer important values in specific aquatic ecosystems, including Potamogeton amplifolius, Potamogeton Richardsonii, Potamogeton praelongus, Stuckenia pectinata (Potamogeton pectinatus), Potamogeton illinoensis, Potamogeton robbinsii, Eleocharis spp., Scirpus spp., Valisneria spp., Zizania spp., Zannichellia palustris and Brasenia schreberi.

(h) If wild rice is involved, the stipulations incorporated by *Lac Courte Oreilles v. Wisconsin*, 775 F. Supp. 321 (W.D. Wis. 1991) shall be complied with.

(i) The proposed introduction or control will interfere with the rights of riparian owners.

(j) The proposed management is inconsistent with a department approved aquatic plant management plan for the body of water.

(4) The department may approve the application in whole or in part consistent with the provisions of sub. (3). A denial shall be in writing stating the reasons for the denial.

(5) (a) The department may issue an aquatic plant management permit on less than one acre in a single riparian area for a 3–year term.

(b) The department may issue an aquatic plant management permit for a one–year term for more than one acre or more than one riparian area. The permit may be renewed annually for up to a total of 3 years in succession at the written request of the permit holder, provided no modifications or changes are made from the original permit.

(c) The department may issue an aquatic plant management permit containing a department–approved plan for a 3 to 5 year term.

(d) The department may issue an aquatic plant management permit to a licensed nursery grower for a 3–year term for the harvesting of aquatic plants from a publicly owned lake bed or for a 5–year term for harvesting of aquatic plants from privately owned beds with the permission of the property owner.

(6) The approval of an aquatic plant management permit does not represent an endorsement of the permitted activity, but represents that the applicant has complied with all criteria of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03**; reprinted to restore dropped language from rule order, Register October 2003 No. 574.**

NR 109.06 Waivers. The department waives the permit requirements under this chapter for any of the following:

(1) Manual removal or use of mechanical devices to control or remove aquatic plants from a body of water 10 acres or less that is entirely confined on the property of one person with the permission of that property owner.

Note: A person who introduces native aquatic plants or removes aquatic plants by manual or mechanical means in the course of operating an aquatic nursery as authorized under s. 94.10, Stats., on privately owned non–navigable waters of the state is not required to obtain a permit for the activities.

(2) A riparian owner who manually removes aquatic plants from a body of water or uses mechanical devices designed for cutting or mowing vegetation to control plants on an exposed lake bed that abuts the owner's property provided that the removal meets all of the following:

(a) 1. Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the

shoreline provided that any piers, boatlifts, swimrafts and other recreational and water use devices are located within that 30–foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method; or

2. Removal of nonnative or invasive aquatic plants as designated under s. NR 109.07 when performed in a manner that does not harm the native aquatic plant community; or

3. Removal of dislodged aquatic plants that drift on–shore and accumulate along the waterfront.

(b) Is not located in a sensitive area as defined by the department under s. NR 107.05 (3) (i) 1., or in an area known to contain threatened or endangered resources or floating bogs.

(c) Does not interfere with the rights of other riparian owners.

(d) If wild rice is involved, the procedures of s. NR 19.09 (1) shall be followed.

(4) Control of purple loosestrife by manual removal or use of mechanical devices when performed in a manner that does not harm the native aquatic plant community or result in or encourage re–growth of purple loosestrife or other nonnative vegetation.

(5) Any aquatic plant management activity that is conducted by the department and is consistent with the purposes of this chapter.

(6) Manual removal and collection of native aquatic plants for lake study or scientific research when performed in a manner that does not harm the native aquatic plant community.

Note: Scientific collectors permit requirements are still applicable.

(7) Incidental cutting, removal or destroying of aquatic plants when engaged in beneficial water use activities.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.07 Invasive and nonnative aquatic plants. (1) The department may designate any aquatic plant as an invasive aquatic plant for a water body or a group of water bodies if it has the ability to cause significant adverse change to desirable aquatic habitat, to significantly displace desirable aquatic vegetation, or to reduce the yield of products produced by aquaculture.

(2) The following aquatic plants are designated as invasive aquatic plants statewide: Eurasian water milfoil, curly leaf pondweed and purple loosestrife.

(3) Native and nonnative aquatic plants of Wisconsin shall be determined by using scientifically valid publications and findings by the department.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.08 Prohibitions. (1) No person may distribute an invasive aquatic plant, under s. NR 109.07.

(2) No person may intentionally introduce Eurasian water milfoil, curly leaf pondweed or purple loosestrife into waters of this state without the permission of the department.

(3) No person may intentionally cut aquatic plants in public/navigable waters without removing cut vegetation from the body of water.

(4) (a) No person may place equipment used in aquatic plant management in a navigable water if the person has reason to believe that the equipment has any aquatic plants or zebra mussels attached.

(b) This subsection does not apply to equipment used in aquatic plant management when re–launched on the same body of water without having visited different waters, provided the re–launching will not introduce or encourage the spread of existing aquatic species within that body of water.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.09 Plan specifications and approval. (1) Applicants required to submit an aquatic plant management plan, under s. NR 109.04 (3), shall develop and submit the plan in a format specified by the department.

(2) The plan shall present and discuss each of the following items:

(a) The goals and objectives of the aquatic plant management and protection activities.

(b) A physical, chemical and biological description of the waterbody.

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

(e) An evaluation of chemical, mechanical, biological and physical aquatic plant control methods.

(f) Recommendations for an integrated aquatic plant management strategy utilizing some or all of the methods evaluated in par. (e).

(g) An education and information strategy.

(h) A strategy for evaluating the efficacy and environmental impacts of the aquatic plant management activities.

(i) The involvement of local units of government and any lake organizations in the development of the plan.

(3) The approval of an aquatic plant management plan does not represent an endorsement for plant management, but represents that adequate considerations in planning the actions have been made.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.10 Other permits. Permits issued under s. 30.12, 30.20, 31.02 or 281.36, Stats., or under ch. NR 107 may contain provisions which provide for aquatic plant management. If a permit issued under one of these authorities contains the appropriate conditions as required under this chapter for aquatic plant management, a separate permit is not required under this chapter. The permit shall explicitly state that it is intended to comply with the substantive requirements of this chapter.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

NR 109.11 Enforcement. (1) Violations of this chapter may be prosecuted by the department under chs. 23, 30 and 31, Stats.

(2) Failure to comply with the conditions of a permit issued under or in accordance with this chapter may result in cancellation of the permit and loss of permit privileges for the subsequent year. Notice of cancellation or loss of permit privileges shall be provided by the department to the permit holder.

History: CR 02–061: cr. Register May 2003 No. 569, eff. 6–1–03.

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APPENDIX H

RESOURCE FOR ADDITIONAL INFORMATION

Online References for More Information

General Information

http://www.dnr.state.wi.us/org/water/fhp/lakes/aquaplan.htm
Wisconsin Department of Natural Resources - Aquatic Plant Management

http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp
UW Extension Lakes Program – Aquatic Plant Management in Wisconsin

http://www.wisconsinlakes.org/
Wisconsin Association of Lakes

http://www.uwsp.edu/cnr/uwexlakes/
UW Extension Lakes Program – Homepage

http://datcp.state.wi.us/index.jsp
Wisconsin Department of Agriculture, Trade and Consumer Protection

http://el.erdc.usace.army.mil/aqua/
Army Corps of Engineers – Aquatic Plant Control Research Program

http://www.nalms.org/
North American Lake Management Society

http://www.apms.org/
Aquatic Plant Management Society

http://www.fapms.org/
Florida Aquatic Plant Management Society

http://www.mapms.org/
Midwest Aquatic Plant Management Society

http://www.epa.gov/
Environmental Protection Agency

http://web.fisheries.org/main/
American Fisheries Society

http://www.botany.wisc.edu/herbarium/
Wisconsin State Herbarium – Aquatic Plant Indenfication

http://www.uwsp.edu/cnr/uwexlakes/CBCW/default.asp
UW Extension Lakes Program – Clean Boats Clean Waters

Aquatic Invasive Species

http://www.dnr.state.wi.us/invasives/aquatic/
Wisconsin Department of Natural Resources – Aquatic Invasive Species

http://www.uwex.edu/erc/invasives.html
UW Extension- Environmental Resources Center

http://www.ipaw.org/
Invasive Plants Association of Wisconsin

http://www.seagrant.wisc.edu/ais/
University of Wisconsin Sea Grant Institute– Aquatic Invasive Species

http://www.anstaskforce.gov/default.php
Aquatic Nuisance Species Task Force

http://www.invasivespeciesinfo.gov/aquatics/databases.shtml
United States Department of Agriculture – Invasive Species Information Center

http://aquat1.ifas.ufl.edu/welcome.html
University of Florida - Center for Aquatic and Invasive Plants

Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/Largelake.html
Lake Management Planning – Large Scale Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/smalllake.html
Lake Management Planning – Small Scale Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/invasivespecies.html
Aquatic Invasive Species

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Lakes/lakeprotection.html
Lake Protection and Classification Grants

http://www.dnr.state.wi.us/org/caer/cfa/Grants/recboat.html
Recreation Boating Facilities

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Rivers/riverplanning.html
River Protection Planning

http://www.dnr.state.wi.us/org/caer/cfa/Grants/Rivers/riverprotection.html
River Protection Management