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AQUATIC PLANT MANAGEMENT PLAN

CRANBERRY LAKE
VILAS COUNTY, WISCONSIN

June 26, 2007
Revised August 6, 2007

Prepared for:

Town of Washington Water Resource Task Force
Town of Cloverland, Town of Lincoln, and City of Eagle River

Prepared by:

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

FIGURES

TABLES

APPENDICES

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Many organizations and citizens contributed to the development of this Aquatic Plant Management (APM) Plan. Northern Environmental would like to acknowledge the Vilas County Aquatic Invasive Species (AIS) Planning Partnership, who was responsible for promoting local governments to form lake committees and raising awareness about AIS. We also thank the Town of Washington Water Resource Task Force whose members had the foresight for the importance of a baseline aquatic plant survey and APM Plan development project, and who solicited project support outside political boundaries. We also thank the partnering municipalities: the Town of Lincoln, Town of Cloverland, and the City of Eagle River, who also recognized the importance of this project and contributed financially. We also thank the Eagle River Area Unified Lakes Committee for their roles throughout planning and information dissemination. The aquatic plant survey could not have been completed without the expertise of the University of Wisconsin Trout Lake Station experts who assisted during portions of the plant survey and provided invaluable support for specimen confirmation. We thank the Wisconsin Department of Natural Resource (WDNR) for matching grant funds, and guidance throughout plan development. The APM planning project would not be complete without the input from the Eagle River Chain of Lakes Association (ERCLA) members. We express appreciation to the local residents and lake users for participating in the public questionnaire and providing comments regarding the draft document.

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1.0 EXECUTIVE SUMMARY

The Town of Washington Water Resource Task Force and partnering municipalities (Town of Lincoln, Town of Cloverland, and the City of Eagle River) pursued a Wisconsin Department of Natural Resources (WDNR) Lake Management Planning Grant to complete a baseline aquatic plant survey and develop an Aquatic Plant Management (APM) Plan for Cranberry Lake and other lakes of the Eagle River Chain of Lakes (ERC). Cranberry Lake is part of the ERC which has a 286,618 acre watershed. Land cover within the watershed is primarily forest. Cranberry is a eutrophic to mesotrophic lake system according to the Wisconsin Trophic State Index (TSI). The shoreline is mostly developed with some scattered undeveloped areas.

An aquatic plant survey was completed in July 2006 which identified twenty four aquatic plant species. The most abundant aquatic plants identified during the July survey were wild celery and small pondweed. 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. Cranberry Lake exhibited an FQI higher than the state average (22.2) and the Northern Ecological regions average of 24.3. Despite the high FQI, one aquatic invasive species (AIS) was identified. Eurasian watermilfoil (EWM) is an AIS that was confirmed to be present on Cranberry Lake in 2001. EWM was found at approximately 8 acres of Cranberry Lake using the July 2006 lake wide aquatic plant survey data.

Documented aquatic plant management efforts on the lake date are minimal. Specific previous EWM control efforts include herbicide treatment of 7.5 acres in 2003.

The overall aquatic plant management objective is to reduce the acreage and frequency of occurrence of EWM on the Eagle River Chain of Lakes and to restore the native plant community. Management efforts such focus on the EWM reduction and allow the natural restoration of the native aquatic plant community as the EWM is minimized. An achievable and quantitative goal for EWM reduction is to minimize the total acreage within 5 years to small-scale herbicide treatment levels on each lake. Wisconsin Administrative Code NR 107.04(3) defines a large-scale treatment as anything over ten acres or more than 10% of the water body that is less than ten feet deep. This overall goal correlates to a reduction of EWM acres by 75 percent over the next five years, with a focus on the upper lakes to minimize and prevent the spread downstream. If this goal is achieved, the remaining EWM would be at a level small enough to be considered small-scale. A 75 percent reduction of EWM in Cranberry Lake correlates to annual reduction of 1.2 acres per year with a remaining population of two acres of EWM in 2011. EWM was found at 4 sample sites out of the 159 vegetated sites, a frequency of occurrence within vegetated areas of 2.52 percent. With a decline of EWM of 75 percent over five years the frequency of occurrence within vegetated areas will decline 0.37 percent each year. By 2011 EWM should have a relative frequency of occurrence of 0.64 percent, down from 2.52 percent in 2006. The following table depicts this reduction by year and acreage. The table also assumes no major re-growth or expansion of EWM on a yearly basis. Highly used recreational areas and public boat launches or access points should be give priority when considered treatment locations due to a greater potential for EWM spread coming from these areas. The APM plan should be updated in 2011 to evaluate the aquatic plant community and to assess the current management strategies.

Year	Acreage	Frequency of Occurrence within Vegetated Areas
2007	7.8	2.12
2008	5.6	1.75
2009	4.4	1.38
2010	3.2	1.01
2011	2	0.64

If the 75 percent reduction goal is met, then EWM chemical treatments should be considered maintenance activities instead of restoration activities and limited resources should be directed toward other priority areas on the Chain.

Information gathered from the public questionnaire indicated most enjoyed using the lake for fishing and boating. Most people have experienced problems with aquatic plant growth affecting their recreation and believe that AIS is a concern that justifies active management.

The APM Plan involved evaluating physical, mechanical, biological, and chemical management alternatives and outlines specific management activities for the EWM on Cranberry Lake.

Recommended APM Plan

Proposed management of EWM includes manual removal in isolated shallow locations. No permit is required to remove EWM along a landowner's shoreline property, but removal of native plants is restricted to a 30 foot wide recreation zone (for pier, boatlift, or swim raft access). Additional native plant removal is not recommended and would require a permit from the WDNR. Larger EWM areas will be treated with a selective herbicide containing 2,4-D in accordance with a WDNR issued permit under NR 107 Wisconsin Administrative Code. EWM treatments will be completed in the spring when native plant growth is minimal to increase the selectivity of the herbicide. Pre and post treatment monitoring is required for all EWM treatments. The APM Plan also: includes prevention components such as the Wisconsin Clean Boats Clean Waters Program; assigns responsibilities for APM activities; and outlines a monitoring protocol to evaluate the EWM treatment effectiveness, changes in the lake's aquatic plant community, water quality, and public opinion.

2.0 INTRODUCTION

People are drawn to Vilas County lakes for their scenic beauty and quality outdoor recreation. Recognizing the importance of their lakes to both residents and visitors, local government units and lake associations are working together to protect these important water resources. One of the latest lake protection efforts is the formation of the Vilas County Aquatic Invasive Species (AIS) Planning Partnership aimed at preventing and controlling AIS infestations within Vilas County. A critical component of the partnership is the formation of town lake committees across Vilas County who can identify and prioritize local concerns about waters within their township.

Town of Washington ("the Town") recognized the importance of the Eagle River Chain of Lakes (ERC) to the local communities. A primary concern for the Town is the presence of AIS in southeast Vilas County. This concern sparked the formation of the Town of Washington Water Resource Task Force (Task Force) to address lake concerns within the Town and adjacent municipalities. The Task Force's first order of business was to obtain a better understanding of the AIS problems and the overall aquatic plant community within the Eager River Chain of Lakes. Neighboring municipalities including the Town of Cloverland, Town of Lincoln, and the City of Eagle River shared similar concerns for the ERC, and therefore formed a partnership with the Town of Washington. This partnership applied for several Lake Management Planning (LMP) grants from the Wisconsin Department of Natural Resources (WDNR) to complete baseline aquatic plant surveys and develop Aquatic Plant Management (APM) Plans for lakes of the ERC. The Town acted as a project sponsor for, and received several LMP grants to complete the APM project. An APM Plan is a prerequisite for funding many APM activities and large scale WDNR permits. This document is the APM Plan for Cranberry Lake and discusses the following:

- Lake morphology and lake watershed characteristics
- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2006 baseline aquatic plant survey
- Feasible aquatic plant management alternatives
- Selected suite of aquatic plant management options

3.0 BACKGROUND INFORMATION

3.1 Lake History and Morphology

Cranberry Lake is located in the Towns of Washington in southeast Vilas County, Wisconsin and within the town of Three Lakes in Oneida County, Wisconsin. Figure 1 depicts the lake location and the ERC. The following summarizes the lake's physical attributes:

Lake Type	**Drainage**
Surface Area (acres)	956
Maximum depth (feet)	23
Shoreline Length (miles)	9.6

Source Wisconsin Lakes, WDNR 2005

Figure 2 illustrates the lake bathymetry. Cranberry Lake provides year-round recreation activities ranging from, fishing, swimming, waterskiing, pleasure boating, snowmobiling, and more. It is part of the ERC, which includes the following lakes:

- Catfish Lake
- Cranberry Lake
- Voyager Lake
- Eagle Lake
- Scattering Rice Lake
- Otter Lake
- Lynx Lake
- Duck Lake
- Yellow Birch
- Watersmeet Lake

The ERC is an impoundment of the Eagle and Wisconsin Rivers. The Eagle River Light and Water Commission built the original Otter Rapids dam and power plant downstream of Watersmeet Lake on the Wisconsin River in 1906 (Eagleriver.org,2006). Figure 1 depicts Cranberry Lake and the ERC. The Eagle River flows from the Burnt Rollway Dam located upstream of Cranberry Lake. The Burnt Rollway Dam was put into operation in 1911. At this dam, a boat hoist is operated by the Wisconsin Valley Improvement Company for watercraft traveling upstream to the Three Lakes Chain of Lakes located in Oneida County.

The ERC water level is maintained at approximately 1616 feet above mean sea level (msl). Upstream, the Three Lakes Chain is maintailed at approximtely 1625 feet above msl. Downstream, below Watersmeet Lake, Otter Rapids Dam maintains at least 12 feet of hydraulic head above the Wisconsin River below.

3.2 Watershed Overview

The Eagle River Chain of Lakes watershed encompassing 448 square miles in Wisconsin (286,618 acres) includes the following three regional watersheds:

- Eagle River (116,285 acres)
- Deerskin River (36,403 acres)
- Tamarack Pioneer River (133,930 acres)

Land cover within the overall watershed includes the following:

- Forested (88.5%)
- Wetland (9.9%)
- Agriculture (0.4%)
- Urban/Developed (0.1%)
- Open Water (1%)

(Source: WDNR Land Sat Imagery and WISCLAND database)

Figure 3 illustrates these regional watersheds and land uses. The watershed is in the Northern Highland physiographic region of Wisconsin (United States Department of Agriculture [USDA], 1988). The Wisconsin River and its tributary streams drain approximately 40 percent (%) of Vilas County. The region includes two major physiographic characteristics, including an area of drumlins and ground moraines in the eastern portion of the County deposited after the last glacial advance. The topography of this area is characterized by low, rounded, and oval ridges bisected by long narrow drainages. Outside of the moraine areas are outwash plains that formed from glacial melt water deposits (USDA, 1988). Wetlands have formed in low areas of outwash. Some outwash areas are pitted with many depressions and small lakes with no outlets. The unconsolidated sediments are underlain by Precambrian aged igneous rocks.

The Cranberry Lake sub-watershed encompasses approximately 3,836 acres and is primarily forested and contains some wetlands. Figure 4 illustrates the Cranberry lake sub-watershed. The shoreline areas are primarily residential lots and woodlands. A shoreline survey describing the level of shoreline development is summarized later in this report.

3.3 Water Quality

Available information from the on-line WDNR Lake Water Quality Database indicates a volunteer citizen monitoring network measured the following perimeter on Cranberry Lake in 1993 through 1997 and 2002.

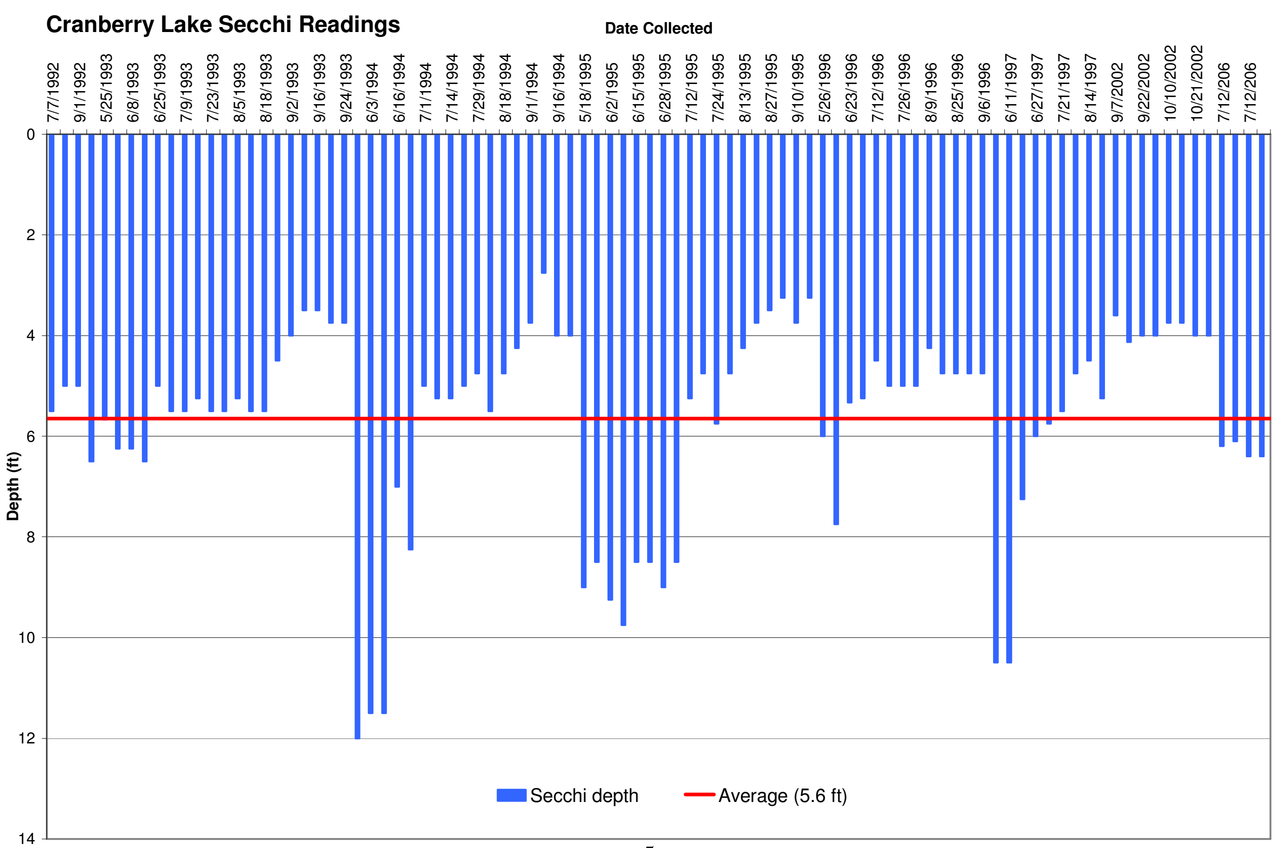
- Water clarity (secchi depth)

Water clarity is measured by lowering an 8-inch disk with alternating black and white quadrants into the water until it is no longer visible. The disk is raised until it is again visible. The two readings are averaged providing the secchi depth or water clarity measurement. Additionally, Northern Environmental measured water clarity at 4 locations on Cranberry Lake during the July 2006 aquatic plant survey.

A review of WDNR files determined that one or more of the following: Total Phosphorus; Chlorophyll *a;* and water clarity was also measured historically by Department staff, contractors, and/or volunteers in 1971 and 1992. Total Phosphorus is a measure of nutrients available for plant growth and chlorophyll *a* is a measure of pigment in the water that is within algae.

3.3.1 Water Clarity

The historical water clarity average is 5.6 feet (1.7 meters). The following graph illustrates historical and current water clarity measurements on Cranberry Lake.



3.3.2 Total Phosphorus and Chlorophyll *a*

The following table illustrates the historical water quality parameters measured on Cranberry Lake.

Date	**Total P (*mg/l*)**	**Chlorophyll *a* (*µg/l***
July 7, 1992	0.030	14
July 29, 1992	0.042	9.87
September 1, 1992	0.027	16.7
October 14, 1992	0.021	8.84

Notes: *mg/l= milligrams per liter, (parts per million)*
ug/l = micrograms per liter, (parts per billion)

3.3.3 Trophic State Index

Trophic State Index (TSI) values are assigned to a lake based on Total phosphorus, chlorophyll *a*, and water clarity values. The TSI is a measure of a lake's biological productivity. The TSI used for Wisconsin lakes is described below.

Category	**TSI**	**Lake Characteristics**	Total P (*mg/l*)	Chlorophyll *a* (*ug/l*)	Water Clarity (*meters*)
Oligotrophic	1-40	Clear water; oxygen rich at all depths, except if close to mesotrophic border; then may have low or no oxygen; cold-water fish likely in deeper lakes.	0.003 to 0.01	2 to 5	3.7 to 2.4
Mesotrophic	41-50	Moderately clear; increasing probability of low to no oxygen in bottom waters.	0.018 to 0.027	8 to 10	1.8
Eutrophic	51-70	Decreased water clarity; probably no oxygen in bottom waters during summer; warm-water fisheries only; blue-green algae likely in summer in upper range; plants also excessive.	0.03 to 0.05	11 to 15	1.5 to 1.2 (less is hyper-eutrophic)

Adopted from Lillie and Mason, 1983, and Shaw 1994 et. al.

The historical water clarity, total phosphorus, and chlorophyll *a* data indicate that Cranberry Lake is a eutrophic to mesotrophic lake, according to the Wisconsin TSI.

3.4 Summary of Lake Fishery

The following table identifies the fish species that are present in Cranberry Lake.

Fish Species	Present	Common	Abundant
Muskellunge		X	
Northern Pike	X		
Walleye			X
Largemouth Bass	X		
Smallmouth Bass	X		
Panfish		X	

Source: WDNR Wisconsin Lakes Publication # PUB-FH-800, 2005

Available information indicates that walleyes were stocked in 1973, 1974, and 1976. Muskellunge were also stocked in 1974, 1977, 1979, 1982, 1984, 1985, 1987, 1989, 1991, 1992, 1993, 1996, 1998, 1999, 2002, and 2004 (WDNR Fish stocking website, 2006).

3.5 Aquatic Plant Management History

According to WDNR records, aquatic plant management efforts on the lake are minimal. One nuisance aquatic plant complaint was recorded in 1993. EWM was officially confirmed on Cranberry Lake in 2001. In 2003, 7.5 acres of EWM were treated using an aquatic herbicide containing 2,4- D (a discussion of this aquatic herbicide is provided later in this report).

Eagle River Chain of Lakes Association (ERCLA) also completed an AIS Grant project in 2004, which placed pink buckets at various public use points around the ERC. Buckets were labeled and signage was provided to encourage lake users to deposit EWM from their watercraft or boat trailers in the buckets.

3.6 Goals and Objectives

The Task Force formed in 2005 and quickly identified a lack of specific and quantifiable aquatic plant community data on lakes of the ERC. Therefore, a primary objective was to complete baseline aquatic plant surveys on all lakes of the ERC, which can then be used to quantify and map the abundance and distribution of aquatic plant species, and be used to compare future aquatic plant monitoring efforts. Given the widespread concern over AIS within the chain and other area waters, and since no formal plan existed, the next logical objective was to develop an APM Plan. During the grant application process, discussions with Task Force identified the following important APM Plan goals and objectives:

- Preserve native aquatic plants
- Prevent the introductions of new AIS
- Prevent the spread of existing AIS
- Protect and improve fish and wildlife habitat
- Maintain and improve recreational opportunities
- Identify and Protect sensitive areas
- Raise awareness and promote education about aquatic plant problems on the Eagle River Chain of Lakes
- Identify and discuss various sources of financial assistance for aquatic plant management activities

- Coordinate sound aquatic plant management practices where needed within the Eagle River Chain of Lakes and Deerskin River watershed
- Reduce the acres and frequency of occurrence of EWM within Catfish lake by 75 percent within five years

4.0 PROJECT METHODS

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

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

Offsite and onsite research methods were used during this study. Offsite methods included a thorough review of available background information on the Lake, its watershed and water quality. An aquatic plant community survey was completed onsite to provide data needed to evaluate aquatic plant management alternatives.

4.1 Existing Data Review

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

- Local and regional geologic, limnologic, hydrologic, and hydrogeologic research
- Discussions with Task Force members
- Available topographic maps and aerial photographs
- Data from WDNR files
- Past lake study reports (if available)

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. Specific references are listed in Section 8.0 of this report.

4.2 Aquatic Plant Survey and Analysis

The aquatic plant community of the Lake was surveyed on July 11 and July 12, 2006. During those surveys the point intercept sampling method described by Madsen (1999) was used, as recommended in the WDNR draft guidance entitled "Aquatic Plant Management in Wisconsin" (WDNR, 2005).

WDNR research staff determined the sampling point resolution in accordance with the WDNR guidance and provided a base map with the specified sample point locations. The sample resolution was an 80 meter grid with 588 pre-determined intercept points (Figure 5). When completing the actual aquatic plant survey, some points were "terrestrial" and were not sampled. Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid (Appendix A). Geographic coordinates were uploaded into a Trimble GeoXT™ global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected by tossing a specialized rake on a rope and dragging the rake along the bottom sediments. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus or species) and recorded on field data sheets. Visual observations of aquatic plants were also recorded. Water depth and, when detectable, sediment types at each intercept point were also recorded on field data sheets. Two specimens of each aquatic plant species identified on the ERC were collected and dried in a plant press for later use as sample vouchers and educational purposes.

The point intercept method was used to evaluate the existing emergent, submergent, floating-leaf, and free-floating aquatic plants. At each intercept point, a value of 1-3 was assigned to the species collected based on densities observed on the rake, or rake fullness ratings. 1 being a few plants on the rake head, 2 when the rake head is approximately ½ full, and three being full of aquatic plants with the rake head not visible. If a species was not collected at that point, the space was left blank. For the survey, 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 Shoreline Characterization

The point intercept method described above may not accurately identify emergent and floating leaved aquatic plants in near shore areas. Therefore, a boat tour was completed traveling the entire perimeter of the lake's shoreline. During the boat tour, visual observations of the emergent and floating leaved plant communities were located and recorded. The boat tour also included a shoreline characterization, which provides an evaluation of shoreline development on the Lake. The following scale was used to rate the level of shoreline development.

- **1: Undeveloped** (i.e. Forested or wetland)
- **2: Minor development** (i.e. Properties may have mostly natural shoreline, sparse structures set further away from the lake, one pier, and little or no clearing of natural vegetation).
- **3: Moderate development** (i.e. Properties may exhibit additional clearing and/or manipulation to the shore and lawn areas but not to waters edge. More elaborate piers or boathouses may be present).
- **4: Major development** (i.e. Properties may include larger lawn areas extending to the shoreline, which contains little or no natural shoreline vegetation. Increased building density, possibly close to the shore, multiple docks or boathouses, and significant shoreline alteration such as seawalls or rip rap may be present).

4.4 Public Survey

A public questionnaire was developed by Northern Environmental, the Task Force, and the WDNR. This questionnaire was designed to gauge lake users' opinions on a number of important topics related to APM Plan implementation. The survey inquired about the users' perception of aquatic plant problems and other lake issues. The survey was also developed to determine what lake users consider an appropriate plant management intensity and cost.

5.0 DISCUSSION OF PROJECT RESULTS

5.1 Aquatic Plant Ecology

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 (macrophytes) are extremely important for the well being of a lake community and posses many positive attributes. Despite their importance, aquatic macrophytes sometimes grow to nuisance levels that hamper recreational activities. This is especially prevalent in degraded ecosystems. 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 well-balanced, stable, and diverse aquatic plant community that contains high percentages of desirable native species. To be effective, aquatic plant management in most lakes must maintain a plant community that is robust, species rich, and diverse.

5.1.1 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).

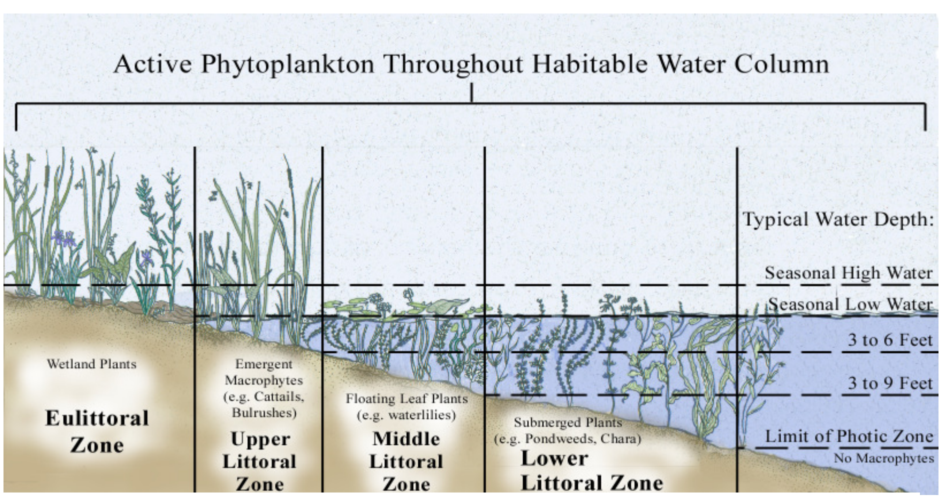
Eulittoral Zone: Includes the area between the highest and lowest seasonal water levels, and often contains many wetland plants.

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).

5.1.2 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, a direct 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).

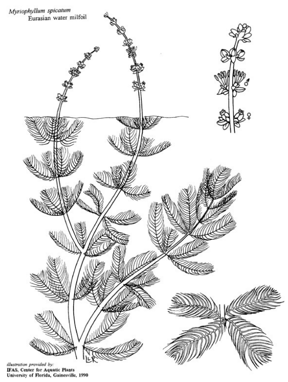
Aquatic plants also play a key role in the ecology of a lake system. Aquatic plants provide food and shelter for fish, wildlife and invertebrates. Plants also improve water quality by protecting shorelines and the lake bottom, improving water quality, adding to the aesthetic quality of the lake and impacting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

5.1.3 Aquatic Invasive Plant Species

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.

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 far northern portion of the state including Vilas and Oneida Counties.

Unlike many other plants, EWM does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces 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 downstream 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 (WDNR website, 2006).

Once established in an aquatic community, EWM reproduces from shoot 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 milfoil claim the water column early in spring, photosynthesize, divide, and 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).

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. 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).

Curly leaf pondweed *(Potamogeton crispus)*

Curly-leaf pondweed (CLP) 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. 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. CLP forms surface mats that interfere with aquatic recreation (WDNR website, 2006).

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. 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, and has been recorded in 70 of Wisconsin's 72 counties. 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).

5.1.4 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. Rusty Crayfish were positively identified on Catfish Lake in 2003 (USGS website, 2006).

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 Flea (*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.

5.2 Aquatic Plant Survey

The survey included sampling at 572 intercept points. Several of the 588 pre-determined points were not sampled because they were actually located on land. The aquatic macrophyte community of the Lake included 21 floating leaved, emergent, and submerged aquatic vascular plant species and 3 algal genera during 2006. Table 1 lists the taxa identified during the July 2006 aquatic plant survey. Figures 6a through Figure 6c illustrate the locations of each species identified.

Vegetation was identified to a maximum depth of 12 feet (photic zone). Aquatic vegetation was detected at 43 percent (%) of photic zone intercept points. A diverse plant community inhabited the Lake during 2006. During the July survey, the Simpson Diversity Index value of the community was 0.92. With the taxonomic richness at 24 species, including algal genera, there was an averages of 0.87 species identified at points that were within the photic zone. There was an average of 2.02 species present at points with vegetation present. Table 2 summarizes these overall aquatic plant community statistics.

The most abundant aquatic plant identified during the July survey was wild celery (*Vallisneria americana*) It exhibited a 13 % frequency of occurrence (percent of photic zone intercept points at which the taxa was detected). It was present at 31 % of the sites with vegetation, and had a 15% relative frequency of occurrence. Small pondweed (*Potamogeton pusillus*) was the second most abundant vascular plant species occurring at 12% of the photic zone. It was present at 28% of the sites with vegetation and had a 14 % relative frequency of occurrence. Common water weed (*Elodea canadensis*) was the third most common taxa. Table 3 lists the taxa specific statistics.

Eurasian watermilfoil [EWM] (*Myriophyllum spicatum*) was found at 1% of the photic zone points and at 2% of vegetated sampling sites. This accounted for an AutoCAD estimate of 8 acres of EWM using the sample points to create polygons.

5.2.1 Free-Floating Plants

No free-floating aquatic plant species were identified during the 2006 aquatic plant survey.

5.2.2 Floating-Leaf Plants

Two Floating-leaf aquatic plant species were identified during the 2006 aquatic plant survey. Table 1 lists the species identified and a brief description follows.

White Water Lily
Source: UW Herbarium 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).

Nuphar variegata (Spatterdock) has a flexible stalk and an oval shaped leaf. It grows in water less than 6 feet deep and prefers soft sediment. Yellow flowers occur throughout the summer. Floating leaves provide cover and shade for fish as well as habitat for invertebrates (Borman, et al., 1997).

Spatterdock
Source: UW Herbarium Website

5.2.3 Submergent Plants

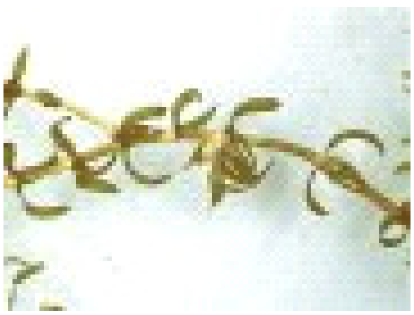
Submergent aquatic plant species were identified during the 2006 aquatic plant surveys. Table 1 lists these plant species and a brief description follows.

Coontail
Source: UW Herbarium Website

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.

Although *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.

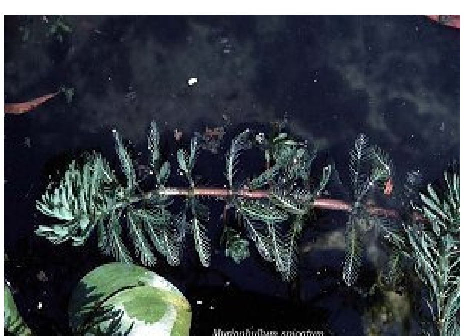

Chara sp.
Source: UW Herbarium Website


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.


Northern watermilfoil
Source: UW Herbarium Website



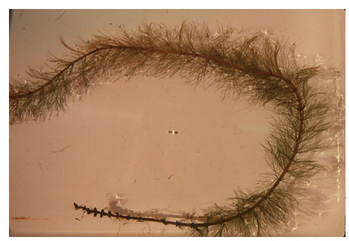
Eurasian watermilfoil
Source: UW Herbarium Website

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).

Myriophyllum verticillatum (Whorled watermilfoil) is a native watermilfoil that grows to water depths of 4 meters. Its vegetation is also easily mistaken for EWM. This species normally has more than 8 and fewer than 14 segments on each half of the leaf. It has no substrate preference. It is an infrequent species found in northern and eastern Wisconsin (Nichols, 1999).



Whorled watermilfoil
Source: UW Herbarium Website

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).

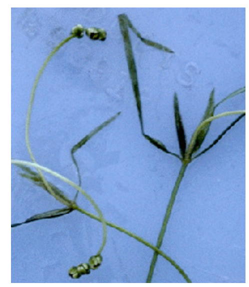
Nitella sp. (Nitella) is another type of macroalgae that looks like a vascular plant. Nitella is similar in appearance to muskgrass and is often found in similar habitats. However, Nitella can be distinguished from muskgrass by its smooth stems and branches, which are smooth (Borman, et al., 1997).

Nitella sp.
Source: UW Herbarium Website

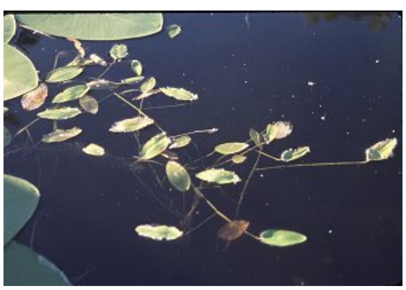
Large-leaf Pondweed
Source: UW Herbarium Website

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).

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).



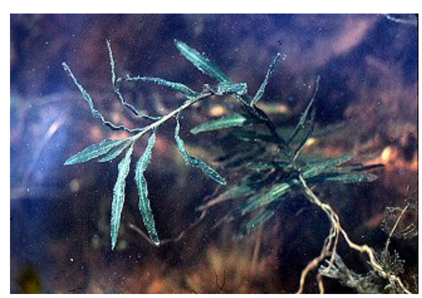
Small Pondweed
Source: UW Herbarium Website



Floating-leaf Pondweed
Source: UW Herbarium Website

Potamogeton natans (Floating-Leaf Pondweed) has stems that emerge from red-spotted rhizomes. Submersed leaves are stalk-like, with no obvious leaf blade. Floating leaves are heart-shaped at their base. Floating-leaf pondweed is usually found in water less than 1.5 meters deep. Fruit of floating-leaf pondweed is held on the stalk until late in the growing season. It provides valuable grazing opportunities for ducks and geese. It may also be consumed by muskrat, beaver and deer (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).

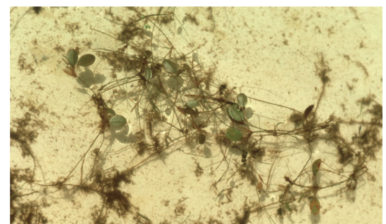


Fern Pondweed
Source: UW Herbarium Website

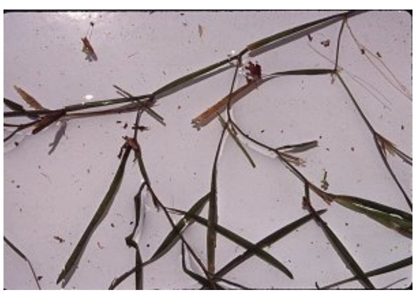
Spiral-Fruited Pondweed
Source: UW-Green Bay website

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).

Potamogeton vaseyi (Vasey's Pondweed) is a rare aquatic plant in Wisconsin. Its fine, hair-like leaves may be confused with Water-Thread Pondweed (Potamogeton diversifolius) and/or Small Pondweed (Borman, et al., 1997). It is generally found in water 6 feet deep of less and produces small, elliptical floating leaves (Nichols, 1999). Vasey's pondweed provides food for waterfowl, invertebrate habitat, and foraging opportunities for fish (Borman, et al., 1997).



Vasey's Pondweed
Source: UW Herbarium Website



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 that are finely divided. The divisions are filament-like, have no midrib, and fork 3-7 times. Scattered on these branches are the bladders that trap prey. Young bladders are transparent and green tinted, but they become dark brown to black as they age. 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


Wild Celery
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).

5.2.4 Emergent Plants

Emergent aquatic plant species were identified during the 2006 aquatic plant survey and the shoreline survey. Table 1 lists these plant species and a brief description follows.


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).

Schoenoplectus tabernaemontanti (Softstem Bulrush) has tall cylindrical, bluish-green stems. They are spongy when pressed between your fingers. Softstem bulrush usually grows in water less than 2 meters deep, but it has been found considerably deeper and shows no preference for substrate (Nichols, 1999). Softstem bulrush offers habitat for invertebrates and shelter for young fish, especially northern pike. The nutlets are consumed by a wide variety of waterfowl, marsh birds and upland birds. (Borman, et al., 1997).


Softstem Bulrush
Source: UW Herbarium Website


Bur-reed
Source: UW Herbarium Website

(Sparganium spp.) Bur-reed is a variable species ranging from erect, emergent leaves to wide, flat, floating leaves only. However, all species have a distinguishable "bur", or fruit, that takes on a prickly appearance created by the beaks of the fruits within the cluster. They grow in moist shoreline soils to water up to three feet deep in softer sediements. Bur-reed provides nesting sites for waterfowl and shorebirds with the fruit being eaten by waterfowl and the plant itself being grazed upon by deer and muskrat (Borman, et al., 1997).

Typha latifolia (Broad-leaf Cattail) has pale green, sword-like leaves that are sheathed around one another at the base. Broad-leaved cattail can be distinguished from narrow-leaved cattail by somewhat wider and flatter leaves and the presence of male and female flower spikes immediately adjacent to each other,. Cattails can grow to nuisance levels, but do provide nesting habitat for many marsh birds and cover for small fish (Borman, et al., 1997).


Broad-leaf Cattail
Source: UW Herbarium Website

5.3 Floristic Quality Index

Higher FQI numbers indicate higher floristic quality and biological integrity and a lower level of disturbance impacts. 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 2006 aquatic plant survey data was 27.7. This FQI value is higher than Wisconsin's median of 22.2 and suggests that Cranberry Lake exhibits above average water quality when using the aquatic plant community as an indicator of lake health. Cranberry lake also has a higher than average FQI than the Wisconsin Northern Lakes and Forests Ecoregion (24.3).

5.4 Shoreline Characterization

Emergent and floating leaved plants identified along the shoreline outside of formal grid sample points included: *Carex spp (* sedges*).*, *sagitaria spp* (Arrowhead), *Pontederia cordata* (pickerelweed), *Nuphar variegata* (Spatterdock), *Nymphaea odorata* (white water lily), *Gale palustris* (sweet gale), *Typha latifolia* (broad leaved cattail), *Sparganium sp*. (bur-reed), *Lysimachia thyrsiflora* (swamp loosestrife), and *Schoenoplectus tabernaemontanti* (softstem bulrush), *Alnus incana* subsp. *Rugosa* (tag alder) and *iris sp*. Refer to section 5.2.4 for descriptions of some of these plants). Figure 7 illustrates the floating leaved and emergent plant locations identified during the boat survey. Plants identified during the shoreline survey but not during the point-intercept method were not included in the community statistics or calculation of the FQI.

Also, the level of shoreline development was noted and recorded around the lake. The shoreline was mostly developed. Small areas of little to no development were present along the far northern and eastern reaches of the lake and in scattered areas between developed sites. Figure 8 illustrates the level of shoreline development.

5.5 Eagle River

After the point intercept aquatic plant survey, A qualitative survey of the Eagle River was completed to evaluate for the presence of EWM up to the Burnt Rollway Dam. Four sampling points were established on the Eagle River (Figure 5). Field staff boated to each sample point and observed aquatic plants present on the sampling rake and also recorded visual observations. No EWM was found on the Eagle River between Cranberry Lake and the Burnt Rollway Dam.

5.6 Public Questionnaire

33 questionnaires were completed for Cranberry Lake. Nearly 82 % of respondents were shoreline landowners. Respondents ranked fishing, pleasure boating, pontoon boating, and enjoyment of scenery as the most enjoyable activities on Cranberry Lake. 78 % of the surveyed people rated their experiences on Cranberry Lake as very enjoyable. 54 % of the respondents listed AIS as their primary lake concern, followed by excessive aquatic plant growth (27%) and water quality (18%) as second concerns.

56 % of the people polled reported that aquatic plants growth negatively affected their use of the lake sometimes and 94% of the lake users believed that aquatic plant management is needed on Cranberry Lake. 76 % responded that they supported aquatic herbicide use for AIS management. Most respondents would be willing to pay for some aquatic plant management but 74% listed state grant assistance as the top choice from a list of funding options. Appendix B includes additional information gathered from the public questionnaire.

6.0 CONCLUSIONS AND MANAGEMENT ALTERNATIVES

6.1 Conclusions

Cranberry Lake is part of the ERC which has an 286,618 acre watershed. Land cover within the watershed is primarily forest. The shoreline was mostly developed with some scattered undeveloped areas. Limited available in-lake water quality information suggests that Cranberry is between the eutrophic and mesotrophic TSI categories.

Aquatic plant management efforts on the lake have been minimal. EWM was confirmed to be present on Cranberry Lake in 2001. EWM control efforts using chemical herbicides have occurred in 2003 on 7.5 acres. The overall aquatic plant management objective is to reduce the acreage and frequency of occurrence of EWM and to restore the native plant community. Management efforts such focus on the EWM reduction and allow the natural restoration of the native aquatic plant community as the EWM is minimized. An achievable and quantitative goal for EWM reduction is to minimize the total acreage within 5 years to small-scale herbicide treatment levels on each lake. Wisconsin Administrative Code NR 107.04(3) defines a large-scale treatment as anything over ten acres or more than 10% of the water body that is less than ten feet deep This overall goal correlates to a reduction of EWM acres by 75 percent over the next five years, with a focus on the upper lakes to minimize and prevent the spread downstream. If this goal is achieved, the remaining EWM would be at a level small enough to be considered small-scale. A 75 percent reduction of EWM in Cranberry Lake correlates to annual reduction of 1.2 acres per year with a remaining population of 2 acres of EWM in 2011. EWM was found at 4 sample sites out of the 159 vegetated sites, a frequency of occurrence within vegetated areas of 2.52 percent. With a decline of EWM of 75 percent over five years the frequency of occurrence within vegetated areas will decline 0.37 percent each year. By 2011 EWM should have a frequency of occurrence within vegetated areas of occurrence of 0.64 percent, down from 2.52 percent in

2006. The following table depicts this reduction by year and acreage. The table also assumes no major re-growth or expansion of EWM on a yearly basis. Highly used recreational areas and public boat launches or access points should be give priority when considered treatment locations due to a greater potential for EWM spread coming from these areas. The APM plan should be updated in 2011 to evaluate the aquatic plant community and to assess the current management strategies.

Year	Acreage	Frequency of Occurrence Within Vegetated Areas
2007	7.8	2.12
2008	5.6	1.75
2009	4.4	1.38
2010	3.2	1.01
2011	2	0.64

If the 75 percent reduction goal is met, then EWM chemical treatments should be considered maintenance activities instead of restoration activities and limited resources should be directed toward other priority areas on the Chain.

Information gathered from the public questionnaire indicated most enjoyed using the lake for fishing and boating. Most people have experienced problems with aquatic plant growth affecting their recreation and believe that AIS is a concern that justifies active management.

During the July 2006 aquatic plant survey, twenty four aquatic plant species were found (including algal genera). The most abundant aquatic plants identified during the July survey were wild celery (*Vallisneria americana*) and small pondweed (*Potamogeton pusillus*), which were found at 13% and 12% of the photic zone, respectively. Eurasian watermilfoil [EWM] (*Myriophyllum spicatum*) was found at 1 % of the photic zone. The FQI for Cranberry Lake (27.7) is higher than the state and ecological regions' average and indicates above average water quality when using aquatic plants as an indicator of lake health.

6.2 Management Alternatives for EWM

Lake users' reports of nuisance aquatic plants and the presence of EWM on Cranberry Lake prompted APM efforts. WDNR requires development of an APM Plan for certain large scale management activities and for AIS control grant cost sharing. A necessary component of an APM Plan is an evaluation of chemical, mechanical, biological, and physical aquatic plant control methods. While there may be additional AIS control measures used elsewhere (e.g. grass carp, or alternative herbicides), only those options approved for use in Wisconsin are discussed here. Appendix C includes a comprehensive description of available APM techniques, including descriptions about the technology, benefits, drawbacks, and estimated cost.

6.2.1 Manual Removal

Manual removal efforts include hand raking or hand pulling individual unwanted plants from the water. Specialized rakes are available for this purpose. All aquatic plant material must be removed from the water. Portions of roots may remain in the sediments, so removal may need to be repeated periodically. This technique is well suited for small areas in shallow water. Scuba divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal include low cost compared to other control methods. The drawback of this alternative is that raking or pulling are quite labor intensive. Hiring high school students or landscape companies to remove aquatic vegetation is an option, but also increases cost. Manual removal by individual landowners can be completed to a maximum width of 30 feet to provide pier, boatlift or swimming raft access (recreation zone). A permit is not required for hand pulling or raking if the maximum width cleared does not exceed 30 feet within this recreation zone. Permits are also not required for manual removal of AIS only, beyond a 30 foot zone. Manual removal of native aquatic vegetation beyond the 30 foot area would require a permit from the WDNR that satisfies the requirements of Chapter NR 109, Wisconsin Administrative Code (NR 109). Appendix C contains a copy of NR 109.

This technique could be used on Cranberry Lake for nuisance vegetation along riparian landowners shorelines within a 30 foot recreation zone (i.e. containing swim raft, boatlift or pier). Only EWM can be removed beyond the 30 foot zone manually without a NR 109 permit.

6.2.2 Mechanical Harvesting

Mechanical harvesting is the removal of aquatic plants from a lake using a harvester machine that cuts the plants and collects them on the harvester for transport to the shoreline for off-site disposal. Harvesters have a cutting head that can be raised or lowered to a desired depth up to 5 feet. Large scale harvesting operations may involve additional equipment including a transport barge and shore conveyor. Harvesting is often used for large areas with dense monotypic AIS plant growth that significantly impedes boating or recreation on the lake. Advantages of this technology include: immediate results; removal of plant material and nutrients; and the flexibility to move to problem areas and at multiple times of the year "as needed". Disadvantages of this method include the limited depth of operation in shallow areas; possible need to repeat harvest an area throughout the summer; high initial equipment costs; maintenance, labor, and insurance costs; disposal site requirements; and a need for trained staff. A WDNR permit is requested by NR 109 for aquatic plant harvesting.

Mechanical harvesting on Cranberry Lake would not be advised. EWM is not one of the most abundant plants on the lake and harvesting could actually promote its spread by creating additional plant fragments. Most of the lake did not support aquatic plant growth, therefore "opening up" recreation areas or boat navigation lanes is not needed.

6.2.3 Drawdown

Lowering the water level to expose near shore lake bed can be an effective management tool for EWM control, although results are variable. By lowering the lake level, the lake bed could be exposed and subject to freezing conditions. Benefits of a water level drawdown include the relative inexpense of the proposed action. Drawdowns have the capability to significantly impact populations of aquatic plants and are sometimes used during lake wide restoration efforts, inlcuding multiple year or periodic drawdowns to simulate drought and promote emergent plant growth. Disadvantages include adverse affects on other aquatic plants, the controversy associated with shoreline landowners, and temporary destruction of habitat for invertibrates and herptiles. The drawdown may be largely successful if there is a cold winter with relatively little snow cover. Conversely, mild winters and increased snow limit their effectiveness.

The Otter Rapids Dam maintains a relatively constant water level on the ERC. This dam presumably has a water level control structure, which could lower the water level of all lakes on the ERC. This physical alternative has many variables and careful consideration should be given throughout planning a water level drawdown. This management technique is better suited for a lake system in which EWM is more abundant on the entire flowage and other lake restoration goals would also benefit from the drawdown.

6.2.4 Native Vegetation

Native plants are an important natural biological AIS control measure. A healthy native plant population can inhibit or slow an invasion of EWM by competing for space and nutrients, although in some lakes, even healthy native plant populations may eventually become infested with EWM. Damaging or stressing native plant communities may increase the potential for an AIS infestation. Any management of a low to mid level infestation should consider the benefits of native vegetation as an EWM deterrent, and plan for their protection.

Native plant communities on Cranberry Lake appear healthy and could be slowing the spread of EWM in some areas.

6.2.5 Milfoil Weevils

The use of aquatic weevils (*Euhrychiopsis lecontei*) is a biological control option that has shown effective EWM control in some Wisconsin lakes. The aquatic weevil is native to Wisconsin and normally is present in healthy stands of northern watermilfoil. The weevils however, prefer to feed on EWM plants. The weevil burrows into the plant's stem, destroying plant tissue. Increasing a natural population of weevils can be a costly endeavor but EWM reductions can be observed if the weevil population is maintained. This management alternative is best suited for lakes with limited shoreline development because the insects need to over-winter on a shoreline with vegetation and adequate leaf litter. During the plant survey on Cranberry Lake, no weevil damage was observed and the majority of the shoreline was developed. It is unlikely that a weevil augmentation program would be cost effective in controlling EWM.

6.2.6 Selective Aquatic Herbicides

Chemical herbicides or pesticides designed for aquatic use can be used to eliminate or significantly reduce the abundance of unwanted aquatic plant species. The United States Environmental Protection Agency (EPA) researches aquatic pesticides and determines what product can be registered for aquatic use. Aquatic pesticides that are registered for use in Wisconsin requires a strict registration process and most demonstrate they are safe on the environment and do not pose a risk to human health when used according to label requirements. Numerous aquatic herbicides are registered for aquatic use and are designed to target specific plant types. Herbicides can be grouped into two general categories, contact and systemic. A contact herbicide will kill any part of the plant it contacts. Plant tissue not exposed to the chemical may survive. A systemic herbicide is one that is taken up within the plant tissue, translocated throughout the plant, and destroys the entire plant. Herbicides are also categorized as broad based, ones that can kill many different plant species, and selective, ones that can kill a targeted plant species if applied correctly. The WDNR requires a permit (Chapter NR 107. Wis. Adm. Code) for aquatic herbicide applications in public waters. Appendix D includes a copy of NR 107. The product must be approved for aquatic use in Wisconsin and the applicator must be certified with the Wisconsin Department of Agriculture, Trade, and Consumer Protection (WDATCP) and licensed by WDNR. Advantages of herbicides include better control in confined areas (e.g. around docks) than harvesters can achieve. Disadvantages include negative public perception of chemicals, the potential to affect non-target plant species (if not applied at an appropriate application rate and/or time of year) and water use restrictions after application may be necessary.

A few herbicides have demonstrated EWM control. The most successful, WDNR-approved herbicide is one containing 2,4, D (*2,4-dichlorophenoxyacetic acid*). 2,4-D is a systemic herbicide that simulates a plant growth hormone and interferes with division of the plant cells, resulting in plant death. 2,4-D is relatively selective for EWM control when applied at a suitable application rate. 2,4-D has been rated as excellent in controlling the spread of EWM by the Army Corps of Engineers (UACoE Website, 2007). Trade names of 2,4-D products include Navigate®, Aqua Kleen®, and Weeder 64®. Selective control can be enhanced by applying the product when EWM is actively growing, but native plant growth is minimal. There is a 24 hour swimming and water use restriction following the application in some areas. <u>Also, water from treatment area should not be used to irrigate ornamentals until the herbicide concentration is less than 100 parts per billion (ppb) [0.1 ppm].</u> An industry guidance is a 14 day watering use restriction. Also, water treated areas should not be used for potable water sources until the herbicide concentration is less then 70 ppb (0.07 ppm).

7.0 RECOMMENDED ACTION PLAN

To accomplish the APM Plan goals, the partners have developed an action plan. This plan selects appropriate aquatic plant management techniques for EWM growth on Cranberry Lake based on the evaluations completed in Section 6.2. The specific implementation of the management recommendations, including monitoring, responsibilities, and funding are discussed in the following sections. The APM Plan also addresses protection of native aquatic plants, education and prevention efforts. In addition to the specific action plan described below, the partners must be willing to accept adaptive management. For example, if selective EWM herbicide treatments are successful at reducing the EWM to the established 75% goal within three years, the partners should consider using alternative control methods, such as manual removal. This adaptation to the action plan would allow the money to be used elsewhere on the Chain such as priority areas. If the 75 percent reduction goal is met, then EWM chemical treatments should be considered maintenance activities instead of restoration activities and limited resources should be directed toward other priority areas on the Chain.

This APM Plan should be updated periodically to reflect current aquatic plant problems, and the most recent acceptable APM methods. Information is available from the WDNR website: http://dnr.wi.gov/org/water/fhp/lakes/aquaplan.htm or from Northern Environmental upon request.

7.1 Manual EWM Removal

Individual property owners can manually remove nuisance aquatic plants in the lake offshore from their property. Manual removal can be completed to a maximum width of 30 feet to provide pier, swim raft, or boat hoist access. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed 30 feet. Manual removal of EWM can be completed beyond 30 feet without a permit. Individuals removing EWM must try to remove all of the plant material and fragments from the water. Removal of any native vegetation beyond 30 feet would require a permit under NR 109, Wis. Adm. Code. Native plant removal is not recommended because it could actually facilitate the spread of EWM.

Landowners should know the difference between EWM and other native species. If an individual has questions about a particular aquatic plant or what manual removal is allowed , they should talk to an ERCLA representative, a Township representative who is a member of the Eagle River Area Unified Lakes Committee, Vilas County LWCD, and/or the WDNR. Appendix E identifies additional resources for plant identification.

7.2 Selective EWM Herbicide Treatment

EWM beds beyond the 30 foot manual removal zone or too dense for effective hand removal efforts should be treated with an aquatic herbicide containing 2,4-D that is registered with the State of Wisconsin for use on public waters. 2,4-D products have demonstrated selective control of EWM if applied correctly. All treatments will need to be completed in accordance with a permit issued under NR 107, Wis. Adm. Code. No nuisance levels of native plants should be treated on a large scale. A commercial aquatic pesticide applicator, certified with the Wisconsin Department of Agriculture and Consumer Protection (DATCP) and licensed by the WDNR should be hired to treat priority EWM beds as local funding allows. The applicator shall specify in the NR 107 permit application the chemical application size, rate, and location of proposed treatment areas. A list of licensed applicators may be available from DATCP or on the "Lake List" located at UW Extension Lakes Program website at http://www.uwsp.edu/cnr/uwexlakes/lakelist/ where people can search for companies offering select APM services by company name or area of expertise.

Eradication of EWM is not feasible on Cranberry Lake. Aggressive management may prevent the spread of EWM and get the infestation "under control", where subsequent year's treatments could be reduced in size ("spot treatments"). Figure 9 illustrates the July 2006 aquatic plant distribution. Note that this EWM distribution map was created from aquatic plant survey data collected during July 2006. This effort involved sampling points on an 80 meter grid. This sampling resolution is designed to characterize the entire aquatic plant community on a particular lake, and can be formally repeated in the future. The intent of this survey is not to map the full distribution of one particular species. Reported EWM locations should be noted on a base map such as Figure 9 and recorded with a GPS, preferably one with sub-meter accuracy. Reported EWM locations can then be verified by a WDNR or a hired professional if necessary prior to applying for permits or funding.

The above mentioned verification of EWM beds should preferably occur in late summer or early fall, when EWM would be at its maximum growth. A permit application process should begin in the fall prior to the year of the proposed treatment. This mapping effort will be used to determine potential treatment acreages. Next, priority treatment areas should be selected from these areas. For example, upper chain lakes and boat landings will be a higher priority to prevent the spread of EWM and reduce to overall EWM. A permit application should be completed by December of each year to allow for full utilization of WDNR AIS grant funds. Application for WDNR AIS grants are due February 1st and August 1st of each year. WDNR personnel prefer to see a draft grant application at least one month prior to the application deadline. Since grant preference is given to local units of government, the lake organization should work closely with the Town and the WDNR throughout the permitting process. A spring EWM Assessment or "Pre-Treatment survey" should be completed each year to modify the permit application prior to the actual EWM treatment. This pre treatment survey allows the permit application to be modified to accurately reflect proposed treatment areas and current EWM locations/acreages. This modification request will be submitted in writing to WDNR along with a map of proposed treatment areas.

One major EWM treatment per season should be complete. This treatment should occur before water temperatures reach approximately 60°F, realizing that this is a target time when EWM is actively growing and natives are not. However, one potential follow up "spot treatment" may also be needed which will be determined by completing a post treatment aquatic plant survey one month after the initial treatment. All NR 107 public notice and water use restriction posting requirements should be followed. A public notice must be filed in the Vilas County News Review, if the treatment is > 10 acres or the treatment area is > % of the lakes area, and a public informational meeting held if requested. All property owners within or adjacent to treatment areas should be notified with a copy of the permit application and map indicating the proposed treatment areas. A yellow sign describing the treatment must be posted by the dock or shoreline of any properties being treated. The WDNR requires post and pre EWM treatment assessments completed annually to apply for subsequent permits and funds. Copies of the WDNR protocol for these assessments are available at local WDNR service centers and are not yet available via the WDNR website. Figure 9 will be updated annually.

7.2.1 Schedule of Events

The following table describes a schedule of required activities for the EWM treatment program on Cranberry Lake.

Activity	Frequency	Date
Mapping of EWM or post-treatment survey	Annually	No later than September 30th
Establish Priority Treatment Areas	Annually	October 30th
Prepare NR 107 Permit Application for grant and conditional permit purposes	Annually	December 1st
Prepare DRAFT WDNR AIS Control Grant Application	Annually/Multi-year	January 1st
Submit WNDR AIS Control Grant Application*	Annually	February 1st
Pre-treatment Survey	Annually	2 weeks after ice-out or when EWM plants are approximately 6 inches tall
EWM treatment**	Annually	Before May 31st or before water temperatures reach 60°F
Lake Association Budget Voting	Annually	??
Town Budget Voting	Annually	??
Lake wide Aquatic Plant Survey	Every 5 years	July 30th 2011
Update APM Plan	Every 5 years	December 1, 2011

* = August 1st is a second AIS Control grant deadline.
** = Activity will not be completed until water temperature reaches approximately 60 degrees Fahrenheit.

7.2.2 Designation of Responsibility

The following table assigns responsibility for the EWM treatment program events listed above. When the Town or Association is identified as a responsible party, these entities should identify which individual, or committee should complete the specified activity. For example, the Town of Lincoln may elect to form a committee to review association authored grant applications and submit grant applications to the WDNR.

Activity	Responsible Party
Mapping of EWM or post-treatment EWM survey	Aquatic Plant Professional or with assistance from trained volunteers
Establish Priority Treatment Areas	Eagle River Area Unified Lakes Committee, WDNR and aquatic plant professional
Prepare NR 107 Permit Application (*for grant purposes*)	Certified/Licensed Applicator or Lake Association
Prepare DRAFT WDNR AIS Control Grant Application	Eagle River Area Unified Lakes Committee

Submit WDNR AIS Control Grant Application	Town* (acts as grant sponsor)
Pre-treatment EWM Survey	Aquatic Plant Professional
EWM treatment	Certified/Licensed Applicator
Lake Association Budget Voting	Lake Association
Town Budget Voting	Town
Lake wide Aquatic Plant Survey	Aquatic Plant Professional hired by Lake Association or Town
Update APM Plan	Aquatic Plant Professional , ERAULC and WDNR

* Local units of government receive preference in AIS Control grant projects and should act as project sponsor

7.3 Prevention Efforts

The following sections discuss recommended activities to prevent the spread of new AIS such as Curly Leaf Pondweed into Cranberry Lake. Prevention efforts can also prevent the spread of EWM from Cranberry Lake into other area lakes.

7.3.1 Watercraft Inspection

A watercraft inspection program should be developed for Cranberry Lake and the ERC similar to the 2006 Clean Boat/ Clean Waters (CB/CW) Program completed by the Town of Washington. A watercraft inspection program is extremely important to prevent the introductions of new AIS into Cranberry Lake. CB/CW is a highly regarded volunteer watercraft inspection program developed by the WDNR and University of Wisconsin Extension Lakes Program.

The CB/CW efforts in Wisconsin involves providing information to lake users about what invasive species look like and what precautions they should take to avoid spreading them. It also involves visual inspection of boats to make sure they are "clean" and demonstration to the public of how to take the proper steps to clean their boats and trailers. Watercraft inspectors also install signs at boat landings informing boaters of infestation status, state law, and steps to prevent spreading AIS. The **Clean Boats Clean Waters** Program is sponsored by the DNR, UW Extension, and the Wisconsin Association of Lakes and offers training to volunteers on how to organize a watercraft inspection program. For more information see the following website:

http://www.uwsp.edu/cnr/uwexlakes/CBCW/default.asp

Training materials, a list of workshop dates, publications, supplies, and links to other important information are all provided on the CB/CW web page. Volunteers may also contact Erin Henegar, Volunteer Coordinator for the Invasive Species Program, UW Extension-Lakes Program

at (715) 346-4978 for details. Please note if any of the above hyperlinks to web addresses become inactive, please contact the WDNR, UW Extension Lakes Program, or Northern Environmental for appropriate program and contact information.

7.3.2 Aquatic Plant Protection and Shoreline Management

Protection of the native aquatic plant community is needed to slow the spread of EWM. Therefore, riparian landowners should refrain from removing native vegetation. Additionally, EWM can thrive in nutrient (phosphorus and nitrogen) enriched waters or where nutrient rich sediments occur. Two simple actions can prevent excessive nutrients and sediments from reaching the lake. The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. Establishing natural shoreline vegetation can sometimes be as easy as not mowing to the waters edge. Native plants can also be purchased from nurseries for restoration efforts. Shoreline restoration has the added benefits of providing wildlife habitat and erosion prevention. The Vilas County Land and Water Conservation Department offers a cost-share program for county landowners to be to restore native vegetation to shoreland property. Landowners can be reimbursed up to 70% of the costs of restoration activities. Interested shoreline property owners can contact the Vilas County LWCD at (715) 479-3648 to request additional information.

The second easy nutrient prevention effort is the use of phosphorus free fertilizers. The fertilizers commonly used for lawns and gardens have three major plant macronutrients - Nitrogen, Phosphorus, and Potassium. These are summarized on the fertilizer package by three numbers. The middle number represents the amount of phosphorus. Since most Wisconsin lakes are "Phosphorus limited", meaning additions of phosphorus can cause increased aquatic plant or algae growth, preventing phosphorus from reaching the lake is a good practice. Landowners should be encouraged to use phosphorus free fertilizers on lakeshore lawns. Local retailers and lawn care companies can provide soil test kits to determine a lawn's nutrient needs.

Nutrients from old or failing septic systems may also contribute nutrients to the lake. Septic systems should be inspected and maintained in accordance with the Vilas County Sanitary Ordinance #75.

Appendix E includes resources for further information about these AIS Prevention efforts.

7.4 Public Education and Involvement

Public involvement and education efforts to date include a presentation by Northern Environmental at a town of Washington board meeting on July 7, 2005 to introduce the APM Plan project and discuss preliminary goals. Northern Environmental also provided a progress report during an October 18, 2006 planning meeting of the Eagle River Area Unified Lakes Committee. The information presented included the results of the aquatic plant survey. This meeting was open to the public and questions were answered after the presentation. WDNR staff was also present to answer questions.

Northern Environmental also presented the aquatic plant survey results and discussed APM alternatives during a public informational meeting on November 1st, 2006. Northern Environmental and WDNR staff were present to answer questions.

The Town of Lincoln and Lake Association should both collectively continue to educate lake users about the importance of aquatic plants to the lake ecosystem and EWM management efforts. Vilas County Lakes Association (VCLA), Vilas County AIS Planning Partnership, WDNR, UW Extension Lakes Program are superb sources of public education materials and programs. Many important materials can be ordered at the following website:

http://www.uwsp.edu/cnr/uwexlakes/publications/

Appendix E includes resources for further information about public education opportunities.
If the above hyperlink to web address becomes inactive, please contact Northern Environmental for appropriate program and contact information.

7.5 Monitoring

To evaluate the effectiveness of the APM Program, monitoring of multiple components should be completed. Some of these are discussed in the section(s) above related to a specific management activity, but are re-iterated here in the context of overall monitoring efforts.

7.5.1 Aquatic Plant Monitoring

In some lake systems, native aquatic plants "hold their own" and AIS never grow to nuisance levels, in others, however vigilant management is required. Areas that have not been treated or were treated in previous years should also be monitored to see if native plant communities have inhibited further spread of AIS. Additionally, the lake should be monitored for new AIS infestations (i.e. curly leaf pondweed). At a minimum the public boat launch area should be inspected at least once per year. Grants may be available to help fund hiring professionals to complete these monitoring efforts or local lake enthusiasts can become trained AIS monitors. The Wisconsin Citizen Monitoring Network offers training of volunteers for AIS monitoring and other citizen monitoring opportunities such as water quality monitoring. Additional information about this program can be obtained at

http://www.dnr.state.wi.us/org/water/fhp/lakes/selfhelp/shlmhowto.htm

Appendix E includes resources for further information about volunteer monitoring opportunities.

If the above hyperlink to web address becomes inactive, please contact Northern Environmental for appropriate program and contact information.

Cranberry Lake should complete pre-treatment and post-treatment EWM monitoring to gauge the effectiveness of EWM treatments. See section 7.2 for monitoring dates and assignment of responsibility for EWM treatment monitoring.

Northern Environmental also recommends completing lakewide aquatic macrophyte surveys following current DNR protocols every 5 to 10 years to monitor changes in the overall aquatic plant community and the effects of the APM activities. Aquatic plant communities may change with varying water levels, water clarity, nutrient levels, and aquatic plant management actions. These formal surveys should duplicate the 2006 point intercept survey.

7.5.2 APM Technologies

The APM technologies listed in Appendix C should be re-visited periodically to evaluate if new or improved alternatives are available. The professional environmental science community includes universities, state natural resource agencies (e.g. WDNR), and federal agencies (e.g. EPA, United States Army Corps of Engineers [USACE]) are excellent sources for information. Appendix E includes resources for further information about APM alternatives and current research. This activity should be completed in conjunction with an overall APM Plan update effort, which includes a lake wide aquatic plant survey.

7.5.3 Public

Periodically, the lake users should be polled to evaluate the public's perception of APM activities on the lake. A questionnaire similar to the one solicited during this project could be used. Other methods of soliciting public opinion include telephone interviews, face to face interviews, web-based online surveys, and focus groups. A professional with experience conducting public surveys may be required for this activity.

7.5.4 Water Quality

The WDNR citizen monitoring website did not identify any current water quality data. Members of the lake association should consider becoming an active Citizen Lake Monitor for water quality (secchi depth, total phosphorus and chlorophyll a). At a minimum, water clarity (secchi depth) monitoring is recommended. Secchi depth monitoring is an easy volunteer activity that yields useful information about lake health over the long term. For more information, please visit:

http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/shlmhowto.htm

If the above hyperlink to web address becomes inactive, please contact Northern Environmental for appropriate program and contact information.

7.6 Funding

The Lake Association and Town should work together to fund the activities listed in this Recommended Action Plan. First, all available volunteer roles should be filled if possible. Then, cost estimates or professional bids should be solicited for the remaining activities (e.g. monitoring and EWM treatments) from professional firms. These cost estimates can be used to budget for needed activities.

One example of how funding APM efforts could work is that the individual lake association can determine what individual property owners are willing to pay for EWM treatment. This dollar amount can then be presented to the Town (through a Lake Association / Town liaison) who can decide what the Town may be willing to sponsor for additional management dollars. Collectively, these funds can then be used as local matching funds to apply for cost sharing assistance from the WDNR AIS Control grant program. Qualified lake associations and local governments are both eligible applicants, but funding preference goes to local units of government. Eligible projects include monitoring, permit fees, and EWM treatment. The application deadline is February 1st annually. A proposed schedule and assignment of responsibility are provided in Section 7.2. For more detailed information about AIS Control grants, please visit:

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

A second source for EWM control projects is the WDNR Recreational Boating Facilities (RBF) grant program. Projects are presented to the Wisconsin Waterways Commission (WWC) which meets approximately 4 times per year to review project presentations. This program funds 50 % of eligible activities.

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

If the above hyperlink to web address becomes inactive, please contact Northern Environmental for appropriate program and contact information. If the above funding combinations appear woefully inadequate to fund the management activities, then additional sources should be considered. Other funding alternatives may include:

- Additional State grant assistance
- Private (landowner) funding
- Countywide sales or room tax
- Resource user fee (e.g. AIS boat sticker)
- Property tax or special assessment
- Federal invasive species management partnerships

These sources would require government action at the State and/or County levels.

7.7 Closing

This APM Plan was prepared in cooperation with the Eagle River Area Unified Lakes Committee, representatives from the local units of government, and ERCLA members. It includes the major components outlined in the WDNR Aquatic Plant Management guidance. The "Recommended Action Plan" section of this report can be used as a stand alone document to facilitate EWM management activities for the lake. This section outlines roles and responsibilities for local governments and lake associations. The greater APM Plan document provides a central source of information for the lake's aquatic plant community information and the overall lake ecology. If there are any questions about how to use this APM Plan or its contents, Please contact Northern Environmental.

8.0 REFERENCES

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APPENDIX A

POINT INTERCEPT SAMPLE COORDINATES

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APPENDIX B

PUBLIC SURVEY INFORMATION

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APPENDIX C

SUMMARY OF AQUATIC PLANT MANAGEMENT ALTERNATIVES

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APPENDIX D

NR 107 AND NR 109 WISCONSIN ADMINISTRATIVE CODE

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APPENDIX E

RESOURCE FOR ADDITIONAL INFORMATION

AQUATIC PLANT MANAGEMENT PLAN

CRANBERRY LAKE
VILAS COUNTY, WISCONSIN

DNR LAKE PLANNING
GRANT NO: LPL–1078-06

June 26, 2007